APPENDIX B

U.S. FISH AND WILDLIFE SERVICE COORDINATION REPORT

TERREBONNE BASIN BARRIER SHORELINE RESTORATION

FINAL FISH AND WILDLIFE COORDINATION ACT REPORT

September 17, 2010

Final
Fish and Wildlife Coordination Act Report

Louisiana Coastal Area (LCA)
Terrebonne Basin Barrier Shoreline Restoration
Terrebonne and Lafourche Parishes, Louisiana

Submitted To
New Orleans District
U.S. Army Corps of Engineers
and
Office of Coastal Protection and Restoration

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INTRODUCTION

The Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration (LCA-TBBSR) Integrated Feasibility Report and Environmental Impact Statement (EIS) was prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration (OCPR), under the authority of Title VII of the Water Resources Development Act (WRDA) of 2007. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005. That report recommended projects and features in the interest of hurricane protection, prevention of salt water intrusion, preservation of fish and wildlife, prevention of erosion, and related water resources purposes. One recommended project was the TBBSR.

The LCA-TBBSR project is designed to: 1) restore the minimized barrier island conditions that provide the geomorphic form and ecological function of the Terrebonne Basin barrier islands, 2) restore and improve various barrier island habitats that provide essential habitats for fish, migratory birds, and other terrestrial and aquatic species, mimicking, as closely as possible, conditions which occur naturally in the area, and 3) increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline by mechanically introducing compatible sediment, and increasing the ability of the restored area to continue to function and provide habitat with minimum continuing intervention.

This final report contains a description of existing fish and wildlife resources in the project area, discusses future with-project (FWP) and future without-project (FWOP) habitat conditions, identifies fish and wildlife-related impacts, and provides recommendations to improve the proposed restoration measures. Copies of the draft report were provided to the National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries for their review and their comments were incorporated into the final report. This report is transmitted pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and constitutes the report of the Secretary of the Interior as required by Section 2(b) of that Act.

DESCRIPTION OF STUDY AREA

The Terrebonne Basin Barrier Shoreline is divided into two reaches (Isles Dernieres and Timbalier) in Terrebonne and Lafourche Parishes, Louisiana. Those reaches are comprised of a chain of barrier islands, separated by tidal inlets, which enclose shallow bays. The barrier islands within those reaches define the southern boundary of the Terrebonne Basin and separate the shallow estuarine bays and saline marshes from the Gulf of Mexico.

The study area (Figure 1) is composed of a series of barrier islands formed by the reworking of abandoned Mississippi River delta complexes. The main distributary location of the Mississippi River switches to a more hydraulically efficient route about every 1,000 years, building a new delta complex. The abandoned delta subsides and the seaward margins are reworked by coastal processes, forming a sandy barrier shoreline (headland) and eventually detached barrier islands. The Mississippi River Deltaic Plain is composed of six major delta complexes: two prograding and four degrading. The Atchafalaya and Modern Delta complexes are active and the Lafourche,

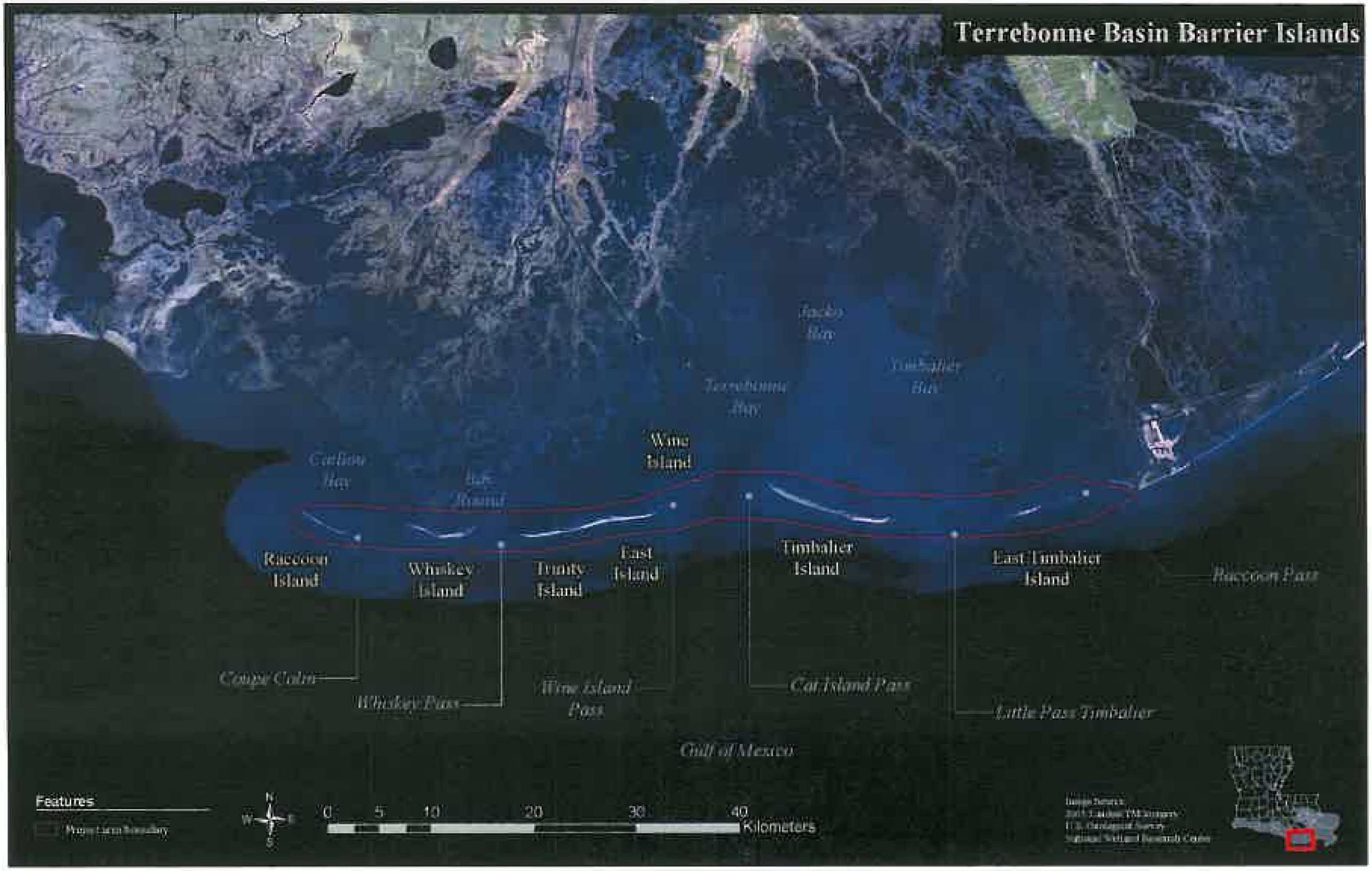

Figure1. Terrebonne Basin Barrier Shoreline Restoration Study Area

St. Bernard, Teche, and Maringouin complexes are inactive. Present day Terrebonne Basin is the result of the Lafourche delta formation, through seaward advancement from deposition of Mississippi River distributary sediment, the subsequent delta degradation and detachment, and the reworking of seaward headlands to form barrier islands (USACE 2004a).

Isles Dernieres Reach

The Isles Dernieres reach represents a barrier island arc approximately 22 miles long in the southern reaches of Terrebonne Parish and extends from Caillou Bay east to Cat Island Pass. Raccoon, Whiskey, Trinity, East, and Wine, the primary islands that comprise the Isles Dernieres barrier island chain, are backed by Bay Blanc, Bay Round, Caillou Bay and Terrebonne Bay, and bordered by the Gulf of Mexico on the seaward side. The remnant of Wine Island is located in Wine Island Pass, about midway between East and Timbalier Islands. The islands of the Isles Dernieres Reach range from approximately 0.1 to 1.2 miles wide and are typically composed of a thin sand cap over a thick mud platform. Elevations are generally low and the islands are frequently overwashed (USACE 2004b).

The Isles Dernieres chain is considered one of the most rapidly deteriorating barrier shorelines in the United States. The average long-term (1887-2002) rate of shoreline change for the Isles Dernieres was -34.7 feet per year (ft/yr) with a range of -56.0/-17.0 ft/yr. The average short-term (1988-2002) rate of shoreline change was -61.9 ft/yr with a range of -86.0/-38.6 ft/yr (USACE 2004b).

Raccoon Island

Raccoon Island is approximately 2.6 miles long (USDA 2007) and is located at the western end of the Isles Dernieres reach. Raccoon Island is characterized by sandy beach with well-vegetated washover terraces backed by thick groves of black mangrove and salt marsh. The recurved spit at the west end is low and dominated by washover flats. The habitats found on Raccoon Island provide for the largest brown pelican rookery in the state, as well as the greatest species diversity of nesting colonial waterbirds found on any barrier island in the state (USDA-NRCS 2005).

The average long-term shoreline change rate between 1887 and 2002 was -27.4 ft/yr with a range of -28.9/-24.9 ft/yr. The average short-term shoreline rate was -60.5 ft/yr with a range of -144.5/-8.6 ft/yr between 1988 and 2002. It is noted the average shoreline change rate increased over time, specifically from -27.4 ft/yr to -60.5 ft/yr during the two time periods, 1887-2002 and 1988-2002, respectively (USACE 2004b).

Raccoon Island rapidly decreased in area from 368.2 to 200.2 acres between 1978 and 1988. During this time period, multiple hurricane impacts occurred in 1979 (Bob and Claudette) and 1985 (Danny, Elena, and Juan). From 1988 to 1992, Raccoon Island further decreased in area from 200.2 acres to 167.8 acres. With the impact of 1992's Hurricane Andrew, the area of Raccoon Island continued to decrease even further to 112.8 acres. By 1993, Raccoon Island had further reduced in area to 99.2 acres. A Federal Emergency Management Agency (FEMA) restoration project in 1994 increased the size of Raccoon Island to 127.2 acres by 1996. A Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) project (TE-29) further increased the area of Raccoon Island to 145.5 acres by 2002 via constriction of eight segmented breakwaters on the eastern end of the island.. In 2005, eight additional breakwaters were constructed immediately west of the original eight structures (Project TE-48). While Hurricanes Katrina and Rita in 2005 caused erosion, those breakwaters continued to benefit the island (USACE 2004b) and an increase in acreage was observed in 2006 (215 acres). The effects of Hurricanes Gustav and Ike reduced Raccoon Island to 121 acres by the winter of 2008 (Barras 2009). The breakwaters have been effective in holding sand on the eastern portion of the island; however, the western portion has continued to erode.

Whiskey Island

Whiskey Island is located near the middle of five islands in the Isles Dernieres barrier island chain. It is approximately 4.6 miles long (USDA 2007) and located approximately 17.5 miles southwest from Cocodrie, Louisiana in Terrebonne Parish. The Louisiana Department of Wildlife and Fisheries is currently attempting to re-establish a brown pelican rookery on that island.

The average long-term shoreline change rate between 1887 and 2002 was -56.0 ft/yr with a range of -77.5/- 45.7 ft/yr. The average short-term shoreline change rate was -86.0 ft between 1988 and 2002 with a range of -139.4/-48.4 ft/yr (USACE 2004b).

Prior to restoration, the morphology of Whiskey Island was dominated by washover flats and isolated washover terraces. CWPRRA restoration project TE-27 at Whiskey Island created an artificial dune +4 to +6 feet in elevation, which was 2 to 3 feet above the natural pre-restoration surface. As seen throughout the Isles Dernieres chain, Whiskey Island is historically erosional and decreasing in area. Between 1978 and 1988, Whiskey Island decreased in area from 904.4 acres to 564.2 acres. The hurricanes of 1979 and 1985 were contributing factors to the decrease in area. By 1992, Whiskey Island had decreased to 505.6 acres. During the 1992 hurricane season, Hurricane Andrew impacted this area dramatically, reducing Whiskey Island to 440.8 acres. By 1993 it had further decreased in area to 428.4 acres. Post storm recovery processes increased the area of Whiskey Island to 474.8 acres by 1996. Construction of the CWPPRA Whiskey Island project (TE-27) began in February 1998 and was completed in August 1998. By 2002, the area of Whiskey Island had increased to 642.8 acres, a 36% increase in area. While the hurricanes in 2005 impacted the island, overwash processes and longshore sediment transport from Trinity and East Islands benefited Whiskey Island (USACE 2004b). The effects of Hurricanes Gustav and Ike decreased the area of Whiskey Island to 509 acres by the winter of 2008 (Barras 2009). CWPPRA Project TE50 (Whiskey Island Back Barrier Marsh Creation) was completed in September 2009. That project was designed to increase the longevity of the previous TE-27 restoration effort by increasing the island's width.

Trinity Island

Trinity Island, the largest island of the Isles Dernieres chain, is approximately 5.2 miles long (USDA 2007) and lies immediately to the east of Whiskey Island. The morphology includes low dune terraces, with isolated dunes of up to 3 to 4 feet in elevation. Overwash is more frequent at the west and east ends of the island where elevations decrease. It is a remnant of the original mainland marsh and is well-vegetated by black mangroves and salt marsh species. Trinity Island is historically eroding. Between 1978 and 1988, Trinity Island decreased in area from 1,317.1 acres to 894.6 acres. This was a time period of multiple hurricanes in occurring in 1979 and 1985. By 1992, Trinity Island further decreased to 796.5 acres. During the 1992 hurricane season, Hurricane Andrew impacted this area, reducing Trinity Island to 678.5 acres and by 1993, the island decreased further to 651.4 acres. By 1996, the area of Trinity Island continued to decrease to 617.4 acres. Trinity Island increased in area from 617.4 to 710.1 in 2002 as a result of a restoration project constructed on the western end of the islands (USACE 2004b). Though the impacts of Hurricanes Katrina and Rita were offset by the New Cut Project in 2006 (increasing Trinity Island to 764 acres), the effects of Hurricanes Gustav and Ike decreased the total area of the island to 509 acres by 2008 (Barras 2009).

The average long-term shoreline change rate between 1887 and 2002 was -38.4 ft/yr with a range of -47.9/-34.3 ft/yr. The 1988–2002 average short-term change rate was -62.5 ft/yr with a range of -107.3/-41.1 ft/yr. The acceleration between the long-term and short-term shoreline change rates is linked to the major hurricane impacts of Hurricanes Andrew in 1992 and Tropical Storm Isidore and Hurricane Lili in 2002 (USACE 2004b).

East Island

East Island is approximately 3.1 miles long (USDA 2007) and is the easternmost island of the Isles Dernieres. It is characterized by low dunes and washover terraces, with elevations ranging from +3 to +5 North American Vertical Datum 1988 (NAVD88).

Prior to restoration, East Island was rapidly eroding and decreasing in area since 1887. In 1978, East Island was 368.2 acres in area and by 1988 it had decreased in size to 202.2 acres. The average long-term shoreline change between 1887 and 2002 was -17.0 ft/yr with a range of -34.6/-5.1 ft/yr. Short-term, between 1988 and 2002, the average shoreline erosion rates increased to -38.6 ft/yr with a range of -64.0/-14.0 ft/yr. During this period of time multiple hurricane impacts occurred in 1979 and in 1985. The 1985 impacts prompted island restoration efforts by way of the Terrebonne Parish Barrier Island Restoration Project. The East Island portion of this project, which measured 3,200 ft long, 1,000 feet wide, and encompassed 38 acres, used sediment from the margins of Wine Island Pass to build foredunes to an average elevation of eight feet, and raised backbarrier elevations by an average of 3.5 ft. Subsequent to sediment settling and leaching, vegetative planting was performed for island stability (Penland and Suter 1988). By 1992, East Island had continued to lose land and measured 173.4 acres in size. After Hurricane Andrew made landfall in 1992, East Island was further reduced to 93.4 acres, and this continued into 1993 when East Island reached 88.5 acres in size. Following Hurricane Andrew, FEMA constructed an emergency restoration project east of the former Terrebonne Parish restoration site, resulting in East Island enlarging from 88.5 acres in 1993 to 193.1 acres in 1996. The CWPPRA East Island restoration was completed in 1998, and the area of the island increased from 193.1 acres to 380.4 acres by 2002 (USACE 2004b). By 2008 East Island decreased to approximately 300 acres due to the hurricane impacts in 2005 and 2008.

Wine Island

Wine Island, located approximately 2.5 miles northeast of East Island and 3.9 miles west of Timbalier Island, lies on Wine Island Shoal, with Wine Island Pass to the west and Cat Island Pass to the east. Historically, Wine Island was the easternmost of the Isles Dernieres chain. It was approximately three miles in length, and located across the mouth of the present Wine Island/Cat Island Pass (Penland et al. 2005). By the mid-20th Century the island had migrated north and eroded away. What is now called Wine Island is a dredge spoil disposal site, associated with the Houma Navigation Canal (HNC). In 1991 the present configuration was created when the South Terrebonne Tidewater Management and Conservation District (District) constructed the rock containment dike and the Corps filled it with dredge spoil from the HNC. The original restoration created a 24-acre island, approximately 1,500 feet wide, east to west. The island was vegetated with a mixture of cordgrass, black mangrove, and ryegrass by the District and the Coastal Restoration Division of the Louisiana Department of Natural Resources in the same year. In 1992 Hurricane Andrew overwashed the island, decimated the vegetation, and washed approximately one-third of the land away. The Corps placed additional dredged material from the HNC within the rock containment dike, but because of the fine grain consistency of the spoil little, if any, remained on site. Responsibility for the island was transferred to the Louisiana Department of Wildlife and Fisheries. The present island is small; approximately 800 feet wide in an east-west dimension. The island is no longer contained within the revetment; its area has been reduced significantly and its footprint has migrated north such that about one third of it presently lies outside the rock containment dike. Albeit small, that island hosts some of the largest brown pelican and colonial nesting waterbird rookeries in the state.

Timbalier Reach

The Timbalier Reach is comprised of Timbalier Island and East Timbalier Island. Timbalier and East Timbalier Islands are on the western edge of the Lafourche barrier shoreline and are located about 60 miles southwest of New Orleans, Louisiana. This barrier island shoreline is approximately 20 miles long and backed by Terrebonne and Timbalier Bay to the north and delimited by Raccoon Pass to the east and Cat Island Pass to the west. The islands range from 0.1 to 0.6 miles wide, with low elevations.

Historically, the Timbalier Islands have undergone both negative and positive areal rate changes. Between 1887 and 1934 the area of the Timbalier Islands decreased from 4,142 acres to 2,875 acres at a rate of 27.0 acres/year (yr). Between the next two periods, 1934-1955 and 1956-1978, the Timbalier Islands increased from 2,875 acres to 3,280 acres and then to 3,693 acres at a rate of + 18.8 acres/yr respectively. This was a period of extensive back-barrier canal dredging and dredge spoil placement to support oil and gas development; those activities resulted in an increase in acreage of the Timbalier Islands. The large decrease in the area between 1978 and 1988 is a function of the extension of the Belle Pass jetties to the east and the disruption of the dominant longshore sediment transport to the west (USACE 2004b). The combination of a diminishing sediment supply and hurricanes continued to drive island barrier loss, reducing the Timbalier Islands to 1,354 acres by 2008.

The average long-term rates of shoreline change for the Timbalier Islands was -36.1 ft/yr with a range of -61.2/-4.1 ft/yr between 1887 and 2002. The average short-term rate of shoreline change was -76.4 ft/yr with a range of -179.4/-13.4 ft/yr between 1988 and 2002 (USACE 2004b).

Timbalier Island

Timbalier Island is approximately 7 miles long (USDA 2007) and lies in Terrebonne and Lafourche Parishes. Over the last 115 years, Timbalier Island has migrated 2.5 miles to the west by the erosion of its east end and the recurve spit extension of its west end. With this westward migration, Timbalier Island has developed two distinct shoreline change rate regimes (USACE 2004b).

The average long-term rate of shoreline change for the eastern portion of Timbalier Island was -42.9 ft/yr between 1887 and 2002 with a range of -48.6/-37.3 ft/yr. Between 1988 and 2002, the average short-term erosion rate accelerated to -179.4 ft/yr with a range of -205.5/-153.3 ft/yr for the eastern portion. The high rates of negative change reflect the impact of the 1992 and 2002 hurricanes. Conversely, with the western migration of Timbalier Island, the western portion of the island has historically shown a lower rate of shoreline change. The average long-term erosion rate for the western portion is -4.1 ft/yr with a range of -31.0/+20.9 ft/yr between 1887 and 2002. The western portion has experienced an average short-term erosion rate between 1988 and 2002 of 13.4 ft/yr with a range of -118.7/+31.9 ft/yr. The combination of the 1985/1992/2002 hurricanes and disruption of the westward sediment transport by the Belle Pass jetties have all contributed to the high rates of shoreline change in this area (USACE 2004b).

Two CWPPRA projects have been constructed on Timbalier Island. The first project (TE18) involved the installation of sand fencing (greater than a mile in total) and the subsequent planting of dune-stabilizing vegetation. The second project (TE40) involved: 1) the restoration of approximately 2.2 miles of beach and dune, 2) the installation of sand fencing, 3) the planting of dune-stabilizing vegetation, and 4) marsh creation. A second component of TE40 was the addition of sediment into the nearshore system to facilitate longshore transport without eroding the restored beach.

East Timbalier Island

East Timbalier Island is approximately 3.6 miles long (USDA 2007) and lies east of Little Pass Timbalier and directly west of the Bayou Lafourche headland. East Timbalier Island is occupied by a major oil and gas operation at the inshore Timbalier Bay Field. The island and surrounding bay supports major offshore production facilities. East Timbalier Island is known for the massive rip-rap seawall along its Gulf shoreline and numerous revetments landward of it. The combination of the position of East Timbalier Island immediately downdrift of the Bayou Lafourche headland and the Belle Pass jetties creates one of the most erosional areas in coastal Louisiana (USACE 2004b).

The average long-term erosion rate between 1887 and 2002 was -61.2 ft/yr with a range of -74.3 to -49.2 ft/yr. The average short-term erosion rate between 1988 and 2002 decreased to -36.3

ft/yr with a range of -65.5 to -4.9 ft/yr. The erosion rate diminished here in spite of the 1992 and 2002 hurricanes. This shoreline erosion decrease is partially related to the construction of CWPPRA restoration project TE-25/30 in 2000, which included the creation of dune, back barrier marsh platform, rubble rock revetment, sand fencing, and vegetative plantings (USACE 2004b).

FISH AND WILDLIFE RESOURCES

Description of Habitats

The Terrebonne Basin is an abandoned delta complex that is bordered by Bayou Lafourche on the east and the Atchafalaya Basin floodway on the west. The southern end of the basin is defined by a series of narrow, low-lying barrier islands (the Isles Dernieres and Timbalier chains) separated from the mainland marshes by a series of wide, shallow lakes and bays (e.g., Lake Pelto, Terrebonne Bay, Timbalier Bay). The proposed barrier shoreline restoration sites are within the southern extreme of the basin.

The habitat types in the study area primarily consist of beach, overwash, dune, barrier flats (scrub/shrub and salt flats), back-barrier saline marsh, intertidal flats, and open water. Loss of those habitats has been identified as one of the most serious and complex problems in the study area. The Terrebonne Basin barrier islands have undergone significant reductions in size due to a number of natural processes and human actions including lack of sediment, storm-induced erosion and breaching, subsidence, sea level rise and hydrologic modifications such as navigation and oil and gas canals.

Beach and Overwash

Active beach and overwash areas occur on the gulfside of barrier shorelines from the intertidal zone to the toe of the dune. This area contains wave-washed, sandy sediments and is usually 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 may include sea purslane, marsh hay cordgrass, sea rocket, and seaside heliotrope. Overwash areas may become colonized by grasses (i.e., coastal dropseed, salt grass, and *Paspalum* spp.) as well as morning glory and sea purslane.

Dune

Dunes form when sand, deposited by storm surges and/or transported by wind, is trapped by dune grasses. Dune height and orientation are a function of prevailing wind direction and speed and sand size. Sea oats can tolerate salt spray and sand burial, and contribute to the dune building process by stabilizing windblown sand. Other species present within this habitat type may include marsh hay cordgrass, bitter panicum, and beach croton.

Barrier Flats and Shrub/Scrub

Plants requiring elevation and protection from coastal processes may be found behind the dunes.

Saltwort, creeping glasswort, and Bigelow glasswort are found in pockets of high salinity, often in areas that are only intermittently flooded due to their higher elevation. In areas subjected to frequent drying, seaside goldenrod and groundsel bush are occasionally found, as well as the salt-tolerant shrubs including sea myrtle, sea ox-eye and marsh elder. Shrubs are occasionally covered with the parasitic vines, including common dodder and pretty dodder. These plants may also be found in the high marsh zone.

Saline Marsh

Saline marshes in the project area occur on the bayside of the barrier islands. Those intertidal marshes usually exhibit fairly firm mineral soils and experience moderate to high daily tidal energy. 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 salt marshes of the project area is saltmarsh cordgrass, a perennial grass that grows from extensive rhizomes. Saltmarsh cordgrass also dominates the high marsh areas subject to intermittent flooding, although the highly salt-tolerant salt grass, black needle rush, and glassworts are also frequently present. Black mangrove occurs as a shrub along the flooded marsh edges of the barrier 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. The Louisiana Natural Heritage Program (Smith 1988) classifies the mangrove zones separately from salt marsh as intertidal saltwater swamps. Mangroves are at their northern natural limit here and are periodically killed back by winter freezes.

Intertidal Flats

Intertidal mud flats are typically ephemeral areas of unconsolidated organic and mud deposits that occur in areas of low wave and tidal energy. Although those areas are considered "non-vegetated," mats of algae 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, 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 protected intertidal mud flats. Sand flats are the preferred habitats of various invertebrates, crustaceans, and mollusks.

Open Water

The major water bodies in the study area are the Gulf of Mexico, Caillou Bay, Wine Island Pass, Bay Blanc, Bay Round, Terrebonne Bay, Timbalier Bay, Raccoon Pass, and Cat Island Pass. In the majority of the study area, the levels of turbidity and energy are too high for the growth of submerged aquatic vegetation.

Borrow Sources

It is expected that two types of borrow sources will be used for this project: a high-quality sand source for the beach-dune portion of the project and a nearshore mixed-sediment deposit to be used for the marsh construction. The initially-proposed source of borrow sand for beach and dune restoration was Ship Shoal, an elongate sand body in the Gulf, located 20 to more than 40 miles west of Belle Pass and four to ten miles south of the Isles Dernieres. It is approximately 31 miles long and 7 miles wide, lying in a water depth of 9 to 30 ft. Sand particle sizes present within Ship Shoal are equal to or greater than those found on the Terrebonne Basin barrier islands. Coarser grain sand is more resistant to erosion. Ship Shoal is the nearest, accessible sand source that contains a sufficient quantity of sand of appropriate quality to match the native sand found on the islands. Several closer sand sources, previously identified for other CWPPRA project use, however, were also identified and investigated. Of those, the two areas most likely to be utilized include Subarea 3a of the Whiskey Island TE-50 Borrow Area 3 and the New Cut TE-37 Borrow Area 4.

It is proposed that nearshore resources seaward of the depth of closure would be utilized to provide mixed sediments consisting of fine sand, silts, and clays for the marsh creation portion of the project. The two marsh sediment borrow areas identified are the Raccoon Island TE-48 Borrow Area 5 and the overburden stratum on Subarea 3a of the Whiskey Island TE-50 Borrow Area 3.

Fishery Resources and Essential Fish Habitat

Terrebonne Basin Barrier Shoreline's transitional habitats provide unique nursery, foraging, predator refugia, and spawning habitat for numerous economically important marine and estuarine species that exhibit a preference for or are dependent on these habitats as transients during portions of their life history. Surf zone, intra-island ponds and tidal creeks, and back-bay sand flats, including those along barrier islands and headlands support distinct fish and crustacean assemblages in comparison to mainland or inland saline marshes (Williams 1998). Common surf zone species include Gulf menhaden, spot, striped mullet, southern kingfish, anchovies, scaled sardine, Florida pompano, Atlantic bumper, Spotfin mojarra, and rough silverside. The surf zone is used temporarily by larval and juvenile life stages of some of these species awaiting transport to back-barrier, bay, or mainland habitats. Barrier island flats typically are used by white mullet, longnose killifish, darter gobies, and inland silversides. Marsh edge and interior creeks are used by white and brown shrimp, Atlantic croaker, spotted seatrout, sheepshead minnow, killifish, and sand seatrout, some of which are constituents of assemblages that use the other island aquatic habitats (Foreman 1968; Zimmerman 1988).

Economically important fish species such as spotted seatrout, red drum, black drum, spotted seatrout, Gulf menhaden, striped mullet, and southern flounder, use barrier island habitats (e.g., shorelines and passes) for foraging areas, nursery habitat, and staging areas during spawning or associated migratory aggregations (Saucier and Baltz 1993). Additionally, young of the year red drum and mangrove snapper have a high affinity for quiescent intra-island creeks and ponds in the post larval early juvenile stages (Thompson 1988). Commercially and recreationally important species of shellfish include blue crab, white and brown shrimp, American oyster, and Gulf stone crab. The U.S. Environmental Protection Agency (1997) reports that the Barataria-Terrebonne estuarine complex generates more brown and white shrimp than any other zone in the state, and supports approximately 20 percent of the estuarine-dependent fishery resources of the United States. In addition, the proposed restoration alternatives would potentially mine sand from Ship Shoal and/or South Pelto lease blocks. A portion of Ship Shoal has been identified as spawning, hatching, and foraging habitat for blue crab from at least April through October and an off-shore blue crab mating site; the proposed mining could adversely impact those support functions (Gelpi et al 2009).

Other finfishes and crustaceans expected to occur in the study area include gafftopsail catfish, Spanish mackerel, bull shark, ladyfish, Atlantic needlefish, Gulf killifish, fat sleeper, gobies, speckled wormeel, least puffer, Gulf pipefish, Atlantic spadefish, alligator gar, pink shrimp, seabob, roughneck shrimp, grass shrimp, mysid shrimp, and mud crab. Other invertebrates found in the study area include *Rangia* clam, jellyfish, and ctenophores.

Temperature and salinity govern the general patterns of estuarine use by fishes and macroinvertebrates (Day et al. 1989; Baltz and Jones 2003). Freshwater species are not expected to occur in the study area.

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; P.L. 104-297) set forth a new mandate for NOAA's National Marine Fisheries Service (NMFS), regional fishery management councils (FMC), and other federal agencies to identify and protect important marine and anadromous fish habitat. The Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act support one of the nation's overall marine resource management goals- maintaining sustainable fisheries. Essential to achieving this goal is the maintenance of suitable marine fishery habitat quality and quantity. Detailed information on Federally managed fisheries and their EFH is provided in the 1999 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico FMC. The generic FMP subsequently was updated and revised in 2005 and became effective in January 2006 (70 FR 76216). NMFS administers EFH regulations. Categories of EFH in the project vicinity include estuarine and marine areas. Estuarine categories include estuarine emergent wetlands, mangrove wetlands, submerged aquatic vegetation, and estuarine water column, mud, sand, and shell water bottoms. Marine areas include water column, non-vegetated bottoms, and continental shelf features. EFH has been designated within the study area for white shrimp, brown shrimp, pink shrimp, red drum, lane snapper, dog snapper, Gulf stone crab, King mackerel, cobia, and red snapper managed by the Gulf of Mexico Fishery Management Council (GMFMC). In addition, the waterbodies and wetlands in the study area provide nursery and foraging habitats supportive of a variety of economically important fishery species, such as striped mullet, Atlantic croaker, Gulf menhaden, spotted and sand seatrout, southern flounder, black drum, and blue crab. Some of these species serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC.

Salinity conditions are primarily saline and the project areas usually do not contain submerged aquatic vegetation. Much of the open water has become established at the expense of the barrier shoreline and emergent marsh.

Wildlife Resources

Because of their permeable skin and the need for osmoregulation, amphibians are typically restricted to the less-saline areas that are located primarily in the upper portions of the Basin. Amphibians found in the lower basin where suitable freshwater pools may form include the green tree frog, squirrel treefrog, Gulf coast toad, and eastern narrow-mouthed toad (Dundee and

Rossman 1989). Mabie (1976) indicates that the only species typically found in the Gulf salt marsh environment is the Gulf coast toad and little information is available on their distribution on the barrier islands. Dundee and Rossman (1989) report that the eastern narrow-mouthed toad has been found on sea beaches in southeastern Louisiana, as well as under boards in a salt marsh in Cameron Parish.

In saline marshes, reptiles are limited primarily to the salt marsh snake and the diamond-backed terrapin. Condrey et al. (1995) reports that coastal erosion and barrier island retreat directly threatens the diamond-backed terrapin. Sea turtles may seasonally utilize the bays and saline marshes adjacent to and including the Gulf and barrier island beaches.

Many mammals, because of their life history requirements, would not likely be found in the project area. The Coast 2050 Report (LCWCRTF and WCRA 1999) indicates an overall decline in furbearers that were historically present in the study area over the past 10 to 20 years. The bottlenose dolphin is the primary marine mammal that would likely be found in the study area, and then only in estuarine/marine open water portions of the area. However, the West Indian manatees are occasionally observed along the Louisiana Gulf coast. In addition, various species of whales have been documented in the offshore waters of the study area.

Birds are the most diverse group of terrestrial vertebrate species that can be found in the study area and include both resident and migrant species among the following groups: waterfowl, seabirds, wading birds, shorebirds, raptors, and songbirds. Avian use of existing wetlands within the study area varies, depending upon existing seasonal and environmental conditions.

The outer coast and barrier habitats are especially critical to migrating birds, such as songbirds, shorebirds, and waterfowl as they provide a place to land, recover, and feed. Trans-gulf migrants use the Terrebonne Basin barrier shoreline and surrounding areas as a staging area and as a final departure area for their fall migration as well as first landfall during spring migration. The study area is located within the Mississippi Flyway, which is the largest waterfowl migration route in North America. The 1986 *North American Waterfowl Management Plan* (Secretary, U.S. Department of the Interior and Canada Minister of the Environment 1986) identified the preservation and maintenance of critical over-wintering habitats as a key factor in preventing the further decline in the continental waterfowl population. The 2004 North American Waterfowl Plan outlined in *Strategic Guidance* (Secretary, U.S. Department of the Interior and Canada Minister of the Environment, Mexico Secretary of the Environment and Natural Resources 2004) renews the commitment to the 1986 Plan as well as providing goals, priorities, and strategies for the next 15 years.

The Coast 2050 Report (LCWCRTF and WCRA 1999) characterizes trends since 1985 for dabbling duck populations as steady in the open water and salt marsh habitat of the Isles Dernieres Shorelines but decreasing in the Timbalier Island Shorelines; diving duck population trends are reported as steady in both the open water and salt marsh habitat of the Isle Dernieres Shorelines and the Timbalier Island Shorelines. However, waterfowl are not historically present on the barrier shorelines.

Shorebirds such as the piping plover, semipalmated sandpiper, western sandpiper, curlew, ruddy turnstone, American avocet, oystercatcher, greater yellowlegs, common snipe, and killdeer are found within the study area. Shorebirds inhabit saline marsh, and shallow water/mud flat habitats of the barrier shorelines and surrounding estuary. Roosting habitats include beaches, sandbars, spits, or flats above high tide and shallowly flooded areas or islands free of vegetation (Helmers 1992). Many shorebird species are regular to accidental migrants, although some are common residents throughout the study area. Shorebird populations have been steady for the past 10 to 20 years in both the Isles Derniers and Timbalier Island portions of the study area, (LCWCRTF and WCRA 1999).

Seabirds including pelicans, gulls, terns, and skimmers are also found within and are known to nest on the project area barrier islands. Condrey et al. (1995) reported that most seabird species nest on islands because of their remoteness and lack of predators. Non-island breeding sites are more frequently abandoned by the seabird species that use them, in contrast to the barrier island sites, which tend to be used for 10 years or more. The Coast 2050 Report (LCWCRTF and WCRA 1999) indicates that since 1985 seabird populations have been steady within the salt marsh, open water, and barrier shorelines of both Timbalier and Isles Dernieres. There has been an overall increasing trend of brown pelicans within the Isles Dernieres reach since 1985. Raccoon Island harbors the largest brown pelican rookery in the state, as well as the greatest species diversity of nesting colonial waterbirds found on any barrier island in the state, while Wine Island hosts some of the largest brown pelican and colonial nesting waterbird rookeries in the state. In addition, LDWF is currently attempting to re-establish a brown pelican rookery on Whiskey Island.

Condrey et al. (1995) indicate that most colonies of wading birds (herons and egrets) are found in the swamp, although most species of wading birds will also nest on barrier islands and in almost any marsh, fresh to saline, where shrubs and mangroves are available. The Coast 2050 Report (LCWCRTF and WCRA 1999) characterizes wading bird population trends since 1985 as steady in the salt marsh and barrier beaches of the Isles Dernieres and Timbalier reaches.

During a 2008 survey conducted by the Louisiana Department of Wildlife and Fisheries (LDWF), approximately 44,771 nesting pairs of wading birds and seabirds were observed throughout the Isle Derniere chain. During a 2006 survey, LDWF observed approximately 1,265 nesting pairs of wading birds and seabirds along East Timbalier Island and Bayou Lafouche (Personal Communication Mike Carlos LDWF 2009).

Raptors are not typically or have not been historically present on the barrier shorelines and surrounding open water and salt marsh of the study area (LCWCRTF and WCRA 1999). The Coast 2050 Report (LCWCRTF and WCRA 1999) indicates that rails, coots, and gallinules have not been historically present on the barrier shorelines and have low numbers in the salt marsh habitat of the study area.

Because of their life history requirements, few other bird species are expected to inhabit the surrounding marshes and open water areas of the study area except to use them as temporary staging areas before and after trans-gulf migrations. The seaside sparrow is associated with the pounding surf and the densely matted grasses and sedges along the shorelines of Louisiana beaches with their nest placed often only a foot or so high in a mangrove bush (Lowery 1974).

Where these species of birds exist in the study area populations have been steady (LCWCRTF and WCRA 1999).

Invasive Species

The nutria and the Norway rat are the primary invasive mammalian species that could occur throughout the study area. The nutria, however, is typically found in the freshwater swamps and marshes of the Barataria-Terrebonne estuary system which are located outside of the study area.

Eurasian collared-dove, English sparrow, and European starling are all potential invasive avian species that could be found in the study area.

No problems caused by encroachment of invasive plant species have been reported on Louisiana's barrier islands. This is likely due to the extreme environmental conditions, such as higher salinities, shifting substrates, and frequent storm disturbance that may severely limit suitability of the habitat for colonization.

Threatened and Endangered Species

Federally listed threatened (T) and endangered (E) species and/or their designated critical habitat occurring in the study area include the piping plover (T) and its designated critical habitat, and the West Indian manatee (E). Several species of threatened/endangered sea turtles are also known to forage in the coastal waters of the study area. Those species include the loggerhead sea turtle (T), Kemp's ridley Sea turtle (E), green sea turtle (T), leatherback sea turtle (E), and hawksbill sea turtle (E).

West Indian Manatee

Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

To avoid any impacts to that species the Service recommends the following measures be incorporated into all contracts for this project. All contract personnel associated with the project should be informed of the potential presence of manatees and the need to avoid collisions with manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. All construction personnel are responsible for observing water-related activities for the presence of manatee(s). Temporary signs should be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., work area), and at least one sign should be placed where it is visible to the vessel operator. Siltation barriers, if used, should be made of material in which manatees could not become entangled, and should be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions should be implemented, including: no operation of moving equipment within 50 feet of a manatee; all vessels should operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, should be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area on its own accord, special operating conditions are no longer necessary, but careful observations should be resumed. Care should also be taken to avoid entrapment of individuals if any structure is to be installed that could be a barrier or impediment to manatee movement. Any manatee sighting should be immediately reported to the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).

Piping Plover

Federally listed as a threatened species, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers.

Based on the information that the Corps has provided to the Service regarding the subject project, the timing of construction between the islands (regardless of whether an island is in Phase I or II of the project) would likely affect the recovery time of benthic communities within the intertidal zones of those islands. Piping plovers feed upon benthic invertebrates and invertebrates found in organic material remaining after high tide events (i.e., wrack). The best available science indicates that benthic communities within the intertidal zones of barrier islands may take anywhere from 6 months to 2 years to fully recover, if there is a nearby source from which they can re-colonize an affected area. Because an entire island would be affected during one construction event, and because adjacent islands may undergo construction within 2 years or less, the ability of those islands to provide enough suitable foraging habitat to piping plovers will likely be affected until all construction is completed.

The Corps is responsible for determining whether the selected alternative is likely (or not likely) to adversely affect any listed species and/or critical habitat, and for requesting the Service's concurrence with that determination. If the Corps determines, and the Service concurs, that the selected alternative is likely to adversely affect listed species and/or critical habitat, a request for formal consultation in accordance with Section 7 of the ESA should be submitted to the Service. That request should also include the Corps' rationale supporting their determination.

Sea Turtles

The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species (i.e., Kemp's riddle and loggerhead sea turtles). Please contact Eric Hawk (727/824-5312) at the NMFS Regional Office in St. Petersburg, Florida, for information concerning those species in the aquatic environment. When sea turtles leave the aquatic environment and come onshore to nest, however, the Service is responsible for consultation. Consultation regarding nesting sea turtles should be conducted with this office.

The Kemp's ridley (*Lepidochelys kempii*) is an endangered sea turtle that occurs mainly in the coastal areas of the Gulf of Mexico and northwestern Atlantic Ocean. Juveniles and sub-adults occupy shallow, coastal regions and are commonly associated with crab-laden, sandy or muddy water bottoms. Small turtles are generally found in nearshore areas of the Louisiana coast from May through October. Adults may be abundant near the mouth of the Mississippi River in the spring and summer. Adults and juveniles move offshore to deeper, warmer water during the winter. Between the East Gulf Coast of Texas and the Mississippi River Delta, Kemp's ridleys use nearshore waters, ocean sides of jetties, small boat passageways through jetties, and dredged and nondredged channels. Kemp's ridley are not known to nest in Louisiana, however, their nesting range is apparently expanding. Major threats to this species include over-exploitation on their nesting beaches, drowning in fishing nets, and pollution.

Federally listed as a threatened species, loggerhead sea turtles (*Caretta caretta*) nest within the coastal United States from Louisiana to Virginia, with major nesting concentrations occurring on the coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida. In Louisiana, loggerheads have been historically known to nest on the Chandeleur Islands. Nesting and hatching dates for the loggerhead in the northern Gulf of Mexico are from May 1 through November 30. Threats to this species include destruction of nesting habitat and drowning in fishing nets. When loggerhead sea turtles leave the aquatic environment and come onshore to nest the Service is responsible for consultation. Accordingly, we recommend that you address potential impacts to this species within your Biological Assessment if your activities would occur on beach areas during the loggerhead nesting season.

Species of Special Interest

Brown Pelican

The proposed project would occur within an area that is known to be inhabited by nesting brown pelicans (*Pelecanus occidentalis*). That species was officially removed from the List of Endangered and Threatened Species on December 17, 2009. Brown pelicans nest in Louisiana from April through August. Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this breeding window could be altered based upon the dynamics of the individual colony. The Louisiana Department of Wildlife and Fisheries' Coastal and Nongame Resources Division (225/765-2811) should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies.

Brown pelicans are known to nest on barrier islands in Lafourche and Terrebonne Parishes. Current nesting locations within the project area include Raccoon Island and Wine Island. In spring and summer, nests are built in mangrove trees or other shrubby vegetation, although ground nesting may also occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

Although the brown pelican has been removed from the List of Endangered and Threatened Species, brown pelicans and their nests continue to be protected under the Migratory Bird Treaty Act (MBTA). To minimize disturbance to nesting colonies of brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this activity window could be altered based upon the dynamics of the individual colony. The Louisiana Department of Wildlife and Fisheries' Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. Brown pelicans are known to nest on barrier islands and other coastal islands in Lafourche and Terrebonne parishes.

Colonial Nesting Waterbirds

The proposed project would be located in an area where colonial nesting waterbirds are known to be present. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present).

2. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e.,

September 16 through April 1, exact dates may vary within this window depending on species present).

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season. Because of the extent of the proposed restoration project (i.e., entire and multiple island designs/phases) we understand that it may not be feasible to conduct all construction related activities outside of pertinent nesting seasons. The Service fully supports this restoration effort and is committed to working with your agency during project planning to resolve any potential conflicts that could occur as a result of migratory bird use of the proposed project area.

Refuges and Wildlife Management Areas

Terrebonne Barrier Islands Refuge (TBIR) consists of three barrier islands in the Isles Dernieres Chain. Wine Island, Whiskey Island, and Raccoon Island were acquired by LDWF in June of 1992 from Louisiana Land and Exploration Company via a 25-year free lease. The three islands comprise a total of approximately 630 acres, although the lease agreement covers several thousand acres of water.

The chain of islands that comprise the Isles Dernieres serves as permanent and migratory stopover habitat for shorebirds and passerine species (USEPA 1997). Of the numerous waterbird nesting colonies within the Terrebonne Basin barrier islands complex, the most significant are those found within the TBIR. Raccoon Island, which supports one of the greatest diversities of nesting and aquatic birds in North America, harbors the largest nesting colonies of brown pelicans in Louisiana and a significant colony of piping plovers (129 identified during winter census; Louisiana Coastal Wetlands Conservation and Restoration Task Force, 2006a). To the east, Whiskey Island currently contains nesting black skimmers and LDWF is attempting to re-establish a brown pelican rookery.

Management of Wine Island, on the eastern end of the Isle Derniere chain, was successfully reestablished in 1991 by the Louisiana Department of Natural Resources. Bird activity on the islands is monitored by Fur and Refuge Division staff from the Atchafalaya Delta, New Iberia, and Rockefeller Refuge. That island hosts some of the largest brown pelican and colonial nesting waterbird rookeries in the state.

Coastal Barrier Resource Act (CBRA)

Section 206.344 (c) Limitations on Federal Expenditures - This Section of the CBRA states that there would be Federal financial limitations to carry out "... any project to prevent erosion of, or to otherwise stabilize, an inlet, shoreline, or inshore area, except that such assistance and expenditures may be made available on units designated pursuant to Section 4 on the maps numbered S01 through S08 for purposes other than encouraging development and, in all units in cases where an emergency threatens life, land, and property immediately adjacent to that unit." (emphasis added)

Units S01 through S08 extend from Bastian Bay in Plaquemines Parish to Cheniere Au Tigre in

Vermilion Parish. Since the intent of coastal restoration projects is not to encourage development, all such restoration projects in units S01 through S08 would be exempt from the limitations of the CBRA, and therefore, eligible for Federal expenditures.

EVALUATION METHODOLOGY

Evaluation of project-related impacts on fish and wildlife resources was aided by use of the Wetland Value Assessment (WVA) methodology developed for the evaluation of proposed Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects (LCWCRTF 2006b). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for future without-project (FWOP) and future with-project (FWP) conditions. The Barrier Island Community Model was used for this project. Instead of the species-based approach of HEP, this model utilizes an assemblage of variables considered important to the suitability of a given habitat type for supporting a diversity of fish and wildlife species. As with HEP, this model allows a numeric comparison of each future condition and provides a combined quantitative and qualitative estimate of project-related impacts to fish and wildlife resources.

WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each habitat type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Indices) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

The WVA methodology was initially developed in 1991 by the CWPPRA Environmental Work Group (LCWCRTF 2006b). Initially, emergent marsh habitat models were developed for fresh, intermediate, brackish and saline marsh types. Subsequently, models were also developed for swamps, barrier islands, barrier headlands, and coastal forested ridges. The habitat variable-habitat suitability relationships within the WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources. The barrier island WVA model consists of seven variables: 1) percent of the total subaerial area that is classified as dune habitat; 2) percent of the total subaerial area that is classified as supratidal habitat; 3) percent of the total subaerial area that is classified as intertidal; 4) percent vegetative cover of dune, supratidal, and intertidal habitats; 5) percent vegetative cover by woody species; 6) degree of marsh edge and interspersion; and 7) beach/surf zone features.

Using the WVA methodology, impact assessments were conducted by the Habitat Evaluation Team (HET), which included representatives of the Service, BEM Systems, and SJB Group. To assess impacts the HET used Storm-induced BEAch CHange (SBEACH) model and GENESIS model outputs, surveys, shoreline erosion and marsh loss data, knowledge of the area, experience with similar projects, CWPPRA project data, the previous LCA Barrier Island study (January 2003), field inspections conducted during July 2009, and Digital Ortho-quarter Quadrangle aerial photographs.

Those elements were used in conjunction with the above-discussed mathematical models to compute an HSI value for each target year (TY). Target years were established when significant changes in habitat quality or quantity were expected during the 50-year project life, under FWP and FWOP conditions.

The product of an HSI and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the period of analysis to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

It is important to note that a limitation of the barrier island WVA model is the dune, supratidal, and intertidal variables are defined by fixed vertical elevations. Of all the variables in the model, the intertidal variable carries the most weight. Therefore, when attempts are made to optimize designs and associated alternatives based in part on AAHUs, intertidal acreage is maximized as early and as long as possible during the project life. Because each of the habitat types in this model are based on fixed vertical elevations, however, no adjustment is possible when the effects of seal level rise on project performance are considered over a 50-year project life. With sea level rise effects included with fixed elevation definitions, there is a substantial loss of intertidal habitat as presently defined in the model. This limits the amount of resulting AAHUs when in reality the intertidal range would adjust with sea level rise. Most applications of this model to date have been through the Coastal Wetlands Planning, Protection, and Restoration Act

(CWPPRA) which has a 20-year project life where sea level rise has less impact on benefits. Furthermore, under CWPPRA, cost/benefit is not the only metric used to compare island versus mainland projects. Until programmatic changes are made to methods, the WVA results should be used for comparing within island alternatives and not between island and mainland projects. In addition, if methods changes were made to allow intertidal habitat to adjust with sea level rise, different design alternatives may have been developed for optimal benefit performance.

Twelve alternatives (including the no action alternative) were included within the final array for the TBBSR project (see Table 1).

Renourishment was considered but was not originally included within those Final Array island designs identified in Table 1. The PDT agreed that the restoration measures (without renourishment) would input additional sediments into the system during construction. After the initial input of sediment, the system would be allowed to "self-regulate" and return to its natural processes. Thus, the islands erode naturally and the benefits produced by the project decline as the islands erode.

Recently, however, there have been questions raised regarding the sustainability of the National Ecosystem (NER) Plan/Selected Plan (SP) without renourishment. Furthermore, since renourishment was originally considered in the LCA 2004 report, excluding it would be inconsistent with the 2007 WRDA authorization. Therefore, the concept of renourishment has been reevaluated to assess benefits and cost effectiveness for each of the islands in the NER Plan/SP.

The initial WVA analysis was completed on all alternatives (without renourishment) within the final array under the low sea level rise (SLR) scenario. As requested by the Corps, additional WVAs were later run to quantify impacts to those alternatives under the intermediate and high SLR scenarios and the NER plus renourishment plans. A combined total of 91 WVA evaluations were completed for this project.

The Project Information Sheet (including assumptions used by the HET) and the WVA summary sheet for the LCA-TBBSR project are presented in Appendix A and B, respectively. The complete WVA analysis can be obtained from the Service's Lafayette, Louisiana Ecological Services Office upon request.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

Barrier island systems provide protection to the wetlands, bays, and estuaries behind them and help reduce wave energy at the margins of coastal wetlands, thereby limiting erosion (Williams et al. 1992) and tropical storm impacts. As such, barrier island systems are key geomorphic structures that help sustain other coastal habitats, particularly the interior coastal marshes and swamps, by reducing marine influences and tropical storm impacts. These island systems also serve as essential habitat for many terrestrial and aquatic species, including federally listed threatened and endangered species (USACE 2004a).

In Louisiana, barrier island erosion is attributable to shoreline erosion, insufficient volumes of

Table 1. Final Array of Alternatives.

Alternative	Plan	Description
Alternative 1	no action	
Alternative 2	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 3	Whiskey Plan C	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 4	Whiskey Plan C	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Trinity Plan C	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 5	Raccoon w/TG Plan E	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss and construction of a terminal groin on the western end
	Whiskey Plan C	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Trinity Plan C	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 6	Raccoon Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function

Alternative	Plan	Description
Alternative 7	Raccoon w/BW Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function along with construction of 8 breakwaters on the western end
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function
Alternative 8	Raccoon w/TG Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function along with construction of a terminal groin on the western end
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function
Alternative 9	Raccoon Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Timbalier Plan B	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function
Alternative 10	Raccoon Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function
	East Plan B	Restoration of East Island to its minimal geomorphologic form and ecologic function
	Wine Plan B	Restoration of Wine Island to its minimal geomorphologic form and ecologic function
	Timbalier Plan B	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function
	East Timbalier Plan B	Restoration of East Timbalier Island to its minimal geomorphologic form and ecologic function

sediment supplied by littoral currents, increasing tidal prism, land subsidence, sea-level rise, storms, and human impacts (Boesch 1982). Significant shoreline erosion and interior marsh loss has occurred within the TBBSR study area. The historic rates of land loss for Louisiana's barrier islands are varied, and can average as high as 50 acres per year, over several decades. Hurricane events can push the rate of land loss to greater than 300 acres per year (USACE 2004a).

The long-term area change of the Isles Dernieres was 8,724 acres in 1887 to 1,879 in 2002. After Hurricane Andrew in 1992 the Isles Dernieres decreased to 1,267 acres by 1993. The long-term rate of area change between 1887 and 2002 was -62.3 ac/yr or a total decrease of -82.2%. The 1988–2002 area rate decrease was -25.0 ac/yr or a -18.4% decrease. The long-term (1887–2002) and short-term (1988–2002) calculated disappearing dates were 2034 and 2075, respectively. McBride et al. (1992) predicted the long-term and short-term disappearance dates at 2015 and 2004 for 1887–1998 and 1978–1988, respectively. However, the 2002 LCA historical area data for the Isles Dernieres extends the long-term and short-term disappearance dates by 60 years and 30 years respectively (USACE 2004b).

Historically, the areas of the Timbalier Islands have undergone significant negative and positive areal rate changes. Between 1887 and 1934 the area of the Timbalier Islands decreased from 4,142 acres (ac) to 2,875 ac at a rate of -27.0 ac/yr. Between the next two periods, 1934–1955 and 1956–1978, the Timbalier Islands increased from 2,875 ac to 3,280 ac and then to 3,693 ac at a rate of + 18.8 ac/yr respectively. This was a period of extensive backbarrier canal dredging and dredge spoil placement to support oil and gas development that inadvertently increased the area of the Timbalier Island areas. The large decrease in the area between 1978 and 1988 is a function of the extension of the Belle Pass jetties to the east and the disruption of the dominant longshore sediment transport to the west. The combination of a diminishing sediment supply and hurricanes between 1988 and 1996 continued to drive island barrier loss between 1996 and 2002 (USACE 2004b).

The continued loss of the barrier shoreline habitat and the accompanying trend toward higher salinities typically leads to lower biodiversity and long-term productivity. Marshes will continue to deteriorate and convert to open water, leaving scattered fragments of marsh and sandy shoals. Fish and wildlife habitat quality will decrease as the barrier shoreline continues to erode and islands breakup or disappear. Increased stress on fish and wildlife is expected as various fish and wildlife breeding, nesting, nursery, feeding, roosting, or overwintering habitats continue to be lost. Habitat for endangered species would be further degraded and/or reduced. The LCA Study (USACE 2004a) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year over the next 50 years. The LCA Study also estimated that an additional net loss of 328,000 acres might occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands. Land loss along Terrebonne Basin Barrier Shoreline would likely continue at rates similar to present resulting in the projected loss of 2,811 acres of barrier island soils by 2062.

Fisheries Resources

Baltz et al. (1993) reports that salinity and proximity to the marsh edge strongly determines the distribution of most fishes, and the abundance of fishes declines dramatically with distance from marsh edge. Intertidal marsh grass stems provide cover for juvenile fishes and adults of smaller species, as well as substrate for epiphytes and epifauna, which small fishes consume. Larger predatory fishes, such as spotted seatrout and red drum, forage along the marsh edge for small fishes, blue crab, and shrimp. Fishes that live in the open water of estuarine bays, such as bay anchovy and Gulf menhaden, gain refuge from sight-feeding predators in the turbid water. Those prey species are typically filter feeders, which eat zooplankton and phytoplankton. Demersal fishes, such as flounders and gobies, live in proximity to the bottom, and are typically indistinguishable from the substrate. The deterioration of emergent wetlands may temporarily benefit some estuarine-dependant fisheries, but an eventual decline in productivity will result as detrital input and marsh-edge habitat are significantly reduced via conversion to open water (Turner et al. 1982).

It is likely that the wetlands of the basin have deteriorated beyond the most productive stage for estuarine-dependant fisheries, and that they will continue to experience loss (and decreased habitat quality) under FWOP conditions. Along with the disappearance of estuarine marsh nursery areas, the continual disappearance of the barrier shorelines and their surrounding estuarine marshes in the study area will substantially contribute to the on-going decline of fishery resources. The loss of barrier island marsh will eliminate nursery habitat for many species of young-of the year estuarine marine fish and macroinvertebrates that move inland to mainland marshes. In addition, high-energy beach habitat utilized by some species as a nursery ground will be lost causing those species to decline. The Coast 2050 report (LCWCRTF and WCRA 1999) estimates that red and black drum, spotted seatrout, Gulf menhaden, southern flounder, white and brown shrimp, and blue crab will continue a decreasing population trend into the future in and around the barrier islands of the study area.

Wildlife Resources

Little, if any, information exists regarding population status and trends of reptiles and amphibians in the study area. According to the Barataria Terrebonne National Estuary Program (BTNEP) (Industrial Economics, Inc. 1996), over-harvesting and the loss of habitat, both within and outside the Barataria-Terrebonne estuary, threatens turtle populations. Over-harvesting and habitat loss threaten the snapping turtle, while coastal erosion and barrier island retreat directly threaten the diamond-backed terrapin.

The Coast 2050 Plan (LCWCRTF and WCRA 1999) indicates that nutria, muskrat, mink, otter, raccoon, rabbits and deer are no longer present on the Timbalier Island Shorelines; habitat for those species was not historically present within the Isles Dernieres Shorelines. In addition, that plan indicates that seabird populations within the study area salt marshes are steady, but are projected to decline through 2050. Waterfowl, wading birds, shorebirds, rails, coots, and gallinules are also expected to decrease by the year 2050 (LCWCRTF and WCRA 1999), as habitat continues to decline. Habitat quality for wildlife is expected to decline as the barrier shoreline in the study area continues to deteriorate and convert to open water under FWOP conditions.

Threatened and Endangered Species

The fate of the piping plover may be influenced by the habitat conditions of Louisiana's barrier islands, which support foraging, roosting, and sheltering needs of the piping plover. Many of Louisiana's barrier islands are used by the piping plover for their wintering habitat, and they may be present for 8 to 10 months annually from late July to late March or April. Activities that disrupt or reduce the birds' foraging efficiency hinders their ability to build-up fat reserves for migration. As barrier islands degrade, so declines those habitat components that support the piping plover's wintering critical habitat; thus, creating increased competition for the scarce coastal resources. Regardless of the efforts of the ESA, if the piping plover's wintering critical habitat in coastal Louisiana continues to decline unabated the species may continue to be negatively affected. In addition, as barrier shorelines continued to deteriorate and be lost the characteristics of the nearshore waters and bays are expected to change, thus potentially impacting sea turtle foraging areas.

The West Indian manatee will not likely be affected by the continued deterioration of the Louisiana coastal barrier shorelines, as their habitat needs are not dependent on those land features. Manatees, however, could possibly be present at the project sites. In the event that this species is observed in any part of the project area during construction or operation, the Corps should contact the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).

Species of Special Interest

The brown pelican, formerly protected under the ESA is now protected under the MBTA, and has recently recovered from very low populations experienced over the last three decades. The Coast 2050 Plan predicts that populations within the Timbalier Island Shoreline will remain steady, while population are expected to increase within the Isles Dernieres Shoreline primarily from efforts of the ESA and restoration efforts on the TBIR.

DESCRIPTION OF NATIONAL ECOSYSTEM RESTORATION PLAN

Alternative 5 - Raccoon with Terminal Groin (Plan E)/Whiskey (Plan C)/Trinity (Plan C)/Timbalier (Plan E) with renourishment was selected as the National Ecosystem Restoration (NER) Plan because it is a "Best Buy" plan that fulfills the projects planning objectives. This alternative restores the geomorphologic form and ecologic function of four islands in the Terrebonne Basin barrier system by creating and restoring a net total of 5,902 acres of barrier island resources. The creation of dune, supratidal, and intertidal habitats will provide essential habitats for fish, migratory birds, and other terrestrial and aquatic species. Furthermore, by using the proposed borrow areas, the project would increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline by mechanically introducing compatible sediment, and increasing the ability of the restored area to continue to function and provide habitat with minimal continuing intervention. The NER plan also represents a system-wide and cost effective approach of restoring as many islands within the Terrebonne Basin barrier system which are constructible with cleared sediment sources. Due to funding limitations and the risk of losing authorization, however, Alternative 5 has not been designated as the SP.

Restoration of ecologic function of the barrier islands includes vegetating both the restored dunes and back barrier marsh platforms with native plants, to provide wetland habitat for a diverse number of plant and animal species and to help retain sediment. Geomorphologic form and ecologic function were defined through analysis of historic planforms and elevations and storm erosion modeling such that the restored island retains this form and function after being subjected to selected design storms. The design storms that were used in template development included a hypothetical 50-year storm as well as the varying intensities, durations, and approach paths of Hurricanes Katrina and Rita, which occurred in 2005, and Hurricanes Gustav and Ike, which occurred in 2008. The minimum design plan consists of a beach/dune component and a marsh component.

Plan B Design (minimum design plan for geomorphologic form and ecologic function)

1. Beach and Dune Restoration

   Based on SBEACH simulations that were performed on an array of various restoration plans, the following design criteria for Plan B were derived:

   - Gulf-side beach width: 250 feet,
   - Beach elevation: 3.8 feet NAVD88,
   - Dune width:100 feet
   - Dune elevation: 6.0 feet North American Vertical Datum (NAVD)88, and
   - Bay-side beach width: 100 feet.

2. Marsh Restoration

   The marsh serves as a roll over platform as the islands migrate landward. Based on the post storm observations from the recent historic storms, there is evidence to suggest that the back barrier marsh width needs to be on the order of 1,000 feet to capture overwash sediments during episodic events; sediment that would otherwise be carried into back bay areas to form shoals or be lost into deeper waters. Cross-shore sediment transport models (e.g., SBEACH) tend to underestimate the extent of overwash. Examination of vertical aerial photographs of the Texas coast, made following Hurricane Ike, show areas of overwash extending from 800 to 1,300 feet inland (Ewing 2009). An extensive study of overwash on the Caminada-Moreau Headland by Ritchie and Penland found that, for much of the low shoreline, overwash penetrated from 700 to more than 1,000 feet beyond the beach (Ritchie and Penland 1989). Examination of the aerial photographs in Williams et al. (1992) show overwash areas extending to 1,300 feet on Timbalier Island and greater than 700 feet on East Island. Personal observations by various PDT members support planning for a minimum marsh width of 1,000 feet. Therefore, 1,000 feet was defined as the design criteria for the minimized restoration template for the marsh platform width.

   Based on similar Louisiana barrier island restoration plans, the average healthy marsh elevation, defined as the target elevation for the marsh platform, is typically within +/-

0.1 feet of Mean High Water (MHW). MHW for the project area is approximately 1.6 feet NAVD88 and was defined as the design criteria for the minimized design plan for the marsh platform elevation.

Plan C, D, and E Design

Plans C through E are scalars of Plan B that incorporate incremental increases in the scales of beach, dune and marsh planforms and elevations to provide plan formulators the ability to determine the optimal increment for restoration of the geomorphologic form and ecologic function of these islands. The optimal level of restoration is defined as the best balance of environmental benefits (e.g., habitat acres), constructability as constrained by available sediment volumes in identified borrow sources, and cost effectiveness. Plan C provides for the minimal geomorphologic form and ecologic function on each island along with 5 years of background erosion/land loss. Plan D provides for the minimal geomorphologic form and ecologic function on each island along with 10 years of background erosion/land loss. Plan E provides for the minimal geomorphologic form and ecologic function on each island along with 25 years of background erosion/land loss.

Alternatives 5 and 8 propose a terminal groin on Raccoon Island to address erosion along the western portion of that island. The terminal groin would be constructed perpendicular to the shoreline at the western end of the island and is designed to trap longshore sediment transport. In addition, Alternative 7 proposes eight segmented breakwaters along the western end of that island. The main function of those breakwaters would be to trap sand by reducing wave energy behind the structure, therefore slowing littoral drift and creating a salient or tombolo behind the structure.

Currently proposed renourishment plans are identified in Table 2 below.

Table 2. Renourishment Plans.

Island Plan	Renourishment Year	Renourishment Plan
Raccoon Plan E w/ TG	TY30	Restore Plan B
Whiskey Plan C	TY20	Add Plan C
	TY40	Add Plan B
Trinity Plan C	TY25	Add Plan C
Timbalier Plan E	TY30	Restore Plan B

EVALUATION OF NATIONAL ECOSYSTEM RESTORATION PLAN

The WVA analyses indicate that the NER (with renourishment) for TBBSR would result in net gains in the quality and quantity of barrier island habitats of 477 AAHUs under Raccoon with

Terminal Groin (Plan E), 678 AAHUs under Whiskey (Plan C), 628 AAHUs under Trinity (Plan C), and 1100 AAHUs under Timbalier (Plan E), for a total net gain of 2,883 AAHUs compared to the future without-project conditions.

Project-related benefits would occur through the creation of dune, supratidal, and intertidal barrier island habitats. The newly created barrier shoreline would provide more sediment to the system, combat subsidence, and increase nutrients available to the area. In addition, the area would be less susceptible to breaching and increased erosion, reduce wave fetch from previously breached islands and broken marsh, and reduce the amount of back barrier marsh converting to open water.

DESCRIPTION OF FIRST COMPONENT OF CONSTRUCTION

As discussed above, the NER plan was the most appealing selection for the SP because it was a "Best Buy" that fulfills the planning objectives of the project. The plan also represents a system-wide and cost effective approach of restoring as many islands within the Terrebonne Basin barrier system which are constructible with cleared sediment sources. Because the NER plan (Alternative 5) cannot be constructed within the currently authorized cost cap, a subset of the NER plan is recommended as the first component of construction.

In order to select the first component of construction from the NER plan, the PDT performed additional cost refinements on each island in the NER. Those refinements inflated the costs of the islands, leaving Trinity Island Plan C and Whiskey Island Plan C (Alternative 11) as the only islands plans within the NER that could be constructed within the budget. Consequently, a separate screening process was conducted on the two islands to select the most appropriate island for the SP.

While Whiskey Plan C provides slightly higher AAHUs than Trinity Island Plan C (678 AAHUs vs. 628 AAHUs), it was also selected as the first increment of construction due to a number of qualitative benefits provided by the plan. For example, Whiskey Plan C was designed to avoid approximately 286 acres of existing mangroves on the island in order to minimize the ecologic impact during construction. Since the island is considered a valuable wildlife habitat (included within the TBIR) and the LDWF is reestablishing a pelican rookery on the island, maintaining adequate areas of healthy beach, dune, and marsh is particularly important. The island also contains critical habitat for the threatened piping plover and is a valuable stopover area for migratory birds.

Furthermore, Whiskey Plan C was designed to complement TE-50, which is an existing CWPPRA project that was constructed in 2009. TE-50 created approximately 316 acres of intertidal back-barrier marsh between the two existing mangrove stands. Restoration of the beach and dune gulfward of TE-50 will help to protect the existing CWPPRA investment.

The barrier islands provide a critical component of the estuary structure, and are the first line of defense against marine and weather influences. Whiskey Island is the closest of the seven barrier islands to the critical marsh habitat located in the southern-most portion of Terrebonne Parish. If the island were to disappear, the marsh habitat on the mainland would be susceptible to the direct impacts of tropical storms and hurricanes.

EVALUATION OF FIRST COMPONENT OF CONSTRUCTION

Because Alternative 11 is a subset of the NER, implementation of that alternative would result in similar benefits as expected under Alternative 5, but to a lesser degree. The WVA analyses indicate that Whiskey (Plan C) for TBBSR would result in a net gain of 678 AAHUs in the quality and quantity of barrier island habitats compared to the future without-project conditions.

While a portion of the constructed acreage created under the first increment of construction is projected to disappear by the end of the period of analysis (i.e., 50 years), the net effect of the plan would be to prevent the loss of Whiskey Island. If no actions are taken, the remaining 820 acres of the island is expected to disappear by 2042 (i.e. all dune, supratidal, and intertidal habitat will be gone); this includes the existing crucial mangrove habitat and the back-barrier marsh created by CWPPRA Project TE-50. The majority of this loss would be prevented with implementation of the first increment of construction.

As a result of the TBBSR project, there is a substantial improvement in terms of resource sustainability within the project area provided under the first increment of construction compared to the future without project conditions. The first increment of construction also meets the restoration objectives of restoring the geomorphic form and ecologic function on Whiskey Island and of restoring and improving essential habitats for fish, migratory birds, and other terrestrial and aquatic species for the 50-year period of analysis.

The restoration of the Whiskey Island would alter the tidal prism, thereby reducing the formation of any additional tidal passes as well as closing or narrowing existing passes and breaches, protecting and preserving the interior marsh habitats which would quickly erode without the protection of the sand shoreline. In addition, the first increment of construction would: 1) increase the sustainability of the barrier island shoreline system; 2) help restore the geomorphic function of the barrier shoreline; 3) create and restore shoreline, dune, and back-barrier marsh, which would be stabilized with vegetative plantings and sand fencing; 4) reduce wave and tidal energies and salinities from the Gulf by providing a natural storm protective buffer for interior marsh; and 5) provide some degree of storm surge protection.

PROJECT IMPACTS

Whiskey Plan C proposes a dune height of +6.4 feet NAVD 88 with a dune crown width of 100 feet. The dune elevation takes into account that there will be approximately 0.4 feet of vertical adjustments (eustatic sea level change, subsidence, and compaction) occurring during the first six months after construction. At the end of the six-month period, the dune is expected to reach the design elevation of 6 feet NAVD 88. The slopes of the beach and dune are set 60:1 and 30:1 (horizontal to vertical), respectively.

The marsh fill is proposed on the landward side of the dune at an elevation of +2.4 feet NAVD 88. Although the design elevation for the marsh is 1.6 feet NAVD 88, the marsh will be constructed at a higher elevation to account for initial vertical adjustments. Approximately 1,289 acres of barrier island resources would be created and restored.

Whiskey Plan C was designed to avoid approximately 286 acres of existing mangroves on the island to minimize the ecologic impact during construction. Plan C was also designed to complement TE-50, which is an existing CWPPRA project that was constructed in 2009. TE-50 created approximately 316 acres of intertidal back-barrier marsh between the two existing mangrove stands.

The first increment of construction will utilize beach/dune material from the Ship Shoal borrow area and marsh material from the Whiskey 3a borrow area. Fill quantities for the initial construction and renourishment components of Whiskey Plan C are 8.9 million and 14.7 million cubic yards, respectively. For the dune area, the material will be pumped from the dredge to the beach. The material will then be worked on the beach by bulldozers and front-end loaders. For the marsh area, the material will be pumped from the offshore borrow site. Containment dikes will be constructed around the perimeter. Sediment for the containment dikes will be dredged from existing material inside the marsh creation area. These operations will be completed in a manner that will minimize turbidity of the water at the dredge site and the discharge site.

Approximately 18,075 feet of sand fencing will be installed. The sand fences are porous barriers that reduce wind speed along the coast such that sand being transported by the wind accumulates on the downwind side of the fence. The sand fences will promote deposition of windblown sand, create dune features, reduce trampling of existing dunes by beach visitors, and protect vegetative plantings. Vegetative plantings will include a variety of native species. The recommended planting density is no greater than 8-foot centers.

Fisheries Resources

Implementing Alternative 11 (the first increment of construction) would restore approximately 1,292 acres of shallow open water and fragmented barrier habitats to higher quality and more continuous transitional barrier habitats. This increase in barrier habitat acreage would provide important habitat for foraging, breeding, spawning, and cover for a variety of larval, juvenile, and adult fishes. In addition, a localized increase in biodiversity and some fish populations would be expected by the net increase of emergent wetlands constructed by Alternative 11 compared to under the future without project scenario. More nutrients and detritus would be added to the food web, thereby increasing fish productivity and providing a benefit to local fisheries.

Wildlife Resources

Alternative 11 (the first increment of construction) would restore and rehabilitate dune, supratidal and intertidal vegetated coastal barrier habitats and reduce conversion of these habitats to open water habitat. Benefits of implementing Alternative 11 would include an increase in essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, and other life requirements; an increase in vegetative growth and productivity; and a reduction in inter- and intra-specific species competition between resident and non-resident wildlife species for limited coastal vegetation. In addition, important stopover habitats used by migrating neotropical birds would be restored and sustained for future use over the 50-year period of analysis and habitat used by piping plovers may be increased by the implementation of Alternative 11.

SERVICE PREFERRED ALTERNATIVE

The coastal barrier island chains in Louisiana are the first line of defense for protecting wetlands, inland bays, and mainland regions from the direct effects of wind, waves, and storms. The barrier system serves multiple defensive purposes which include: reducing coastal flooding during periods of storm surge; preventing direct contact with ocean waves, which would accelerate erosion and degradation of marshes and other wetlands; and helping to maintain gradients between saline and fresh water, thereby helping to preserve estuarine systems. Without ecologic restoration large-scale change would occur within the project area due to the encroachment of the Gulf into the coastal wetlands. Rebuilding Whiskey Island will help protect interior marsh and bays from the intrusion of the Gulf and downdrift shoreline habitats from further deterioration by helping to maintain the salinity gradients, temporarily preventing further disruption to the hydrology of the esturary, and by adding sediment to the system.

The first increment of construction is a component of a comprehensive strategy to sustain the wetlands and associated fish and wildlife productivity of the Terrebonne Basin. The restoration of barrier island habitats would help reduce the decline in fish and wildlife habitat quality and detrital production over time. Though the first increment of construction would provide for many needed benefits, those benefits address only a minor portion of the barrier island restoration needs of the Terrebonne Basin and would be significantly more substantial under a multiple island ecosystem approach.

The proposed NER plan addresses habitat restoration on Raccoon, Whiskey, Trinity, and Timbalier Islands. During the alternative screening process, the PDT discussed potential restoration options on five islands within the Isles Dernieres Reach (including Wine Island) and on two islands within the Timbalier Reach. One option that was developed specifically for Wine Island included placing beach compatible sand within the existing rock revetment locally known as the Wine Island Ring; that "ring" would serve as the containment for the dredged sediment. The small area of the island precludes differentiation of beach, dune, and marsh. Rather, the fill material would be graded and planted with dune-stabilizing vegetation, to prolong sediment retention and provide additional habitat for nesting birds.

Based on the results of the USACE Institute for Water Resource's Planning Suite (IWR) screening run, the above described Wine Island alternative was not included within the most cost-effective "Best Buy" plans. The input parameters for the IWR screening tool, however, are habitat and cost based; qualitative benefits associated with important foraging, nesting, and roosting areas for federal trust resources are not incorporated. Because Wine Island harbors one of the largest brown pelican and colonial nesting waterbird rookeries in the state and is included within the TBIR, the Service recommends that the Corps take into account those qualitative benefits when assessing cost-effectiveness and consider including the subject Wine Island design into the NER plan.

Considering the immediate need for restoration in the area, the Corps and OCPR believe it is in the best interest of the Terrebonne Basin barrier system to proceed with Whiskey Island (Plan C) which would build a foundation for future authorizations and programs that may complete the ultimate project goals. While the Service agrees, we believe that to better meet the project goal of sustaining and improving habitats for migratory and native species for the 50 year project life within the Terrebonne Basin, the NER plan (including the Wine Island design) would be the optimal choice. The NER plan plus Wine Island design better meets the goals and objectives of the 2004 LCA Plan to address critical near-term needs for shoreline restoration for Terrebonne Basin through simulating historical conditions by enlarging the barrier islands (width and dune crest) and reducing the current number of breaches to ensure the continuing geomorphic and hydrologic form and function on multiple barrier islands via an ecosystem approach to restoration. Accordingly, the Service would prefer to see the NER plus Wine Island selected as the SP.

FISH AND WILDLIFE CONSERVATION AND MITIGATION MEASURES

Barrier islands are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Because of the Services' close coordination with the USACE on this project, and because the project is expected to have an overall benefit to the LCA-TBBSR study area, the Service has no conservation measures to offer at this time.

SERVICE POSITION AND RECOMMENDATIONS

The first increment of construction will benefit the fish and wildlife resources of the Terrebonne Basin by creating and nourishing a barrier island and back barrier marsh. The Service will support further planning of the proposed project provided that the following fish and wildlife recommendations are included in the feasibility report and related planning and authorizing documents and are implemented concurrently with project implementation:

1. The Service, NMFS, and LDWF should be provided an opportunity to review and submit recommendations on future detailed planning reports and the draft plans and specifications on the Terrebonne Basin Barrier Shoreline Restoration Project addressed in this report.

2. Consultation should continue with the Service and NMFS on detailed contract specifications to avoid and minimize potential impacts to piping plover and their critical habitat, manatees, sea turtles, migratory birds, and essential fish habitat.

3. Avoid adverse impacts to nesting waterbird colonies through careful design project features and timing of construction. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, exact dates may vary within this window depending on species present). For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or

cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present). Prior to any such work, surveys should be conducted by qualified personnel during the colonial seabird nesting season to determine the presence and location of any such colonies. In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season. Because of the extent of the proposed restoration we understand that it may not be feasible to conduct all construction related activities outside of pertinent nesting seasons. Should those activities overlap with colonial nesting waterbird nesting seasons further coordination with this office will be necessary.

4. To minimize disturbance to nesting colonies of brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Prior to construction activities, surveys should be conducted by qualified personnel during the brown pelican nesting season to determine the presence and location of any such colonies. In addition, we recommend that on-site contract personnel be informed of the need to brown pelicans and their nests, and should avoid affecting them during the breeding season. Because of the extent of the proposed restoration we understand that it may not be feasible to conduct all construction related activities outside of pertinent nesting seasons. Should those activities overlap with the brown pelican nesting season further coordination with this office will be necessary.

5. In order to minimize adverse impacts to blue crabs, we recommend that efforts be made to prohibit the mining of Ship Shoal during annual periods of highest blue crab use (i.e., April through October).

6. If the proposed project has not been constructed within 1 year or if changes are made to the proposed project, the Corps should re-initiate Endangered Species Act consultation with the Service.

7. Portions of the proposed project are within the Isles Dernieres Barrier Islands Refuge. No activities should occur on that refuge without first obtaining a Special Use Permit from LDWF.

8. The newly created barrier island and back-barrier marsh, as well as the surrounding habitats that may be indirectly benefited by long-shore transport and sediment overwash, should be monitored over the project life for effectiveness and the results should be provided to all resource agencies. Development of those monitoring plans should be coordinated with all natural resource agencies. In addition, those monitoring plans should be consistent with the Barrier Island Comprehensive Monitoring requirements developed by the Office of Coastal Protection and Restoration under funding from LCA Science and Technology Program.

9. All dredge material containment features should be breached or degraded, if necessary to restore tidal connectivity, once the marsh creation/nourishment areas have at least 80% coverage of emergent vegetation.

10. The Service recommends that the Wine Island "Rock Ring" alternative be re-analyzed for potential inclusion in the NER plan, taking into account qualitative benefits associated with important foraging, nesting, and roosting areas for federal trust resources that are not incorporated into the IWR.

11. If authorized funding limits for this project are increased the Service recommends that the NER plan (with Wine Island design if feasible) be reconsidered as the potential future SP.

12. If additional dollars become available for constructing further increments of the NER plan, the Service recommends that the Corps fully coordinate with the natural resource agencies in prioritizing restoration of those islands contained within the NER plan that are not within the SP.

13. In addition, to the above recommendations, LDWF believes that hard structures (such as segmented breakwaters) should be reconsidered for inclusion in the proposed project if additional funding becomes available. It has been LDWF's experience that hard structures add considerable longevity to barrier island restoration projects, offering high value for their cost. Therefore, we recommend that the COE coordinate with pertinent natural resource agencies regarding the potential use of hard structures should additional project funding become available.

LITERATURE CITED

Baltz, D. M. and R. F. Jones. 2003. Temporal and spatial patterns of microhabitat use by fishes and decapod crustaceans in a Louisiana estuary. Transactions of the American Fisheries Society. 132:662-678

Baltz, D.M., C. Rakocinski, and J.W. Fleeger. 1993. Microhabitat use by marsh-edge fishes in a Louisiana estuary. Env. Biol. Fish. 36:109-126.

Barras, J.A., 2009, Land area change and overview of major hurricane impacts in coastal Louisiana, 2004-08: U.S. Geological Survey Scientific Investigations Map 3080, scale 1:250,000, 6 p. pamphlet.

Boesch , D. F., ed. 1982. Proceedings of the conference on coastal erosion and wetland modification in Louisiana: causes, consequences, and options. U.W. Fish and Wildlife Service, Biological Services Program, Washington, D.C. FWS/OBS-82/59. 256 pp.

Condrey, R., P. Kemp, J. Vesser, J. Gosselink, D. Lindsted, E. Melancon, G. Peterson, and B. Thompson. 1995. Status, trends, and probable causes of change in living resources in the Barataria and Terrebonne Estuarine systems. BTNEP Publ. No. 21, Barataria-Terrebonne National Estuary Program, Thibodaux, LA. 434 pp.

Day, J. W., C. A. S. Hall, W. M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley & Sons, New York. 558 pp.

Dundee, H.A., and D.A. Rossman. 1989. The amphibians and reptiles of Louisiana. Louisiana State University Press, Baton Rouge. 300 pp.

Ewing, L. et al. 2009. "Field investigation of Hurricane Ike impacts to the upper Texas coast," Shore & Beach, 77(2).

Foreman, W.W. 1968. The ecology of the Cyprinodontidae (Pisces) of Grand Terre Island, Louisiana. M.S. thesis, Louisiana State University, Baton Rouge. 116 pp.

Gelpi, Jr., C.G., R.E. Condrey, J.W. Fleeger, and S.F. Dubois. 2009. Discovery, evaluation and implication of blue crab, *Callinectes sapidus*, spawning, hatching and foraging grounds in Federal (US) water offshore of Louisiana. Bulletin of Marine Science: 85(3)203-222.

Helmers, D.L. 1992. Shorebird management manual. Western Hemisphere Shorebird Reserve Network, Manomet, MA. 58 pp.

Industrial Economics, Inc. 1996. Economic value assessment for the Barataria-Terrebonne Estuarine System. BTNEP Publ. No 26. Prepared by the Industrial Economics, Incorporated, Cambridge, MA, for the Barataria-Terrebonne National Estuary Program, Thibodaux, LA.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006a. Louisiana Coastal Wetlands Planning, Protection and Restoration News: The Paradox of Plenty – Does Today's Bounty Herald Tomorrow's Collapse. Louisiana Coastal Wetlands Planning, Protection and Restoration News. June 2006, Number 31.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006b. Coastal Wetlands Planning, Protection, and Restoration Act - Wetland Value Assessment Methodology: Procedural Manual. Environmental Work Group. 23 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1999. Coast 2050: Toward a sustainable coastal Louisiana, The appendices. Appendix D—Region 2 Supplemental Information. Louisiana Department of Natural Resources. 170pp.

Lowery, G.H., Jr. 1974. Louisiana birds. Louisiana State University Press, Baton Rouge. 651 pp.

Mabie, D.A. 1976. Chapter 8 Wildlife pages 96-109 In Conner, W.H. and J.W. Day, Jr.,(eds.). 1987. The ecology of Barataria Basin, Louisiana: an estuarine profile. U.S. Fish Wildl. Serv. Biol. Rep. 85 (7.13). 165 pp.

McBride RA, Penland S, Hiland, Mattheson W, Williams, Westphal KA, Jaffe BE, and Sallenger AH, Jr. 1992. Analysis of barrier shoreline change in Louisiana from 1853 to 1989. In: Williams SJ, Penland S, and Sallenger AH, Jr. , editors

Penland S., and Suter JR. 1988. Barrier Island Erosion and Protection in Louisiana: A Coastal Geomorphological Perspective. Gulf Coast Association of Geological Societies Transactions, 38:315-322.

Penland, S., P. F. Connor Jr, A. Beall, S. Fearnley, and S. J. Williams. 2005. Changes in Louisiana's shoreline: 1855–2002. Journal of Coastal Research Special Issue No. 44: 7–39.

Ritchie, W. & Penland, S. 1989. Erosion and washover in coastal Louisiana. Proceedings of Sixth Symposium on Coastal and Ocean Management/ASCE July 11-14, 1989, Charleston, SC, pp. 253-264.

Saucier, M.H. and DM. Baltz. 1993. Spawning site selection by spotted seatrout, Cynoscion nebulosus, and black drum, Pogonias cromis, in Louisiana. Environmental Biology of Fishes 36:257-272.

Smith, L. M. 1988. The natural communities of Louisiana. Louisiana Dept. of Wildlife and Fisheries, Louisiana Natural Heritage Program, Baton Rouge. unpublished.

Thompson, B.A. Fish and shellfish. In: Isles Dernieres Barrier Island Stabilization project, State Project No. 750-55-01, Draft Environmental Assessment submitted to State of Louisiana Department of Transportation and Development, September 1988. Plaissance/Smith

Engineers, P.O. Box 2266, Houma, LA. 70361. p31-38.

Turner, R.E., R. Constanza, and W. Scaife. 1982. Canals and wetland erosion rates in coastal Louisiana. *In* D.F. Boesch, (ed.), Proceedings of the conference on coastal erosion and wetland modification in Louisiana: cause, consequences and options. U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS-82/59.

U.S. Army Corps of Engineers, New Orleans District. 2004a. Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study. Volume 1: LCA Study – Main Report.

U.S. Army Corps of Engineers, New Orleans District. 2004b. Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study. Volume 4: LCA Study – Main Report.

U.S. Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS). 2005. Project Plan and Environmental Assessment for Raccoon Island Shore Protection/Marsh Creation Project (TE-48). U.S. Department of Agriculture, Natural Resources Conservation Service. 32 pp. plus Appendices

U.S. Department of Agriculture. 2007. USDA-Farm Service Agency-Aerial Photography Field Office National Agricultural Inventory Project MrSID Mosaic. United States Department of Agriculture – Farm Service Agency, Salt Lake City, Utah.

U.S. Environmental Protection Agency. 1997. "Environmental Assessment for Isles Dernieres Barrier Island Restoration and Coastal Wetland Creation (TE-20/TE-24): Finding Of No Significant Impacts". Terrebonne Parish, Louisiana.

Williams, P.R. 1998. Nekton assemblages associated with the barrier island aquatic habitats of East Timbalier Island, Louisiana. M.S. thesis, Louisiana State University. 121 pp.

Williams, S.J., S. Penland, and A.H. Sallenger, Jr., editors. 1992. Louisiana Barrier Island Erosion Study: Atlas of shoreline changes in Louisiana from 1853 to 1989. Prepared by the U.S. Geological Survey in cooperation with the Louisiana Geological Survey. 103 pp.

Zimmerman, R.J. 1988. A survey and assessment of usage of a salt marsh at Grand Isle Louisiana, by estuarine aquatic fauna. An Interim Report Tl: EPA Region VI Dallas, Texas. 14 pp.

APPENDIX A

PROJECT INFORMATION SHEET WITH ASSUMPTIONS FOR LCA-TBBSR

PROJECT INFORMATION SHEET BARRIER ISLAND VALUE ASSESSMENT
Terrebonne Basin Barrier BVA Project Information Sheet
September 2010

Final

Project Name: LCA Terrebonne Basin Barrier Shoreline Restoration

Project Type(s): Barrier island restoration, marsh creation, vegetative planting

Sponsoring Agency: US Army Corps of Engineers

Preparer of information sheet: Karen Soileau, Aaron Bass, Chris Dean, and Ken Duffy. Information found in this project information sheet was obtained primarily from the Integrated Feasibility Study and Final Environmental Impact Statement for the Terrebonne Basin Barrier Shoreline Restoration Study.

Project Area:
The proposed project provides for the restoration of the Timbalier and Isles Dernieres Barrier Island chains located in Terrebonne and Lafourche Parishes, Louisiana. The Timbalier Reach is comprised of Timbalier Island and East Timbalier Island. Raccoon, Whiskey, Trinity, East, and Wine, are the primary islands that comprise the Isles Dernieres barrier island chain.

Intermediate Array of Alternatives:
Based upon the results of the plan formulation, analyses and screening, twelve (12) plan alternatives have been recommended for inclusion in the Intermediate Array of Alternatives. The twelve alternatives were grouped into five (5) categories described below.

Category 1, Alternative 1 No Action – The No-Action Alternative assumes there would be no future barrier island restoration within the study area. The barrier islands will continue to be subjected to the factors and processes that are contributing to the loss of the Timbalier and Isles Dernieres barrier island chains and will result in a direct loss of the barrier islands to open water.

Category 2, "Best Buy" within Budget – The best-buy alternative based on the IWR screening provides the greatest increase in the value of the output variable for the least increase in the value of the cost variable. In other words, the best-buy alternative yields the maximum habitat acres at the lowest cost per unit within the budget. If the budget falls between two "best buy" alternatives, the lower cost plan could be scaled-up. The "best buy" alternative is geared less toward the system-wide approach of restoring the entire barrier island chain and more toward restoring the island or islands that are most cost-effective.

- **Alternative 2 –** Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss (i.e. advanced fill).
- **Alternative 3 –** Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of advanced fill combined with restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of advanced fill.
- **Alternative 4 –** Restoration of Whiskey and Trinity Islands to their minimal geomorphologic form and ecologic function along with 5 years of advanced fill combined with restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of advanced fill.
- **Alternative 5 –** Restoration of Whiskey and Trinity Islands to their minimal geomorphologic form and ecologic function along with 5 years of advanced fill combined with restoration of Raccoon and Timbalier Islands to their minimal geomorphologic form and ecologic function along with 25 years of advanced fill and construction of a terminal groin on the western end of Raccoon Island.

Category 3, Maximum Number of Islands Constructible with Cleared Sediment Sources – These alternatives would favor those islands where the total costs are lowest, allowing for more islands to be created using cleared sediment sources noting they may or may not be cost effective based on the IWR screening.

- **Alternative 6 –** Restoration of Raccoon, Whiskey, and Trinity Islands, all to their minimal geomorphologic form and ecologic function
- **Alternative 7 –** Restoration of Raccoon, Whiskey, and Trinity Islands, all to their minimal geomorphologic form and ecologic function, along with construction of 8 additional breakwaters on the western end of Raccoon Island
- **Alternative 8 –** Restoration of Raccoon, Whiskey, and Trinity Islands, all to their minimal geomorphologic form and ecologic function, along with construction of a terminal groin on the western end of Raccoon Island
- **Alternative 9 –** Restoration of Raccoon, Whiskey, and Timbalier Islands, all to their minimal geomorphologic form and ecologic function

Category 4, System-wide Barrier Island Restoration – This alternative would take a full system-wide approach to restoring the Terrebonne Basin barrier system. Each of the seven barrier islands would be restored to their minimal geomorphologic form and ecologic function. Similar to the alternatives that include the most islands within the budget, this alternative may or may not be cost effective based on the IWR screening.

- **Alternative 10 –** Restoration of Raccoon, Whiskey, Trinity, East, Wine, Timbalier, and East Timbalier Islands, all to their minimal geomorphologic form and ecologic function

Category 5, Subsets of NER Plan

- **Alternative 11 –** Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
- **Alternative 12 –** Restoration of Trinity Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss

V1, V2, and V3

Variables V1, V2, and V3 represent the percentage of the subaerial portion of the Study Area that is dune, supratidal, and intertidal habitat, respectively. Dune habitat is defined as subaerial habitat > 5 ft NAVD 88 and encompasses foredune, dune, and reardune. Although dune habitat occurs at elevations below 5ft NAVD 88, lower-elevation dunes are more ephemeral and more frequently overwashed, which reduces their habitat value. The variable is calculated as the percent of the total subaerial area that is classified as dune habitat.

Supratidal habitat occurs from 2.0 ft NAVD 88 to 4.9 ft NAVD 88. This habitat type primarily encompasses swale and may include low-elevation dune and beach habitat. The variable is calculated as the percent of the total subaerial area that is classified as supratidal habitat.

Intertidal habitat occurs from 0.0 ft NAVD 88 to 1.9 ft NAVD 88. This habitat type encompasses intertidal marsh, mudflats, beach, and any other habitat within that elevation range on the gulfside and bayside of the barrier island. The variable is calculated as the percent of the total subaerial area that is classified as supratidal habitat.

In order to determine the habitat composition for Future Without Project (FWOP) conditions, the Project Delivery Team (PDT) developed profiles of each of the seven islands in the Study Area. The island profiles were delineated in AutoCad using 2006 survey data that was collected as part of the Barrier Island Comprehensive Monitoring (BICM) program. Since the period of analysis begins in 2012 (designated as TY0), the profiles were adjusted using average historic erosion rates to account for the six years of erosion. The adjusted 2012 profiles were then used to create plan-view polygons of each habitat type to determine acreages of dune, supratidal, and intertidal habitats. This process was repeated to determine the habitat composition for each target year in the 50-year period of analysis.

For the Future With Project (FWP) conditions, the PDT developed four restoration templates (Plans B through E) designed to meet the objectives of the Study. The template for Plan B restores the minimal geomorphologic form and ecologic function of each island by restoring the beach, dune, and marsh to their critical dimensions. These dimensions were defined through analysis of historical planforms and elevations. Furthermore, these dimensions must be maintained after being subjected to selected design storms. The design storms that were used in template development included a hypothetical 50-year storm as well as the varying intensities, durations, and approach paths of Hurricanes Katrina and Rita, which occurred in 2005, and Hurricanes Gustav and Ike, which occurred in 2008.

Plans C through E are scalars of Plan B that incorporate incremental increases in the scales of beach, dune and marsh planforms and elevations to provide plan formulators the ability to determine the optimal increment for restoration of the geomorphologic form and ecologic function of these islands. Plan C provides for the minimal geomorphologic form and ecologic function on each island along with 5 years of additional protection from background erosion/land loss (i.e. advanced fill). Plan D provides for the minimal geomorphologic form and ecologic function on each island along with 10 years of advanced fill. Plan E provides for the minimal geomorphologic form and ecologic function on each island along with 25 years of advanced fill.

Profiles were developed in AutoCad for the proposed restoration plans on each island. It was assumed that construction of the restoration plans would begin in TY0 (i.e. 2012) and would be completed by TY1 (i.e. 2013). Starting in TY1, each restoration plan was eroded using the same procedures used for the FWOP conditions.

In order to increase the sustainability of the restoration plans, a renourishment scenario was also analyzed for each island. The PDT optimized the renourishment quantity and sequencing by determining the minimum amount needed to maintain the geomorphic form and ecologic function of the islands throughout the 50-year period of analysis. This approach minimized the amount of sediment needed for renourishment, thus reducing costs. The resulting configurations are provided in Table 1. It was assumed that the renourishment events would take approximately one year to complete. Therefore the benefits would not be recognized until the year following renourishment. Marsh renourishment was not included since the initial restoration plan provides for significant intertidal habitat throughout the 50 year period of analysis.

Table 1. Renourishment sequencing and quantities

Island Plan	Renourishment Year	Renourishment Plan
Raccoon Plan E w/ TG	TY30	Restore Plan B
Whiskey Plan C[a]	TY20	Add Plan C
	TY40	Add Plan B
Trinity Plan C	TY25	Add Plan C
Timbalier Plan E	TY30	Restore Plan B

[a] Whiskey would require two renourishments, one at TY20 and one at TY40

Additional analyses were conducted on Raccoon Island to determine the effectiveness of breakwaters and terminal groins in reducing shoreline erosion. Raccoon Island was the only island in the Study Area where these hard structures proved to be cost effective. Hard structures were accounted for by reducing the rate of shoreline erosion.

The following sections provide variables V1, V2, and V3 for each restoration plan at each target year.

Raccoon – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0.0	51	188	239	0%	21%	79%
TY1	0.0	51	184	235	0%	22%	78%
TY5	0.0	30	161	191	0%	16%	84%
TY21	0.0	3	74	77	0%	4%	96%
TY30	0.0	0	55	55	0%	0%	100%
TY40	0.0	0	0	0	0%	0%	0%
TY48	0.0	0	0	0	0%	0%	0%
TY50	0.0	0	0	0	0%	0%	0%

Raccoon – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	51	188	239	0%	21%	79%
TY1	45	227	235	506	9%	45%	46%
TY5	33	194	253	481	7%	40%	53%
TY21	0	143	255	398	0%	36%	64%
TY30	0	83	260	343	0%	24%	76%
TY40	0	25	248	273	0%	9%	91%
TY48	0	0	68	68	0%	0%	100%
TY50	0	0	23	23	0%	0%	100%

Raccoon – FWP (Plan B) with breakwaters:

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	51	188	239	0%	21%	79%
TY1	45	227	237	508	9%	45%	47%
TY5	33	198	254	486	7%	41%	52%
TY21	0	166	255	421	0%	39%	61%
TY30	0	112	264	376	0%	30%	70%
TY40	0	62	259	320	0%	19%	81%
TY48	0	0	82	82	0%	0%	100%
TY50	0	0	38	38	0%	0%	100%

Raccoon – FWP (Plan B) with terminal groin:

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	51	188	239	0%	21%	79%
TY1	45	227	237	508	9%	45%	47%
TY5	33	198	254	485	7%	41%	52%
TY21	0	164	255	419	0%	39%	61%
TY30	0	107	264	371	0%	29%	71%
TY40	0	36	279	315	0%	11%	89%
TY48	0	0	83	83	0%	0%	100%
TY50	0	0	34	34	0%	0%	100%

Raccoon – FWP (Plan E) with terminal groin:

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	51	188	239	0%	21%	79%
TY1	63	688	38	789	8%	87%	5%
TY5	50	678	39	767	7%	88%	5%
TY30	0	182	466	648	0%	28%	72%
TY40	0	106	486	592	0%	18%	82%
TY50	0	66	468	534	0%	12%	88%

Raccoon – FWP (Plan E) with terminal groin (renourishment at TY30):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	51	188	239	0%	21%	79%
TY1	63	688	38	789	8%	87%	5%
TY5	50	678	39	767	7%	88%	5%
TY10	29	659	40	728	4%	91%	5%
TY20	20	650	39	709	3%	92%	6%
TY30	0	182	466	648	0%	28%	72%
TY31	45	204	468	717	6%	28%	65%
TY40	15	165	486	666	2%	25%	73%
TY50	3	170	468	641	0%	27%	73%

Whiskey – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0.0	377	443	820	0%	46%	54%
TY1	0.0	367	436	803	0%	46%	54%
TY5	0.0	40	692	731	0%	5%	95%
TY10	0.0	4	616	620	0%	1%	99%
TY17	0.0	0	512	512	0%	0%	100%
TY20	0.0	0	468	468	0%	0%	100%
TY30	0.0	0	375	375	0%	0%	100%
TY50	0.0	0	0	0	0%	0%	0%

Whiskey – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	377	443	820	0%	46%	54%
TY1	57	614	509	1180	5%	52%	43%
TY5	53	220	830	1102	5%	20%	75%
TY10	0	164	801	965	0%	17%	83%
TY17	0	49	791	840	0%	6%	94%
TY20	0	0	786	786	0%	0%	100%
TY30	0	0	594	594	0%	0%	100%
TY50	0	0	276	276	0%	0%	100%

Whiskey – FWP (Plan C):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	377	443	820	0%	46%	54%
TY1	65	830	377	1271	5%	65%	30%
TY5	61	328	808	1197	5%	27%	68%
TY10	57	223	828	1107	5%	20%	75%
TY17	17	126	841	984	2%	13%	85%
TY20	0	84	847	931	0%	9%	91%
TY30	0	0	717	717	0%	0%	100%
TY50	0	0	363	363	0%	0%	100%

Whiskey – FWP (Plan C) with renourishment at TY20 and TY40:

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	0	377	443	820	0%	46%	54%
TY1	65	830	377	1272	5%	65%	30%
TY5	61	328	808	1197	5%	27%	68%
TY10	57	223	828	1108	5%	20%	75%
TY20	0	84	847	931	0%	9%	91%
TY21	65	496	834	1395	5%	36%	60%
TY30	57	223	717	997	6%	22%	72%
TY40	0	84	472	556	0%	15%	85%
TY41	57	387	461	905	6%	43%	51%
TY50	0	164	363	527	0%	31%	69%

Trinity – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	39	232	311	582	7%	40%	53%
TY1	32	206	326	564	6%	37%	58%
TY5	4	137	327	469	1%	29%	70%
TY20	0	3	72	75	0%	4%	96%
TY24	0	2	51	53	0%	4%	96%
TY33	0	0	14	14	0%	0%	100%
TY40	0	0	0	0	0%	0%	0%
TY50	0	0	0	0	0%	0%	0%

Trinity – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	39	232	311	582	7%	40%	53%
TY1	126	338	569	1033	12%	33%	55%
TY5	92	237	626	956	10%	25%	66%
TY20	0	43	627	670	0%	6%	94%
TY24	0	0	560	560	0%	0%	100%
TY33	0	0	406	406	0%	0%	100%
TY40	0	0	279	279	0%	0%	100%
TY50	0	0	33	33	0%	0%	100%

Trinity – FWP (Plan C):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	39	232	311	582	7%	40%	53%
TY1	129	456	564	1149	11%	40%	49%
TY5	122	316	632	1070	11%	30%	59%
TY20	0	190	594	784	0%	24%	76%
TY31	0	0	543	543	0%	0%	100%
TY40	0	0	380	380	0%	0%	100%
TY50	0	0	199	199	0%	0%	100%

Trinity – FWP (Plan C) with renourishment at TY25:

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	39	232	311	582	7%	40%	53%
TY1	129	456	564	1149	11%	40%	49%
TY5	122	316	632	1070	11%	30%	59%
TY10	67	270	635	972	7%	28%	65%
TY20	0	190	594	784	0%	24%	76%
TY25	0	90	597	687	0%	13%	87%
TY26	129	496	590	1215	11%	41%	49%
TY30	122	320	561	1003	12%	32%	56%
TY40	34	230	380	644	5%	36%	59%
TY50	0	90	199	289	0%	31%	69%

East – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	35	178	71	284	12%	63%	25%
TY1	23	176	59	258	9%	68%	23%
TY5	5	86	110	201	2%	43%	55%
TY20	0	6	58	64	0%	10%	90%
TY22	0	5	49	54	0%	9%	91%
TY29	0	0	20	20	0%	0%	100%
TY40	0	0	0	0	0%	0%	0%
TY50	0	0	0	0	0%	0%	0%

East – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	35	178	71	284	12%	63%	25%
TY1	88	229	362	680	13%	34%	53%
TY5	59	165	404	628	9%	26%	64%
TY20	0	33	401	434	0%	8%	92%
TY22	0	0	378	378	0%	0%	100%
TY29	0	0	301	301	0%	0%	100%
TY40	0	0	171	171	0%	0%	100%
TY50	0	0	46	46	0%	0%	100%

Wine – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	1	5	6	12	4%	46%	50%
TY1	0	4	7	11	0%	36%	64%
TY5	0	3	6	9	0%	33%	67%
TY20	0	1	3	4	0%	25%	75%
TY29	0	0	1	1	0%	0%	100%
TY35	0	0	0	0	0%	0%	0%
TY40	0	0	0	0	0%	0%	0%
TY50	0	0	0	0	0%	0%	0%

Wine – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	1	5	6	12	4%	46%	50%
TY1	12	97	97	206	6%	47%	47%
TY5	11	75	109	195	6%	38%	56%
TY20	0	47	106	153	0%	31%	69%
TY29	0	16	111	127	0%	12%	88%
TY35	0	12	98	110	0%	11%	89%
TY40	0	0	96	96	0%	0%	100%
TY50	0	0	5	5	0%	0%	100%

Timbalier – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	57	549	374	979	6%	56%	38%
TY1	53	529	373	955	6%	55%	39%
TY5	31	266	541	837	4%	32%	65%
TY20	0	93	289	382	0%	24%	76%
TY41	0	1	33	34	0%	3%	97%
TY50	0	0	2	2	0%	0%	100%

Timbalier – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	57	549	374	979	6%	56%	38%
TY1	155	748	726	1629	10%	46%	45%
TY5	130	566	811	1507	9%	38%	54%
TY20	0	236	829	1065	0%	22%	78%
TY41	0	0	423	423	0%	0%	100%
TY50	0	0	175	175	0%	0%	100%

Timbalier – FWP (Plan E):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	57	549	374	979	6%	56%	38%
TY1	215	2346	69	2630	8%	89%	3%
TY5	183	2257	71	2511	7%	90%	3%
TY20	0	1996	76	2072	0%	96%	4%
TY41	0	303	1120	1422	0%	21%	79%
TY50	0	53	1088	1141	0%	5%	95%

Timbalier – FWP (Plan E) with renourishment at TY30:

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	57	549	374	980	6%	56%	38%
TY1	215	2346	69	2630	8%	89%	3%
TY5	183	2257	71	2511	7%	90%	3%
TY10	160	2130	74	2364	7%	90%	3%
TY20	0	1996	76	2072	0%	96%	4%
TY30	0	629	1148	1777	0%	35%	65%
TY31	155	667	1146	1968	8%	34%	58%
TY40	13	524	1123	1660	1%	32%	68%
TY50	0	236	1088	1324	0%	18%	82%

East Timbalier – FWOP

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	1	112	119	233	1%	48%	51%
TY1	1	74	133	208	1%	35%	64%
TY5	1	60	140	201	1%	30%	70%
TY10	0	46	111	156	0%	29%	71%
TY20	0	9	98	107	0%	8%	92%
TY43	0	0	13	13	0%	0%	100%
TY45	0	0	10	10	0%	0%	100%
TY50	0	0	4	4	0%	0%	100%

East Timbalier – FWP (Plan B):

Target Year	Dune (acres)	Supratidal (acres)	Intertidal (acres)	Subaerial (acres)	V1 (% Dune)	V2 (% Supratidal)	V3 (% Intertidal)
TY0	1	112	119	233	1%	48%	51%
TY1	63	314	452	828	8%	38%	55%
TY5	58	240	476	775	8%	31%	61%
TY10	54	199	474	727	7%	27%	65%
TY20	0	175	456	631	0%	28%	72%
TY43	0	9	286	295	0%	3%	97%
TY45	0	0	206	206	0%	0%	100%
TY50	0	0	7	7	0%	0%	100%

V4- Vegetative Cover

For each of the subject barrier islands, the subaerial land acreage, total vegetative coverage, and woody vegetative coverage was determined based on an evaluation of the most recent high-resolution aerial photography available to our agency (2008 digital orthophoto quarterquadrangles [DOQQs]). Landscape and vegetative community polygons were delineated from observable imagery signatures and evaluated at scales ranging from 1:1,000 to 1:4,000. Our interpretation of landscape and vegetation imagery signatures was based upon, and verified by, field data collected by an interagency team of biologists during a July 27 – 29, 2009, site inspection. The results of those calculations were compared to historical data collected for the respective islands (i.e., data collected for CWPPRA projects) to ensure a reasonable level of consistency with previous studies and to corroborate our findings.

Under "future with project" conditions we assumed plantings of dune, supratidal, and intertidal habitats. We recommend dune plantings include sea oats, bitter panicum, beach morning glory (if available), and Roseau (use source material for better survivability in saline conditions).

<u>Raccoon – FWOP</u>

TY0	17%	Year 2012
TY1	17%	
TY5	12%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY21	7%	Continued deterioration and lowering of profile.
TY30	5%	Continued deterioration and lowering of profile.
TY40	0%	There are no subaerial acres left by target year 40.
TY48	0%	The island is no longer subaerial.
TY50	0%	The island is no longer subaerial.

<u>Raccoon – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0	17%	Year 2012
TY1	16%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (45 dune acres + 227 supratidal acres @ 10% cover) + (212 acres of marsh platform [90% of 235 intertidal acres = 212 acres of marsh platform] @ 25% cover)/506 subaerial acres
TY5	64%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (33 dune acres + 194 supratidal acres @ 60% cover) + (228 acres of marsh platform [90% of 253 intertidal acres = 228 acres of marsh platform] @ 75% cover)/481 subaerial acres
TY21	51%	Assume 45% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (0 dune acres + 143 supratidal acres @ 45%

cover) + (230 acres of marsh platform [90% of 255 intertidal acres = 230 acres of marsh platform] @ 60% cover)/398 subaerial acres

TY30 37% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 83 supratidal acres @ 25% cover) + (234 acres of marsh platform [90% of 260 intertidal acres = 234 acres of marsh platform] @ 45% cover)/343 subaerial acres

TY40 22% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 25 supratidal acres @ 15% cover) + (223 acres of marsh platform [90% of 248 intertidal acres = 223 acres of marsh platform] @ 25% cover)/273 subaerial acres

TY48 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (61 acres of marsh platform [90% of 68 intertidal acres = 61 acres of marsh platform] @ 15% cover)/68 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (21 acres of marsh platform [90% of 23 intertidal acres = 21 acres of marsh platform] @ 15% cover)/23 subaerial acres

<u>Raccoon – FWP (Plan B) with breakwaters</u>: Assumptions based on Shell Island project

TY0 17% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (45 dune acres + 227 supratidal acres @ 10% cover) + (213 acres of marsh platform [90% of 237 intertidal acres = 213 acres of marsh platform] @ 25% cover)/508 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (33 dune acres + 198 supratidal acres @ 60% cover) + (229 acres of marsh platform [90% of 254 intertidal acres = 228 acres of marsh platform] @ 75% cover)/486 subaerial acres

TY21 50% Assume 45% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (0 dune acres + 167 supratidal acres @ 45% cover) + (230 acres of marsh platform [90% of 255 intertidal acres = 230 acres of marsh platform] @ 60% cover)/421 subaerial acres

TY30 36% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 112 supratidal acres @ 25% cover) + (238 acres of marsh platform [90% of 264 intertidal acres = 238 acres of marsh platform] @ 45% cover)/376 subaerial acres

TY40 21% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 62 supratidal acres @ 15% cover) + (233 acres of marsh platform [90% of 259 intertidal acres = 233 acres of marsh platform] @ 25% cover)/320 subaerial acres

TY48 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (74 acres of marsh platform [90% of 82 intertidal acres = 74 acres of marsh platform] @ 15% cover)/82 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (34 acres of marsh platform [90% of 38 intertidal acres = 34 acres of marsh platform] @ 15% cover)/38 subaerial acres

Raccoon – FWP (Plan B) with terminal groin: Assumptions based on Shell Island project

TY0 17% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (45 dune acres + 227 supratidal acres @ 10% cover) + (213 acres of marsh platform [90% of 237 intertidal acres = 213 acres of marsh platform] @ 25% cover)/508 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (33 dune acres + 198 supratidal acres @ 60% cover) + (229 acres of marsh platform [90% of 254 intertidal acres = 228 acres of marsh platform] @ 75% cover)/485 subaerial acres

TY21 50% Assume 45% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (0 dune acres + 164 supratidal acres @ 45% cover) + (230 acres of marsh platform [90% of 255 intertidal acres = 230 acres of marsh platform] @ 60% cover)/419 subaerial acres

TY30 36% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 107 supratidal acres @ 25% cover) + (238 acres of marsh platform [90% of 264 intertidal acres = 238 acres of marsh platform] @ 45% cover)/371 subaerial acres

TY40 22% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 36 supratidal acres @ 15% cover) + (251 acres of marsh platform [90% of 279 intertidal acres = 251 acres of marsh platform] @ 25% cover)/315 subaerial acres

TY48 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (75 acres of marsh platform [90% of 83 intertidal acres = 75 acres of marsh platform] @ 15% cover)/83 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (31 acres of marsh platform [90% of 34 intertidal acres = 31 acres of marsh platform] @ 15% cover)/34 subaerial acres

<u>Raccoon – FWP (Plan E) with terminal groin</u>: Assumptions based on Shell Island project

TY0 17% Year 2012

TY1 11% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (63 dune acres + 688 supratidal acres @ 10% cover) + (34 acres of marsh platform [90% of 38 intertidal acres = 34 acres of marsh platform] @ 25% cover)/789 subaerial acres

TY5 60% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (50 dune acres + 678 supratidal acres @ 60% cover) + (35 acres of marsh platform [90% of 39 intertidal acres = 35 acres of marsh platform] @ 75% cover)/767 subaerial acres

TY30 36% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 182 supratidal acres @ 25% cover) + (419 acres of marsh platform [90% of 466 intertidal acres = 419 acres of marsh platform] @ 45% cover)/646 subaerial acres

TY40 21% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 106 supratidal acres @ 15% cover) + (437 acres of marsh platform [90% of 486 intertidal acres = 437 acres of marsh platform] @ 25% cover)/592 subaerial acres

TY50 12% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 66 supratidal acres @ 5% cover) + (421 acres of marsh platform [90% of 468 intertidal acres = 421 acres of marsh platform] @ 15% cover)/534 subaerial acres

<u>Raccoon – FWP (Plan E) with terminal groin (renourishment at TY30)</u>: Assumptions based on Shell Island project

TY0 17% Year 2012

TY1 11% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (63 dune acres + 688 supratidal acres @ 10% cover) + (34 acres of marsh platform [90% of 38 intertidal acres = 34 acres of marsh platform] @ 25% cover)/789 subaerial acres

TY5 60% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (50 dune acres + 678 supratidal acres @ 60% cover) + (35 acres of marsh platform [90% of 39 intertidal acres = 35 acres of marsh platform] @ 75% cover)/767 subaerial acres

TY10 51% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (29 dune acres + 659 supratidal acres @ 50% cover) + (36 acres of marsh platform [90% of 40 intertidal acres = 36 acres of marsh platform] @ 70% cover)/728 subaerial acres

TY20	50%	Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (20 dune acres + 650 supratidal acres @ 50% cover) + (35 acres of marsh platform [90% of 39 intertidal acres = 35 acres of marsh platform] @ 70% cover)/709 subaerial acres
TY30	36%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 182 supratidal acres @ 25% cover) + (419 acres of marsh platform [90% of 466 intertidal acres = 419 acres of marsh platform] @ 45% cover)/648 subaerial acres
TY31	38%	All of the supratidal acreage is unvegetated (covered with spoil) so supratidal acres are removed from the vegetative cover formula. Assume 45% vegetative cover of dune and 60% vegetative cover of marsh platform. (45 dune acres @ 45% cover) + (421 acres of marsh platform [90% of 468 intertidal acres = 421 acres of marsh platform] @ 60% cover)/717 subaerial acres
TY40	59%	Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (15 dune acres + 165 supratidal acres @ 50% cover) + (437 acres of marsh platform [90% of 486 intertidal acres = 437 acres of marsh platform] @ 70% cover)/666 subaerial acres
TY50	53%	Assume 50% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (3 dune acres + 170 supratidal acres @ 50% cover) + (421 acres of marsh platform [90% of 468 intertidal acres = 421 acres of marsh platform] @ 60% cover)/641 subaerial acres

<u>Whiskey – FWOP</u>

TY0	53%	Year 2012
TY1	52%	
TY5	45%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY10	35%	Continued deterioration and lowering of profile.
TY17	25%	Continued deterioration and lowering of profile.
TY20	20%	Continued deterioration and lowering of profile.
TY30	15%	Continued deterioration and lowering of profile.
TY50	0%	The island is no longer subaerial.

<u>Whiskey – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0	53%	Year 2012
TY1	15%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (57 dune acres + 614 supratidal acres @ 10% cover) + (458 acres of marsh platform [90% of 509 intertidal acres = 458 acres of marsh platform] @ 25% cover)/1180 subaerial acres
TY5	66%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (53 dune acres + 220 supratidal acres

@ 60% cover) + (747 acres of marsh platform [90% of 830 intertidal acres = 747 acres of marsh platform] @ 75% cover)/1102 subaerial acres

TY10 61% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (0 dune acres + 164 supratidal acres @ 50% cover) + (721 acres of marsh platform [90% of 801 intertidal acres = 721 acres of marsh platform] @ 70% cover)/965 subaerial acres

TY17 58% Assume 50% vegetative cover of dune and supratidal habitat and 65% vegetative cover of marsh platform. (0 dune acres + 49 supratidal acres @ 50% cover) + (712 acres of marsh platform [90% of 791 intertidal acres = 712 acres of marsh platform] @ 65% cover)/840 subaerial acres

TY20 54% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (707 acres of marsh platform [90% of 786 intertidal acres = 707 acres of marsh platform] @ 70% cover)/786 subaerial acres

TY30 41% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 25% cover) + (535 acres of marsh platform [90% of 594 intertidal acres = 535 acres of marsh platform] @ 45% cover)/594 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (248 acres of marsh platform [90% of 276 intertidal acres = 248 acres of marsh platform] @ 15% cover)/276 subaerial acres

<u>Whiskey – FWP (Plan C)</u>: Assumptions based on Shell Island project

TY0 53% Year 2012

TY1 14% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (65 dune acres + 830 supratidal acres @ 10% cover) + (339 acres of marsh platform [90% of 377 intertidal acres = 339 acres of marsh platform] @ 25% cover)/1271 subaerial acres

TY5 65% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (61 dune acres + 328 supratidal acres @ 60% cover) + (727 acres of marsh platform [90% of 808 intertidal acres = 727 acres of marsh platform] @ 75% cover)/1197 subaerial acres

TY10 60% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (57 dune acres + 223 supratidal acres @ 50% cover) + (745 acres of marsh platform [90% of 828 intertidal acres = 745 acres of marsh platform] @ 70% cover)/1107 subaerial acres

TY17 57% Assume 50% vegetative cover of dune and supratidal habitat and 65% vegetative cover of marsh platform. (17 dune acres + 126 supratidal acres @ 50% cover) + (757 acres of marsh platform [90% of 841 intertidal acres = 757 acres of marsh platform] @ 65% cover)/984 subaerial acres

TY20 54% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 84 supratidal acres @ 50% cover) + (762 acres of marsh platform [90% of 847 intertidal acres = 762 acres of marsh platform] @ 70% cover)/931 subaerial acres

TY30 41% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 25% cover) + (645 acres of marsh platform [90% of 717 intertidal acres = 645 acres of marsh platform] @ 45% cover)/717 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (327 acres of marsh platform [90% of 363 intertidal acres = 327 acres of marsh platform] @ 15% cover)/363 subaerial acres

<u>Whiskey – FWP (Plan C) with renourishment at TY20 and TY40</u>: Assumptions based on Shell Island project

TY0 53% Year 2012

TY1 14% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (65 dune acres + 830 supratidal acres @ 10% cover) + (339 acres of marsh platform [90% of 377 intertidal acres = 339 acres of marsh platform] @ 25% cover)/1271 subaerial acres

TY5 65% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (61 dune acres + 328 supratidal acres @ 60% cover) + (727 acres of marsh platform [90% of 808 intertidal acres = 727 acres of marsh platform] @ 75% cover)/1197 subaerial acres

TY10 60% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (57 dune acres + 223 supratidal acres @ 50% cover) + (745 acres of marsh platform [90% of 828 intertidal acres = 745 acres of marsh platform] @ 70% cover)/1107 subaerial acres

TY20 54% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 84 supratidal acres @ 50% cover) + (762 acres of marsh platform [90% of 847 intertidal acres = 762 acres of marsh platform] @ 70% cover)/931 subaerial acres

TY21 34% All of the supratidal acreage is unvegetated (covered with spoil) so supratidal acres are removed from the vegetative cover formula. Assume 45% vegetative cover of dune and 60% vegetative cover of marsh platform. (65 dune acres @ 45% cover) + (751 acres of marsh platform [90% of 834 intertidal acres = 751 acres of marsh platform] @ 60% cover)/1395 subaerial acres

TY30 59% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (57 dune acres + 223 supratidal acres @ 50% cover) + (745 acres of marsh platform [90% of 717 intertidal acres = 745 acres of marsh platform] @ 70% cover)/1107 subaerial acres

TY31 38% All of the supratidal acreage is unvegetated (covered with spoil) so supratidal acres are removed from the vegetative cover formula. Assume 45% vegetative cover of dune and 60% vegetative cover of marsh platform. (65 dune acres @ 45% cover) + (645 acres of marsh platform [90% of 717 intertidal acres = 645 acres of marsh platform] @ 60% cover)/997 subaerial acres

TY40 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 84 supratidal acres @ 50% cover) + (425 acres of marsh platform [90% of 472 intertidal acres = 425 acres of marsh platform] @ 70% cover)/556 subaerial acres

TY41 30% All of the supratidal acreage is unvegetated (covered with spoil) so supratidal acres are removed from the vegetative cover formula. Assume 45% vegetative cover of dune and 60% vegetative cover of marsh platform. (57 dune acres @ 45% cover) + (415 acres of marsh platform [90% of 461 intertidal acres = 415 acres of marsh platform] @ 60% cover)/905 subaerial acres

TY50 59% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (0 dune acres + 164 supratidal acres @ 50% cover) + (327 acres of marsh platform [90% of 363 intertidal acres = 327 acres of marsh platform] @ 70% cover)/527 subaerial acres

<u>Trinity – FWOP</u>

TY0 53% Year 2012

TY1 51%

TY5 45% Project a decrease in percent vegetative cover due to deterioration and lowering of profile.

TY20 15% Continued deterioration and lowering of profile.

TY24 10% Continued deterioration and lowering of profile.

TY33 3% Continued deterioration and lowering of profile.

TY40 0% There are no subaerial acres left by target year 40.

TY50 0% The island is no longer subaerial.

<u>Trinity – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0 53% Year 2012

TY1 17% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (126 dune acres + 338 supratidal acres @ 10% cover) + (512 acres of marsh platform [90% of 569 intertidal acres = 512 acres of marsh platform] @ 25% cover)/1033 subaerial acres

TY5 65% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (92 dune acres + 237 supratidal acres @ 60% cover) + (563 acres of marsh platform [90% of 626 intertidal acres = 563 acres of marsh platform] @ 75% cover)/956 subaerial acres

TY20 54% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 43 supratidal acres @ 50% cover) + (564 acres of marsh platform [90% of 627 intertidal acres = 564 acres of marsh platform] @ 70% cover)/670 subaerial acres

TY24 50% Assume 35% vegetative cover of dune and supratidal habitat and 55% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (504 acres of marsh platform [90% of 560 intertidal acres = 504 acres of marsh platform] @ 70% cover)/560 subaerial acres

TY33 32% Assume 20% vegetative cover of dune and supratidal habitat and 35% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 20% cover) + (365 acres of marsh platform [90% of 406 intertidal acres = 365 acres of marsh platform] @ 35% cover)/406 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (251 acres of marsh platform [90% of 279 intertidal acres = 251 acres of marsh platform] @ 25% cover)/279 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (30 acres of marsh platform [90% of 33 intertidal acres = 30 acres of marsh platform] @ 15% cover)/33 subaerial acres

<u>Trinity – FWP (Plan C)</u>: Assumptions based on Shell Island project

TY0 53% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (129 dune acres + 456 supratidal acres @ 10% cover) + (508 acres of marsh platform [90% of 564 intertidal acres = 508 acres of marsh platform] @ 25% cover)/1149 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (122 dune acres + 316 supratidal acres @ 60% cover) + (569 acres of marsh platform [90% of 632 intertidal acres = 569 acres of marsh platform] @ 75% cover)/1070 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 190 supratidal acres @ 50% cover) + (535 acres of marsh platform [90% of 594 intertidal acres = 535 acres of marsh platform] @ 70% cover)/784 subaerial acres

TY31 36% Assume 25% vegetative cover of dune and supratidal habitat and 40% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (489 acres of marsh platform [90% of 543 intertidal acres = 489 acres of marsh platform] @ 70% cover)/543 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover)

+ (342 acres of marsh platform [90% of 380 intertidal acres = 342 acres of marsh platform] @ 25% cover)/380 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (179 acres of marsh platform [90% of 199 intertidal acres = 179 acres of marsh platform] @ 15% cover)/199 subaerial acres

Trinity – FWP (Plan C) with renourishment at TY25: Assumptions based on Shell Island project

TY0 53% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (129 dune acres + 456 supratidal acres @ 10% cover) + (508 acres of marsh platform [90% of 564 intertidal acres = 508 acres of marsh platform] @ 25% cover)/1149 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (122 dune acres + 316 supratidal acres @ 60% cover) + (569 acres of marsh platform [90% of 632 intertidal acres = 569 acres of marsh platform] @ 75% cover)/1070 subaerial acres

TY10 58% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (67 dune acres + 270 supratidal acres @ 50% cover) + (572 acres of marsh platform [90% of 635 intertidal acres = 572 acres of marsh platform] @ 70% cover)/972 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 190 supratidal acres @ 50% cover) + (535 acres of marsh platform [90% of 594 intertidal acres = 535 acres of marsh platform] @ 70% cover)/784 subaerial acres

TY25 51% Assume 30% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 90 supratidal acres @ 30% cover) + (537 acres of marsh platform [90% of 597 intertidal acres = 537 acres of marsh platform] @ 60% cover)/687 subaerial acres

TY26 31% All of the supratidal acreage is unvegetated (covered with spoil) so supratidal acres are removed from the vegetative cover formula. Assume 45% vegetative cover of dune and 60% vegetative cover of marsh platform. (129 dune acres @ 45% cover) + (531 acres of marsh platform [90% of 590 intertidal acres = 531 acres of marsh platform] @ 60% cover)/1215 subaerial acres

TY30 57% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (122 dune acres + 320 supratidal acres @ 50% cover) + (505 acres of marsh platform [90% of 561 intertidal acres = 505 acres of marsh platform] @ 70% cover)/1003 subaerial acres

TY40 52% Assume 50% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (34 dune acres + 230 supratidal acres @ 50%

cover) + (342 acres of marsh platform [90% of 380 intertidal acres = 342 acres of marsh platform] @ 60% cover)/644 subaerial acres

TY50 36% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 90 supratidal acres @ 25% cover) + (179 acres of marsh platform [90% of 199 intertidal acres = 179 acres of marsh platform] @ 15% cover)/289 subaerial acres

<u>East – FWOP</u>

TY0 29% Year 2012
TY1 28%
TY5 25% Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY20 10% Continued deterioration and lowering of profile.
TY22 8% Continued deterioration and lowering of profile.
TY29 5% Continued deterioration and lowering of profile.
TY40 0% There are no subaerial acres left by target year 40.
TY50 0% The island is no longer subaerial.

<u>East – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0 29% Year 2012

TY1 17% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (88 dune acres + 229 supratidal acres @ 10% cover) + (326 acres of marsh platform [90% of 362 intertidal acres = 326 acres of marsh platform] @ 25% cover)/680 subaerial acres

TY5 65% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (59 dune acres + 165 supratidal acres @ 60% cover) + (364 acres of marsh platform [90% of 404 intertidal acres = 364 acres of marsh platform] @ 75% cover)/628 subaerial acres

TY20 54% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 33 supratidal acres @ 50% cover) + (361 acres of marsh platform [90% of 401 intertidal acres = 361 acres of marsh platform] @ 70% cover)/434 subaerial acres

TY22 54% Assume 40% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (340 acres of marsh platform [90% of 378 intertidal acres = 340 acres of marsh platform] @ 70% cover)/378 subaerial acres

TY29 41% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 25% cover) + (271 acres of marsh platform [90% of 301 intertidal acres = 271 acres of marsh platform] @ 45% cover)/301 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover)

+ (154 acres of marsh platform [90% of 171 intertidal acres = 154 acres of marsh platform] @ 25% cover)/171 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (41 acres of marsh platform [90% of 46 intertidal acres = 41 acres of marsh platform] @ 15% cover)/46 subaerial acres

<u>Wine – FWOP</u>

TY0 16% Year 2012

TY1 16%

TY5 10% Project a decrease in percent vegetative cover due to deterioration and lowering of profile.

TY20 5% Continued deterioration and lowering of profile.

TY29 2% Continued deterioration and lowering of profile.

TY35 0% There are no subaerial acres left by target year 35.

TY40 0% The island is no longer subaerial.

TY50 0% The island is no longer subaerial.

<u>Wine – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0 16% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (12 dune acres + 97 supratidal acres @ 10% cover) + (87 acres of marsh platform [90% of 97 intertidal acres = 87 acres of marsh platform] @ 25% cover)/206 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (11 dune acres + 75 supratidal acres @ 60% cover) + (98 acres of marsh platform [90% of 109 intertidal acres = 98 acres of marsh platform] @ 75% cover)/195 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 47 supratidal acres @ 50% cover) + (95 acres of marsh platform [90% of 106 intertidal acres = 95 acres of marsh platform] @ 70% cover)/153 subaerial acres

TY29 39% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 16 supratidal acres @ 25% cover) + (100 acres of marsh platform [90% of 111 intertidal acres = 100 acres of marsh platform] @ 45% cover)/127 subaerial acres

TY35 26% Assume 20% cover of dune and supratidal habitat and 30% vegetative cover of marsh platform (0 dune acres + 12 supratidal acres @ 25% cover) + (88 acres of marsh platform [90% of 98 intertidal acres = 88 acres of marsh platform] @ 45% cover)/110 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover)

		+ (86 acres of marsh platform [90% of 96 intertidal acres = 86 acres of marsh platform] @ 25% cover)/96 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (5 acres of marsh platform [90% of 5 intertidal acres = 5 acres of marsh platform] @ 15% cover)/5 subaerial acres

<u>Timbalier – FWOP</u>

TY0	64%	Year 2012
TY1	62%	
TY5	55%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY20	25%	Continued deterioration and lowering of profile.
TY41	7%	Continued deterioration and lowering of profile.
TY50	1%	Only 2 subaerial acres remain.

<u>Timbalier – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0	64%	Year 2012
TY1	16%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (155 dune acres + 748 supratidal acres @ 10% cover) + (653 acres of marsh platform [90% of 726 intertidal acres = 653 acres of marsh platform] @ 25% cover)/1629 subaerial acres
TY5	64%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (130 dune acres + 566 supratidal acres @ 60% cover) + (730 acres of marsh platform [90% of 811 intertidal acres = 730 acres of marsh platform] @ 75% cover)/1507 subaerial acres
TY20	53%	Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 236 supratidal acres @ 50% cover) + (746 acres of marsh platform [90% of 829 intertidal acres = 746 acres of marsh platform] @ 70% cover)/1065 subaerial acres
TY41	23%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (381 acres of marsh platform [90% of 423 intertidal acres = 381 acres of marsh platform] @ 25% cover)/423 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (158 acres of marsh platform [90% of 175 intertidal acres = 158 acres of marsh platform] @ 15% cover)/175 subaerial acres

<u>Timbalier – FWP (Plan E)</u>: Assumptions based on Shell Island project

TY0	64%	Year 2012

TY1	10%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (215 dune acres + 2346 supratidal acres @ 10% cover) + (62 acres of marsh platform [90% of 69 intertidal acres = 62 acres of marsh platform] @ 25% cover)/2630 subaerial acres
TY5	60%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (183 dune acres + 2257 supratidal acres @ 60% cover) + (64 acres of marsh platform [90% of 71 intertidal acres = 64 acres of marsh platform] @ 75% cover)/2511 subaerial acres
TY20	50%	Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 1996 supratidal acres @ 50% cover) + (68 acres of marsh platform [90% of 76 intertidal acres = 68 acres of marsh platform] @ 70% cover)/2072 subaerial acres
TY41	21%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 303 supratidal acres @ 15% cover) + (acres of marsh platform [90% of 1120 intertidal acres = 1008 acres of marsh platform] @ 25% cover)/1422 subaerial acres
TY50	13%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 53 supratidal acres @ 5% cover) + (979 acres of marsh platform [90% of 1088 intertidal acres = 979 acres of marsh platform] @ 15% cover)/1141 subaerial acres

<u>Timbalier – FWP (Plan E) with renourishment at TY30</u>: Assumptions based on Shell Island project

TY0	64%	Year 2012
TY1	10%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (215 dune acres + 2346 supratidal acres @ 10% cover) + (62 acres of marsh platform [90% of 69 intertidal acres = 62 acres of marsh platform] @ 25% cover)/2630 subaerial acres
TY5	60%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (183 dune acres + 2257 supratidal acres @ 60% cover) + (64 acres of marsh platform [90% of 71 intertidal acres = 64 acres of marsh platform] @ 75% cover)/2511 subaerial acres
TY10	50%	Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (160 dune acres + 2130 supratidal acres @ 50% cover) + (67 acres of marsh platform [90% of 74 intertidal acres = 67 acres of marsh platform] @ 70% cover)/2364 subaerial acres

TY20 50% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 1996 supratidal acres @ 50% cover) + (68 acres of marsh platform [90% of 76 intertidal acres = 68 acres of marsh platform] @ 60% cover)/2072 subaerial acres

TY30 35% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 629 supratidal acres @ 25% cover) + (1033 acres of marsh platform [90% of 1148 intertidal acres = 1033 acres of marsh platform] @ 45% cover)/1777 subaerial acres

TY31 35% All of the supratidal acreage is unvegetated (covered with spoil) so supratidal acres are removed from the vegetative cover formula. Assume 45% vegetative cover of dune and 60% vegetative cover of marsh platform. (155 dune acres @ 45% cover) + (1031 acres of marsh platform [90% of 1146 intertidal acres = 1031 acres of marsh platform] @ 60% cover)/1968 subaerial acres

TY40 59% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (13 dune acres + 524 supratidal acres @ 50% cover) + (1011 acres of marsh platform [90% of 1123 intertidal acres = 1011 acres of marsh platform] @ 70% cover)/1660 subaerial acres

TY50 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 236 supratidal acres @ 50% cover) + (979 acres of marsh platform [90% of 1088 intertidal acres = 979 acres of marsh platform] @ 60% cover)/1324 subaerial acres

East Timbalier – FWOP

TY0 38% Year 2012

TY1 37%

TY5 35% Project a decrease in percent vegetative cover due to deterioration and lowering of profile.

TY10 30% Continued deterioration and lowering of profile.

TY20 25% Continued deterioration and lowering of profile.

TY43 10% Continued deterioration and lowering of profile.

TY45 5% Continued deterioration and lowering of profile.

TY50 1% Only 4 subaerial acres remain.

East Timbalier – FWP (Plan B): Assumptions based on Shell Island project

TY0 38% Year 2012

TY1 17% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (63 dune acres + 314 supratidal acres @ 10% cover) + (407 acres of marsh platform [90% of 452 intertidal acres = 407 acres of marsh platform] @ 25% cover)/828 subaerial acres

TY5 65% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (58 dune acres + 240 supratidal acres

@ 60% cover) + (428 acres of marsh platform [90% of 476 intertidal acres = 428 acres of marsh platform] @ 75% cover)/775 subaerial acres

TY10 58% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (54 dune acres + 199 supratidal acres @ 50% cover) + (427 acres of marsh platform [90% of 474 intertidal acres = 427 acres of marsh platform] @ 70% cover)/727 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 175 supratidal acres @ 50% cover) + (410 acres of marsh platform [90% of 456 intertidal acres = 410 acres of marsh platform] @ 70% cover)/631 subaerial acres

TY43 18% Assume 10% vegetative cover of dune and supratidal habitat and 20% vegetative cover of marsh platform. (0 dune acres + 9 supratidal acres @ 50% cover) + (257 acres of marsh platform [90% of 286 intertidal acres = 257 acres of marsh platform] @ 70% cover)/ subaerial acres

TY45 18% Assume 10% vegetative cover of dune and supratidal habitat and 20% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (185 acres of marsh platform [90% of 206 intertidal acres = 185 acres of marsh platform] @ 70% cover)/206 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (6 acres of marsh platform [90% of 7 intertidal acres = 6 acres of marsh platform] @ 15% cover)/7 subaerial acres

V5- Woody Cover

For each of the subject barrier islands, the subaerial land acreage, total vegetative coverage, and woody vegetative coverage was determined based on an evaluation of the most recent high-resolution aerial photography available to our agency (2008 digital orthophoto quarterquadrangles [DOQQs]). Landscape and vegetative community polygons were delineated from observable imagery signatures and evaluated at scales ranging from 1:1,000 to 1:4,000. Our interpretation of landscape and vegetation imagery signatures was based upon, and verified by, field data collected by an interagency team of biologists during a July 27 – 29, 2009, site inspection. The results of those calculations were compared to historical data collected for the respective islands (i.e., data collected for CWPPRA projects) to ensure a reasonable level of consistency with previous studies and to corroborate our findings.

<u>Raccoon – FWOP</u>

TY0 43% Year 2012

TY1 43%

TY5 52% Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 18 acres vegetation - assume 1/3 woody lost = 12 acres woody remaining/23 acres vegetated = 52%.

TY21 30% Assume some woody losses relative to non-woody as island degrades).

TY30 20% Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

TY40 0% No vegetation expected to remain on island.
TY48 0% No vegetation expected to remain on island.
TY50 0% No vegetation expected to remain on island.

Raccoon – FWP (Plan B)

TY0 43% Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1 43% Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5 12% Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (308 acres vegetated minus 58 acres mangrove flat = 250 ac. 250 * 5% initial cover = 13 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 38 ac/308 ac total vegetated = 12%).
TY21 23% Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (203-58=145 ac vegetated * 15% = 22 ac. 22+25=47 ac woody. 47 ac/203 vegetated = 23%).
TY30 23% Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species..
TY40 23% Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species..
TY48 20% Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50 20% Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

Raccoon – FWP (Plan B) with breakwaters

TY0 43% Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1 43% Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5 12% Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (308 acres vegetated minus 58 acres mangrove flat = 250 ac. 250 * 5% initial cover = 13 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 38 ac/308 ac total vegetated = 12%).
TY21 23% Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (203-58=145 ac vegetated * 15% = 22 ac. 22+25=47 ac woody. 47 ac/203 vegetated = 23%)
TY30 23% Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY40 23% Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.

TY48	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Raccoon – FWP (Plan B) with terminal groin</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	12%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (311 acres vegetated minus 58 acres mangrove flat = 253 ac. 253 * 5% initial cover = 13 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 38 ac/308 ac total vegetated = 12%).
TY21	23%	Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (211-58=153 ac vegetated * 15% = 23 ac. 23+25=48 ac woody. 48 ac/211 vegetated = 23%)
TY30	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY40	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY48	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Raccoon – FWP (Plan E) with terminal groin</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	10%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (460 acres vegetated minus 58 acres mangrove flat = 402 ac. 402 * 5% initial cover = 20 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 45 ac/460 ac total vegetated = 10%).
TY30	22%	Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (233-58=175 ac vegetated * 15% = 26 ac. 26+25=51 ac woody. 51 ac/233 vegetated = 22%).
TY40	22%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY50	22%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.

Raccoon – FWP (Plan E) with terminal groin and renourishment at TY30

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	10%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (460 acres vegetated minus 58 acres mangrove flat = 402 ac. 402 * 5% initial cover = 20 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 45 ac/460 ac total vegetated = 10%).
TY10	25%	Increase due to growth of planted woody vegetation.
TY20	22%	Percentage of woody vegetation decreases as island degrades.
TY30	20%	Percentage of woody vegetation decreases as island degrades.
TY31	15%	Loss of some woody vegetation due to renourishment, however, mangrove flats would be avoided.
TY40	20%	Increase due to growth of planted woody vegetation.
TY50	20%	Woody vegetation percentage remains constant with minimal change in percent dune and supratidal habitat available.

Whiskey – FWOP

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	
TY5	46%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 106 acres vegetation - assume 1/3 woody lost = 152 acres woody remaining/329 acres vegetated = 46%.
TY10	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY17	35%	Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY20	20%	Only intertidal remains. . Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY30	0%	No vegetation expected to remain on island.
TY50	0%	No vegetation expected to remain on island.

Whiskey – FWP (Plan B)

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~190 acres) are avoided. Percent woody remains constant in that area.

TY5	20%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (727 acres vegetated minus 286 acres mangrove flat = 441 ac. 441 * 5% initial cover = 22 ac. 286 ac mangrove flat * 43% = 123 ac. Total woody of 145 ac/727 ac total vegetated = 20%).
TY10	29%	Mangrove flat (286 ac, 123 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (589-286=303 ac vegetated * 15% = 45 ac. 45+123=168 ac woody. 168 ac/589 vegetated = 29%)
TY17	29%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY20	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY30	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Whiskey – FWP (Plan C)</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~190 acres) are avoided. Percent woody remains constant in that area.
TY5	19%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (778 acres vegetated minus 286 acres mangrove flat = 492 ac. 492 * 5% initial cover = 25 ac. 286 ac mangrove flat * 43% = 123 ac. Total woody of 148 ac/778 ac total vegetated = 19%).
TY10	27%	Mangrove flat (286 ac, 123 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (664-286=378 ac vegetated * 15% = 57 ac. 57+123=180 ac woody. 180 ac/664 vegetated = 27%)
TY17	27%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY20	20%	Almost all supratidal lost. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY30	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Whiskey – FWP (Plan C) with renourishment at TY20 and TY40</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~190 acres) are avoided. Percent woody remains constant in that area.

TY5	19%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (778 acres vegetated minus 286 acres mangrove flat = 492 ac. 492 * 5% initial cover = 25 ac. 286 ac mangrove flat * 43% = 123 ac. Total woody of 148 ac/778 ac total vegetated = 19%).
TY10	27%	Mangrove flat (286 ac, 123 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (664-286=378 ac vegetated * 15% = 57 ac. 57+123=180 ac woody. 180 ac/664 vegetated = 27%)
TY20	20%	Decrease in woody vegetation due to losses of dune and supratidal acreage.
TY21	15%	Loss of some woody vegetation due to renourishment, however, mangrove flats would be avoided.
TY30	25%	Increase due to growth of planted woody vegetation.
TY40	20%	Percentage of woody vegetation decreases as island degrades.
TY41	15%	Loss of some woody vegetation due to renourishment, however, mangrove flats would be avoided.
TY50	20%	Increase due to growth of planted woody vegetation.

<u>Trinity – FWOP</u>

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	59%	
TY5	68%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 77 acres vegetation - assume 1/3 woody lost = 144 acres woody remaining/211 acres vegetated = 68%.
TY20	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY24	30%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY33	20%	Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY40	0%	No vegetation expected to remain on island.
TY50	0%	No vegetation expected to remain on island.

<u>Trinity – FWP (Plan B)</u>

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.

TY24	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY33	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY40	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

<u>Trinity – FWP (Plan C)</u>

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY31	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY40	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

<u>Trinity – FWP (Plan C) with renourishment at TY25</u>

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY10	15%	Increase due to growth of planted woody vegetation.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY25	20%	Woody vegetation percentage remains constant.
TY26	15%	Loss of some woody vegetation due to renourishment.
TY30	20%	Increase due to growth of planted woody vegetation.
TY40	20%	Woody vegetation percentage remains constant.
TY50	20%	Woody vegetation percentage remains constant.

<u>East – FWOP</u>

TY0	56%	Year 2012. 56% of the vegetated subaerial acres are vegetated with woody species.
TY1	56%	

TY5 68% Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 22 acres vegetation - assume 1/3 woody lost = 33 acres woody remaining/50 acres vegetated = 66%.

TY20 40% Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.

TY22 30% Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.

TY29 20% Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.

TY40 0% No vegetation expected to remain on island.

TY50 0% No vegetation expected to remain on island.

East – FWP (Plan B)

TY0 56% Year 2012. 56% of the vegetated subaerial acres are vegetated with woody species.

TY1 5% Burial of majority of woody vegetation is expected.

TY5 10% Black mangrove and other available woody vegetation installed in TY2 or TY3.

TY20 20% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.

TY22 30% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.

TY29 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

TY40 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

TY50 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

Wine – FWOP

TY0 0% Year 2012. 0% of the vegetated subaerial acres are vegetated with woody species.

TY1 0% No woody vegetation expected to establish.

TY5 0% No woody vegetation expected to establish.

TY20 0% No woody vegetation expected to establish.

TY29 0% No woody vegetation expected to establish.

TY35 0% No woody vegetation expected to establish.

TY40 0% No woody vegetation expected to establish.

TY50 0% No woody vegetation expected to establish.

Wine – FWP (Plan B)

TY0	0%	Year 2012. 0% of the vegetated subaerial acres are vegetated with woody species.
TY1	0%	No woody vegetation established yet.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	15%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY29	15%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY35	15%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY40	15%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50	5%	Very little intertidal acreage remains. Overwash processes dominate, reducing mangrove area. Divide SI by 2.

Timbalier – FWOP

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	61%	
TY5	69%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 132 acres vegetation - assume 1/3 woody lost = 317 acres woody remaining/460 acres vegetated = 69%.
TY20	50%	Assume some woody losses relative to non-woody as island degrades.
TY41	20%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY50	0%	Only very little intertidal remains. All supratidal acreage lost. No woody species are expected to remain.

Timbalier – FWP (Plan B)

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY41	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY50	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

Timbalier – FWP (Plan E)

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Large area of supratidal remains. Mangrove dominates woody species.
TY41	30%	Percentage of mangrove cover increases though recruitment and durability. Supratidal acreage converts to intertidal.
TY50	30%	Percentage of mangrove cover remains constant as supratidal and intertidal acreages decrease.

Timbalier – FWP (Plan E) with renourishment at TY30

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY10	15%	Increase due to growth of planted woody vegetation.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Large area of supratidal remains. Mangrove dominates woody species.
TY30	20%	Woody vegetation percentage remains constant.
TY31	15%	Loss of some woody vegetation due to renourishment.
TY40	20%	Increase due to growth of planted woody vegetation.
TY50	20%	Woody vegetation percentage remains constant.

East Timbalier – FWOP

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	61%	
TY5	64%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 7 acres vegetation - assume 1/3 woody lost = 45 acres woody remaining/70 acres vegetated = 64%.
TY10	50%	Assume some woody losses relative to non-woody as island degrades.
TY20	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY43	20%	Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY45	0%	Only very little intertidal remains. All supratidal acreage lost. No woody species are expected to remain.

TY50	0%	Only very little intertidal remains. All supratidal acreage lost. No woody species are expected to remain.

East Timbalier – FWP (Plan B)

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY10	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion and mangrove recruits. Mangrove dominates woody species.
TY20	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion and mangrove recruits. Mangrove dominates woody species.
TY43	30%	Percentage of mangrove cover remains constant as supratidal and intertidal acreages decrease.
TY45	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Only one species remains (Mangrove). Divide SI by 2.
TY50	10%	Very little intertidal acreage remains. Overwash processes dominate, reducing mangrove area. Divide SI by 2.

V6- Edge and Interspersion

This variable is intended to capture the relative juxtaposition of intertidal, subaerial habitat (vegetated and unvegetated) and intra-island aquatic habitats such as ponds, lagoons, and tidal creeks associated with barrier islands. The variable is made up of five classes:

- Class 1 (V6 = 1.0): Represents unvegetated flats and healthy back-barrier marsh with a high degree of tidal creeks, tidal channels, ponds, and/or lagoons.
- Class 2 (V6 = 0.8): Represents a high degree of interspersion, but usually indicates the beginning of marsh breakup and degradation.
- Class 3 (V6 = 0.6): Represents the development of larger open water areas due to overwash and subsidence. Class 3 is also applied to projects designed to create intertidal marsh because they lack functionally distinct interspersion and provide basically one intertidal habitat type.
- Class 4 (V6 = 0.4): Represents extreme stages of subsidence of the dominance of breaching with unstable overwash flats.
- Class 5 (V6 = 0.1): Consists of no emergent, intertidal land.

A high degree of dispersion is considered to be optimal (V6 = 1.0) and the lowest expression of interspersion (open water) is assumed to be less desirable in terms of community-based function quality (V5 = 0.1).

Interspersion for the TBBSR Study was determined by tracking the evolution of the intertidal habitat over the 50-year period of analysis. Existing supratidal habitat that subsides and becomes intertidal habitat was assigned a Class 1 rating. As larger open water areas continue to develop in these intertidal zones, the classification ratings are increased (i.e. become less optimal).

Any new intertidal marsh constructed as part of the project is first assigned a Class 3 rating since the retention dikes prevent the formation of tidal access. As these retention dikes degrade, tidal channels are formed. These channels provide the optimal amount of interspersion (Class 1). The following sections discuss the derivation of variable V6 for each target year.

<u>Raccoon – FWOP</u>

TY0	0.64	10% Class 1; 90% Class 3. This includes 53 acres of CWPPRA project TE-48 (Class 3), 20 acres of existing mangroves (Class 1), and 116 acres of other intertidal area (Class 3). It was assumed that CWPPRA project TE-48 was constructed at TY0 and that it was new confined carpet marsh with retention dikes that would prevent tidal access. According to aerial photography, the existing mangrove stands appear to have healthy interspersion.
TY1	0.64	10% Class 1; 90% Class 3. It was assumed that the retention dikes for TE-48 were not yet degraded. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.
TY5	0.64	47% Class 1; 7% Class 3; 46% Class 4. The retention dikes for TE-48 are expected to degrade, thus providing tidal access. Therefore, the 53-acre CWPPRA project was assigned a Class 1 rating.
TY10	0.58	39% Class 2; 14% Class 3; 47% Class 4
TY20	0.54	70% Class 3; 30% Class 4
TY21	0.53	Interpolated
TY30	0.40	100% Class 4
TY40	0.10	100% Class 5 (no subaerial habitat)
TY48	0.10	100% Class 5 (no subaerial habitat)
TY50	0.10	100% Class 5 (no subaerial habitat)

<u>Raccoon – FWP (Plan B)</u>:

TY0	0.64	Same as FWOP
TY1	0.70	26% Class 1; 74% Class 3. This includes 53 acres of CWPPRA project TE-48 (Class 3), 20 acres of existing mangroves (Class 1), 121 acres of proposed marsh template (Class 3) and 41 acres of other intertidal area (Class 1 It was assumed that CWPPRA project TE-48 was constructed at TY0 and that it was new confined carpet marsh with retention dikes that would temporarily prevent the formation of tidal channels. Retention dikes will also be constructed as part of the proposed marsh template. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.
TY5	0.98	94% Class 1; 6% Class 3. This includes 53 acres of TE-48 (now a Class 1), 20 acres of existing mangroves (still a Class 1), 121 acres of proposed marsh template (now a Class 1) and 60 acres of other intertidal area (16

acres of Class 3 and 44 acres of Class 1). It was assumed that retention dikes constructed for CWPPRA project TE-48 and for the proposed marsh template would degrade, thus providing tidal access.

TY10	0.95	85% Class 1; 8% Class 2; 7% Class 3
TY20	0.78	10% Class 1; 69% Class 2; 21% Class 3
TY21	0.77	Interpolated
TY30	0.70	25% Class 1; 75% Class 3. A large slug of supratidal habitat is converted to intertidal habitat at this point, thus increasing the percentage of Class 1 habitat.
TY40	0.68	23% Class 1; 69% Class 3; 8% Class 4
TY48	0.46	Interpolated
TY50	0.40	100% Class 4

<u>Raccoon – FWP (Plan B) with breakwaters</u>:

TY0	0.64	Same as FWOP
TY1	0.71	27% Class 1; 73% Class 3. This includes 53 acres of CWPPRA project TE-48 (Class 3), 20 acres of existing mangroves (Class 1), 121 acres of proposed marsh template (Class 3) and 43 acres of other intertidal area (Class 1). It was assumed that CWPPRA project TE-48 was constructed at TY0 and that it was new confined carpet marsh with retention dikes that would temporarily prevent the formation of tidal channels. Retention dikes will also be constructed as part of the proposed marsh template. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.
TY5	0.97	92% Class 1; 8% Class 3. This includes 53 acres of TE-48 (now a Class 1), 20 acres of existing mangroves (still a Class 1), 121 acres of proposed marsh template (now a Class 1) and 61 acres of other intertidal area (21 acres of Class 3 and 40 acres of Class 1). It was assumed that retention dikes constructed for CWPPRA project TE-48 and for the proposed marsh template would degrade, thus providing tidal access.
TY10	0.96	85% Class 1; 8% Class 2; 7% Class 3
TY20	0.77	90% Class 2; 8% Class 3; 2% Class 4
TY21	0.77	Interpolated
TY30	0.70	25% Class 1; 75% Class 3. A large slug of supratidal habitat is converted to intertidal habitat at this point, thus increasing the percentage of Class 1 habitat.
TY40	0.66	19% Class 1; 73% Class 3; 8% Class 4
TY48	0.45	Interpolated
TY50	0.40	100% Class 4

<u>Raccoon – FWP (Plan B) with terminal groin</u>:

TY0	0.64	Same as FWOP
TY1	0.71	26% Class 1; 74% Class 3. This includes 53 acres of CWPPRA project TE-48 (Class 3), 20 acres of existing mangroves (Class 1), 121 acres of proposed marsh template (Class 3) and 43 acres of other intertidal area (Class 1). It was assumed that CWPPRA project TE-48 was constructed

at TY0 and that it was new confined carpet marsh with retention dikes that would temporarily prevent the formation of tidal channels. Retention dikes will also be constructed as part of the proposed marsh template. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.

TY5	0.97	93% Class 1; 7% Class 3. This includes 53 acres of TE-48 (now Class 1), 20 acres of existing mangroves (still Class 1), 121 acres of proposed marsh template (now Class 1) and 60 acres of other intertidal area (20 acres of Class 3 and 40 acres of Class 1). It was assumed that retention dikes constructed for CWPPRA project TE-48 and for the proposed marsh template would degrade, thus providing tidal access.
TY10	0.95	84% Class 1; 8% Class 2; 8% Class 3
TY20	0.75	3% Class 1; 69% Class 2; 27% Class 3; 1% Class 4
TY21	0.74	Interpolated
TY30	0.70	25% Class 1; 75% Class 3. A large slug of supratidal habitat is converted to intertidal habitat at this point, thus increasing the percentage of Class 1 habitat.
TY40	0.69	25% Class 1; 67% Class 3; 8% Class 4
TY48	0.46	Interpolated
TY50	0.40	100% Class 4

<u>Raccoon – FWP (Plan E) with terminal groin</u>:

TY0	0.64	Same as FWOP
TY1	1.00	100% Class 1. The design elevations of Plan E are significantly larger than those of Plan B. The proposed marsh template is constructed at an elevation greater than +2 ft NAVD 88 and therefore is not considered to be intertidal habitat. The proposed marsh template is not expected to be converted to intertidal habitat until TY30. At TY1, there is only 38 acres of intertidal habitat, 20 of which consists of the existing mangrove habitat. This habitat was assumed to have optimal interspersion (Class 1).
TY5	0.84	59% Class 1; 41% Class 3.
TY10	0.80	100% Class 2. The Class 3 habitat from TY5 is converted to open water.
TY20	0.79	48% Class 1; 52% Class 3. A large slug of supratidal habitat is converted to intertidal habitat at this point. This habitat is assumed to have optimal interspersion. The Class 2 habitat from TY10 is converted to Class 3.
TY30	0.68	21% Class 1; 79% Class 3. This includes the 53-acres CWPPRA project (Class 3), the 318-acre proposed marsh template, and the remaining intertidal area. The proposed marsh template is converted to intertidal habitat at TY30 due to subsidence. Since the marsh template has been at a higher elevation, tidal inlets have not yet formed. Therefore, the marsh template was assigned a Class 3 rating. CWPPRA project TE-48, which also is converted to intertidal habitat, was assigned a Class 3 rating. The remaining intertidal area was assigned a Class 1 rating since it was assumed to have optimal interspersion.

TY40	0.97	92% Class 1; 8% Class 3. It was assumed that tidal canals would have become established in CWPPRA project TE-48 and in the marsh template. Therefore they were assigned a Class 1 rating.
TY50	0.71	79% Class 2; 12% Class 3; 9% Class 4.

<u>Raccoon – FWP (Plan E) with terminal groin (renourishment at TY30)</u>:

TY0	0.64	Same as FWOP
TY1	1.00	100% Class 1. The design elevations of Plan E are significantly larger than those of Plan B. The proposed marsh template is constructed at an elevation greater than +2 ft NAVD 88 and therefore is not considered to be intertidal habitat. The proposed marsh template is not expected to be converted to intertidal habitat until TY30. At TY1, there is only 38 acres of intertidal habitat, 20 of which consists of the existing mangrove habitat. This habitat was assumed to have optimal interspersion (Class 1).
TY5	0.84	59% Class 1; 41% Class 3.
TY10	0.80	100% Class 2. The Class 3 habitat from TY5 is converted to open water.
TY20	0.79	48% Class 1; 52% Class 3. A large slug of supratidal habitat is converted to intertidal habitat at this point. This habitat is assumed to have optimal interspersion. The Class 2 habitat from TY10 is converted to Class 3.
TY30	0.68	21% Class 1; 79% Class 3. This includes the 53-acres CWPPRA project (Class 3), the 318-acre proposed marsh template, and the remaining intertidal area. The proposed marsh template is converted to intertidal habitat at TY30 due to subsidence. Since the marsh template has been at a higher elevation, tidal inlets have not yet formed. Therefore, the marsh template was assigned a Class 3 rating. CWPPRA project TE-48, which also is converted to intertidal habitat, was assigned a Class 3 rating. The remaining intertidal area was assigned a Class 1 rating since it was assumed to have optimal interspersion.
TY31	0.64	19% Class 1; 1% Class 2; 80% Class 3. This includes the 53-acres CWPPRA project (Class 3), the 318-acre proposed marsh template, and the remaining intertidal area. The proposed marsh template is converted to intertidal habitat at TY30 due to subsidence. Since the marsh template has been at a higher elevation, tidal inlets have not yet formed. Therefore, the marsh template was assigned a Class 3 rating. CWPPRA project TE-48, which also is converted to intertidal habitat, was assigned a Class 3 rating. The remaining intertidal area was assigned a Class 1 or 2 rating since it was assumed to have optimal or near-optimal interspersion. The dune and supratidal portions of the island are renourished at TY31. However, this will not have an immediate impact on interspersion since it does not immediately affect intertidal habitat.
TY40	0.96	90% Class 1; 10% Class 3. It was assumed that tidal canals would have become established in CWPPRA project TE-48 and in the marsh template. Therefore they were assigned a Class 1 rating.

TY50 0.75 79% Class 2; 17% Class 3; 4% Class 4. By TY50, a portion of the renourished dune and supratidal habitat is expected to subside and become intertidal habitat.

Whiskey – FWOP

TY0 0.86 64% Class 1; 36% Class 3. At TY0, CWPPRA project TE-50 is greater than +2ft NAVD 88. Since TE-50 is not intertidal, it does not contribute to the interspersion variable.

TY1 0.80 64% Class 1; 4% Class 3; 32% Class 4. At TY1, CWPPRA project TE-50 is greater than +2ft NAVD 88. Since TE-50 is not intertidal, it does not contribute to the interspersion variable.

TY5 0.82 46% Class 1 (TE-50 becomes intertidal); 34% Class 2 (existing mangrove stands begin to break up); 3% Class 3; 17% Class 4.

TY10 0.69 50% Class 2 (TE-50 begins to break up); 45% Class 3; 5% Class 4

TY17 0.56 Interpolated

TY20 0.52 59% Class 3; 41% Class 4

TY30 0.10 100% Class 5 (no subaerial habitat)

TY40 0.10 100% Class 5 (no subaerial habitat)

TY50 0.10 100% Class 5 (no subaerial habitat)

Whiskey – FWP (Plan B):

TY0 0.86 Same as FWOP

TY1 0.92 81% Class 1; 19% Class 3. This includes 284 acres of existing mangroves (Class 1), the 100-acre proposed marsh template (Class 3), and 125 acres of other intertidal habitat (Class 1). At TY1, the elevation of CWPPRA project TE-50 is greater than +2ft NAVD 88. Since TE-50 is not intertidal, it does not contribute to the interspersion variable. It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.

TY5 0.96 89% Class 1; 11% Class 3. This includes the 316-acre CWPPRA project TE-50 (Class 3), 238 acres of existing mangroves (still Class 1), the 100-acre proposed marsh template (now Class 1), and 175 acres of other intertidal habitat (93 acres of Class 3 and 82 acres of Class 1). At TY5, CWPPRA project TE-50 is expected to subside and become intertidal habitat. Since the CWPPRA project has been at a higher elevation, tidal inlets have not yet formed. Therefore, the TE-50 was assigned a Class 3 rating. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access.

TY10 0.92 64% Class 1; 30% Class 2; 6% Class 3

TY17 0.80 Interpolated

TY20 0.77 17% Class 1; 53% Class 2; 30% Class 3

TY30	0.60	100% Class 3
TY40	0.54	70% Class 3; 30% Class 4
TY50	0.40	100% Class 4

<u>Whiskey – FWP (Plan C)</u>:

TY0	0.86	Same as FWOP
TY1	1.00	100% Class 1. This includes 284 acres of existing mangroves (Class 1), and 125 acres of other intertidal habitat (Class 1). At TY1, the elevations of CWPPRA project TE-50 and the proposed marsh template is greater than +2ft NAVD 88. Since these two components are not intertidal, they does not contribute to the interspersion variable. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.
TY5	0.91	78% Class 1; 22% Class 3. This includes the 316-acre CWPPRA project TE-50 (Class 1), 238 acres of existing mangroves (still Class 1), the 110-acre proposed marsh template (Class 3), and 145 acres of other intertidal habitat (65 acres of Class 3 and 80 acres of Class 1). At TY5, CWPPRA project TE-50 is expected to subside and become intertidal habitat. It was assumed that retention dikes constructed for the CWPPRA project TE-50 and the proposed marsh template would degrade, thus providing tidal access.
TY10	0.92	64% Class 1; 29% Class 2; 7% Class 3
TY17	0.80	Interpolated
TY20	0.79	22% Class 1; 50% Class 2; 28% Class 3
TY30	0.65	12% Class 1; 88% Class 3
TY40	0.54	69% Class 3; 31% Class 4
TY50	0.40	100% Class 4

<u>Whiskey – FWP (Plan C) with renourishment at TY20 and TY40</u>:

TY0	0.86	Same as FWOP
TY1	1.00	100% Class 1. This includes 284 acres of existing mangroves (Class 1), and 125 acres of other intertidal habitat (Class 1). At TY1, the elevations of CWPPRA project TE-50 and the proposed marsh template is greater than +2ft NAVD 88. Since these two components are not intertidal, they does not contribute to the interspersion variable. The existing mangrove stands were assumed to maintain a healthy amount of interspersion at TY1 and were thus assigned a Class 1 rating.
TY5	0.91	78% Class 1; 22% Class 3. This includes the 316-acre CWPPRA project TE-50 (Class 1), 238 acres of existing mangroves (still Class 1), the 110-acre proposed marsh template (Class 3), and 145 acres of other intertidal habitat (65 acres of Class 3 and 80 acres of Class 1). At TY5, CWPPRA project TE-50 is expected to subside and become intertidal habitat. It was assumed that retention dikes constructed for the CWPPRA project TE-50 and the proposed marsh template would degrade, thus providing tidal access.
TY10	0.92	64% Class 1; 29% Class 2; 7% Class 3

TY20	0.79	22% Class 1; 50% Class 2; 28% Class 3
TY21	0.71	2% Class 1; 51% Class 2; 47% Class 3. The dune and supratidal portions of the island are renourished at TY21. However, this will not have an immediate impact on interspersion since it does not immediately affect intertidal habitat.
TY30	0.66	14% Class 1; 86% Class 3. A large slug of supratidal habitat is expected to become intertidal habitat at TY30.
TY40	0.55	4% Class 1; 65% Class 3; 31% Class 4
TY41	0.53	67% Class 3; 32% Class 4. The dune and supratidal portions of the island are renourished again at TY41. However, this will not have an immediate impact on interspersion since it does not immediately affect intertidal habitat.
TY50	0.40	100% Class 4

<u>Trinity – FWOP</u>

TY0	0.60	100% Class 3. Aerial photography indicates the development of larger open water areas within the intertidal zone.
TY1	0.60	100% Class 3
TY5	0.48	40% Class 3; 60% Class 4
TY10	0.47	35% Class 3; 65% Class 4
TY20	0.40	100% Class 4
TY24	0.40	100% Class 4
TY30	0.40	100% Class 4
TY33	0.40	100% Class
TY40	0.10	100% Class 5 (no subaerial habitat)
TY50	0.10	100% Class 5 (no subaerial habitat)

<u>Trinity – FWP (Plan B)</u>:

TY0	0.60	Same as FWOP
TY1	0.64	10% Class 1; 90% Class 3. This includes 512 acres of the proposed marsh template (Class 3) and 57 acres of other intertidal habitat (Class 1). It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating. There are no existing mangrove stands on Trinity Island.
TY5	1.00	100% Class 1. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.
TY10	0.99	97% Class 1; 3% Class 3
TY20	0.84	18% Class 1; 82% Class 2. The Class 3 habitat from TY10 is expected to be converted to open water.
TY24	0.75	Interpolated
TY30	0.63	8% Class 1; 92% Class 3.
TY33	0.57	Interpolated

TY40 0.42 11% Class 3; 89% Class 4.
TY50 0.40 100% Class 4.

<u>Trinity – FWP (Plan C)</u>:

TY0 0.60 Same as FWOP

TY1 0.63 8% Class 1; 92% Class 3. This includes 520 acres of the proposed marsh template (Class 3) and 44 acres of other intertidal habitat (Class 1). It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating. There are no existing mangrove stands on Trinity Island.

TY5 1.00 100% Class 1. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.

TY10 0.99 98% Class 1; 2% Class 3

TY20 0.82 12% Class 1; 88% Class 2. The Class 3 habitat from TY10 is expected to be converted to open water.

TY30 0.63 7% Class 1; 93% Class 3.

TY31 0.62 Interpolated

TY40 0.41 3% Class 3; 97% Class 4.

TY50 0.40 100% Class 4.

<u>Trinity – FWP (Plan C) with renourishment at TY25</u>:

TY0 0.60 Same as FWOP

TY1 0.63 8% Class 1; 92% Class 3. This includes 520 acres of the proposed marsh template (Class 3) and 44 acres of other intertidal habitat (Class 1). It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating. There are no existing mangrove stands on Trinity Island.

TY5 1.00 100% Class 1. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.

TY10 0.99 98% Class 1; 2% Class 3

TY20 0.82 12% Class 1; 88% Class 2. The Class 3 habitat from TY10 is expected to be converted to open water.

TY25 0.83 13% Class 1; 87% Class 2.

TY26 0.61 3% Class 1; 97% Class 3. The Class 2 habitat from TY25 is converted to Class 3. There is a small amount of Class 1 habitat remaining. The dune and supratidal portions of the island are renourished at TY26. However, this will not have an immediate impact on interspersion since it does not immediately affect intertidal habitat.

TY30	0.63	7% Class 1; 93% Class 3. A large slug of supratidal habitat is converted to intertidal habitat.
TY40	0.41	4% Class 3; 96% Class 4.
TY50	0.40	100% Class 4.

East – FWOP

TY0	0.60	100% Class 3. Aerial photography indicates the development of larger open water areas within the intertidal zone.
TY1	0.60	100% Class 3
TY5	0.60	98% Class 3; 2% Class 4
TY10	0.48	41% Class 3; 59% Class 4
TY20	0.40	100% Class 4
TY22	0.40	100% Class 4
TY29	0.40	100% Class 4
TY30	0.40	100% Class 4
TY40	0.10	100% Class 5 (no subaerial habitat)
TY50	0.10	100% Class 5 (no subaerial habitat)

East – FWP (Plan B):

TY0	0.60	Same as FWOP
TY1	0.63	6% Class 1; 94% Class 3. This includes the 339-acre proposed marsh template (Class 3) and 23 acres of other intertidal habitat. It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating. There are no existing mangrove stands on East Island.
TY5	1.00	100% Class 1. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.
TY10	1.00	100% Class 1
TY20	0.83	15% Class 1; 85% Class 2
TY22	0.79	Interpolated
TY29	0.64	Interpolated
TY30	0.62	4% Class 1; 96% Class 3
TY40	0.40	100% Class 4
TY50	0.40	100% Class 4

Wine – FWOP

TY0	0.40	100% Class 4. Aerial photography indicates extremely fragmented marsh within and adjacent to the rock ring. There is very little subaerial habitat present (6 acre)
TY1	0.40	100% Class 4
TY5	0.40	100% Class 4
TY10	0.40	100% Class 4

TY20	0.40	100% Class 4
TY29	0.40	100% Class 4
TY30	0.40	100% Class 4
TY35	0.10	100% Class 5 (no subaerial habitat)
TY40	0.10	100% Class 5 (no subaerial habitat)
TY50	0.10	100% Class 5 (no subaerial habitat)

<u>Wine – FWP (Plan B)</u>:

TY0	0.40	Same as FWOP
TY1	0.77	43% Class 1; 57% Class 3. This includes 55 acres of the proposed marsh template (Class 3) and 42 acres of other intertidal habitat. It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating. The total marsh template is 69 acres. However, 14 acres of the template was constructed in the supratidal zone. Once this portion subsides, it will be accounted for in the interspersion variable. There are no existing mangrove stands on Wine Island.
TY5	0.92	80% Class 1; 20% Class 3. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. By TY5, a total of 64 acres of the proposed marsh template are intertidal. Approximately 23 acres and 22 acres of the remaining intertidal habitat were assigned a Class 1 and Class 3 rating, respectively.
TY10	0.85	59% Class 1; 13% Class 2; 21% Class 3; 7% Class 4
TY20	0.81	23% Class 1; 61% Class 2; 14% Class 3; 2% Class 4
TY29	0.73	Interpolated
TY30	0.72	30% Class 1; 70% Class 3. By TY30, all 69 acres of the proposed marsh template are intertidal.
TY35	0.67	Interpolated
TY40	0.63	14% Class 2; 86% Class 3
TY50	0.40	100% Class 4. There is very little subaerial habitat present (5 acre)

<u>Timbalier – FWOP</u>

TY0	0.60	100% Class 3. Aerial photography indicates the development of larger open water areas within the intertidal zone.
TY1	0.60	100% Class 3.
TY5	0.51	57% Class 3; 43% Class 4.
TY10	0.40	100% Class 4.
TY20	0.54	69% Class 3; 31% Class 4. A large slug of supratidal becomes intertidal at this point. Therefore, the suitability index for dispersion is expected to increase
TY30	0.50	51% Class 3; 49% Class 4.
TY40	0.40	100% Class 4.
TY41	0.40	100% Class 4.
TY50	0.40	100% Class 4.

Timbalier – FWP (Plan B):

TY0	0.60	Same as FWOP.
TY1	0.65	13% Class 1; 87% Class 3. This includes the 630-acre proposed marsh template (Class 3) and 96 acres of other intertidal habitat. It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating.
TY5	1.00	100% Class 1. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.
TY10	0.98	96% Class 1; 4% Class 3
TY20	0.85	24% Class 1; 76% Class 2. The Class 3 habitat from TY10 is expected to covert to open water.
TY30	0.64	9% Class 1; 91% Class 3.
TY40	0.43	4% Class 1; 96% Class 4
TY41	0.42	Interpolated
TY50	0.40	100% Class 4.

Timbalier – FWP (Plan E):

TY0	0.60	Same as FWOP.
TY1	1.00	100% Class 1; The design elevations of Plan E are significantly larger than those of Plan B. The proposed marsh template is constructed at an elevation greater than +2 ft NAVD 88 and therefore is not considered to be intertidal habitat. The proposed marsh template is not expected to be converted to intertidal habitat until TY30. At TY1, there is only 69 acres of intertidal habitat. This habitat was assumed to have optimal interspersion (Class 1).
TY5	1.00	100% Class 1. This includes 71 acres of intertidal habitat.
TY10	1.00	100% Class 1. This includes 74 acres of intertidal habitat.
TY20	1.00	100% Class 1. This includes 76 acres of intertidal habitat.
TY30	0.63	7% Class 1; 93% Class 3. This includes the 1064-acre proposed marsh template and the remaining 84 acres of intertidal area. The proposed marsh template is converted to intertidal habitat at TY30 due to subsidence. Since the marsh template has been at a higher elevation, tidal inlets have not yet formed. Therefore, the marsh template was assigned a Class 3 rating. The remaining intertidal area was assigned a Class 1 rating since it was assumed to have optimal interspersion.
TY40	1.00	100% Class 1. It was assumed that tidal channels would have formed in the proposed marsh template by TY40. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.
TY41	0.96	Interpolated

TY50	0.60	100% Class 3.

Timbalier – FWP (Plan E) with renourishment at TY30:

TY0	0.60	Same as FWOP.
TY1	1.00	100% Class 1; The design elevations of Plan E are significantly larger than those of Plan B. The proposed marsh template is constructed at an elevation greater than +2 ft NAVD 88 and therefore is not considered to be intertidal habitat. The proposed marsh template is not expected to be converted to intertidal habitat until TY30. At TY1, there is only 69 acres of intertidal habitat. This habitat was assumed to have optimal interspersion (Class 1).
TY5	1.00	100% Class 1. This includes 71 acres of intertidal habitat.
TY10	1.00	100% Class 1. This includes 74 acres of intertidal habitat.
TY20	1.00	100% Class 1. This includes 76 acres of intertidal habitat.
TY30	0.63	7% Class 1; 93% Class 3. This includes the 1064-acre proposed marsh template and the remaining 84 acres of intertidal area. The proposed marsh template is converted to intertidal habitat at TY30 due to subsidence. Since the marsh template has been at a higher elevation, tidal inlets have not yet formed. Therefore, the marsh template was assigned a Class 3 rating. The remaining intertidal area was assigned a Class 1 rating since it was assumed to have optimal interspersion.
TY31	0.61	3% Class 1; 97% Class 3. The dune and supratidal portions of the island are renourished at TY31. However, this will not have an immediate impact on interspersion since it does not immediately affect intertidal habitat.
TY40	1.00	100% Class 1. It was assumed that tidal channels would have formed in the proposed marsh template by TY40. Therefore the proposed marsh template was assigned a Class 1 rating. The remaining intertidal habitat was also assigned a Class 1 rating because it was assumed to have optimal interspersion.
TY50	0.60	100% Class 3.

East Timbalier – FWOP

TY0	0.60	100% Class 3. Aerial photography indicates the development of larger open water areas within the intertidal zone.
TY1	0.60	100% Class 3.
TY5	0.60	100% Class 3.
TY10	0.52	61% Class 39% Class 4.
TY20	0.48	38% Class 3; 62% Class 4.
TY30	0.40	100% Class 4.
TY40	0.40	100% Class 4.
TY43	0.40	100% Class 4.
TY45	0.40	100% Class 4.
TY50	0.40	100% Class 4. There is only 4 acres of subaerial habitat remaining.

East Timbalier – FWP (Plan B):

TY0	0.60	Same as FWOP
TY1	0.69	22% Class 1; 78% Class 3. This includes the 353-acre proposed marsh template (Class 3) and 99 acres of other intertidal habitat (Class 1). It was assumed that the proposed marsh template would function as new confined carpet marsh with retention dikes that would temporarily prevent the formation tidal canals. Therefore, the marsh template was assigned a Class 3 rating.
TY5	0.96	90% Class 1; 10% Class 3. It was assumed that retention dikes constructed for the proposed marsh template would degrade, thus providing tidal access. Therefore the proposed marsh template was assigned a Class 1 rating. Approximately 78 acres and 45 acres of the remaining intertidal habitat was assigned a Class 1 and Class 3, respectively.
TY10	0.94	84% Class 1; 16% Class 3
TY20	0.82	17% Class 1; 77% Class 2; 6% Class 3
TY30	0.69	23% Class 1; 77% Class 3. A large slug of supratidal habitat is converted to intertidal habitat at this point, thus increasing the percentage of Class 1 habitat.
TY40	0.48	13% Class 1; 87% Class 4
TY43	0.45	Interpolated
TY45	0.43	Interpolated
TY50	0.40	100% Class 4. There is only 7 acres of subaerial habitat remaining.

V7- Beach/Surf Zone Features

Raccoon – FWOP

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.945

TY5 0.945

TY21 1.00 Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.

TY30 1.00

TY40 0.10 There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.

TY48 0.10

TY50 0.10

Raccoon – FWP (Plan B)

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.945

TY5 0.945

TY21 1.00 Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.

TY30 1.00

TY40 1.00

TY48 1.00

TY50 1.00

Raccoon – FWP (Plan B) with breakwaters

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

		The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained. For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945
TY1	0.917	There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The island will erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained. A third breakwater field has been proposed as part of this project. The breakwater field will consist of 8 additional breakwaters, with a cumulative length of 4500 feet (including gaps). The construction of the breakwaters will be completed by 2013. It was assumed that typical maintenance would be conducted as necessary on the breakwaters in order to maintain their effectiveness. However, the modeling results indicated that the proposed breakwaters would be too far from the islands to be effective by TY21 due to natural erosion processes. Therefore, maintenance of the structures would no longer be effective. The total length of the island is 16,000 ft (source: 2008 USGS aerial). For TY1, there are a total of 13320 ft of breakwaters (4400 + 4420 + 4500), which is 83% of the beach length. Therefore, 83% of the beach is classified as Class 3 (breakwaters) and the remaining 17% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.83*0.9)+(0.17*1)=0.917
TY5	0.917	
TY21	1.00	Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.
TY30	1.00	
TY40	1.00	
TY48	1.00	
TY50	1.00	

Raccoon – FWP (Plan B) with terminal groin

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.90 Based on the modeling results for SBEACH, the entire beach was impacted by either the proposed terminal groin or the 16 existing hard structures. Therefore, the length of beach impacted by the terminal groins was calculated by subtracting as follows: 16,000 - 4400 - 4420 = 7180.

There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The island will erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

A terminal groin will be constructed at the western end of the island as part of this project. The terminal groin will impact approximately 7180 ft of the shoreline (based on the GENESIS modeling results). It was also assumed that the terminal groin would impact the surf zone habitat similar to a breakwater and would thus be assigned a Class 3 rating. The construction of the terminal groin will be completed by 2013. It was assumed that the terminal groin would no longer be effective at TY21.

The total length of the island is 16,000 ft (source: 2008 USGS aerial).

For TY1, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is

		classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9
TY5	0.90	For TY5, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9
TY21	1.00	Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.
TY30	1.00	
TY40	1.00	
TY48	1.00	
TY50	1.00	

<u>Raccoon – FWP (Plan E) with terminal groin</u>

TY0	0.945	There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial). The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained. For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945
TY1	0.90	Based on the modeling results for SBEACH, the entire beach was impacted by either the proposed terminal groin or the 16 existing hard structures. Therefore, the length of beach impacted by the terminal groins was calculated by subtracting as follows: 16,000 - 4400 - 4420 = 7180. There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The island will erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

A terminal groin will be constructed at the western end of the island as part of this project. The terminal groin will impact approximately 7180 ft of the shoreline (based on the GENESIS modeling results). It was also assumed that the terminal groin would impact the surf zone habitat similar to a breakwater and would thus be assigned a Class 3 rating. The construction of the terminal groin will be completed by 2013. It was assumed that the terminal groin would no longer be effective at TY21.

The total length of the island is 16,000 ft (source: 2008 USGS aerial).

For TY1, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9

TY5	0.90	For TY5, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9
TY30	1.00	Since the terminal groin and the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.
TY40	1.00	
TY50	1.00	

Whiskey – FWOP

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY10	1.00	
TY17	1.00	
TY20	1.00	
TY30	1.00	
TY50	0.10	There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.

Whiskey – FWP (Plan B)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY10	1.00	
TY17	1.00	
TY20	1.00	
TY30	1.00	

TY50 1.00

Whiskey – FWP (Plan C)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY10	1.00	
TY17	1.00	
TY20	1.00	
TY30	1.00	
TY50	1.00	

Trinity – FWOP

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY24		
TY33	1.00	
TY40	0.10	There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.
TY50	0.10	

Trinity – FWP (Plan B)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY24	1.00	
TY33	1.00	
TY40	1.00	
TY50	1.00	

Trinity – FWP (Plan C)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY31	1.00	
TY40	1.00	
TY50	1.00	

East – FWOP

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY22	1.00	
TY29	1.00	
TY40	0.10	There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.
TY50	0.10	

East – FWP (Plan B)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY22	1.00	
TY29	1.00	
TY40	1.00	
TY50	1.00	

Wine – FWOP

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY29	1.00	
TY35	0.10	There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.
TY40	0.10	
TY50	0.10	

Wine w/Monkey – FWP (Plan B)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY29	1.00	
TY35	1.00	
TY40	1.00	
TY50	1.00	

Timbalier – FWOP

TY0	0.96	There is an existing seawall that is approximately 1,900 ft long. The seawall is on the beach and acts as a revetment (Class 4). The total island length is 35,570 ft long. Therefore 5.3% of the island will be assigned a Class 4 rating (Seawall - SI = 0.2) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.053 * 0.2)+(0.947 * 1) = 0.96
TY1	0.96	
TY5	0.96	
TY20	1.00	By TY20, the portion of the island that is behind the seawall completely washes away. Although the wall is expected to still be intact, it will not be effecting surf zone habitat. 100% Class 1; Unconfined natural beach with no structures parallel to the shore
TY41	1.00	
TY50	1.00	

Timbalier – FWP (Plan B)

TY0	0.96	There is an existing seawall that is approximately 1,900 ft long. The seawall is on the beach and acts as a revetment (Class 4). The total island length is 35,570 ft long. Therefore 5.3% of the island will be assigned a Class 4 rating (Seawall - SI = 0.2) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.053 * 0.2)+(0.947 * 1) = 0.96
TY1	0.96	
TY5	0.96	
TY20	0.99	There is an existing seawall that is approximately 1,900 ft long. The seawall that was on the beach is expected to be in the surf zone by TY20, due to island migration. Therefore, it will likely function as a breakwater (Class 3). The total island length is 39,630 ft long. Therefore 4.8% of the island will be assigned a Class 3 rating (SI = 0.9) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.048 * 0.9)+(0.952 * 1) = 0.99
TY41	0.99	
TY50	0.99	

Timbalier – FWP (Plan E)

TY0	0.96	There is an existing seawall that is approximately 1,900 ft long. The seawall is on the beach and acts as a revetment (Class 4). The total island length is 35,570 ft long. Therefore 5.3% of the island will be assigned a Class 4 rating (Seawall - SI = 0.2) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.053 * 0.2)+(0.947 * 1) = 0.96
TY1	0.96	
TY5	0.96	
TY20	0.99	There is an existing seawall that is approximately 1,900 ft long. The seawall that was on the beach is expected to be in the surf zone by TY20,

due to island migration. Therefore, it will likely function as a breakwater (Class 3). The total island length is 39,630 ft long. Therefore 4.8% of the island will be assigned a Class 3 rating (SI = 0.9) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.048 * 0.9)+(0.952 * 1) = 0.99

TY41 0.99

TY50 0.99

East Timbalier – FWOP

TY0 0.54 Approximately 49% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 51% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.49*0.9)+(0.51*0.2) = 0.54

TY1 0.54

TY5 0.54

TY10 0.58 Approximately 54% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 46% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.54*0.9)+(0.46*0.2) = 0.58

TY20 0.87 Approximately 96% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 4% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.96*0.9)+(0.04*0.2) = 0.87

TY43 0.90

TY45 0.90

TY50 0.90

East Timbalier – FWP (Plan B)

TY0 0.54 Approximately 49% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 51% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.49*0.9)+(0.51*0.2) = 0.54

TY1 0.69 Approximately 70% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 30% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.7*0.9)+(0.3*0.2) = 0.69

TY5 0.70 Approximately 71% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 29% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.71*0.9)+(0.29*0.2) = 0.70

TY10	0.71	Approximately 72% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 28% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.72*0.9)+(0.28*0.2) = 0.71
TY20	0.88	Approximately 98% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 2% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.98*0.9)+(0.02*0.2) = 0.88
TY43	0.90	Approximately 100% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore). The SI was calculated as follows: (1.0*0.9) = 0.9
TY45	0.90	
TY50	0.90	

APPENDIX B

WVA SUMMARY SHEET FOR LCA-TBBSR

Terrebonne Basin Barrier Shoreline Restoration

WVA Summary

Low SLR

Alternative 2

- Timbalier (Plan E) = 778.85 AAHUs

TOTAL ► **778.85 AAHUs**

Alternative 3

- Whiskey (Plan C) = 319.51 AAHUs
- Timbalier (Plan E) = 778.85 AAHUs

TOTAL ► **1098.36 AAHUs**

Alternative 4

- Whiskey (Plan C) = 319.51 AAHUs
- Trinity (Plan C) = 375.93 AAHUs
- Timbalier (Plan E) = 778.85 AAHUs

TOTAL ► **1474.30 AAHUs**

Alternative 5

- Raccoon with Terminal Groin (Plan E) = 339.51 AAHUs
- Whiskey (Plan C) = 319.51 AAHUs
- Trinity (Plan C) = 375.93 AAHUs
- Timbalier (Plan E) = 778.85 AAHUs

TOTAL ► **1813.81 AAHUs**

Alternative 6

- Raccoon (Plan B) = 233.40 AAHUs
- Whiskey (Plan B) = 264.41 AAHUs
- Trinity (Plan B) = 261.48 AAHUs

TOTAL ► **759.29 AAHUs**

Alternative 7

- Raccoon with Breakwaters (Plan B) = 256.83 AAHUs
- Whiskey (Plan B) = 264.41 AAHUs
- Trinity (Plan B) = 261.48 AAHUs

TOTAL ► **782.71 AAHUs**

Alternative 8

- Raccoon with Terminal Groin (Plan B) = 256.76 AAHUs
- Whiskey (Plan B) = 264.41 AAHUs
- Trinity (Plan B) = 261.48 AAHUs

TOTAL ► **782.65 AAHUs**

Alternative 9

- Raccoon (Plan B) = 233.40 AAHUs
- Whiskey (Plan B) = 264.41 AAHUs
- Timbalier (Plan B) = 345.14 AAHUs

TOTAL ► **842.95 AAHUs**

Alternative 10

- Raccoon (Plan B) = 233.40 AAHUs
- Trinity (Plan B) = 261.48 AAHUs
- East Island (Plan B) = 197.00 AAHUs
- Whiskey (Plan B) = 264.41 AAHUs
- Timbalier (Plan B) = 345.14 AAHUs
- East Timbalier (Plan B) = 372.16 AAHUs
- Wine with Monkey (Plan B) = 95.64 AAHUs

TOTAL ► **1769.23 AAHUs**

Intermediate SLR

Alternative 2

- Timbalier (Plan E) = 870.83 AAHUs

TOTAL ► **870.83 AAHUs**

Alternative 3

- Whiskey (Plan C) = 379.12 AAHUs
- Timbalier (Plan E) = 870.83 AAHUs

TOTAL ► **1249.95 AAHUs**

Alternative 4

- Whiskey (Plan C) = 379.12 AAHUs
- Trinity (Plan C) = 387.48 AAHUs
- Timbalier (Plan E) = 870.83 AAHUs

TOTAL ► **1637.43 AAHUs**

Alternative 5

- Raccoon with Terminal Groin (Plan E) = 425.99 AAHUs
- Whiskey (Plan C) = 379.12 AAHUs
- Trinity (Plan C) = 387.48 AAHUs
- Timbalier (Plan E) = 870.83 AAHUs

TOTAL ► **2063.42 AAHUs**

Alternative 6

- Raccoon (Plan B) = 239.56 AAHUs
- Whiskey (Plan B) = 268.16 AAHUs
- Trinity (Plan B) = 277.64 AAHUs

TOTAL ► **785.36 AAHUs**

Alternative 7

- Raccoon with Breakwaters (Plan B) = 262.49 AAHUs
- Whiskey (Plan B) = 268.16 AAHUs
- Trinity (Plan B) = 277.64 AAHUs

TOTAL ► **808.29 AAHUs**

Alternative 8

- Raccoon with Terminal Groin (Plan B) = 255.03 AAHUs
- Whiskey (Plan B) = 268.16 AAHUs
- Trinity (Plan B) = 277.64 AAHUs

TOTAL ► **800.84 AAHUs**

Alternative 9

- Raccoon (Plan B) = 239.56 AAHUs
- Whiskey (Plan B) = 268.16 AAHUs
- Timbalier (Plan B) = 381.81 AAHUs

TOTAL ► **889.53 AAHUs**

Alternative 10

- Raccoon (Plan B) = 239.56 AAHUs
- Trinity (Plan B) = 277.64 AAHUs
- East Island (Plan B) = 200.35 AAHUs
- Whiskey (Plan B) = 268.16 AAHUs
- Timbalier (Plan B) = 381.81 AAHUs
- East Timbalier (Plan B) = 368.46 AAHUs
- Wine with Monkey (Plan B) = 105.60 AAHUs

TOTAL ► **1841.58 AAHUs**

High SLR

Alternative 2

- Timbalier (Plan E) = 914.50 AAHUs

TOTAL ► **914.50 AAHUs**

Alternative 3

- Whiskey (Plan C) = 323.97 AAHUs
- Timbalier (Plan E) = 914.50 AAHUs

TOTAL ► **1238.48 AAHUs**

Alternative 4

- Whiskey (Plan C) = 323.97 AAHUs
- Trinity (Plan C) = 365.19 AAHUs
- Timbalier (Plan E) = 914.50 AAHUs

TOTAL ► **1603.66 AAHUs**

Alternative 5

- Raccoon with Terminal Groin (Plan E) = 437.57 AAHUs
- Whiskey (Plan C) = 323.97 AAHUs
- Trinity (Plan C) = 365.19 AAHUs
- Timbalier (Plan E) = 914.50 AAHUs

TOTAL ► **2041.23 AAHUs**

Alternative 6

- Raccoon (Plan B) = 210.44 AAHUs
- Whiskey (Plan B) = 211.86 AAHUs
- Trinity (Plan B) = 235.64 AAHUs

TOTAL ► **657.94 AAHUs**

Alternative 7

- Raccoon with Breakwaters (Plan B) = 229.22 AAHUs
- Whiskey (Plan B) = 211.86 AAHUs
- Trinity (Plan B) = 235.64 AAHUs

TOTAL ► **676.72 AAHUs**

Alternative 8

- Raccoon with Terminal Groin (Plan B) = 229.96 AAHUs
- Whiskey (Plan B) = 211.86 AAHUs
- Trinity (Plan B) = 235.64 AAHUs

TOTAL ► **677.46 AAHUs**

Alternative 9

- Raccoon (Plan B) = 210.44 AAHUs
- Whiskey (Plan B) = 211.86 AAHUs
- Timbalier (Plan B) = 379.25 AAHUs

TOTAL ► **801.55 AAHUs**

Alternative 10

- Raccoon (Plan B) = 210.44 AAHUs
- Trinity (Plan B) = 235.64 AAHUs
- East Island (Plan B) = 172.83 AAHUs
- Whiskey (Plan B) = 211.86 AAHUs
- Timbalier (Plan B) = 379.25 AAHUs
- East Timbalier (Plan B) = 339.00 AAHUs
- Wine with Monkey (Plan B) = 92.98 AAHUs

TOTAL ► **1642.00 AAHUs**

Renourishment

Alternative 5

- Raccoon with Terminal Groin (Plan E) = 476.76 AAHUs
- Whiskey (Plan C) = 678.43 AAHUs
- Trinity (Plan C) = 627.69 AAHUs
- Timbalier (Plan E) = 1100.02 AAHUs

TOTAL ► **2882.91 AAHUs**

APPENDIX C

NATURAL RESOUCE AGENCY COMMENT LETTERS

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

May 25, 2010

F/SER46/PW:jk
225/389-0508

Mr. James F. Boggs, Field Supervisor
Louisiana Field Office
U.S. Fish and Wildlife Service
646 Cajundome Boulevard, Suite 400
Lafayette, Louisiana 70506

Dear Mr. Boggs:

NOAA's National Marine Fisheries Service (NMFS) has received the draft Fish and Wildlife Coordination Act Report (Report) titled "Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration, Integrated Feasibility Study" (TBBSR). The Report discusses the U.S. Fish and Wildlife Service's initial findings and recommendations associated with the National Ecosystem Restoration (NER) Plan and Corps of Engineers' Tentatively Selected Plan (TSP) for barrier island restoration in Terrebonne Parish, Louisiana.

As described in the Report, 12 alternatives were included in the final array. Various plans of differing widths and elevations were evaluated. After numerous iterations of TSP formulation, the Corps of Engineers identified the TSP to consist of Plan C for Whiskey Island only. That alternative includes 622 acres of beach/dune with a +6.4 feet NAVD 88 dune crown, that is 100 feet wide, and approximately 100 acres of created marsh elevations constructed landward of the dune to a +2.4 feet NAVD 88 for a settled target of +1.6 feet NAVD 88.

NMFS supports further emphasis in the Report on two broad points. These are: 1) implementation of a comprehensive coastal ecosystem restoration plan should include construction of both barrier islands and mainland habitats; and, 2) construction of multiple islands rather than one island should be pursued as the TSP.

The goal of the Louisiana Coastal Area (LCA) Study is a comprehensive and integrated plan for multiple benefits, including the environment, economy and culture of southern Louisiana. This includes sustaining and restoring coastal ecosystems with essential functions and diversity. Barrier islands, including those under the TBBSR, are an important component of a complete coastal ecosystem plan and NMFS is supportive of accomplishing as much barrier island restoration as possible. Although Whiskey Island Plan C contributes to NER, selection of a single island as the TSP incompletely meets the near-term barrier island restoration needs for Terrebonne Basin by only addressing one of seven islands. Further, the ability to attain long-term restoration needs for TBBSR will be more daunting and fleeting while degradation of the remaining barrier island arc exceeds the capabilities of other restoration programs. We encourage the Report be revised to further emphasize this shortcoming by including a discussion of the measurement of the quantity and quality of benefit (i.e., NER outputs) and how those net changes may be compared to the one-island TSP and other multi-island plans.

In discussing the limits of applicability of project justification, the importance of barrier islands in providing unique habitat for fish and wildlife resources that is distinctly different from mainland marshes cannot be understated. The environmental benefits for all plans/projects under the LCA Study are quantified using various fish and wildlife community-based models. Each of those has a common output metric, the Average Annual Habitat Unit (AAHU). In the case of TBBSR, the Barrier Island Community Model was used. A substantial limitation of that model is the dune, supratidal, and intertidal variables are defined by fixed vertical elevations. Of all the variables in the model, the intertidal variable carries the most weight. So, when attempts are made to optimize designs and associated alternatives based in part on AAHUs, intertidal acreage is maximized as early and as long as possible during the project life. However, because each of the habitat types in this model are based on fixed vertical elevations, no adjustment is possible when the effects of sea level rise on project performance are considered over a 50-year project life. With sea level rise effects included with fixed elevation definitions, there is a substantial loss of intertidal habitat as presently defined in the model. This limits the amount of resulting AAHUs when in reality the intertidal range would adjust with sea level rise. Most applications of this model to date have been through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) which has a 20-yr project life where sea level rise has less impact on benefits. Further, under CWPPRA, cost/benefit is not the only metric used to compare island verses mainland projects. We recommend the Report be revised to discuss this methodology limitation and to indicate that until programmatic changes are made to methods, the results should be used for comparing within island alternatives and not between island and mainland projects. We also recommend the Report indicate that if methods changes were made to allow intertidal habitat to adjust with sea level rise, different design alternatives may have been developed for optimal benefit performance.

NMFS concurs with and supports the Fish and Wildlife Service's recommendation that the TSP should consist of the NER Plan plus Wine Island. Although re-building Whiskey Island further than restoration efforts undertaken by CWPPRA would result in substantial net positive benefits to the environment, a single island action is not representative of ecosystem restoration. Recognizing the funding limits of the existing authorization, NMFS is supportive of proceeding with as many islands under the NER Plan as possible while emphasizing that anything less than the NER Plan is representative of only a near term solution that addresses only a minor part of the barrier island restoration needs for the Terrebonne Basin. We recommend the Report indicate the preferred priority for restoration of the islands identified in the NER Plan with presently limited and potential future available funds. We are interested in developing a priority with your staff and that of the Louisiana Department of Wildlife and Fisheries based on the completed analyses.

Fishery Resources and Essential Fish Habitat

The proposed restoration alternatives potentially would mine sand from Ship Shoal and/or South Pelto lease blocks. Please revise the fishery resources discussion to indicate that a portion of Ship Shoal has been identified as spawning, hatching, and foraging habitat for blue crab and the proposed mining may adversely affect these support functions[1]. We suggest the Report discuss the potential need for prohibiting mining during annual periods of highest blue crab use of the shoals. Essential fish habitat has been designated for areas in the vicinity of offshore shoals for various life stages of King mackerel, cobia, and red snapper. We recommend the Report be revised accordingly.

Report Position and Recommendations

We request recommendation number two number be revised to also include impacts to essential fish habitat to ensure contract plans and specifications are coordinated with the FWS and NMFS Habitat Conservation Division. In addition, we request recommendation number six be revised to indicate the

[1] Gelpi, Jr., C.G., R.E. Condrey, J.W. Fleeger, and S.F. Dubois. 2009. Discovery, evaluation and implications of blue crab, *Callinectes sapidus*, spawning, hatching and foraging grounds in Federal (US) water offshore of Louisiana. Bulletin of Marine Science: 85(3)203-222.

monitoring plans should be consistent with the Barrier Island Comprehensive Monitoring requirements developed by the Office of Coastal Protection and Restoration under funding from LCA Science and Technology Program.

Thank you for the efforts of your staff to assess impacts of plans under the TBBSR, coordination with the NMFS, and for the opportunity to review and comment on this Report. Please direct questions pertaining to these comments to Patrick Williams at (225) 389-0508, extension 208.

Sincerely,

for Miles M. Croom
Assistant Regional Director
Habitat Conservation Division

c:
USACE, Planning, Klein, Lochney
LA DNR, Consistency, Ducote
F/SER4, Dale
F/SER46, Swafford
Files

Bobby Jindal
Governor

State of Louisiana

Department of Wildlife and Fisheries
Office of Wildlife

Robert J. Barham
Secretary

Jimmy L. Anthony
Assistant Secretary

June 25, 2010

Mr. James F. Boggs, Supervisor
Fish and Wildlife Service
Louisiana Field Office
646 Cajundome Blvd.
Lafayette, LA 70506

RE: *Application Number: Draft Report – Terrebonne Basin Barrier Shoreline Restoration*
Notice Date: April 30, 2010

Dear Mr. Boggs:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed the above referenced draft Fish and Wildlife Coordination Act Report. Based upon this review, the following has been determined:

LDWF concurs with the positions and recommendations outlined by the U.S. Fish and Wildlife Service.

LDWF believes that the Wine Island "Rock Ring" alternative should be re-analyzed for inclusion into the plan. Further, if additional funding becomes available, it is our opinion that the lead agencies should consider the inclusion of additional protective hard structures into the plan. It has been our experience that hard structures such as segmented breakwaters add considerable longevity to barrier island restoration projects, offering high value for their cost.

Portions of the proposed activity are within Isles Dernieres Barrier Islands Refuge. No activities shall occur on any LDWF Wildlife Management Area or Refuge without obtaining a Special Use Permit from LDWF. Please contact Mike Carloss at 225-765-2814 for more information.

The Louisiana Department of Wildlife and Fisheries appreciates the opportunity to review and provide recommendations to you regarding this proposed activity. Please do not hesitate to contact Habitat Section biologist Matthew Weigel at 225-763-3587 should you need further assistance.

Sincerely,

Kyle F. Balkum
Biologist Program Manager

mw/rb

c: Matthew Weigel, Biologist
Rob Bourgeois, Fisheries Biologist
EPA, Marine & Wetlands Section
Mike Carloss, Assistant Administrator

TERREBONNE BASIN BARRIER SHORELINE RESTORATION

DRAFT FISH AND WILDLIFE COORDINATION ACT REPORT

April 30, 2010

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

April 30, 2010

Colonel Alvin B. Lee
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee

Please reference the "Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration, Integrated Feasibility Study". This report contains a description of existing fish and wildlife resources in the project area, discusses future with-project and future without-project habitat conditions, identifies fish and wildlife-related impacts, and provides project recommendations. This document does not constitute the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). The Service is coordinating with National Marine Fisheries and the Louisiana Department of Wildlife and Fisheries; their comments will be incorporated into the final report.

We appreciate the cooperation of your staff on this study. Should you have any questions regarding the enclosed report, please contact Ms. Karen Soileau (337/291-3132) of this office.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

Attachment

cc: EPA, Dallas, TX
National Marine Fisheries Service, Baton Rouge, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
Office of Coastal Protection and Restoration, Baton Rouge, LA
SJB Group, Baton Rouge, LA

Draft

Fish and Wildlife Coordination Act Report

Louisiana Coastal Area (LCA)
Terrebonne Basin Barrier Shoreline Restoration
Terrebonne and Lafourche Parishes, Louisiana

U.S.
FISH & WILDLIFE
SERVICE
DEPARTMENT OF THE INTERIOR

Submitted To
New Orleans District
U.S. Army Corps of Engineers
and
Office of Coastal Protection and Restoration

Prepared by
Karen Soileau
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Ecological Services
Lafayette, Louisiana

April 2010

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INTRODUCTION

The Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration (LCA-TBBSR) Integrated Feasibility Report and Environmental Impact Statement (EIS) was prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration (OCPR), under the authority of Title VII of the Water Resources Development Act (WRDA) of 2007. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005. That report recommended projects and features in the interest of hurricane protection, prevention of salt water intrusion, preservation of fish and wildlife, prevention of erosion, and related water resources purposes. One recommended project was the TBBSR.

The LCA-TBBSR project is designed to: 1) restore the minimized barrier island conditions that provide the geomorphic form and ecological function of the Terrebonne Basin barrier islands, 2) restore and improve various barrier island habitats that provide essential habitats for fish, migratory birds, and other terrestrial and aquatic species, mimicking, as closely as possible, conditions which occur naturally in the area, and 3) increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline by mechanically introducing compatible sediment, and increasing the ability of the restored area to continue to function and provide habitat with minimum continuing intervention.

This draft report contains a description of existing fish and wildlife resources in the project area, discusses future with-project (FWP) and future without-project (FWOP) habitat conditions, identifies fish and wildlife-related impacts, and provides recommendations to improve the proposed restoration measures. When finalized, this report will be submitted in fulfillment of the requirements of the Fish and Wildlife Coordination Act (FWCA; 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and will constitute the report of the Secretary of the Interior as required by Section 2(b) of that Act. This draft FWCA Report is being provided to the Louisiana Department of Wildlife and Fisheries (LDWF) and the National Marine Fisheries Service (NMFS); their comments will be incorporated into the final report.

DESCRIPTION OF STUDY AREA

The Terrebonne Basin Barrier Shoreline is divided into two reaches (Isles Dernieres and Timbalier) in Terrebonne and Lafourche Parishes, Louisiana. Those reaches are comprised of a chain of barrier islands, separated by tidal inlets, which enclose shallow bays. The barrier islands within those reaches define the southern boundary of the Terrebonne Basin and separate the shallow estuarine bays and saline marshes from the Gulf of Mexico.

The study area (Figure 1) is composed of a series of barrier islands formed by the reworking of abandoned Mississippi River delta complexes. The main distributary location of the Mississippi River switches to a more hydraulically efficient route about every 1,000 years, building a new delta complex. The abandoned delta subsides and the seaward margins are reworked by coastal processes, forming a sandy barrier shoreline (headland) and eventually detached barrier islands. The Mississippi River Deltaic Plain is composed of six major delta complexes: two prograding and four degrading. The Atchafalaya and Modern Delta complexes are active and the Lafourche,

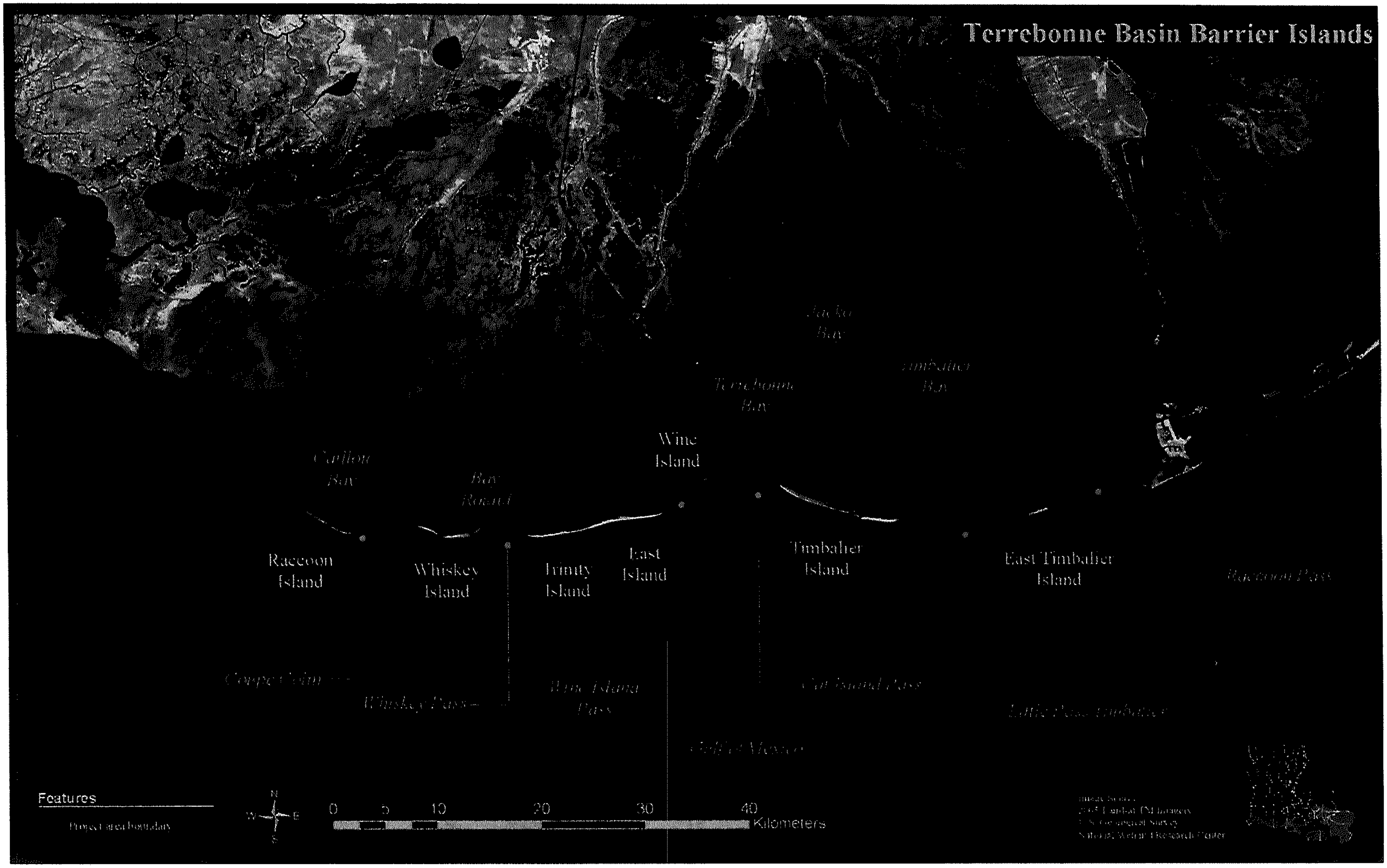

Figure1. Terrebonne Basin Barrier Shoreline Restoration Study Area

St. Bernard, Teche, and Maringouin complexes are inactive. Present day Terrebonne Basin is the result of the Lafourche delta formation, through seaward advancement from deposition of Mississippi River distributary sediment, the subsequent delta degradation and detachment, and the reworking of seaward headlands to form barrier islands (USACE 2004a).

Isles Dernieres Reach

The Isles Dernieres reach represents a barrier island arc approximately 22 miles long in the southern reaches of Terrebonne Parish and extends from Caillou Bay east to Cat Island Pass. Raccoon, Whiskey, Trinity, East, and Wine, the primary islands that comprise the Isles Dernieres barrier island chain, are backed by Bay Blanc, Bay Round, Caillou Bay and Terrebonne Bay, and bordered by the Gulf of Mexico on the seaward side. The remnant of Wine Island is located in Wine Island Pass, about midway between East and Timbalier Islands. The islands of the Isles Dernieres Reach range from approximately 0.1 to 1.2 miles wide and are typically composed of a thin sand cap over a thick mud platform. Elevations are generally low and the islands are frequently overwashed (USACE 2004b).

The Isles Dernieres chain is considered one of the most rapidly deteriorating barrier shorelines in the United States. The average long-term (1887-2002) rate of shoreline change for the Isles Dernieres was -34.7 feet per year (ft/yr) with a range of -56.0/-17.0 ft/yr. The average short-term (1988-2002) rate of shoreline change was -61.9 ft/yr with a range of -86.0/-38.6 ft/yr (USACE 2004b).

<u>Raccoon Island</u>

Raccoon Island is approximately 2.6 miles long (USDA 2007) and is located at the western end of the Isles Dernieres reach. Raccoon Island is characterized by sandy beach with well-vegetated washover terraces backed by thick groves of black mangrove and salt marsh. The recurved spit at the west end is low and dominated by washover flats. The habitats found on Raccoon Island provide for the largest brown pelican rookery in the state, as well as the greatest species diversity of nesting colonial waterbirds found on any barrier island in the state (USDA-NRCS 2005).

The average long-term shoreline change rate between 1887 and 2002 was -27.4 ft/yr with a range of -28.9/-24.9 ft/yr. The average short-term shoreline rate was -60.5 ft/yr with a range of -144.5/-8.6 ft/yr between 1988 and 2002. It is noted the average shoreline change rate increased over time, specifically from -27.4 ft/yr to -60.5 ft/yr during the two time periods, 1887-2002 and 1988-2002, respectively (USACE 2004b).

Raccoon Island rapidly decreased in area from 368.2 to 200.2 acres between 1978 and 1988. During this time period, multiple hurricane impacts occurred in 1979 (Bob and Claudette) and 1985 (Danny, Elena, and Juan). From 1988 to 1992, Raccoon Island further decreased in area from 200.2 acres to 167.8 acres. With the impact of 1992's Hurricane Andrew, the area of Raccoon Island continued to decrease even further to 112.8 acres. By 1993, Raccoon Island had further reduced in area to 99.2 acres. A Federal Emergency Management Agency (FEMA) restoration project in 1994 increased the size of Raccoon Island to 127.2 acres by 1996. A Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) project (TE-29) further increased the area of Raccoon Island to 145.5 acres by 2002 via constriction of eight segmented breakwaters on the eastern end of the island. In 2005, eight additional breakwaters were constructed immediately west of the original eight structures (Project TE-48). While Hurricanes Katrina and Rita in 2005 caused erosion, those breakwaters continued to benefit the island (USACE 2004b) and an increase in acreage was observed in 2006 (215 acres). The effects of Hurricanes Gustav and Ike reduced Raccoon Island to 121 acres by the winter of 2008 (Barras 2009). The breakwaters have been effective in holding sand on the eastern portion of the island; however, the western portion has continued to erode.

Whiskey Island

Whiskey Island is located near the middle of five islands in the Isles Dernieres barrier island chain. It is approximately 4.6 miles long (USDA 2007) and located approximately 17.5 miles southwest from Cocodrie, Louisiana in Terrebonne Parish. The Louisiana Department of Wildlife and Fisheries is currently attempting to re-establish a brown pelican rookery on that island.

The average long-term shoreline change rate between 1887 and 2002 was -56.0 ft/yr with a range of -77.5/- 45.7 ft/yr. The average short-term shoreline change rate was -86.0 ft between 1988 and 2002 with a range of -139.4/-48.4 ft/yr (USACE 2004b).

Prior to restoration, the morphology of Whiskey Island was dominated by washover flats and isolated washover terraces. CWPRRA restoration project TE-27 at Whiskey Island created an artificial dune +4 to +6 feet in elevation, which was 2 to 3 feet above the natural pre-restoration surface. As seen throughout the Isles Dernieres chain, Whiskey Island is historically erosional and decreasing in area. Between 1978 and 1988, Whiskey Island decreased in area from 904.4 acres to 564.2 acres. The hurricanes of 1979 and 1985 were contributing factors to the decrease in area. By 1992, Whiskey Island had decreased to 505.6 acres. During the 1992 hurricane season, Hurricane Andrew impacted this area dramatically, reducing Whiskey Island to 440.8 acres. By 1993 it had further decreased in area to 428.4 acres. Post storm recovery processes increased the area of Whiskey Island to 474.8 acres by 1996. Construction of the CWPPRA Whiskey Island project (TE-27) began in February 1998 and was completed in August 1998. By 2002, the area of Whiskey Island had increased to 642.8 acres, a 36% increase in area. While the hurricanes in 2005 impacted the island, overwash processes and longshore sediment transport from Trinity and East Islands benefited Whiskey Island (USACE 2004b). The effects of Hurricanes Gustav and Ike decreased the area of Whiskey Island to 509 acres by the winter of 2008 (Barras 2009). CWPPRA Project TE50 (Whiskey Island Back Barrier Marsh Creation) was completed in September 2009. That project was designed to increase the longevity of the previous TE-27 restoration effort by increasing the island's width.

Trinity Island

Trinity Island, the largest island of the Isles Dernieres chain, is approximately 5.2 miles long (USDA 2007) and lies immediately to the east of Whiskey Island. The morphology includes low dune terraces, with isolated dunes of up to 3 to 4 feet in elevation. Overwash is more frequent at the west and east ends of the island where elevations decrease. It is a remnant of the original mainland marsh and is well-vegetated by black mangroves and salt marsh species. Trinity Island is historically eroding. Between 1978 and 1988, Trinity Island decreased in area from 1,317.1 acres to 894.6 acres. This was a time period of multiple hurricanes in occurring in 1979 and 1985. By 1992, Trinity Island further decreased to 796.5 acres. During the 1992 hurricane season, Hurricane Andrew impacted this area, reducing Trinity Island to 678.5 acres and by 1993, the island decreased further to 651.4 acres. By 1996, the area of Trinity Island continued to decrease to 617.4 acres. Trinity Island increased in area from 617.4 to 710.1 in 2002 as a result of a restoration project constructed on the western end of the islands (USACE 2004b). Though the impacts of Hurricanes Katrina and Rita were offset by the New Cut Project in 2006 (increasing Trinity Island to 764 acres), the effects of Hurricanes Gustav and Ike decreased the total area of the island to 509 acres by 2008 (Barras 2009).

The average long-term shoreline change rate between 1887 and 2002 was -38.4 ft/yr with a range of -47.9/-34.3 ft/yr. The 1988–2002 average short-term change rate was -62.5 ft/yr with a range of -107.3/-41.1 ft/yr. The acceleration between the long-term and short-term shoreline change rates is linked to the major hurricane impacts of Hurricanes Andrew in 1992 and Tropical Storm Isidore and Hurricane Lili in 2002 (USACE 2004b).

East Island

East Island is approximately 3.1 miles long (USDA 2007) and is the easternmost island of the Isles Dernieres. It is characterized by low dunes and washover terraces, with elevations ranging from +3 to +5 North American Vertical Datum 1988 (NAVD88).

Prior to restoration, East Island was rapidly eroding and decreasing in area since 1887. In 1978, East Island was 368.2 acres in area and by 1988 it had decreased in size to 202.2 acres. The average long-term shoreline change between 1887 and 2002 was -17.0 ft/yr with a range of -34.6/-5.1 ft/yr. Short-term, between 1988 and 2002, the average shoreline erosion rates increased to -38.6 ft/yr with a range of -64.0/-14.0 ft/yr. During this period of time multiple hurricane impacts occurred in 1979 and in 1985. The 1985 impacts prompted island restoration efforts by way of the Terrebonne Parish Barrier Island Restoration Project. The East Island portion of this project, which measured 3,200 ft long, 1,000 feet wide, and encompassed 38 acres, used sediment from the margins of Wine Island Pass to build foredunes to an average elevation of eight feet, and raised backbarrier elevations by an average of 3.5 ft. Subsequent to sediment settling and leaching, vegetative planting was performed for island stability (Penland and Suter 1988). By 1992, East Island had continued to lose land and measured 173.4 acres in size. After Hurricane Andrew made landfall in 1992, East Island was further reduced to 93.4 acres, and this continued into 1993 when East Island reached 88.5 acres in size. Following Hurricane Andrew, FEMA constructed an emergency restoration project east of the former Terrebonne Parish restoration site, resulting in East Island enlarging from 88.5 acres in 1993 to 193.1 acres in 1996. The CWPPRA East Island restoration was completed in 1998, and the area of the island increased from 193.1 acres to 380.4 acres by 2002 (USACE 2004b). By 2008 East Island decreased to approximately 300 acres due to the hurricane impacts in 2005 and 2008.

Wine Island

Wine Island, located approximately 2.5 miles northeast of East Island and 3.9 miles west of Timbalier Island, lies on Wine Island Shoal, with Wine Island Pass to the west and Cat Island Pass to the east. Historically, Wine Island was the easternmost of the Isles Dernieres chain. It was approximately three miles in length, and located across the mouth of the present Wine Island/Cat Island Pass (Penland et al. 2005). By the mid-20th Century the island had migrated north and eroded away. What is now called Wine Island is a dredge spoil disposal site, associated with the Houma Navigation Canal (HNC). In 1991 the present configuration was created when the South Terrebonne Tidewater Management and Conservation District (District) constructed the rock containment dike and the Corps filled it with dredge spoil from the HNC. The original restoration created a 24-acre island, approximately 1,500 feet wide, east to west. The island was vegetated with a mixture of cordgrass, black mangrove, and ryegrass by the District and the Coastal Restoration Division of the Louisiana Department of Natural Resources in the same year. In 1992 Hurricane Andrew overwashed the island, decimated the vegetation, and washed approximately one-third of the land away. The Corps placed additional dredged material from the HNC within the rock containment dike, but because of the fine grain consistency of the spoil little, if any, remained on site. Responsibility for the island was transferred to the Louisiana Department of Wildlife and Fisheries. The present island is small; approximately 800 feet wide in an east-west dimension. The island is no longer contained within the revetment; its area has been reduced significantly and its footprint has migrated north such that about one third of it presently lies outside the rock containment dike. Albeit small, that island hosts some of the largest brown pelican and colonial nesting waterbird rookeries in the state.

Timbalier Reach

The Timbalier Reach is comprised of Timbalier Island and East Timbalier Island. Timbalier and East Timbalier Islands are on the western edge of the Lafourche barrier shoreline and are located about 60 miles southwest of New Orleans, Louisiana. This barrier island shoreline is approximately 20 miles long and backed by Terrebonne and Timbalier Bay to the north and delimited by Raccoon Pass to the east and Cat Island Pass to the west. The islands range from 0.1 to 0.6 miles wide, with low elevations.

Historically, the Timbalier Islands have undergone both negative and positive areal rate changes. Between 1887 and 1934 the area of the Timbalier Islands decreased from 4,142 acres to 2,875 acres at a rate of 27.0 acres/year (yr). Between the next two periods, 1934-1955 and 1956-1978, the Timbalier Islands increased from 2,875 acres to 3,280 acres and then to 3,693 acres at a rate of + 18.8 acres/yr respectively. This was a period of extensive back-barrier canal dredging and dredge spoil placement to support oil and gas development; those activities resulted in an increase in acreage of the Timbalier Islands. The large decrease in the area between 1978 and 1988 is a function of the extension of the Belle Pass jetties to the east and the disruption of the dominant longshore sediment transport to the west (USACE 2004b). The combination of a diminishing sediment supply and hurricanes continued to drive island barrier loss, reducing the Timbalier Islands to 1,354 acres by 2008.

The average long-term rates of shoreline change for the Timbalier Islands was -36.1 ft/yr with a range of -61.2/-4.1 ft/yr between 1887 and 2002. The average short-term rate of shoreline change was -76.4 ft/yr with a range of -179.4/-13.4 ft/yr between 1988 and 2002 (USACE 2004b).

Timbalier Island

Timbalier Island is approximately 7 miles long (USDA 2007) and lies in Terrebonne and Lafourche Parishes. Over the last 115 years, Timbalier Island has migrated 2.5 miles to the west by the erosion of its east end and the recurve spit extension of its west end. With this westward migration, Timbalier Island has developed two distinct shoreline change rate regimes (USACE 2004b).

The average long-term rate of shoreline change for the eastern portion of Timbalier Island was -42.9 ft/yr between 1887 and 2002 with a range of -48.6/-37.3 ft/yr. Between 1988 and 2002, the average short-term erosion rate accelerated to -179.4 ft/yr with a range of -205.5/-153.3 ft/yr for the eastern portion. The high rates of negative change reflect the impact of the 1992 and 2002 hurricanes. Conversely, with the western migration of Timbalier Island, the western portion of the island has historically shown a lower rate of shoreline change. The average long-term erosion rate for the western portion is -4.1 ft/yr with a range of -31.0/+20.9 ft/yr between 1887 and 2002. The western portion has experienced an average short-term erosion rate between 1988 and 2002 of 13.4 ft/yr with a range of -118.7/+31.9 ft/yr. The combination of the 1985/1992/2002 hurricanes and disruption of the westward sediment transport by the Belle Pass jetties have all contributed to the high rates of shoreline change in this area (USACE 2004b).

Two CWPPRA projects have been constructed on Timbalier Island. The first project (TE18) involved the installation of sand fencing (greater than a mile in total) and the subsequent planting of dune-stabilizing vegetation. The second project (TE40) involved: 1) the restoration of approximately 2.2 miles of beach and dune, 2) the installation of sand fencing, 3) the planting of dune-stabilizing vegetation, and 4) marsh creation. A second component of TE40 was the addition of sediment into the nearshore system to facilitate longshore transport without eroding the restored beach.

East Timbalier Island

East Timbalier Island is approximately 3.6 miles long (USDA 2007) and lies east of Little Pass Timbalier and directly west of the Bayou Lafourche headland. East Timbalier Island is occupied by a major oil and gas operation at the inshore Timbalier Bay Field. The island and surrounding bay supports major offshore production facilities. East Timbalier Island is known for the massive rip-rap seawall along its Gulf shoreline and numerous revetments landward of it. The combination of the position of East Timbalier Island immediately downdrift of the Bayou Lafourche headland and the Belle Pass jetties creates one of the most erosional areas in coastal Louisiana (USACE 2004b).

The average long-term erosion rate between 1887 and 2002 was -61.2 ft/yr with a range of -74.3 to -49.2 ft/yr. The average short-term erosion rate between 1988 and 2002 decreased to -36.3 ft/yr with a range of -65.5 to -4.9 ft/yr. The erosion rate diminished here in spite of the 1992 and 2002 hurricanes. This shoreline erosion decrease is partially related to the construction of

CWPPRA restoration project TE-25/30 in 2000, which included the creation of dune, back barrier marsh platform, rubble rock revetment, sand fencing, and vegetative plantings (USACE 2004b).

FISH AND WILDLIFE RESOURCES

Description of Habitats

The Terrebonne Basin is an abandoned delta complex that is bordered by Bayou Lafourche on the east and the Atchafalaya Basin floodway on the west. The southern end of the basin is defined by a series of narrow, low-lying barrier islands (the Isles Dernieres and Timbalier chains) separated from the mainland marshes by a series of wide, shallow lakes and bays (e.g., Lake Pelto, Terrebonne Bay, Timbalier Bay). The proposed barrier shoreline restoration sites are within the southern extreme of the basin.

The habitat types in the study area primarily consist of beach, overwash, dune, barrier flats (scrub/shrub and salt flats), back-barrier saline marsh, intertidal flats, and open water. Loss of those habitats has been identified as one of the most serious and complex problems in the study area. The Terrebonne Basin barrier islands have undergone significant reductions in size due to a number of natural processes and human actions including lack of sediment, storm-induced erosion and breaching, subsidence, sea level rise and hydrologic modifications such as navigation and oil and gas canals.

Beach and Overwash

Active beach and overwash areas occur on the gulfside of barrier shorelines from the intertidal zone to the toe of the dune. This area contains wave-washed, sandy sediments and is usually 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 may include sea purslane, marsh hay cordgrass, sea rocket, and seaside heliotrope. Overwash areas may become colonized by grasses (i.e., coastal dropseed, salt grass, and *Paspalum* spp.) as well as morning glory and sea purslane.

Dune

Dunes form when sand, deposited by storm surges and/or transported by wind, is trapped by dune grasses. Dune height and orientation are a function of prevailing wind direction and speed and sand size. Sea oats can tolerate salt spray and sand burial, and contribute to the dune building process by stabilizing windblown sand. Other species present within this habitat type may include marsh hay cordgrass, bitter panicum, and beach croton.

Barrier Flats and Shrub/Scrub

Plants requiring elevation and protection from coastal processes may be found behind the dunes. Saltwort, creeping glasswort, and Bigelow glasswort are found in pockets of high salinity, often in areas that are only intermittently flooded due to their higher elevation. In areas subjected to frequent drying, seaside goldenrod and groundsel bush are occasionally found, as well as the salt-tolerant shrubs including sea myrtle, sea ox-eye and marsh elder. Shrubs are occasionally covered with the parasitic vines, including common dodder and pretty dodder. These plants may also be found in the high marsh zone.

Saline Marsh

Saline marshes in the project area occur on the bayside of the barrier islands. Those intertidal marshes usually exhibit fairly firm mineral soils and experience moderate to high daily tidal energy. 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 salt marshes of the project area is saltmarsh cordgrass, a perennial grass that grows from extensive rhizomes. Saltmarsh cordgrass also dominates the high marsh areas subject to intermittent flooding, although the highly salt-tolerant salt grass, black needle rush, and glassworts are also frequently present. Black mangrove occurs as a shrub along the flooded marsh edges of the barrier 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. The Louisiana Natural Heritage Program (Smith 1988) classifies the mangrove zones separately from salt marsh as intertidal saltwater swamps. Mangroves are at their northern natural limit here and are periodically killed back by winter freezes.

Intertidal Flats

Intertidal mud flats are typically ephemeral areas of unconsolidated organic and mud deposits that occur in areas of low wave and tidal energy. Although those areas are considered "non-vegetated," mats of algae 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, 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 protected intertidal mud flats. Sand flats are the preferred habitats of various invertebrates, crustaceans, and mollusks.

Open Water

The major water bodies in the study area are the Gulf of Mexico, Caillou Bay, Wine Island Pass, Bay Blanc, Bay Round, Terrebonne Bay, Timbalier Bay, Raccoon Pass, and Cat Island Pass. In the majority of the study area, the levels of turbidity and energy are too high for the growth of submerged aquatic vegetation.

Borrow Sources

It is expected that two types of borrow sources will be used for this project: a high-quality sand source for the beach-dune portion of the project and a nearshore mixed-sediment deposit to be used for the marsh construction. The initially-proposed source of borrow sand for beach and dune restoration was Ship Shoal, an elongate sand body in the Gulf, located 20 to more than 40 miles west of Belle Pass and four to ten miles south of the Isles Dernieres. It is approximately 31 miles long and 7 miles wide, lying in a water depth of 9 to 30 ft. Sand particle sizes present within Ship Shoal are equal to or greater than those found on the Terrebonne Basin barrier islands. Coarser grain sand is more resistant to erosion. Ship Shoal is the nearest, accessible sand source that contains a sufficient quantity of sand of appropriate quality to match the native sand found on the islands. Several closer sand sources, previously identified for other CWPPRA project use, however, were also identified and investigated. Of those, the two areas most likely to be utilized include Subarea 3a of the Whiskey Island TE-50 Borrow Area 3 and the New Cut TE-37 Borrow Area 4.

It is proposed that nearshore resources seaward of the depth of closure would be utilized to provide mixed sediments consisting of fine sand, silts, and clays for the marsh creation portion of the project. The two marsh sediment borrow areas identified are the Raccoon Island TE-48 Borrow Area 5 and the overburden stratum on Subarea 3a of the Whiskey Island TE-50 Borrow Area 3.

Fishery Resources and Essential Fish Habitat

Terrebonne Basin Barrier Shoreline's transitional habitats provide unique nursery, foraging, predator refugia, and spawning habitat for numerous economically important marine and estuarine species that exhibit a preference for or are dependent on these habitats as transients during portions of their life history. Surf zone, intra-island ponds and tidal creeks, and back-bay sand flats, including those along barrier islands and headlands support distinct fish and crustacean assemblages in comparison to mainland or inland saline marshes (Williams 1998). Common surf zone species include Gulf menhaden, spot, striped mullet, southern kingfish, anchovies, scaled sardine, Florida pompano, Atlantic bumper, Spotfin mojarra, and rough silverside. The surf zone is used temporarily by larval and juvenile life stages of some of these species awaiting transport to back-barrier, bay, or mainland habitats. Barrier island flats typically are used by white mullet, longnose killifish, darter gobies, and inland silversides. Marsh edge and interior creeks are used by white and brown shrimp, Atlantic croaker, spotted seatrout, sheepshead minnow, killifish, and sand seatrout, some of which are constituents of assemblages that use the other island aquatic habitats (Foreman 1968; Zimmerman 1988).

Economically important fish species such as spotted seatrout, red drum, black drum, spotted seatrout, Gulf menhaden, striped mullet, and southern flounder, use barrier island habitats (e.g., shorelines and passes) for foraging areas, nursery habitat, and staging areas during spawning or associated migratory aggregations (Saucier and Baltz 1993). Additionally, young of the year red drum and mangrove snapper have a high affinity for quiescent intra-island creeks and ponds in the post larval early juvenile stages (Thompson 1988). Commercially and recreationally important species of shellfish include blue crab, white and brown shrimp, American oyster, and Gulf stone crab. The U.S. Environmental Protection Agency (1997) reports that the Barataria-Terrebonne estuarine complex generates more brown and white shrimp than any other zone in the state, and supports approximately 20 percent of the estuarine-dependent fishery resources of the United States.

Other finfishes and crustaceans expected to occur in the study area include gafftopsail catfish, Spanish mackerel, bull shark, ladyfish, Atlantic needlefish, Gulf killifish, fat sleeper, gobies, speckled wormeel, least puffer, Gulf pipefish, Atlantic spadefish, alligator gar, pink shrimp, seabob, roughneck shrimp, grass shrimp, mysid shrimp, and mud crab. Other invertebrates found in the study area include *Rangia* clam, jellyfish, and ctenophores.

Temperature and salinity govern the general patterns of estuarine use by fishes and macroinvertebrates (Day et al. 1989; Baltz and Jones 2003). Freshwater species are not expected to occur in the study area.

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act; P.L. 104-297) set forth a new mandate for NOAA's National Marine Fisheries Service (NMFS), regional fishery management councils (FMC), and other federal agencies to identify and protect important marine and anadromous fish habitat. The Essential Fish Habitat (EFH) provisions of the Magnuson-Stevens Act support one of the nation's overall marine resource management goals- maintaining sustainable fisheries. Essential to achieving this goal is the maintenance of suitable marine fishery habitat quality and quantity. Detailed information on Federally managed fisheries and their EFH is provided in the 1999 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico FMC. The generic FMP subsequently was updated and revised in 2005 and became effective in January 2006 (70 FR 76216). NMFS administers EFH regulations. Categories of EFH in the project vicinity include estuarine and marine areas. Estuarine categories include estuarine emergent wetlands, mangrove wetlands, submerged aquatic vegetation, and estuarine water column, mud, sand, and shell water bottoms. Marine areas include water column, non-vegetated bottoms, and continental shelf features. EFH has been designated within the study area for white shrimp, brown shrimp, pink shrimp, red drum, lane snapper, dog snapper, and Gulf stone crab managed by the Gulf of Mexico Fishery Management Council (GMFMC). In addition, the waterbodies and wetlands in the study area provide nursery and foraging habitats supportive of a variety of economically important fishery species, such as striped mullet, Atlantic croaker, Gulf menhaden, spotted and sand seatrout, southern flounder, black drum, and blue crab. Some of these species serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC.

Salinity conditions are primarily saline and the project areas usually do not contain submerged aquatic vegetation. Much of the open water has become established at the expense of the barrier shoreline and emergent marsh.

Wildlife Resources

Because of their permeable skin and the need for osmoregulation, amphibians are typically restricted to the less-saline areas that are located primarily in the upper portions of the Basin. Amphibians found in the lower basin where suitable freshwater pools may form include the green tree frog, squirrel treefrog, Gulf coast toad, and eastern narrow-mouthed toad (Dundee and Rossman 1989). Mabie (1976) indicates that the only species typically found in the Gulf salt marsh environment is the Gulf coast toad and little information is available on their distribution on the barrier islands. Dundee and Rossman (1989) report that the eastern narrow-mouthed toad has been found on sea beaches in southeastern Louisiana, as well as under boards in a salt marsh in Cameron Parish.

In saline marshes, reptiles are limited primarily to the salt marsh snake and the diamond-backed terrapin. Condrey et al. (1995) reports that coastal erosion and barrier island retreat directly threatens the diamond-backed terrapin. Sea turtles may seasonally utilize the bays and saline marshes adjacent to and including the Gulf and barrier island beaches.

Many mammals, because of their life history requirements, would not likely be found in the project area. The Coast 2050 Report (LCWCRTF and WCRA 1999) indicates an overall decline in furbearers that were historically present in the study area over the past 10 to 20 years. The bottlenose dolphin is the primary marine mammal that would likely be found in the study area, and then only in estuarine/marine open water portions of the area. However, the West Indian manatees are occasionally observed along the Louisiana Gulf coast. In addition, various species of whales have been documented in the offshore waters of the study area.

Birds are the most diverse group of terrestrial vertebrate species that can be found in the study area and include both resident and migrant species among the following groups: waterfowl, seabirds, wading birds, shorebirds, raptors, and songbirds. Avian use of existing wetlands within the study area varies, depending upon existing seasonal and environmental conditions.

The outer coast and barrier habitats are especially critical to migrating birds, such as songbirds, shorebirds, and waterfowl as they provide a place to land, recover, and feed. Trans-gulf migrants use the Terrebonne Basin barrier shoreline and surrounding areas as a staging area and as a final departure area for their fall migration as well as first landfall during spring migration. The study area is located within the Mississippi Flyway, which is the largest waterfowl migration route in North America. The 1986 *North American Waterfowl Management Plan* (Secretary, U.S. Department of the Interior and Canada Minister of the Environment 1986) identified the preservation and maintenance of critical over-wintering habitats as a key factor in preventing the further decline in the continental waterfowl population. The 2004 North American Waterfowl Plan outlined in *Strategic Guidance* (Secretary, U.S. Department of the Interior and Canada Minister of the Environment, Mexico Secretary of the Environment and Natural Resources 2004) renews the commitment to the 1986 Plan as well as providing goals, priorities, and strategies for the next 15 years.

The Coast 2050 Report (LCWCRTF and WCRA 1999) characterizes trends since 1985 for dabbling duck populations as steady in the open water and salt marsh habitat of the Isles Dernieres Shorelines but decreasing in the Timbalier Island Shorelines; diving duck population trends are reported as steady in both the open water and salt marsh habitat of the Isle Dernieres Shorelines and the Timbalier Island Shorelines. However, waterfowl are not historically present on the barrier shorelines.

Shorebirds such as the piping plover, semipalmated sandpiper, western sandpiper, curlew, ruddy turnstone, American avocet, oystercatcher, greater yellowlegs, common snipe, and killdeer are found within the study area. Shorebirds inhabit saline marsh, and shallow water/mud flat habitats of the barrier shorelines and surrounding estuary. Roosting habitats include beaches, sandbars, spits, or flats above high tide and shallowly flooded areas or islands free of vegetation (Helmers 1992). Many shorebird species are regular to accidental migrants, although some are common residents throughout the study area. Shorebird populations have been steady for the past 10 to 20 years in both the Isles Derniers and Timbalier Island portions of the study area, (LCWCRTF and WCRA 1999).

Seabirds including pelicans, gulls, terns, and skimmers are also found within and are known to nest on the project area barrier islands. Condrey et al. (1995) reported that most seabird species nest on islands because of their remoteness and lack of predators. Non-island breeding sites are more frequently abandoned by the seabird species that use them, in contrast to the barrier island sites, which tend to be used for 10 years or more. The Coast 2050 Report (LCWCRTF and WCRA 1999) indicates that since 1985 seabird populations have been steady within the salt marsh, open water, and barrier shorelines of both Timbalier and Isles Dernieres. There has been an overall increasing trend of brown pelicans within the Isles Dernieres reach since 1985. Raccoon Island harbors the largest brown pelican rookery in the state, as well as the greatest species diversity of nesting colonial waterbirds found on any barrier island in the state, while Wine Island hosts some of the largest brown pelican and colonial nesting waterbird rookeries in the state. In addition, LDWF is currently attempting to re-establish a brown pelican rookery on Whiskey Island.

Condrey et al. (1995) indicate that most colonies of wading birds (herons and egrets) are found in the swamp, although most species of wading birds will also nest on barrier islands and in almost any marsh, fresh to saline, where shrubs and mangroves are available. The Coast 2050 Report (LCWCRTF and WCRA 1999) characterizes wading bird population trends since 1985 as steady in the salt marsh and barrier beaches of the Isles Dernieres and Timbalier reaches.

During a 2008 survey conducted by the Louisiana Department of Wildlife and Fisheries (LDWF), approximately 44,771 nesting pairs of wading birds and seabirds were observed throughout the Isle Derniere chain. During a 2006 survey, LDWF observed approximately 1,265 nesting pairs of wading birds and seabirds along East Timbalier Island and Bayou Lafouche (Personal Communication Mike Carlos LDWF 2009).

Raptors are not typically or have not been historically present on the barrier shorelines and surrounding open water and salt marsh of the study area (LCWCRTF and WCRA 1999). The Coast 2050 Report (LCWCRTF and WCRA 1999) indicates that rails, coots, and gallinules have not been historically present on the barrier shorelines and have low numbers in the salt marsh habitat of the study area.

Because of their life history requirements, few other bird species are expected to inhabit the surrounding marshes and open water areas of the study area except to use them as temporary staging areas before and after trans-gulf migrations. The seaside sparrow is associated with the pounding surf and the densely matted grasses and sedges along the shorelines of Louisiana beaches with their nest placed often only a foot or so high in a mangrove bush (Lowery 1974). Where these species of birds exist in the study area populations have been steady (LCWCRTF and WCRA 1999).

Invasive Species

The nutria and the Norway rat are the primary invasive mammalian species that could occur throughout the study area. The nutria, however, is typically found in the freshwater swamps and marshes of the Barataria-Terrebonne estuary system which are located outside of the study area.

Eurasian collared-dove, English sparrow, and European starling are all potential invasive avian species that could be found in the study area.

No problems caused by encroachment of invasive plant species have been reported on Louisiana's barrier islands. This is likely due to the extreme environmental conditions, such as higher salinities, shifting substrates, and frequent storm disturbance that may severely limit suitability of the habitat for colonization.

Threatened and Endangered Species

Federally listed threatened (T) and endangered (E) species and/or their designated critical habitat occurring in the study area include the piping plover (T) and its designated critical habitat, and the West Indian manatee (E). Several species of threatened/endangered sea turtles are also known to forage in the coastal waters of the study area. Those species include the loggerhead sea turtle (T), Kemp's ridley Sea turtle (E), green sea turtle (T), leatherback sea turtle (E), and hawksbill sea turtle (E).

<u>West Indian Manatee</u>

Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

To avoid any impacts to that species the Service recommends the following measures be incorporated into all contracts for this project. All contract personnel associated with the project should be informed of the potential presence of manatees and the need to avoid collisions with manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. All construction personnel are responsible for observing water-related activities for the presence of manatee(s). Temporary signs should be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., work area), and at least one sign should be placed where it is visible to the vessel operator. Siltation barriers, if used, should be made of material in which manatees could not become entangled, and should be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions should be implemented, including: no operation of moving equipment within 50 feet of a manatee; all vessels should operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, should be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area on its own accord, special operating conditions are no longer necessary, but careful observations should be resumed. Care should also be taken to avoid entrapment of individuals if any structure is to be installed that could be a barrier or impediment to manatee movement. Any manatee sighting should be immediately reported to the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).

Piping Plover

Federally listed as a threatened species, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

On July 10, 2001, the Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers.

Based on the information that the Corps has provided to the Service regarding the subject project, the timing of construction between the islands (regardless of whether an island is in Phase I or II of the project) would likely affect the recovery time of benthic communities within the intertidal zones of those islands. Piping plovers feed upon benthic invertebrates and invertebrates found in organic material remaining after high tide events (i.e., wrack). The best available science indicates that benthic communities within the intertidal zones of barrier islands may take anywhere from 6 months to 2 years to fully recover, if there is a nearby source from which they can re-colonize an affected area. Because an entire island would be affected during one construction event, and because adjacent islands may undergo construction within 2 years or less, the ability of those islands to provide enough suitable foraging habitat to piping plovers will likely be affected until all construction is completed.

The Corps is responsible for determining whether the selected alternative is likely (or not likely) to adversely affect any listed species and/or critical habitat, and for requesting the Service's concurrence with that determination. If the Corps determines, and the Service concurs, that the selected alternative is likely to adversely affect listed species and/or critical habitat, a request for formal consultation in accordance with Section 7 of the ESA should be submitted to the Service. That request should also include the Corps' rationale supporting their determination.

Sea Turtles

The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species (i.e., Kemp's riddle and loggerhead sea turtles). Please contact Eric Hawk (727/824-5312) at the NMFS Regional Office in St. Petersburg, Florida, for information concerning those species in the aquatic environment. When sea turtles leave the aquatic environment and come onshore to nest, however, the Service is responsible for consultation. Consultation regarding nesting sea turtles should be conducted with this office.

The Kemp's ridley (*Lepidochelys kempii*) is an endangered sea turtle that occurs mainly in the coastal areas of the Gulf of Mexico and northwestern Atlantic Ocean. Juveniles and sub-adults occupy shallow, coastal regions and are commonly associated with crab-laden, sandy or muddy water bottoms. Small turtles are generally found in nearshore areas of the Louisiana coast from May through October. Adults may be abundant near the mouth of the Mississippi River in the spring and summer. Adults and juveniles move offshore to deeper, warmer water during the winter. Between the East Gulf Coast of Texas and the Mississippi River Delta, Kemp's ridleys use nearshore waters, ocean sides of jetties, small boat passageways through jetties, and dredged and nondredged channels. Kemp's ridley are not known to nest in Louisiana, however, their nesting range is apparently expanding. Major threats to this species include over-exploitation on their nesting beaches, drowning in fishing nets, and pollution.

Federally listed as a threatened species, loggerhead sea turtles (*Caretta caretta*) nest within the coastal United States from Louisiana to Virginia, with major nesting concentrations occurring on the coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida. In Louisiana, loggerheads have been historically known to nest on the Chandeleur Islands. Nesting and hatching dates for the loggerhead in the northern Gulf of Mexico are from May 1 through November 30. Threats to this species include destruction of nesting habitat and drowning in fishing nets. When loggerhead sea turtles leave the aquatic environment and come onshore to nest the Service is responsible for consultation. Accordingly, we recommend that you address potential impacts to this species within your Biological Assessment if your activities would occur on beach areas during the loggerhead nesting season.

Species of Special Interest

Brown Pelican

The proposed project would occur within an area that is known to be inhabited by nesting brown pelicans (*Pelecanus occidentalis*). That species was officially removed from the List of Endangered and Threatened Species on December 17, 2009. Brown pelicans nest in Louisiana from April through August. Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this breeding window could be altered based upon the dynamics of the individual colony. The Louisiana Department of Wildlife and Fisheries' Coastal and Nongame Resources Division (225/765-2811) should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies.

Brown pelicans are known to nest on barrier islands in Lafourche and Terrebonne Parishes. Current nesting locations within the project area include Raccoon Island and Wine Island. In spring and summer, nests are built in mangrove trees or other shrubby vegetation, although ground nesting may also occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

Although the brown pelican has been removed from the List of Endangered and Threatened Species, brown pelicans and their nests continue to be protected under the Migratory Bird Treaty Act (MBTA). To minimize disturbance to nesting colonies of brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this activity window could be altered based upon the dynamics of the individual colony. The Louisiana Department of Wildlife and Fisheries' Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. Brown pelicans are known to nest on barrier islands and other coastal islands in Lafourche and Terrebonne parishes.

Colonial Nesting Waterbirds

The proposed project would be located in an area where colonial nesting waterbirds are known to be present. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present).

2. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, exact dates may vary within this window depending on species present).

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season. Because of the extent of the proposed restoration project (i.e., entire and multiple island designs/phases) we understand that it may not be feasible to conduct all construction related activities outside of pertinent nesting seasons. The Service fully supports this restoration effort and is committed to working with your agency during project planning to resolve any potential conflicts that could occur as a result of migratory bird use of the proposed project area.

Refuges and Wildlife Management Areas

Terrebonne Barrier Islands Refuge (TBIR) consists of three barrier islands in the Isles Dernieres Chain. Wine Island, Whiskey Island, and Raccoon Island were acquired by LDWF in June of 1992 from Louisiana Land and Exploration Company via a 25-year free lease. The three islands comprise a total of approximately 630 acres, although the lease agreement covers several thousand acres of water.

The chain of islands that comprise the Isles Dernieres serves as permanent and migratory stopover habitat for shorebirds and passerine species (USEPA 1997). Of the numerous waterbird nesting colonies within the Terrebonne Basin barrier islands complex, the most significant are those found within the TBIR. Raccoon Island, which supports one of the greatest diversities of nesting and aquatic birds in North America, harbors the largest nesting colonies of brown pelicans in Louisiana and a significant colony of piping plovers (129 identified during winter census; Louisiana Coastal Wetlands Conservation and Restoration Task Force, 2006a). To the east, Whiskey Island currently contains nesting black skimmers and LDWF is attempting to re-establish a brown pelican rookery.

Management of Wine Island, on the eastern end of the Isle Derniere chain, was successfully reestablished in 1991 by the Louisiana Department of Natural Resources. Bird activity on the islands is monitored by Fur and Refuge Division staff from the Atchafalaya Delta, New Iberia, and Rockefeller Refuge. That island hosts some of the largest brown pelican and colonial nesting waterbird rookeries in the state.

Coastal Barrier Resource Act (CBRA)

Section 206.344 (c) Limitations on Federal Expenditures - This Section of the CBRA states that there would be Federal financial limitations to carry out "... any project to prevent erosion of, or to otherwise stabilize, an inlet, shoreline, or inshore area, except that such assistance and expenditures may be made available on units designated pursuant to Section 4 on the maps numbered S01 through S08 for purposes other than encouraging development and, in all units in cases where an emergency threatens life, land, and property immediately adjacent to that unit." (emphasis added)

Units S01 through S08 extend from Bastian Bay in Plaquemines Parish to Cheniere Au Tigre in Vermilion Parish. Since the intent of coastal restoration projects is not to encourage development, all such restoration projects in units S01 through S08 would be exempt from the limitations of the CBRA, and therefore, eligible for Federal expenditures.

EVALUATION METHODOLOGY

Evaluation of project-related impacts on fish and wildlife resources was aided by use of the Wetland Value Assessment (WVA) methodology developed for the evaluation of proposed Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects (LCWCRTF 2006b). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for future without-project (FWOP) and future with-project (FWP) conditions. The Barrier Island Community Model was used for this project. Instead of the species-based approach of HEP, this model utilizes an assemblage of variables considered important to the suitability of a given habitat type for supporting a diversity of fish and wildlife species. As with HEP, this model allows a numeric comparison of each future condition and provides a combined quantitative and qualitative estimate of project-related impacts to fish and wildlife resources.

WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each habitat type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Indices) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

The WVA methodology was initially developed in 1991 by the CWPPRA Environmental Work Group (LCWCRTF 2006b). Initially, emergent marsh habitat models were developed for fresh, intermediate, brackish and saline marsh types. Subsequently, models were also developed for swamps, barrier islands, barrier headlands, and coastal forested ridges. The habitat variable-habitat suitability relationships within the WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources. The barrier island WVA model consists of seven variables: 1) percent of the total subaerial area that is classified as dune habitat; 2) percent of the total subaerial area that is classified as supratidal habitat; 3) percent of the total subaerial area that is classified as intertidal; 4) percent vegetative cover of dune, supratidal, and intertidal habitats; 5) percent vegetative cover by woody species; 6) degree of marsh edge and interspersion; and 7) beach/surf zone features.

Using the WVA methodology, impact assessments were conducted by the Habitat Evaluation Team (HET), which included representatives of the Service, BEM Systems, and SJB Group. To assess impacts the HET used Storm-induced BEAch CHange (SBEACH) model and GENESIS model outputs, surveys, shoreline erosion and marsh loss data, knowledge of the area, experience with similar projects, CWPPRA project data, the previous LCA Barrier Island study (January 2003), field inspections conducted during July 2009, and Digital Ortho-quarter Quadrangle aerial photographs.

Those elements were used in conjunction with the above-discussed mathematical models to compute an HSI value for each target year (TY). Target years were established when significant changes in habitat quality or quantity were expected during the 50-year project life, under FWP and FWOP conditions.

The product of an HSI and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the project life to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

Twelve alternatives (including the no action alternative) were included within the final array for the TBBSR project (see Table 1).

Table 1. Final Array of Alternatives.

Alternative	Plan	Description
Alternative 1	no action	
Alternative 2	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 3	Whiskey Plan C	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 4	Whiskey Plan C	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Trinity Plan C	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 5	Raccoon w/TG Plan E	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss and construction of a terminal groin on the western end
	Whiskey Plan C	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Trinity Plan C	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss
	Timbalier Plan E	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
Alternative 6	Raccoon Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function

Alternative	Plan	Description
Alternative 7	Raccoon w/BW Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function along with construction of 8 breakwaters on the western end
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function
Alternative 8	Raccoon w/TG Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function along with construction of a terminal groin on the western end
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function
Alternative 9	Raccoon Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Timbalier Plan B	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function
Alternative 10	Raccoon Plan B	Restoration of Raccoon Island to its minimal geomorphologic form and ecologic function
	Whiskey Plan B	Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function
	Trinity Plan B	Restoration of Trinity Island to its minimal geomorphologic form and ecologic function
	East Plan B	Restoration of East Island to its minimal geomorphologic form and ecologic function
	Wine Plan B	Restoration of Wine Island to its minimal geomorphologic form and ecologic function
	Timbalier Plan B	Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function
	East Timbalier Plan B	Restoration of East Timbalier Island to its minimal geomorphologic form and ecologic function

The initial WVA analysis was completed on all alternatives within the final array under the low sea level rise (SLR) scenario. As requested by the Corps, additional WVAs were later run to quantify impacts to those alternatives under the intermediate and high SLR scenarios. A combined total of 39 WVA evaluations were completed.

The Project Information Sheet (including assumptions used by the HET) and the WVA summary sheet for the LCA-TBBSR project are presented in Appendix A and B, respectively. The complete WVA analysis can be obtained from the Service's Lafayette, Louisiana Ecological Services Office upon request.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

Barrier island systems provide protection to the wetlands, bays, and estuaries behind them and help reduce wave energy at the margins of coastal wetlands, thereby limiting erosion (Williams et al. 1992) and tropical storm impacts. As such, barrier island systems are key geomorphic structures that help sustain other coastal habitats, particularly the interior coastal marshes and swamps, by reducing marine influences and tropical storm impacts. These island systems also serve as essential habitat for many terrestrial and aquatic species, including federally listed threatened and endangered species (USACE 2004a).

In Louisiana, barrier island erosion is attributable to shoreline erosion, insufficient volumes of sediment supplied by littoral currents, increasing tidal prism, land subsidence, sea-level rise, storms, and human impacts (Boesch 1982). Significant shoreline erosion and interior marsh loss has occurred within the TBBSR study area. The historic rates of land loss for Louisiana's barrier islands are varied, and can average as high as 50 acres per year, over several decades. Hurricane events can push the rate of land loss to greater than 300 acres per year (USACE 2004a).

The long-term area change of the Isles Dernieres was 8,724 acres in 1887 to 1,879 in 2002. After Hurricane Andrew in 1992 the Isles Dernieres decreased to 1,267 acres by 1993. The long-term rate of area change between 1887 and 2002 was -62.3 ac/yr or a total decrease of -82.2%. The 1988–2002 area rate decrease was -25.0 ac/yr or a -18.4% decrease. The long-term (1887–2002) and short-term (1988–2002) calculated disappearing dates were 2034 and 2075, respectively. McBride et al. (1992) predicted the long-term and short-term disappearance dates at 2015 and 2004 for 1887–1998 and 1978–1988, respectively. However, the 2002 LCA historical area data for the Isles Dernieres extends the long-term and short-term disappearance dates by 60 years and 30 years respectively (USACE 2004b).

Historically, the areas of the Timbalier Islands have undergone significant negative and positive areal rate changes. Between 1887 and 1934 the area of the Timbalier Islands decreased from 4,142 acres (ac) to 2,875 ac at a rate of -27.0 ac/yr. Between the next two periods, 1934–1955 and 1956–1978, the Timbalier Islands increased from 2,875 ac to 3,280 ac and then to 3,693 ac at a rate of + 18.8 ac/yr respectively. This was a period of extensive backbarrier canal dredging and dredge spoil placement to support oil and gas development that inadvertently increased the area of the Timbalier Island areas. The large decrease in the area between 1978 and 1988 is a function of the extension of the Belle Pass jetties to the east and the disruption of the dominant longshore sediment transport to the west. The combination of a diminishing sediment supply and hurricanes between 1988 and 1996 continued to drive island barrier loss between 1996 and 2002 (USACE 2004b).

The continued loss of the barrier shoreline habitat and the accompanying trend toward higher salinities typically leads to lower biodiversity and long-term productivity. Marshes will continue to deteriorate and convert to open water, leaving scattered fragments of marsh and sandy shoals. Fish and wildlife habitat quality will decrease as the barrier shoreline continues to erode and islands breakup or disappear. Increased stress on the fish and wildlife is expected as various fish and wildlife breading, nesting, nursery, feeding, roosting, or overwintering habitats continue to be lost. Habitat for endangered species would be further degraded and/or reduced. The LCA Study (USACE 2004a) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year over the next 50 years. The LCA Study also estimated that an additional net loss of 328,000 acres might occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands. Land loss along Terrebonne Basin Barrier Shoreline would likely continue at rates similar to present resulting in the projected loss of 2,811 acres of barrier island soils by 2062.

Fisheries Resources

Baltz et al. (1993) reports that salinity and proximity to the marsh edge strongly determines the distribution of most fishes, and the abundance of fishes declines dramatically with distance from marsh edge. Intertidal marsh grass stems provide cover for juvenile fishes and adults of smaller species, as well as substrate for epiphytes and epifauna, which small fishes consume. Larger predatory fishes, such as spotted seatrout and red drum, forage along the marsh edge for small fishes, blue crab, and shrimp. Fishes that live in the open water of estuarine bays, such as bay anchovy and Gulf menhaden, gain refuge from sight-feeding predators in the turbid water. Those prey species are typically filter feeders, which eat zooplankton and phytoplankton. Demersal fishes, such as flounders and gobies, live in proximity to the bottom, and are typically indistinguishable from the substrate. The deterioration of emergent wetlands may temporarily benefit some estuarine-dependant fisheries, but an eventual decline in productivity will result as detrital input and marsh-edge habitat are significantly reduced via conversion to open water (Turner et al. 1982).

It is likely that the wetlands of the basin have deteriorated beyond the most productive stage for estuarine-dependant fisheries, and that they will continue to experience loss (and decreased habitat quality) under FWOP conditions. Along with the disappearance of estuarine marsh nursery areas, the continual disappearance of the barrier shorelines and their surrounding estuarine marshes in the study area will substantially contribute to the on-going decline of fishery resources. The loss of barrier island marsh will eliminate nursery habitat for many species of young-of the year estuarine marine fish and macroinvertebrates that move inland to mainland marshes. In addition, high-energy beach habitat utilized by some species as a nursery ground will be lost causing those species to decline. The Coast 2050 report (LCWCRTF and WCRA 1999) estimates that red and black drum, spotted seatrout, Gulf menhaden, southern flounder, white and brown shrimp, and blue crab will continue a decreasing population trend into the future in and around the barrier islands of the study area.

Wildlife Resources

Little, if any, information exists regarding population status and trends of reptiles and amphibians in the study area. According to the Barataria Terrebonne National Estuary Program (BTNEP) (Industrial Economics, Inc. 1996), over-harvesting and the loss of habitat, both within and outside the Barataria-Terrebonne estuary, threatens turtle populations. Over-harvesting and habitat loss threaten the snapping turtle, while coastal erosion and barrier island retreat directly threaten the diamond-backed terrapin.

The Coast 2050 Plan (LCWCRTF and WCRA 1999) indicates that nutria, muskrat, mink, otter, raccoon, rabbits and deer are no longer present on the Timbalier Island Shorelines; habitat for those species was not historically present within the Isles Dernieres Shorelines. In addition, that plan indicates that seabird populations within the study area salt marshes are steady, but are projected to decline through 2050. Waterfowl, wading birds, shorebirds, rails, coots, and gallinules are also expected to decrease by the year 2050 (LCWCRTF and WCRA 1999), as habitat continues to decline. Habitat quality for wildlife is expected to decline as the barrier shoreline in the study area continues to deteriorate and convert to open water under FWOP conditions.

Threatened and Endangered Species

The fate of the piping plover may be influenced by the habitat conditions of Louisiana's barrier islands, which support foraging, roosting, and sheltering needs of the piping plover. Many of Louisiana's barrier islands are used by the piping plover for their wintering habitat, and they may be present for 8 to 10 months annually from late July to late March or April. Activities that disrupt or reduce the birds' foraging efficiency hinders their ability to build-up fat reserves for migration. As barrier islands degrade, so declines those habitat components that support the piping plover's wintering critical habitat; thus, creating increased competition for the scarce coastal resources. Regardless of the efforts of the ESA, if the piping plover's wintering critical habitat in coastal Louisiana continues to decline unabated the species may continue to be negatively affected. In addition, as barrier shorelines continued to deteriorate and be lost the characteristics of the nearshore waters and bays are expected to change, thus potentially impacting sea turtle foraging areas.

The West Indian manatee will not likely be affected by the continued deterioration of the Louisiana coastal barrier shorelines, as their habitat needs are not dependent on those land features. Manatees, however, could possibly be present at the project sites. In the event that this species is observed in any part of the project area during construction or operation, the Corps should contact the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).

Species of Special Interest

The brown pelican, formerly protected under the ESA is now protected under the MBTA, and has recently recovered from very low populations experienced over the last three decades. The Coast 2050 Plan predicts that populations within the Timbalier Island Shoreline will remain steady, while population are expected to increase within the Isles Dernieres Shoreline primarily from efforts of the ESA and restoration efforts on the TBIR.

DESCRIPTION OF NATIONAL ECOSYSTEM RESTORATION PLAN

Alternative 5 - Raccoon with Terminal Groin (Plan E)/Whiskey (Plan C)/Trinity (Plan C)/Timbalier (Plan E) was selected as the National Ecosystem Restoration (NER) Plan because it is a "Best Buy" plan that fulfills the projects planning objectives. This alternative restores the geomorphologic form and ecologic function of four islands in the Terrebonne Basin barrier system by creating a total of 3,048 acres of beach/dune habitat and 2,002 acres of marsh habitat. The creation of dune, supratidal, and intertidal habitats will provide essential habitats for fish, migratory birds, and other terrestrial and aquatic species. Furthermore, by using the proposed borrow areas, the project would increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline by mechanically introducing compatible sediment, and increasing the ability of the restored area to continue to function and provide habitat with minimal continuing intervention. The NER plan also represents a system-wide and cost effective approach of restoring as many islands within the Terrebonne Basin barrier system which are constructible with cleared sediment sources. Due to funding limitations and the risk of losing authorization, however, Alternative 5 has not been designated as the tentatively selected plan (TSP).

Restoration of ecologic function of the barrier islands includes vegetating both the restored dunes and back barrier marsh platforms with native plants, to provide wetland habitat for a diverse number of plant and animal species and to help retain sediment. Geomorphologic form and ecologic function were defined through analysis of historic planforms and elevations and storm erosion modeling such that the restored island retains this form and function after being subjected to selected design storms. The design storms that were used in template development included a hypothetical 50-year storm as well as the varying intensities, durations, and approach paths of Hurricanes Katrina and Rita, which occurred in 2005, and Hurricanes Gustav and Ike, which occurred in 2008. The minimum design plan consists of a beach/dune component and a marsh component.

Plan B Design (minimum design plan for geomorphologic form and ecologic function)

1. Beach and Dune Restoration

   Based on SBEACH simulations that were performed on an array of various restoration plans, the following design criteria for Plan B were derived:

   - Gulf-side beach width: 250 feet,
   - Beach elevation: 3.8 feet NAVD88,
   - Dune width:100 feet
   - Dune elevation: 6.0 feet NAVD88, and
   - Bay-side beach width: 100 feet.

2. Marsh Restoration

The marsh serves as a roll over platform as the islands migrate landward. Based on the post storm observations from the recent historic storms, there is evidence to suggest that the back barrier marsh width needs to be on the order of 1,000 feet to capture overwash sediments during episodic events; sediment that would otherwise be carried into back bay areas to form shoals or be lost into deeper waters. Cross-shore sediment transport models (e.g., SBEACH) tend to underestimate the extent of overwash. Examination of vertical aerial photographs of the Texas coast, made following Hurricane Ike, show areas of overwash extending from 800 to 1,300 feet inland (Ewing 2009). An extensive study of overwash on the Caminada-Moreau Headland by Ritchie and Penland found that, for much of the low shoreline, overwash penetrated from 700 to more than 1,000 feet beyond the beach (Ritchie and Penland 1989). Examination of the aerial photographs in Williams et al. (1992) show overwash areas extending to 1,300 feet on Timbalier Island and greater than 700 feet on East Island. Personal observations by various PDT members support planning for a minimum marsh width of 1,000 feet. Therefore, 1,000 feet was defined as the design criteria for the minimized restoration template for the marsh platform width.

Based on similar Louisiana barrier island restoration plans, the average healthy marsh elevation, defined as the target elevation for the marsh platform, is typically within +/- 0.1 feet of Mean High Water (MHW). MHW for the project area is approximately 1.6 feet NAVD88 and was defined as the design criteria for the minimized design plan for the marsh platform elevation.

Plan C, D, and E Design

Plans C through E are scalars of Plan B that incorporate incremental increases in the scales of beach, dune and marsh planforms and elevations to provide plan formulators the ability to determine the optimal increment for restoration of the geomorphologic form and ecologic function of these islands. The optimal level of restoration is defined as the best balance of environmental benefits (e.g., habitat acres), constructability as constrained by available sediment volumes in identified borrow sources, and cost effectiveness. Plan C provides for the minimal geomorphologic form and ecologic function on each island along with 5 years of background erosion/land loss. Plan D provides for the minimal geomorphologic form and ecologic function on each island along with 10 years of background erosion/land loss. Plan E provides for the minimal geomorphologic form and ecologic function on each island along with 25 years of background erosion/land loss.

Alternatives 5 and 8 propose a terminal groin on Raccoon Island to address erosion along the western portion of that island. The terminal groin would be constructed perpendicular to the shoreline at the western end of the island and is designed to trap longshore sediment transport. In addition, Alternative 7 proposes eight segmented breakwaters along the western end of that island. The main function of those breakwaters would be to trap sand by reducing wave energy behind the structure, therefore slowing littoral drift and creating a salient or tombolo behind the structure.

EVALUATION OF NATIONAL ECOSYSTEM RESTORATION PLAN

The WVA analyses indicate that the NER for TBBSR would result in net gains in the quality and quantity of barrier island habitats of 426 AAHUs under Raccoon with Terminal Groin (Plan E), 379 AAHUs under Whiskey (Plan C), 387 AAHUs under Trinity (Plan C), and 871 AAHUs under Timbalier (Plan E), for a total net gain of 2,063 AAHUs compared to the future without-project conditions (under the intermediate sea level rise scenario).

Project-related benefits would occur through the creation of dune, supratidal, and intertidal barrier island habitats. The newly created barrier shoreline would provide more sediment to the system, combat subsidence, and increase nutrients available to the area. In addition, the area would be less susceptible to breaching and increased erosion, reduce wave fetch from previously breached islands and broken marsh, and reduce the amount of back barrier marsh converting to open water.

DESCRIPTION OF TENTATIVELY SELECTED PLAN

As discussed above, the NER plan was the most appealing selection for the TSP because it was a "Best Buy" that fulfills the planning objectives of the project. The plan also represents a system-wide and cost effective approach of restoring as many islands within the Terrebonne Basin barrier system which are constructible with cleared sediment sources. Because the NER plan (Alternative 5) cannot be constructed within the currently authorized cost cap, a subset of the NER plan is recommended as the TSP.

In order to select the TSP from the NER plan, the PDT performed additional cost refinements on each island in the TSP. Those refinements inflated the costs of the islands, leaving Trinity Island Plan C and Whiskey Island Plan C (Alternative 11) as the only islands plans within the NER that could be constructed within the budget. Consequently, a separate screening process was conducted on the two islands to select the most appropriate island for the TSP.

Although Whiskey Plan C provides slightly fewer AAHUs than Trinity Island Plan C (379 AAHUs vs. 387 AAHUs), it was selected as the TSP due to a number of qualitative benefits provided by the plan. For example, Whiskey Plan C was designed to avoid approximately 286 acres of existing mangroves on the island in order to minimize the ecologic impact during construction. Since the island is considered a valuable wildlife habitat (included within the TBIR) and the LDWF is reestablishing a pelican rookery on the island, maintaining adequate areas of healthy beach, dune, and marsh is particularly important. The island also contains critical habitat for the threatened piping plover and is a valuable stopover area for migratory birds.

Furthermore, Whiskey Plan C was designed to complement TE-50, which is an existing CWPPRA project that was constructed in 2009. TE-50 created approximately 316 acres of intertidal back-barrier marsh between the two existing mangrove stands. Restoration of the beach and dune gulfward of TE-50 will help to protect the existing CWPPRA investment.

The barrier islands provide a critical component of the estuary structure, and are the first line of defense against marine and weather influences. Whiskey Island is the closest of the seven barrier islands to the critical marsh habitat located in the southern-most portion of Terrebonne Parish. If the island were to disappear, the marsh habitat on the mainland would be susceptible to the direct impacts of tropical storms and hurricanes.

EVALUATION OF TENTATIVELY SELECTED PLAN

Because Alternative 11 is a subset of the NER, implementation of that alternative would result in similar benefits as expected under Alternative 5, but to a lesser degree. The WVA analyses indicate that Whiskey (Plan C) for TBBSR would result in a net gain of 379 AAHUs in the quality and quantity of barrier island habitats compared to the future without-project conditions (under the intermediate sea level rise scenario).

While much of the constructed acreage created under the TSP is projected to disappear by the end of the period of analysis (i.e., 50 years), the net effect of the plan would be to prevent the loss of Whiskey Island. If no actions are taken, the remaining 820 acres of the island is expected to disappear by 2042 (i.e. all dune, supratidal, and intertidal habitat will be gone); this includes the existing crucial mangrove habitat and the back-barrier marsh created by CWPPRA Project TE-50. The majority of this loss would be prevented with implementation of the TSP.

As a result of the TBBSR project, there is a substantial improvement in terms of resource sustainability within the project area provided under the TSP compared to the future without project conditions. The TSP also meets the restoration objectives of restoring the geomorphic form and ecologic function on Whiskey Island and of restoring and improving essential habitats for fish, migratory birds, and other terrestrial and aquatic species for the 50-year period of analysis.

The restoration of the Whiskey Island would alter the tidal prism, thereby reducing the formation of any additional tidal passes as well as closing or narrowing existing passes and breaches, protecting and preserving the interior marsh habitats which would quickly erode without the protection of the sand shoreline. In addition, the TSP would: 1) increase the sustainability of the barrier island shoreline system; 2) help restore the geomorphic function of the barrier shoreline; 3) create and restore shoreline, dune, and back-barrier marsh, which would be stabilized with vegetative plantings and sand fencing; 4) reduce wave and tidal energies and salinities from the Gulf by providing a natural storm protective buffer for interior marsh; and 5) provide some degree of storm surge protection.

PROJECT IMPACTS

Whiskey Plan C proposes a dune height of +6.4 feet NAVD 88 with a dune crown width of 100 feet. The dune elevation takes into account that there will be approximately 0.4 feet of vertical adjustments (eustatic sea level change, subsidence, and compaction) occurring during the first six months after construction. At the end of the six-month period, the dune is expected to reach the design elevation of 6 feet NAVD 88. The slopes of the beach and dune are set 60:1 and 30:1 (horizontal to vertical), respectively.

The marsh fill is proposed on the landward side of the dune at an elevation of +2.4 feet NAVD 88. Although the design elevation for the marsh is 1.6 feet NAVD 88, the marsh will be constructed at a higher elevation to account for initial vertical adjustments. Approximately 622 acres of beach/dune and 110 acres of marsh will be created, resulting in a total of 732 acres.

Whiskey Plan C was designed to avoid approximately 286 acres of existing mangroves on the island to minimize the ecologic impact during construction. Plan C was also designed to complement TE-50, which is an existing CWPPRA project that was constructed in 2009. TE-50 created approximately 316 acres of intertidal back-barrier marsh between the two existing mangrove stands.

The TSP will utilize beach/dune material from the Ship Shoal borrow area and marsh material from the Whiskey 3a borrow area. Fill quantities for the dune/beach and marsh components of Whiskey Plan C are 8.3 million and 0.6 million cubic yards, respectively. For the dune area, the material will be pumped from the dredge to the beach. The material will then be worked on the beach by bulldozers and front-end loaders. For the marsh area, the material will be pumped from the offshore borrow site. Containment dikes will be constructed around the perimeter. Sediment for the containment dikes will be dredged from existing material inside the marsh creation area. These operations will be completed in a manner that will minimize turbidity of the water at the dredge site and the discharge site.

Approximately 18,075 feet of sand fencing will be installed. The sand fences are porous barriers that reduce wind speed along the coast such that sand being transported by the wind accumulates on the downwind side of the fence. The sand fences will promote deposition of windblown sand, create dune features, reduce trampling of existing dunes by beach visitors, and protect vegetative plantings. Vegetative plantings will include a variety of native species. The recommended planting density is no greater than 8-foot centers.

Fisheries Resources

Implementing Alternative 11 (TSP) would restore a total of 1,272 acres of shallow open water and fragmented barrier habitats to higher quality and more continuous transitional barrier habitats. This increase in barrier habitat acreage would provide important habitat for foraging, breeding, spawning, and cover for a variety of larval, juvenile, and adult fishes. In addition, a localized increase in biodiversity and some fish populations would be expected by the net increase of emergent wetlands constructed by Alternative 11 compared to under the future without project scenario. More nutrients and detritus would be added to the food web, thereby increasing fish productivity and providing a benefit to local fisheries.

Wildlife Resources

Alternative 11 (TSP) would restore and rehabilitate dune, supratidal and intertidal vegetated coastal barrier habitats and reduce conversion of these habitats to open water habitat. Benefits of implementing Alternative 11 (TSP) would include an increase in essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, and other life requirements; an increase in vegetative growth and productivity; and a reduction in inter- and intra-specific species competition between resident and non-resident wildlife species for limited coastal vegetation. In addition, important stopover habitats used by migrating neotropical birds would be restored and sustained for future use over the 50-year period of analysis and habitat used by piping plovers may be increased by the implementation of the TSP.

SERVICE PREFERRED ALTERNATIVE

The coastal barrier island chains in Louisiana are the first line of defense for protecting wetlands, inland bays, and mainland regions from the direct effects of wind, waves, and storms. The barrier system serves multiple defensive purposes which include: reducing coastal flooding during periods of storm surge; preventing direct contact with ocean waves, which would accelerate erosion and degradation of marshes and other wetlands; and helping to maintain gradients between saline and fresh water, thereby helping to preserve estuarine systems. Without ecologic restoration large-scale change would occur within the project area due to the encroachment of the Gulf into the coastal wetlands. Rebuilding Whiskey Island will help protect interior marsh and bays from the intrusion of the Gulf and downdrift shoreline habitats from further deterioration by helping to maintain the salinity gradients, temporarily preventing further disruption to the hydrology of the esturary, and by adding sediment to the system.

The TSP is a component of a comprehensive strategy to sustain the wetlands and associated fish and wildlife productivity of the Terrebonne Basin. The restoration of barrier island habitats would help reduce the decline in fish and wildlife habitat quality and detrital production over time. Though the TSP would provide for many needed benefits, those benefits would be more substantial under a multiple island ecosystem approach.

The proposed NER addresses habitat restoration on Raccoon, Whiskey, Trinity, and Timbalier Islands. During the alternative screening process, the PDT discussed potential restoration options on five islands within the Isles Dernieres Reach (including Wine Island) and on two islands within the Timbalier Reach. One option that was developed specifically for Wine Island included placing beach compatible sand within the existing rock revetment locally known as the Wine Island Ring; that "ring" would serve as the containment for the dredged sediment. The small area of the island precludes differentiation of beach, dune, and marsh. Rather, the fill material would be graded and planted with dune-stabilizing vegetation, to prolong sediment retention and provide additional habitat for nesting birds.

Based on the results of the USACE Institute for Water Resource's Planning Suite (IWR) screening run, the above described Wine Island alternative was not included within the most cost-effective "Best Buy" plans. The input parameters for the IWR screening tool, however, are habitat and cost based; qualitative benefits associated with important foraging, nesting, and roosting areas for federal trust resources are not incorporated. Because Wine Island harbors one of the largest brown pelican and colonial nesting waterbird rookeries in the state and is included within the TBIR, the Service recommends that the Corps take into account those qualitative benefits when assessing cost-effectiveness and consider including the subject Wine Island design into the NER plan.

Considering the immediate need for restoration in the area, the Corps and OCPR believe it is in the best interest of the Terrebonne Basin barrier system to proceed with Whiskey Island (Plan C) which would build a foundation for future authorizations and programs that may complete the ultimate project goals. While the Service agrees, we believe that to better meet the project goal of sustaining and improving habitats for migratory and native species for the 50 year project life within the Terrebonne Basin, the NER plan (including the Wine Island design) would be the optimal choice. The NER plan plus Wine Island design better meets the goals and objectives of the 2004 LCA Plan to address critical near-term needs for shoreline restoration for Terrebonne Basin through simulating historical conditions by enlarging the barrier islands (width and dune crest) and reducing the current number of breaches to ensure the continuing geomorphic and hydrologic form and function on multiple barrier islands via an ecosystem approach to restoration. Accordingly, the Service would prefer to see the NER plus Wine Island selected as the TSP.

FISH AND WILDLIFE CONSERVATION AND MITIGATION MEASURES

Barrier islands are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Because of the Services' close coordination with the USACE on this project, and because the project is expected to have an overall benefit to the LCA-TBBSR study area, the Service has no conservation measures to offer at this time.

SERVICE POSITION AND RECOMMENDATIONS

The TSP will benefit the fish and wildlife resources of the Terrebonne Basin by creating and nourishing a barrier island and back barrier marsh. The Service will support further planning of the proposed project provided that the following fish and wildlife recommendations are included in the feasibility report and related planning and authorizing documents and are implemented concurrently with project implementation:

1. The Service, NMFS, and LDWF should be provided an opportunity to review and submit recommendations on future detailed planning reports and the draft plans and specifications on the Terrebonne Basin Barrier Shoreline Restoration Project addressed in this report.

2. Consultation should continue with the Service and NMFS on detailed contract specifications to avoid and minimize potential impacts to piping plover and their critical habitat, manatees, sea turtles, and migratory birds.

3. Avoid adverse impacts to nesting waterbird colonies through careful design project features and timing of construction. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, exact dates may vary within this window depending on species present). For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present). Prior to any such work, surveys

should be conducted by qualified personnel during the colonial seabird nesting season to determine the presence and location of any such colonies. In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season. Because of the extent of the proposed restoration we understand that it may not be feasible to conduct all construction related activities outside of pertinent nesting seasons. Should those activities overlap with colonial nesting waterbird nesting seasons further coordination with this office will be necessary.

4. To minimize disturbance to nesting colonies of brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Prior to construction activities, surveys should be conducted by qualified personnel during the brown pelican nesting season to determine the presence and location of any such colonies. In addition, we recommend that on-site contract personnel be informed of the need to brown pelicans and their nests, and should avoid affecting them during the breeding season. Because of the extent of the proposed restoration we understand that it may not be feasible to conduct all construction related activities outside of pertinent nesting seasons. Should those activities overlap with the brown pelican nesting season further coordination with this office will be necessary.

5. If the proposed project has not been constructed within 1 year or if changes are made to the proposed project, the Corps should re-initiate Endangered Species Act consultation with the Service.

6. The newly created barrier island and back-barrier marsh, as well as the surrounding habitats that may be indirectly benefited by long-shore transport and sediment overwash, should be monitored over the project life for effectiveness and the results should be provided to all resource agencies. Development of those monitoring plans should be coordinated with all natural resource agencies.

7. All dredge material containment features should be breached or degraded, if necessary to restore tidal connectivity, once the marsh creation/nourishment areas have at least 80% coverage of emergent vegetation.

8. The Service recommends that the Wine Island "Rock Ring" alternative be re-analyzed for potential inclusion in the NER plan.

9. If authorized funding limits for this project are increased the Service recommends that the NER plan (with Wine Island design if feasible) be reconsidered as the potential future TSP.

10. If additional dollars become available for constructing further increments of the NER plan, the Service recommends that the Corps fully coordinate with the natural resource agencies in prioritizing restoration of those islands contained within the NER plan that are not within the TSP.

LITERATURE CITED

Baltz, D. M. and R. F. Jones. 2003. Temporal and spatial patterns of microhabitat use by fishes and decapod crustaceans in a Louisiana estuary. Transactions of the American Fisheries Society. 132:662-678

Baltz, D.M., C. Rakocinski, and J.W. Fleeger. 1993. Microhabitat use by marsh-edge fishes in a Louisiana estuary. Env. Biol. Fish. 36:109-126.

Barras, J.A., 2009, Land area change and overview of major hurricane impacts in coastal Louisiana, 2004-08: U.S. Geological Survey Scientific Investigations Map 3080, scale 1:250,000, 6 p. pamphlet.

Boesch , D. F., ed. 1982. Proceedings of the conference on coastal erosion and wetland modification in Louisiana: causes, consequences, and options. U.W. Fish and Wildlife Service, Biological Services Program, Washington, D.C. FWS/OBS-82/59. 256 pp.

Condrey, R., P. Kemp, J. Vesser, J. Gosselink, D. Lindsted, E. Melancon, G. Peterson, and B. Thompson. 1995. Status, trends, and probable causes of change in living resources in the Barataria and Terrebonne Estuarine systems. BTNEP Publ. No. 21, Barataria-Terrebonne National Estuary Program, Thibodaux, LA. 434 pp.

Day, J. W., C. A. S. Hall, W. M. Kemp, and A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley & Sons, New York. 558 pp.

Dundee, H.A., and D.A. Rossman. 1989. The amphibians and reptiles of Louisiana. Louisiana State University Press, Baton Rouge. 300 pp.

Ewing, L. et al. 2009. "Field investigation of Hurricane Ike impacts to the upper Texas coast," Shore & Beach, 77(2).

Foreman, W.W. 1968. The ecology of the Cyprinodontidae (Pisces) of Grand Terre Island, Louisiana. M.S. thesis, Louisiana State University, Baton Rouge. 116 pp.

Helmers, D.L. 1992. Shorebird management manual. Western Hemisphere Shorebird Reserve Network, Manomet, MA. 58 pp.

Industrial Economics, Inc. 1996. Economic value assessment for the Barataria-Terrebonne Estuarine System. BTNEP Publ. No 26. Prepared by the Industrial Economics, Incorporated, Cambridge, MA, for the Barataria-Terrebonne National Estuary Program, Thibodaux, LA.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006a. Louisiana Coastal Wetlands Planning, Protection and Restoration News: The Paradox of Plenty – Does Today's Bounty Herald Tomorrow's Collapse. Louisiana Coastal Wetlands Planning, Protection and Restoration News. June 2006, Number 31.

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 2006b. Coastal Wetlands Planning, Protection, and Restoration Act - Wetland Value Assessment Methodology: Procedural Manual. Environmental Work Group. 23 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1999. Coast 2050: Toward a sustainable coastal Louisiana, The appendices. Appendix D—Region 2 Supplemental Information. Louisiana Department of Natural Resources. 170pp.

Lowery, G.H., Jr. 1974. Louisiana birds. Louisiana State University Press, Baton Rouge. 651 pp.

Mabie, D.A. 1976. Chapter 8 Wildlife pages 96-109 In Conner, W.H. and J.W. Day, Jr.,(eds.). 1987. The ecology of Barataria Basin, Louisiana: an estuarine profile. U.S. Fish Wildl. Serv. Biol. Rep. 85 (7.13). 165 pp.

McBride RA, Penland S, Hiland, Mattheson W, Williams, Westphal KA, Jaffe BE, and Sallenger AH, Jr. 1992. Analysis of barrier shoreline change in Louisiana from 1853 to 1989. In: Williams SJ, Penland S, and Sallenger AH, Jr. , editors

Penland S., and Suter JR. 1988. Barrier Island Erosion and Protection in Louisiana: A Coastal Geomorphological Perspective. Gulf Coast Association of Geological Societies Transactions, 38:315-322.

Penland, S., P. F. Connor Jr, A. Beall, S. Fearnley, and S. J. Williams. 2005. Changes in Louisiana's shoreline: 1855–2002. Journal of Coastal Research Special Issue No. 44: 7–39.

Ritchie, W. & Penland, S. 1989. Erosion and washover in coastal Louisiana. Proceedings of Sixth Symposium on Coastal and Ocean Management/ASCE July 11-14, 1989, Charleston, SC, pp. 253-264.

Saucier, M.H. and DM. Baltz. 1993. Spawning site selection by spotted seatrout, Cynoscion nebulosus, and black drum, Pogonias cromis, in Louisiana. Environmental Biology of Fishes 36:257-272.

Smith, L. M. 1988. The natural communities of Louisiana. Louisiana Dept. of Wildlife and Fisheries, Louisiana Natural Heritage Program, Baton Rouge. unpublished.

Thompson, B.A. Fish and shellfish. In: Isles Dernieres Barrier Island Stabilization project, State Project No. 750-55-01, Draft Environmental Assessment submitted to State of Louisiana Department of Transportation and Development, September 1988. Plaissance/Smith Engineers, P.O. Box 2266, Houma, LA. 70361. p31-38.

Turner, R.E., R. Constanza, and W. Scaife. 1982. Canals and wetland erosion rates in coastal Louisiana. *In* D.F. Boesch, (ed.), Proceedings of the conference on coastal erosion and wetland modification in Louisiana: cause, consequences and options. U.S. Fish and Wildlife Service, Biological Services Program, FWS/OBS-82/59.

U.S. Army Corps of Engineers, New Orleans District. 2004a. Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study. Volume 1: LCA Study – Main Report.

U.S. Army Corps of Engineers, New Orleans District. 2004b. Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study. Volume 4: LCA Study – Main Report.

U.S. Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS). 2005. Project Plan and Environmental Assessment for Raccoon Island Shore Protection/Marsh Creation Project (TE-48). U.S. Department of Agriculture, Natural Resources Conservation Service. 32 pp. plus Appendices

U.S. Department of Agriculture. 2007. USDA-Farm Service Agency-Aerial Photography Field Office National Agricultural Inventory Project MrSID Mosaic. United States Department of Agriculture – Farm Service Agency, Salt Lake City, Utah.

U.S. Environmental Protection Agency. 1997. "Environmental Assessment for Isles Dernieres Barrier Island Restoration and Coastal Wetland Creation (TE-20/TE-24): Finding Of No Significant Impacts". Terrebonne Parish, Louisiana.

Williams, P.R. 1998. Nekton assemblages associated with the barrier island aquatic habitats of East Timbalier Island, Louisiana. M.S. thesis, Louisiana State University. 121 pp.

Williams, S.J., S. Penland, and A.H. Sallenger, Jr., editors. 1992. Louisiana Barrier Island Erosion Study: Atlas of shoreline changes in Louisiana from 1853 to 1989. Prepared by the U.S. Geological Survey in cooperation with the Louisiana Geological Survey. 103 pp.

Zimmerman, R.J. 1988. A survey and assessment of usage of a salt marsh at Grand Isle Louisiana, by estuarine aquatic fauna. An Interim Report Tl: EPA Region VI Dallas, Texas. 14 pp.

APPENDIX A

PROJECT INFORMATION SHEET WITH ASSUMPTIONS FOR LCA-TBBSR

PROJECT INFORMATION SHEET BARRIER ISLAND VALUE ASSESSMENT
Terrebonne Basin Barrier BVA Project Information Sheet
13 November 2009

Draft

Project Name: LCA Terrebonne Basin Barrier Shoreline Restoration

Project Type(s): Barrier island restoration, marsh creation, vegetative planting

Sponsoring Agency: US Army Corps of Engineers

Preparer of information sheet: Karen Soileau, Aaron Bass, Chris Dean, and Ken Duffy. Information found in this project information sheet was obtained primarily from the Feasibility Scoping Meeting Report.

Project Area:
The proposed project provides for the restoration of the Timbalier and Isles Dernieres Barrier Island chains located in Terrebonne and Lafourche Parishes, Louisiana. The Timbalier Reach is comprised of Timbalier Island and East Timbalier Island. Raccoon, Whiskey, Trinity, East, and Wine, are the primary islands that comprise the Isles Dernieres barrier island chain.

Final Array of Alternatives:
Based upon the results of the plan formulation, analyses and screening, seventeen (17) plan alternatives have been recommended for inclusion in the Final Array of Alternatives. The seventeen alternatives were grouped into five (5) categories described below.

Category 1, Alternative 1 No Action – The No-Action Alternative assumes there would be no future barrier island restoration within the study area. The barrier islands will continue to be subjected to the factors and processes that are contributing to the loss of the Timbalier and Isles Dernieres barrier island chains and will result in a direct loss of the barrier islands to open water.

Category 2, "Best Buy" within Budget – The best-buy alternative based on the IWR screening provides the greatest increase in the value of the output variable for the least increase in the value of the cost variable. In other words, the best-buy alternative yields the maximum habitat acres at the lowest cost per unit within the budget. If the budget falls between two "best buy" alternatives, the lower cost plan could be scaled-up. The "best buy" alternative is geared less toward the system-wide approach of restoring the entire barrier island chain and more toward restoring the island or islands that are most cost-effective.

- **Alternative 2** – Restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss

- **Alternative 3** – Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss combined with restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
- **Alternative 4** – Restoration of Whiskey and Trinity Islands to their minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss combined with restoration of Timbalier Island to its minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss
- **Alternative 5** – Restoration of Whiskey and Trinity Islands to their minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss combined with restoration of Raccoon and Timbalier Islands to their minimal geomorphologic form and ecologic function along with 25 years of background erosion/land loss and construction of a terminal groin on the western end of Raccoon Island

Category 3, Maximum Number of Islands Constructible with Cleared Sediment Sources – These alternatives would favor those islands where the total costs are lowest, allowing for more islands to be created using cleared sediment sources noting they may or may not be cost effective based on the IWR screening.

- **Alternative 6** – Restoration of Raccoon, Whiskey, and Trinity Islands, all to their minimal geomorphologic form and ecologic function
- **Alternative 7** – Restoration of Raccoon, Whiskey, and Trinity Islands, all to their minimal geomorphologic form and ecologic function, along with construction of 8 additional breakwaters on the western end of Raccoon Island
- **Alternative 8** – Restoration of Raccoon, Whiskey, and Trinity Islands, all to their minimal geomorphologic form and ecologic function, along with construction of a terminal groin on the western end of Raccoon Island
- **Alternative 9** – Restoration of Raccoon, Whiskey, and Timbalier Islands, all to their minimal geomorphologic form and ecologic function

Category 4, System-wide Barrier Island Restoration – This alternative would take a full system-wide approach to restoring the Terrebonne Basin barrier system. Each of the seven barrier islands would be restored to their minimal geomorphologic form and ecologic function. Similar to the alternatives that include the most islands within the budget, this alternative may or may not be cost effective based on the IWR screening.

- **Alternative 10** – Restoration of Raccoon, Whiskey, Trinity, East, Wine, Timbalier, and East Timbalier Islands, all to their minimal geomorphologic form and ecologic function

Category 5, Subsets of NER Plan

- **Alternative 11** – Restoration of Whiskey Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss

- **Alternative 12 –** Restoration of Trinity Island to its minimal geomorphologic form and ecologic function along with 5 years of background erosion/land loss

V1, V2, and V3

Variables provided to the Service from SJB Group.

V4- Vegetative Cover

For each of the subject barrier islands, the subaerial land acreage, total vegetative coverage, and woody vegetative coverage was determined based on an evaluation of the most recent high-resolution aerial photography available to our agency (2008 digital orthophoto quarterquadrangles [DOQQs]). Landscape and vegetative community polygons were delineated from observable imagery signatures and evaluated at scales ranging from 1:1,000 to 1:4,000. Our interpretation of landscape and vegetation imagery signatures was based upon, and verified by, field data collected by an interagency team of biologists during a July 27 – 29, 2009, site inspection. The results of those calculations were compared to historical data collected for the respective islands (i.e., data collected for CWPPRA projects) to ensure a reasonable level of consistency with previous studies and to corroborate our findings.

Under "future with project" conditions we assumed plantings of dune, supratidal, and intertidal habitats. We recommend dune plantings include sea oats, bitter panicum, beach morning glory (if available), and Roseau (use source material for better survivability in saline conditions).

Intermediate Sea Level Rise Scenario

Raccoon – FWOP

TY0	17%	Year 2012
TY1	17%	
TY5	12%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY21	7%	Continued deterioration and lowering of profile.
TY30	5%	Continued deterioration and lowering of profile.
TY40	0%	There are no subaerial acres left by target year 40.
TY48	0%	The island is no longer subaerial.
TY50	0%	The island is no longer subaerial.

Raccoon – FWP (Plan B): Assumptions based on Shell Island project

TY0	17%	Year 2012
TY1	16%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf

side. (45 dune acres + 227 supratidal acres @ 10% cover) + (212 acres of marsh platform [90% of 235 intertidal acres = 212 acres of marsh platform] @ 25% cover)/506 subaerial acres

TY5	64%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (33 dune acres + 194 supratidal acres @ 60% cover) + (228 acres of marsh platform [90% of 253 intertidal acres = 228 acres of marsh platform] @ 75% cover)/481 subaerial acres
TY21	51%	Assume 45% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (0 dune acres + 143 supratidal acres @ 45% cover) + (230 acres of marsh platform [90% of 255 intertidal acres = 230 acres of marsh platform] @ 60% cover)/398 subaerial acres
TY30	37%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 83 supratidal acres @ 25% cover) + (234 acres of marsh platform [90% of 260 intertidal acres = 234 acres of marsh platform] @ 45% cover)/343 subaerial acres
TY40	22%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 25 supratidal acres @ 15% cover) + (223 acres of marsh platform [90% of 248 intertidal acres = 223 acres of marsh platform] @ 25% cover)/273 subaerial acres
TY48	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (61 acres of marsh platform [90% of 68 intertidal acres = 61 acres of marsh platform] @ 15% cover)/68 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (21 acres of marsh platform [90% of 23 intertidal acres = 21 acres of marsh platform] @ 15% cover)/23 subaerial acres

Raccoon – FWP (Plan B) with breakwaters: Assumptions based on Shell Island project

TY0	17%	Year 2012
TY1	16%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (45 dune acres + 227 supratidal acres @ 10% cover) + (213 acres of marsh platform [90% of 237 intertidal acres = 213 acres of marsh platform] @ 25% cover)/508 subaerial acres
TY5	64%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (33 dune acres + 198 supratidal acres @ 60% cover) + (229 acres of marsh platform [90% of 254 intertidal acres = 228 acres of marsh platform] @ 75% cover)/486 subaerial acres
TY21	50%	Assume 45% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (0 dune acres + 167 supratidal acres @ 45% cover) + (230 acres of marsh platform [90% of 255 intertidal acres = 230 acres of marsh platform] @ 60% cover)/421 subaerial acres

TY30	36%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 112 supratidal acres @ 25% cover) + (238 acres of marsh platform [90% of 264 intertidal acres = 238 acres of marsh platform] @ 45% cover)/376 subaerial acres
TY40	21%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 62 supratidal acres @ 15% cover) + (233 acres of marsh platform [90% of 259 intertidal acres = 233 acres of marsh platform] @ 25% cover)/320 subaerial acres
TY48	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (74 acres of marsh platform [90% of 82 intertidal acres = 74 acres of marsh platform] @ 15% cover)/82 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (34 acres of marsh platform [90% of 38 intertidal acres = 34 acres of marsh platform] @ 15% cover)/38 subaerial acres

<u>Raccoon – FWP (Plan B) with terminal groin</u>: Assumptions based on Shell Island project

TY0	17%	Year 2012
TY1	16%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (45 dune acres + 227 supratidal acres @ 10% cover) + (213 acres of marsh platform [90% of 237 intertidal acres = 213 acres of marsh platform] @ 25% cover)/508 subaerial acres
TY5	64%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (33 dune acres + 198 supratidal acres @ 60% cover) + (229 acres of marsh platform [90% of 254 intertidal acres = 228 acres of marsh platform] @ 75% cover)/485 subaerial acres
TY21	50%	Assume 45% cover of dune and supratidal habitat and 60% vegetative cover of marsh platform (0 dune acres + 164 supratidal acres @ 45% cover) + (230 acres of marsh platform [90% of 255 intertidal acres = 230 acres of marsh platform] @ 60% cover)/419 subaerial acres
TY30	36%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 107 supratidal acres @ 25% cover) + (238 acres of marsh platform [90% of 264 intertidal acres = 238 acres of marsh platform] @ 45% cover)/371 subaerial acres
TY40	22%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 36 supratidal acres @ 15% cover) + (251 acres of marsh platform [90% of 279 intertidal acres = 251 acres of marsh platform] @ 25% cover)/315 subaerial acres
TY48	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) +

(75 acres of marsh platform [90% of 83 intertidal acres = 75 acres of marsh platform] @ 15% cover)/83 subaerial acres

TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (31 acres of marsh platform [90% of 34 intertidal acres = 31 acres of marsh platform] @ 15% cover)/34 subaerial acres

Raccoon – FWP (Plan E) with terminal groin: Assumptions based on Shell Island project

TY0	17%	Year 2012
TY1	11%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (63 dune acres + 688 supratidal acres @ 10% cover) + (34 acres of marsh platform [90% of 38 intertidal acres = 34 acres of marsh platform] @ 25% cover)/789 subaerial acres
TY5	60%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (50 dune acres + 678 supratidal acres @ 60% cover) + (35 acres of marsh platform [90% of 39 intertidal acres = 35 acres of marsh platform] @ 75% cover)/767 subaerial acres
TY30	36%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 182 supratidal acres @ 25% cover) + (419 acres of marsh platform [90% of 466 intertidal acres = 419 acres of marsh platform] @ 45% cover)/646 subaerial acres
TY40	21%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 106 supratidal acres @ 15% cover) + (437 acres of marsh platform [90% of 486 intertidal acres = 437 acres of marsh platform] @ 25% cover)/592 subaerial acres
TY50	12%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 66 supratidal acres @ 5% cover) + (421 acres of marsh platform [90% of 468 intertidal acres = 421 acres of marsh platform] @ 15% cover)/534 subaerial acres

Whiskey – FWOP

TY0	53%	Year 2012
TY1	52%	
TY5	45%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY10	35%	Continued deterioration and lowering of profile.
TY17	25%	Continued deterioration and lowering of profile.
TY20	20%	Continued deterioration and lowering of profile.
TY30	15%	Continued deterioration and lowering of profile.
TY50	0%	The island is no longer subaerial.

Whiskey – FWP (Plan B): Assumptions based on Shell Island project

TY0	53%	Year 2012
TY1	15%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (57 dune acres + 614 supratidal acres @ 10% cover) + (458 acres of marsh platform [90% of 509 intertidal acres = 458 acres of marsh platform] @ 25% cover)/1180 subaerial acres
TY5	66%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (53 dune acres + 220 supratidal acres @ 60% cover) + (747 acres of marsh platform [90% of 830 intertidal acres = 747 acres of marsh platform] @ 75% cover)/1102 subaerial acres
TY10	61%	Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (0 dune acres + 164 supratidal acres @ 50% cover) + (721 acres of marsh platform [90% of 801 intertidal acres = 721 acres of marsh platform] @ 70% cover)/965 subaerial acres
TY17	58%	Assume 50% vegetative cover of dune and supratidal habitat and 65% vegetative cover of marsh platform. (0 dune acres + 49 supratidal acres @ 50% cover) + (712 acres of marsh platform [90% of 791 intertidal acres = 712 acres of marsh platform] @ 65% cover)/840 subaerial acres
TY20	54%	Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (707 acres of marsh platform [90% of 786 intertidal acres = 707 acres of marsh platform] @ 70% cover)/786 subaerial acres
TY30	41%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 25% cover) + (535 acres of marsh platform [90% of 594 intertidal acres = 535 acres of marsh platform] @ 45% cover)/594 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (248 acres of marsh platform [90% of 276 intertidal acres = 248 acres of marsh platform] @ 15% cover)/276 subaerial acres

<u>Whiskey – FWP (Plan C)</u>: Assumptions based on Shell Island project

TY0	53%	Year 2012
TY1	14%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (65 dune acres + 830 supratidal acres @ 10% cover) + (339 acres of marsh platform [90% of 377 intertidal acres = 339 acres of marsh platform] @ 25% cover)/1271 subaerial acres
TY5	65%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (61 dune acres + 328 supratidal acres

		@ 60% cover) + (727 acres of marsh platform [90% of 808 intertidal acres = 727 acres of marsh platform] @ 75% cover)/1197 subaerial acres
TY10	60%	Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (57 dune acres + 223 supratidal acres @ 50% cover) + (745 acres of marsh platform [90% of 828 intertidal acres = 745 acres of marsh platform] @ 70% cover)/1107 subaerial acres
TY17	57%	Assume 50% vegetative cover of dune and supratidal habitat and 65% vegetative cover of marsh platform. (17 dune acres + 126 supratidal acres @ 50% cover) + (757 acres of marsh platform [90% of 841 intertidal acres = 757 acres of marsh platform] @ 65% cover)/984 subaerial acres
TY20	54%	Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 84 supratidal acres @ 50% cover) + (762 acres of marsh platform [90% of 847 intertidal acres = 762 acres of marsh platform] @ 70% cover)/931 subaerial acres
TY30	41%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 25% cover) + (645 acres of marsh platform [90% of 717 intertidal acres = 645 acres of marsh platform] @ 45% cover)/717 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (327 acres of marsh platform [90% of 363 intertidal acres = 327 acres of marsh platform] @ 15% cover)/363 subaerial acres

<u>Trinity – FWOP</u>

TY0	53%	Year 2012
TY1	51%	
TY5	45%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY20	15%	Continued deterioration and lowering of profile.
TY24	10%	Continued deterioration and lowering of profile.
TY33	3%	Continued deterioration and lowering of profile.
TY40	0%	There are no subaerial acres left by target year 40.
TY50	0%	The island is no longer subaerial.

<u>Trinity – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0	53%	Year 2012
TY1	17%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (126 dune acres + 338 supratidal acres @ 10% cover) + (512 acres of marsh platform [90% of 569 intertidal acres = 512 acres of marsh platform] @ 25% cover)/1033 subaerial acres
TY5	65%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (92 dune acres + 237 supratidal acres

@ 60% cover) + (563 acres of marsh platform [90% of 626 intertidal acres = 563 acres of marsh platform] @ 75% cover)/956 subaerial acres

TY20 54% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 43 supratidal acres @ 50% cover) + (564 acres of marsh platform [90% of 627 intertidal acres = 564 acres of marsh platform] @ 70% cover)/670 subaerial acres

TY24 50% Assume 35% vegetative cover of dune and supratidal habitat and 55% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (504 acres of marsh platform [90% of 560 intertidal acres = 504 acres of marsh platform] @ 70% cover)/560 subaerial acres

TY33 32% Assume 20% vegetative cover of dune and supratidal habitat and 35% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 20% cover) + (365 acres of marsh platform [90% of 406 intertidal acres = 365 acres of marsh platform] @ 35% cover)/406 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (251 acres of marsh platform [90% of 279 intertidal acres = 251 acres of marsh platform] @ 25% cover)/279 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (30 acres of marsh platform [90% of 33 intertidal acres = 30 acres of marsh platform] @ 15% cover)/33 subaerial acres

<u>Trinity – FWP (Plan C)</u>: Assumptions based on Shell Island project

TY0 53% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (129 dune acres + 456 supratidal acres @ 10% cover) + (508 acres of marsh platform [90% of 564 intertidal acres = 508 acres of marsh platform] @ 25% cover)/1149 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (122 dune acres + 316 supratidal acres @ 60% cover) + (569 acres of marsh platform [90% of 632 intertidal acres = 569 acres of marsh platform] @ 75% cover)/1070 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 190 supratidal acres @ 50% cover) + (535 acres of marsh platform [90% of 594 intertidal acres = 535 acres of marsh platform] @ 70% cover)/784 subaerial acres

TY31 36% Assume 25% vegetative cover of dune and supratidal habitat and 40% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (489 acres of marsh platform [90% of 543 intertidal acres = 489 acres of marsh platform] @ 70% cover)/543 subaerial acres

TY40	23%	Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (342 acres of marsh platform [90% of 380 intertidal acres = 342 acres of marsh platform] @ 25% cover)/380 subaerial acres
TY50	14%	Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (179 acres of marsh platform [90% of 199 intertidal acres = 179 acres of marsh platform] @ 15% cover)/199 subaerial acres

<u>East – FWOP</u>

TY0	29%	Year 2012
TY1	28%	
TY5	25%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY20	10%	Continued deterioration and lowering of profile.
TY22	8%	Continued deterioration and lowering of profile.
TY29	5%	Continued deterioration and lowering of profile.
TY40	0%	There are no subaerial acres left by target year 40.
TY50	0%	The island is no longer subaerial.

<u>East – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0	29%	Year 2012
TY1	17%	Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (88 dune acres + 229 supratidal acres @ 10% cover) + (326 acres of marsh platform [90% of 362 intertidal acres = 326 acres of marsh platform] @ 25% cover)/680 subaerial acres
TY5	65%	Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (59 dune acres + 165 supratidal acres @ 60% cover) + (364 acres of marsh platform [90% of 404 intertidal acres = 364 acres of marsh platform] @ 75% cover)/628 subaerial acres
TY20	54%	Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 33 supratidal acres @ 50% cover) + (361 acres of marsh platform [90% of 401 intertidal acres = 361 acres of marsh platform] @ 70% cover)/434 subaerial acres
TY22	54%	Assume 40% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (340 acres of marsh platform [90% of 378 intertidal acres = 340 acres of marsh platform] @ 70% cover)/378 subaerial acres
TY29	41%	Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 25% cover) + (271 acres of marsh platform [90% of 301 intertidal acres = 271 acres of marsh platform] @ 45% cover)/301 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (154 acres of marsh platform [90% of 171 intertidal acres = 154 acres of marsh platform] @ 25% cover)/171 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (41 acres of marsh platform [90% of 46 intertidal acres = 41 acres of marsh platform] @ 15% cover)/46 subaerial acres

Wine – FWOP

TY0	16%	Year 2012
TY1	16%	
TY5	10%	Project a decrease in percent vegetative cover due to deterioration and lowering of profile.
TY20	5%	Continued deterioration and lowering of profile.
TY29	2%	Continued deterioration and lowering of profile.
TY35	0%	There are no subaerial acres left by target year 35.
TY40	0%	The island is no longer subaerial.
TY50	0%	The island is no longer subaerial.

Wine – FWP (Plan B): Assumptions based on Shell Island project

TY0 16% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (12 dune acres + 97 supratidal acres @ 10% cover) + (87 acres of marsh platform [90% of 97 intertidal acres = 87 acres of marsh platform] @ 25% cover)/206 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (11 dune acres + 75 supratidal acres @ 60% cover) + (98 acres of marsh platform [90% of 109 intertidal acres = 98 acres of marsh platform] @ 75% cover)/195 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 47 supratidal acres @ 50% cover) + (95 acres of marsh platform [90% of 106 intertidal acres = 95 acres of marsh platform] @ 70% cover)/153 subaerial acres

TY29 39% Assume 25% cover of dune and supratidal habitat and 45% vegetative cover of marsh platform (0 dune acres + 16 supratidal acres @ 25% cover) + (100 acres of marsh platform [90% of 111 intertidal acres = 100 acres of marsh platform] @ 45% cover)/127 subaerial acres

TY35 26% Assume 20% cover of dune and supratidal habitat and 30% vegetative cover of marsh platform (0 dune acres + 12 supratidal acres @ 25% cover) + (88 acres of marsh platform [90% of 98 intertidal acres = 88 acres of marsh platform] @ 45% cover)/110 subaerial acres

TY40 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (86 acres of marsh platform [90% of 96 intertidal acres = 86 acres of marsh platform] @ 25% cover)/96 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (5 acres of marsh platform [90% of 5 intertidal acres = 5 acres of marsh platform] @ 15% cover)/5 subaerial acres

<u>Timbalier – FWOP</u>

TY0 64% Year 2012

TY1 62%

TY5 55% Project a decrease in percent vegetative cover due to deterioration and lowering of profile.

TY20 25% Continued deterioration and lowering of profile.

TY41 7% Continued deterioration and lowering of profile.

TY50 1% Only 2 subaerial acres remain.

<u>Timbalier – FWP (Plan B)</u>: Assumptions based on Shell Island project

TY0 64% Year 2012

TY1 16% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (155 dune acres + 748 supratidal acres @ 10% cover) + (653 acres of marsh platform [90% of 726 intertidal acres = 653 acres of marsh platform] @ 25% cover)/1629 subaerial acres

TY5 64% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (130 dune acres + 566 supratidal acres @ 60% cover) + (730 acres of marsh platform [90% of 811 intertidal acres = 730 acres of marsh platform] @ 75% cover)/1507 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 236 supratidal acres @ 50% cover) + (746 acres of marsh platform [90% of 829 intertidal acres = 746 acres of marsh platform] @ 70% cover)/1065 subaerial acres

TY41 23% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 15% cover) + (381 acres of marsh platform [90% of 423 intertidal acres = 381 acres of marsh platform] @ 25% cover)/423 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (158 acres of marsh platform [90% of 175 intertidal acres = 158 acres of marsh platform] @ 15% cover)/175 subaerial acres

<u>Timbalier – FWP (Plan E)</u>: Assumptions based on Shell Island project

TY0 64% Year 2012

TY1 10% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (215 dune acres + 2346 supratidal acres @ 10% cover) + (62 acres of marsh platform [90% of 69 intertidal acres = 62 acres of marsh platform] @ 25% cover)/2630 subaerial acres

TY5 60% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (183 dune acres + 2257 supratidal acres @ 60% cover) + (64 acres of marsh platform [90% of 71 intertidal acres = 64 acres of marsh platform] @ 75% cover)/2511 subaerial acres

TY20 50% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 1996 supratidal acres @ 50% cover) + (68 acres of marsh platform [90% of 76 intertidal acres = 68 acres of marsh platform] @ 70% cover)/2072 subaerial acres

TY41 21% Assume 15% cover of dune and supratidal habitat and 25% vegetative cover of marsh platform (0 dune acres + 303 supratidal acres @ 15% cover) + (acres of marsh platform [90% of 1120 intertidal acres = 1008 acres of marsh platform] @ 25% cover)/1422 subaerial acres

TY50 13% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 53 supratidal acres @ 5% cover) + (979 acres of marsh platform [90% of 1088 intertidal acres = 979 acres of marsh platform] @ 15% cover)/1141 subaerial acres

East Timbalier – FWOP

TY0 38% Year 2012

TY1 37%

TY5 35% Project a decrease in percent vegetative cover due to deterioration and lowering of profile.

TY10 30% Continued deterioration and lowering of profile.

TY20 25% Continued deterioration and lowering of profile.

TY43 10% Continued deterioration and lowering of profile.

TY45 5% Continued deterioration and lowering of profile.

TY50 1% Only 4 subaerial acres remain.

East Timbalier – FWP (Plan B): Assumptions based on Shell Island project

TY0 38% Year 2012

TY1 17% Assume 10% vegetative cover of dune and supratidal habitat and 25% vegetative cover of marsh platform. Because the amount of intertidal habitat occurring within the bay-side versus the gulf-side has not been identified, we assume that 90% of the intertidal habitat is located on the bay side of islands (i.e., the marsh platform), while 10% occurs on the gulf side. (63 dune acres + 314 supratidal acres @ 10% cover) + (407 acres of marsh platform [90% of 452 intertidal acres = 407 acres of marsh platform] @ 25% cover)/828 subaerial acres

TY5 65% Assume 60% vegetative cover of dune and supratidal habitat and 75% vegetative cover of marsh platform. (58 dune acres + 240 supratidal acres @ 60% cover) + (428 acres of marsh platform [90% of 476 intertidal acres = 428 acres of marsh platform] @ 75% cover)/775 subaerial acres

TY10 58% Assume 50% vegetative cover of dune and supratidal habitat and 70% vegetative cover of marsh platform. (54 dune acres + 199 supratidal acres @ 50% cover) + (427 acres of marsh platform [90% of 474 intertidal acres = 427 acres of marsh platform] @ 70% cover)/727 subaerial acres

TY20 53% Assume 50% vegetative cover of dune and supratidal habitat and 60% vegetative cover of marsh platform. (0 dune acres + 175 supratidal acres @ 50% cover) + (410 acres of marsh platform [90% of 456 intertidal acres = 410 acres of marsh platform] @ 70% cover)/631 subaerial acres

TY43 18% Assume 10% vegetative cover of dune and supratidal habitat and 20% vegetative cover of marsh platform. (0 dune acres + 9 supratidal acres @ 50% cover) + (257 acres of marsh platform [90% of 286 intertidal acres = 257 acres of marsh platform] @ 70% cover)/ subaerial acres

TY45 18% Assume 10% vegetative cover of dune and supratidal habitat and 20% vegetative cover of marsh platform. (0 dune acres + 0 supratidal acres @ 50% cover) + (185 acres of marsh platform [90% of 206 intertidal acres = 185 acres of marsh platform] @ 70% cover)/206 subaerial acres

TY50 14% Assume 5% cover of dune and supratidal habitat and 15% vegetative cover of marsh platform (0 dune acres + 0 supratidal acres @ 5% cover) + (6 acres of marsh platform [90% of 7 intertidal acres = 6 acres of marsh platform] @ 15% cover)/7 subaerial acres

V5- Woody Cover

For each of the subject barrier islands, the subaerial land acreage, total vegetative coverage, and woody vegetative coverage was determined based on an evaluation of the most recent high-resolution aerial photography available to our agency (2008 digital orthophoto quarterquadrangles [DOQQs]). Landscape and vegetative community polygons were delineated from observable imagery signatures and evaluated at scales ranging from 1:1,000 to 1:4,000. Our interpretation of landscape and vegetation imagery signatures was based upon, and verified by, field data collected by an interagency team of biologists during a July 27 – 29, 2009, site inspection. The results of those calculations were compared to historical data collected for the respective islands (i.e., data collected for CWPPRA projects) to ensure a reasonable level of consistency with previous studies and to corroborate our findings.

Intermediate Sea Level Rise Scenario

Raccoon – FWOP

TY0 43% Year 2012

TY1 43%

TY5	52%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 18 acres vegetation - assume 1/3 woody lost = 12 acres woody remaining/23 acres vegetated = 52%.
TY21	30%	Assume some woody losses relative to non-woody as island degrades).
TY30	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY40	0%	No vegetation expected to remain on island.
TY48	0%	No vegetation expected to remain on island.
TY50	0%	No vegetation expected to remain on island.

<u>Raccoon – FWP (Plan B)</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	12%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (308 acres vegetated minus 58 acres mangrove flat = 250 ac. 250 * 5% initial cover = 13 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 38 ac/308 ac total vegetated = 12%).
TY21	23%	Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (203-58=145 ac vegetated * 15% = 22 ac. 22+25=47 ac woody. 47 ac/203 vegetated = 23%).
TY30	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species..
TY40	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species..
TY48	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Raccoon – FWP (Plan B) with breakwaters</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	12%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (308 acres vegetated minus 58 acres mangrove flat = 250 ac. 250 * 5% initial cover = 13 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 38 ac/308 ac total vegetated = 12%).

TY21	23%	Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (203-58=145 ac vegetated * 15% = 22 ac. 22+25=47 ac woody. 47 ac/203 vegetated = 23%)
TY30	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY40	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY48	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Raccoon – FWP (Plan B) with terminal groin</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	12%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (311 acres vegetated minus 58 acres mangrove flat = 253 ac. 253 * 5% initial cover = 13 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 38 ac/308 ac total vegetated = 12%).
TY21	23%	Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (211-58=153 ac vegetated * 15% = 23 ac. 23+25=48 ac woody. 48 ac/211 vegetated = 23%)
TY30	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY40	23%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY48	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

<u>Raccoon – FWP (Plan E) with terminal groin</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~58 acres) are avoided. Percent woody remains constant in that area.
TY5	10%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (460 acres vegetated minus 58 acres mangrove flat = 402 ac. 402 * 5% initial cover = 20 ac. 58 ac mangrove flat * 43% = 25 ac. Total woody of 45 ac/460 ac total vegetated = 10%).

TY30	22%	Mangrove flat (58 ac, 25 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (233-58=175 ac vegetated * 15% = 26 ac. 26+25=51 ac woody. 51 ac/233 vegetated = 22%).
TY40	22%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY50	22%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.

<u>Whiskey – FWOP</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	
TY5	46%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 106 acres vegetation - assume 1/3 woody lost = 152 acres woody remaining/329 acres vegetated = 46%.
TY10	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY17	35%	Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY20	20%	Only intertidal remains. . Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY30	0%	No vegetation expected to remain on island.
TY50	0%	No vegetation expected to remain on island.

<u>Whiskey – FWP (Plan B)</u>

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~190 acres) are avoided. Percent woody remains constant in that area.
TY5	20%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (727 acres vegetated minus 286 acres mangrove flat = 441 ac. 441 * 5% initial cover = 22 ac. 286 ac mangrove flat * 43% = 123 ac. Total woody of 145 ac/727 ac total vegetated = 20%).
TY10	29%	Mangrove flat (286 ac, 123 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (589-286=303 ac vegetated * 15% = 45 ac. 45+123=168 ac woody. 168 ac/589 vegetated = 29%)
TY17	29%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY20	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

TY30	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

Whiskey – FWP (Plan C)

TY0	43%	Year 2012. 43% of the vegetated subaerial acres are vegetated with woody species.
TY1	43%	Burial of woody vegetation is minimized, since mangrove flats (~190 acres) are avoided. Percent woody remains constant in that area.
TY5	19%	Black mangrove and other available woody vegetation installed on dune and swale in TY2 or TY3 (15% of installed vegetation is woody). Existing mangrove flat still there, but smaller proportion of total vegetated area. (778 acres vegetated minus 286 acres mangrove flat = 492 ac. 492 * 5% initial cover = 25 ac. 286 ac mangrove flat * 43% = 123 ac. Total woody of 148 ac/778 ac total vegetated = 19%).
TY10	27%	Mangrove flat (286 ac, 123 ac woody) remains. Woody cover of remaining vegetated areas increases to 15%. (664-286=378 ac vegetated * 15% = 57 ac. 57+123=180 ac woody. 180 ac/664 vegetated = 27%)
TY17	27%	Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY20	20%	Almost all supratidal lost. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY30	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.
TY50	20%	Only intertidal remains. Most of vegetation would be marsh grass. Only one woody species (mangrove) present. Divide SI by 2.

Trinity – FWOP

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	59%	
TY5	68%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 77 acres vegetation - assume 1/3 woody lost = 144 acres woody remaining/211 acres vegetated = 68%.
TY20	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY24	30%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY33	20%	Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY40	0%	No vegetation expected to remain on island.
TY50	0%	No vegetation expected to remain on island.

Trinity – FWP (Plan B)

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY24	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY33	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY40	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

Trinity – FWP (Plan C)

TY0	59%	Year 2012. 59% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY31	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY40	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

East – FWOP

TY0	56%	Year 2012. 56% of the vegetated subaerial acres are vegetated with woody species.
TY1	56%	
TY5	68%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 22 acres vegetation - assume 1/3 woody lost = 33 acres woody remaining/50 acres vegetated = 66%.
TY20	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.

TY22 30% Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY29 20% Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY40 0% No vegetation expected to remain on island.
TY50 0% No vegetation expected to remain on island.

East – FWP (Plan B)
TY0 56% Year 2012. 56% of the vegetated subaerial acres are vegetated with woody species.
TY1 5% Burial of majority of woody vegetation is expected.
TY5 10% Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20 20% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY22 30% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY29 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY40 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

Wine – FWOP
TY0 0% Year 2012. 0% of the vegetated subaerial acres are vegetated with woody species.
TY1 0% No woody vegetation expected to establish.
TY5 0% No woody vegetation expected to establish.
TY20 0% No woody vegetation expected to establish.
TY29 0% No woody vegetation expected to establish.
TY35 0% No woody vegetation expected to establish.
TY40 0% No woody vegetation expected to establish.
TY50 0% No woody vegetation expected to establish.

Wine – FWP (Plan B)
TY0 0% Year 2012. 0% of the vegetated subaerial acres are vegetated with woody species.
TY1 0% No woody vegetation established yet.
TY5 10% Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20 15% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.

TY29 15% Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY35 15% Woody percentage remains constant as supratidal acreage is lost. Mangrove dominates woody species.
TY40 15% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.
TY50 5% Very little intertidal acreage remains. Overwash processes dominate, reducing mangrove area. Divide SI by 2.

Timbalier – FWOP
TY0 61% Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1 61%
TY5 69% Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 132 acres vegetation - assume 1/3 woody lost = 317 acres woody remaining/460 acres vegetated = 69%.
TY20 50% Assume some woody losses relative to non-woody as island degrades.
TY41 20% Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY50 0% Only very little intertidal remains. All supratidal acreage lost. No woody species are expected to remain.

Timbalier – FWP (Plan B)
TY0 61% Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1 5% Burial of majority of woody vegetation is expected.
TY5 10% Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20 20% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species.
TY41 30% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Mangrove dominates woody species. No supratidal acreage left. Only one species of woody (Mangrove). Divide SI by 2.
TY50 30% Percentage of mangrove cover remains constant as intertidal acreage decreases. Divide SI by 2.

Timbalier – FWP (Plan E)
TY0 61% Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1 5% Burial of majority of woody vegetation is expected.
TY5 10% Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY20 20% Woody percentage increases as herbaceous vegetation is lost in greater proportion. Large area of supratidal remains. Mangrove dominates woody species.

TY41	30%	Percentage of mangrove cover increases though recruitment and durability. Supratidal acreage converts to intertidal.
TY50	30%	Percentage of mangrove cover remains constant as supratidal and intertidal acreages decrease.

East Timbalier – FWOP

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	61%	
TY5	64%	Most of supratidal acreage lost would be unvegetated or vegetated with non-woody veg. Lost 7 acres vegetation - assume 1/3 woody lost = 45 acres woody remaining/70 acres vegetated = 64%.
TY10	50%	Assume some woody losses relative to non-woody as island degrades.
TY20	40%	Almost all supratidal acreage lost. Treat as though only intertidal remains. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY43	20%	Only intertidal remains. All supratidal acreage lost. Percentage of woody vegetation decreases as island degrades. Only one woody species (mangrove) present. Divide SI by 2.
TY45	0%	Only very little intertidal remains. All supratidal acreage lost. No woody species are expected to remain.
TY50	0%	Only very little intertidal remains. All supratidal acreage lost. No woody species are expected to remain.

East Timbalier – FWP (Plan B)

TY0	61%	Year 2012. 61% of the vegetated subaerial acres are vegetated with woody species.
TY1	5%	Burial of majority of woody vegetation is expected.
TY5	10%	Black mangrove and other available woody vegetation installed in TY2 or TY3.
TY10	20%	Woody percentage increases as herbaceous vegetation is lost in greater proportion and mangrove recruits. Mangrove dominates woody species.
TY20	30%	Woody percentage increases as herbaceous vegetation is lost in greater proportion and mangrove recruits. Mangrove dominates woody species.
TY43	30%	Percentage of mangrove cover remains constant as supratidal and intertidal acreages decrease.
TY45	30%	Percentage of mangrove cover remains constant as intertidal acreage decreases. Only one species remains (Mangrove). Divide SI by 2.
TY50	10%	Very little intertidal acreage remains. Overwash processes dominate, reducing mangrove area. Divide SI by 2.

V6- Edge and Interspersion

Variables provided to the Service from SJB Group

Intermediate Sea Level Rise Scenario

V7- Beach/Surf Zone Features

Intermediate Sea Level Rise Scenario

Raccoon – FWOP

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.945

TY5 0.945

TY21 1.00 Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.

TY30 1.00

TY40 0.10 There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.

TY48 0.10

TY50 0.10

Raccoon – FWP (Plan B)

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.945

TY5 0.945

TY21 1.00 Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.

TY30 1.00

TY40 1.00

TY48 1.00

TY50 1.00

Raccoon – FWP (Plan B) with breakwaters

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.917 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The island will erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

A third breakwater field has been proposed as part of this project. The breakwater field will consist of 8 additional breakwaters, with a cumulative length of 4500 feet (including gaps). The construction of the breakwaters will be completed by 2013. It was assumed that typical maintenance would be conducted as necessary on the breakwaters in order to maintain their effectiveness. However, the modeling results indicated that the proposed breakwaters would be too far from the islands to be effective by TY21 due to natural erosion processes. Therefore, maintenance of the structures would no longer be effective.

The total length of the island is 16,000 ft (source: 2008 USGS aerial).

For TY1, there are a total of 13320 ft of breakwaters (4400 + 4420 + 4500), which is 83% of the beach length. Therefore, 83% of the beach is classified as Class 3 (breakwaters) and the remaining 17% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.83*0.9)+(0.17*1)=0.917

TY5 0.917

TY21 1.00 Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.

TY30 1.00

TY40 1.00

TY48 1.00

TY50 1.00

<u>Raccoon – FWP (Plan B) with terminal groin</u>

TY0 0.945 There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.90 Based on the modeling results for SBEACH, the entire beach was impacted by either the proposed terminal groin or the 16 existing hard structures. Therefore, the length of beach impacted by the terminal groins was calculated by subtracting as follows: 16,000 - 4400 - 4420 = 7180.

There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The island will erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

A terminal groin will be constructed at the western end of the island as part of this project. The terminal groin will impact approximately 7180 ft of the shoreline (based on the GENESIS modeling results). It was also assumed that the terminal groin would impact the surf zone habitat similar to a breakwater and would thus be assigned a Class 3 rating. The construction of the terminal groin will be completed by 2013. It was assumed that the terminal groin would no longer be effective at TY21.

The total length of the island is 16,000 ft (source: 2008 USGS aerial).

For TY1, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9

TY5	0.90	For TY5, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9
TY21	1.00	Since the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.
TY30	1.00	
TY40	1.00	
TY48	1.00	
TY50	1.00	

<u>Raccoon – FWP (Plan E) with terminal groin</u>

TY0	0.945	There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The total length of the island was 16,000 ft (source: 2008 USGS aerial).

The island will continue to erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

For TY0, there are a total of 8820 ft of breakwaters (4400 + 4420), which is 55% of the beach length. Therefore, 55% of the beach is classified as Class 3 (breakwaters) and the remaining 45% is classified as Class 1 (unconfined beach). The resulting suitability index is calculated as follows: (0.55*0.9)+(0.45*1)=0.945

TY1 0.90 Based on the modeling results for SBEACH, the entire beach was impacted by either the proposed terminal groin or the 16 existing hard structures. Therefore, the length of beach impacted by the terminal groins was calculated by subtracting as follows: 16,000 - 4400 - 4420 = 7180.

There are two existing breakwater fields. The first was implemented in 1997 and includes 8 breakwaters. The total length of this breakwater field is 4400 ft (including gaps) (source: PIS for TE-48). Eight additional breakwaters were constructed in 2005. This additional breakwater field was 4420 feet long (source: PIS for TE-48). The island will erode away from the breakwaters due to natural processes. According to the modeling results, the existing 16 breakwaters will be too far from the island to be effective by TY21. We assumed that none of the existing breakwaters would be maintained.

A terminal groin will be constructed at the western end of the island as part of this project. The terminal groin will impact approximately 7180 ft of the shoreline (based on the GENESIS modeling results). It was also assumed that the terminal groin would impact the surf zone habitat similar to a breakwater and would thus be assigned a Class 3 rating. The construction of the terminal groin will be completed by 2013. It was assumed that the terminal groin would no longer be effective at TY21.

The total length of the island is 16,000 ft (source: 2008 USGS aerial).

For TY1, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9

TY5 0.90 For TY5, the entire length of the beach will be impacted by the terminal groin and the existing breakwaters. Therefore, 100% of the beach is classified as Class 3 (breakwaters). The resulting suitability index is calculated as follows: (1.0*0.9) = 0.9

TY30 1.00 Since the terminal groin and the existing breakwater fields are no longer effective at TY21, the entire beach is classified as Class 1 (unconfined beach) with a suitability index of 1.

TY40 1.00
TY50 1.00

Whiskey – FWOP

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY10	1.00	
TY17	1.00	
TY20	1.00	
TY30	1.00	
TY50	0.10	There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.

Whiskey – FWP (Plan B)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY10	1.00	
TY17	1.00	
TY20	1.00	
TY30	1.00	
TY50	1.00	

Whiskey – FWP (Plan C)

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY10	1.00	
TY17	1.00	
TY20	1.00	
TY30	1.00	
TY50	1.00	

Trinity – FWOP

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY24		
TY33	1.00	

TY40 0.10 There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.

TY50 0.10

Trinity – FWP (Plan B)

TY0 1.00 100% Class 1; Unconfined natural beach with no structures parallel to the shore.

TY1 1.00
TY5 1.00
TY20 1.00
TY24 1.00
TY33 1.00
TY40 1.00
TY50 1.00

Trinity – FWP (Plan C)

TY0 1.00 100% Class 1; Unconfined natural beach with no structures parallel to the shore.

TY1 1.00
TY5 1.00
TY20 1.00
TY31 1.00
TY40 1.00
TY50 1.00

East – FWOP

TY0 1.00 100% Class 1; Unconfined natural beach with no structures parallel to the shore.

TY1 1.00
TY5 1.00
TY20 1.00
TY22 1.00
TY29 1.00
TY40 0.10 There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.

TY50 0.10

East – FWP (Plan B)

TY0 1.00 100% Class 1; Unconfined natural beach with no structures parallel to the shore.

TY1 1.00
TY5 1.00
TY20 1.00
TY22 1.00
TY29 1.00
TY40 1.00

TY50 1.00

<u>Wine – FWOP</u>

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY29	1.00	
TY35	0.10	There are no subaerial acres at this point; therefore the island is given a Class 5 rating (No emergent habitat). The suitability index is 0.1.
TY40	0.10	
TY50	0.10	

<u>Wine w/Monkey – FWP (Plan B)</u>

TY0	1.00	100% Class 1; Unconfined natural beach with no structures parallel to the shore.
TY1	1.00	
TY5	1.00	
TY20	1.00	
TY29	1.00	
TY35	1.00	
TY40	1.00	
TY50	1.00	

<u>Timbalier – FWOP</u>

TY0	0.96	There is an existing seawall that is approximately 1,900 ft long. The seawall is on the beach and acts as a revetment (Class 4). The total island length is 35,570 ft long. Therefore 5.3% of the island will be assigned a Class 4 rating (Seawall - SI = 0.2) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.053 * 0.2)+(0.947 * 1) = 0.96
TY1	0.96	
TY5	0.96	
TY20	1.00	By TY20, the portion of the island that is behind the seawall completely washes away. Although the wall is expected to still be intact, it will not be effecting surf zone habitat. 100% Class 1; Unconfined natural beach with no structures parallel to the shore
TY41	1.00	
TY50	1.00	

<u>Timbalier – FWP (Plan B)</u>

TY0	0.96	There is an existing seawall that is approximately 1,900 ft long. The seawall is on the beach and acts as a revetment (Class 4). The total island length is 35,570 ft long. Therefore 5.3% of the island will be assigned a Class 4 rating (Seawall - SI = 0.2) and the remaining portion of the island

will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.053 * 0.2)+(0.947 * 1) = 0.96

TY1 0.96

TY5 0.96

TY20 0.99 There is an existing seawall that is approximately 1,900 ft long. The seawall that was on the beach is expected to be in the surf zone by TY20, due to island migration. Therefore, it will likely function as a breakwater (Class 3). The total island length is 39,630 ft long. Therefore 4.8% of the island will be assigned a Class 3 rating (SI = 0.9) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.048 * 0.9)+(0.952 * 1) = 0.99

TY41 0.99

TY50 0.99

<u>Timbalier – FWP (Plan E)</u>

TY0 0.96 There is an existing seawall that is approximately 1,900 ft long. The seawall is on the beach and acts as a revetment (Class 4). The total island length is 35,570 ft long. Therefore 5.3% of the island will be assigned a Class 4 rating (Seawall - SI = 0.2) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.053 * 0.2)+(0.947 * 1) = 0.96

TY1 0.96

TY5 0.96

TY20 0.99 There is an existing seawall that is approximately 1,900 ft long. The seawall that was on the beach is expected to be in the surf zone by TY20, due to island migration. Therefore, it will likely function as a breakwater (Class 3). The total island length is 39,630 ft long. Therefore 4.8% of the island will be assigned a Class 3 rating (SI = 0.9) and the remaining portion of the island will be assigned a Class 1 (SI = 1) rating. The suitability index is calculated as follows: (0.048 * 0.9)+(0.952 * 1) = 0.99

TY41 0.99

TY50 0.99

<u>East Timbalier – FWOP</u>

TY0 0.54 Approximately 49% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 51% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.49*0.9)+(0.51*0.2) = 0.54

TY1 0.54

TY5 0.54

TY10 0.58 Approximately 54% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 46% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.54*0.9)+(0.46*0.2) = 0.58

TY20 0.87 Approximately 96% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 4% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.96*0.9)+(0.04*0.2) = 0.87

TY43 0.90

TY41 0.90

TY50 0.90

East Timbalier – FWP (Plan B)

TY0 0.54 Approximately 49% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 51% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.49*0.9)+(0.51*0.2) = 0.54

TY1 0.69 Approximately 70% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 30% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.7*0.9)+(0.3*0.2) = 0.69

TY5 0.70 Approximately 71% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 29% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.71*0.9)+(0.29*0.2) = 0.70

TY10 0.71 Approximately 72% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 28% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.72*0.9)+(0.28*0.2) = 0.71

TY20 0.88 Approximately 98% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore), while 2% is protected by a portion of the rockwall that is now on the beach, functioning as a revetment. The SI was calculated as follows: (0.98*0.9)+(0.02*0.2) = 0.88

TY43 0.90 Approximately 100% of the island is protected by breakwaters (TE-25, TE-30, or the existing rock wall that is now offshore). The SI was calculated as follows: (1.0*0.9) = 0.9

TY45 0.90

TY50 0.90

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 17, 2010

Colonel Edward R. Fleming
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Fleming:

Enclosed is the Final Fish and Wildlife Coordination Act Report on the Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration, Integrated Feasibility Study. Copies of the draft report were provided to the National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries for their review and their comments were incorporated into the final report. This report is transmitted pursuant the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and constitutes the report of the Secretary of the Interior as required by Section 2(b) of that Act.

We appreciate the cooperation of your staff on this study. Should your staff have any questions regarding the enclosed report, please have them contact Ms. Karen Soileau (337/291-3132) of this office.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

Enclosure

cc: EPA, Dallas, TX
National Marine Fisheries Service, Baton Rouge, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
Office of Coastal Protection and Restoration, Baton Rouge, LA
SJB Group, Baton Rouge, LA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 17, 2010

Mr. Richard Hartman
Branch Chief
Habitat Conservation Division
National Marine Fisheries Service
c/o Louisiana State University
Baton Rouge, Louisiana 70803-7535

Dear Mr. Hartman:

Enclosed, for your records, is the Final Fish and Wildlife Coordination Act Report on the Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration, Integrated Feasibility Study. Your agencies comments were incorporated into this final report. This report was prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and constitutes the report of the Secretary of the Interior as required by Section 2(b) of that Act.

We appreciate the cooperation of your staff on this study. Should your staff have any questions regarding the enclosed report, please have them contact Karen Soileau (337/291-3132) of this office.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 17, 2010

Robert J. Barham
Secretary
Louisiana Department of Wildlife and Fisheries
Post Office Box 98000
Baton Rouge, Louisiana 70898-9000

Dear Mr. Barham:

Enclosed, for your records, is the Final Fish and Wildlife Coordination Act Report on the Louisiana Coastal Area – Terrebonne Basin Barrier Shoreline Restoration, Integrated Feasibility Study. This report was prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and constitutes the report of the Secretary of the Interior as required by Section 2(b) of that Act.

We appreciate the cooperation of your staff on this study. Should your staff have any questions regarding the enclosed report, please have them contact Karen Soileau (337/291-3132) of this office.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

Enclosure