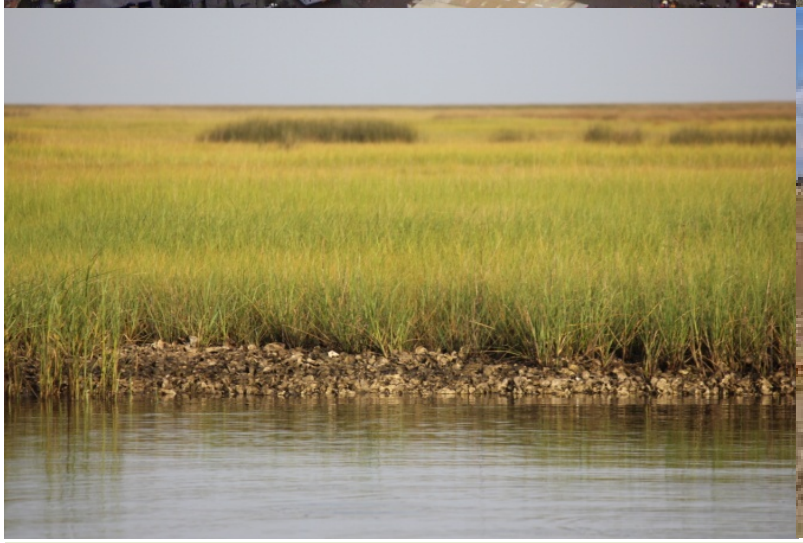
Southwest Coastal Louisiana



Revised Integrated Draft Feasibility Report
and
Environmental Impact Statement

US Army Corps of Engineers®

U.S. Army Corps of Engineers
Mississippi Valley Division
New Orleans District

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Abstract
(*NEPA Required)

The "Southwest Coastal Louisiana Draft Integrated Feasibility Report and Programmatic Environmental Impact Statement" was released in December 2013 and public review was completed in February 2014. However, due to public, technical, and policy comments received, additional analyses completed since the last public review have resulted in revisions significant enough to justify resubmission of a revised draft report for a second public review. This Revised Integrated Draft Feasibility Report and Environmental Impact Statement updates stakeholders and interested parties on changes to the Tentatively Selected Plans (TSPs) for the National Economic Development (NED) and National Ecosystem Restoration (NER) components of the study. The SWC project proposes to provide nonstructural hurricane and storm surge damage risk reduction measures and ecosystem restoration features across 4,700 square miles in Calcasieu, Cameron, and Vermilion Parishes in southwest Louisiana. Potential impacts of both the NED and the NER plans are further described in this Report.

The NED purpose is to reduce the risk of hurricane and storm surge and flood damages. The NED TSP still consists of a programmatic nonstructural plan for the flood proofing of eligible structures in the 25-year floodplain by various methods including the elevation of eligible residential structures, dry flood proofing of eligible non-residential commercial structures, and the construction of berms and floodwalls of less than six feet in height around eligible industrial complexes and warehouses. Although the program is primarily voluntary in nature, some structures may be subject to eminent domain if certain established criteria as outlined in the NED TSP are met. Additional National Environmental Policy Act (NEPA) assessments will be required prior to implementation of the nonstructural program.

The purpose of the NER plan is to restore environmental conditions for the Chenier Plain ecosystem as more fully described in the LCA Ecosystem Restoration Study (2004). The NER TSP consists of 51 ecosystem restoration features that are now being recommended for construction, in addition to the recommendation for a long-range study of the Calcasieu Ship Channel salinity control structure. The plan includes nine marsh restoration measures, one hydrologic and salinity control measure, five shoreline protection measures, and a Chenier reforestation program consisting of planting seedling trees and invasive species control at 35 locations in Cameron and Vermilion Parishes. The previously released SWC draft report documented a NER TSP consisting of features for restoration but under a programmatic recommendation (thus requiring additional NEPA and design documentation to be completed before construction could occur). This Report addresses the need for outstanding NEPA and feasibility-level design work on the NER TSP. The 2013 draft report is incorporated herein by reference and included in Appendix M.

There is a potential for beneficial direct, indirect, and cumulative impacts to wetlands, wildlife, fisheries, and water quality with implementation of the NER TSP. Environmental Justice (EJ) requires the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. There is a potential for adverse impacts and an inequitable distribution of environmental burdens to certain communities depending on how the NED TSP is applied. Additional analysis and outreach to EJ communities would be conducted before implementing the nonstructural program to minimize any potential disproportionate impacts and develop appropriate mitigation strategies if necessary. The nonstructural program will be fully compliant with Executive Order 12898.

Comments: Please send comments to the U.S. Army Corps of Engineers, New Orleans District, Attention: Sandra Stiles, CEMVN-PDN-CEP, P.O. Box 60267, New Orleans, LA 70160-0267, by e-mail: SWCoastalAdmin@usace.army.mil or by Fax: (504) 862-1892. Please direct questions by telephone: (504) 862-1583. The comment period closing date will be 45 days from the date of publication of the Notice of Availability in the *Federal Register*.




Hurricane Ike flooding in Delcambre, Louisiana.

This Report revises the draft "Southwest Coastal Louisiana Draft Integrated Feasibility Report and Programmatic Environmental Impact Statement" which was previously released in December 2013 and contains modified Tentatively Selected Plans (TSP) for the National Economic Development (NED) and National Ecosystem Restoration (NER) components of the Study.

The people, economy, environment, and cultural heritage of coastal areas in Southwest Louisiana are at risk from damages caused by hurricane and storm surge flooding. Southwest coastal Louisiana's topography, and low elevation, proximity to the Gulf of Mexico, subsiding lands, and rising seas, are all contributing factors which cause coastal flooding, shoreline erosion, saltwater intrusion, and loss of wetland and Chenier habitats which are conditions that are expected to continue to worsen.

Through separate reciprocal authorizations, Congress authorized the investigation of alternatives to: (1) provide hurricane protection and storm damage reduction, and (2) significantly restore environmental conditions. Planning to address hurricane protection and storm surge damage reduction (the NED component) was primarily focused on communities and areas located north of the Gulf Intracoastal Waterway (GIWW), but measures for all at-risk structures both inside and outside of the coastal zone were considered. Planning measures for ecosystem restoration (the NER component) concentrated exclusively on locations within the coastal zone.

The SWC study area encompasses over 4,700 square miles of varying terrain in the Calcasieu, Cameron, and Vermilion Parishes). The major physiographic divisions are the Gulf Coast Prairies and the Gulf Coast Marsh. The major hydrologic basins in the Study Area are the Mermentau River, the Calcasieu-Sabine Lakes, and the Teche/Vermilion Basin. Dominant water features in the Study Area are the Calcasieu, Sabine, Neches, Mermentau, and Vermilion Rivers and Calcasieu, Sabine, Grand, and White Lakes. Man-made channels in the Study Area are the Sabine-Neches Waterway, Calcasieu Ship Channel, GIWW, Mermentau Ship Channel, and Freshwater Bayou Canal. The channels and waterways, except for the GIWW, are oriented north to south along the Gulf coast.

The GIWW is the longest channel crossing the Study Area and generally runs along the State's coastal zone boundary. Water control structures in the Study Area are the Calcasieu and Leland Bowman Locks, the Freshwater Bayou Canal Lock, the Schooner Bayou Canal Structure, and the Catfish Point Control Structure. Key highways in the Study Area are LA-82 and LA-27 and I-10. Population centers are mainly north of the GIWW, and include the largest municipalities of Lake Charles, Sulphur, and Abbeville.

The Project Delivery Team (PDT) used information from prior Federal, state, and local efforts to focus the Study on the most critical areas. System-wide problems and opportunities were used to identify and define site-specific problems and opportunities. Problems in the SWC study area include:

- Flooding from tidal surge and waves associated with hurricanes and tropical storms.
- Increased flood durations in wetlands, resulting in wetland loss.
- Erosion of channel banks and shorelines, resulting in wetland loss.
- Deforestation and mining of chenier ridges.

Opportunities to solve these problems include:

- Incorporate structural and nonstructural coastal storm damage risk reduction measures to reduce the risk of damages and prevent loss of community cohesion.
- Improve internal system hydrology to restore wetlands.
- Manage salinity levels to maintain fresh and intermediate marsh.
- Reduce bank and shoreline erosion.
- Prevent loss of significant historic and cultural resources.

The PDT developed the following five planning objectives for the 50-year period of analysis (2025-2075):




- *Objective 1.* Reduce the risk of damages and losses from hurricane and storm surge flooding.
- *Objective 2.* Manage tidal flows to improve drainage and prevent salinity from exceeding 2 parts per thousand (ppt) for fresh marsh and 6 ppt for intermediate marsh.
- *Objective 3.* Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.
- *Objective 4.* Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.
- *Objective 5.* Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.

The following planning constraints to be avoided or minimized were identified:

- *Commercial navigation.* The Calcasieu and Sabine ship channels and the GIWW carry significant navigation traffic. Therefore, features that might result in shipping delays or undermine the purposes of authorized navigation projects would likely result in negative National Economic Development (NED) impacts.
- *Federally listed threatened and endangered species and their critical habitats.* Construction windows for resident and migratory species overlap and/or may include the entire year: piping plover, Gulf sturgeon, red-cockaded woodpecker, red knot, whooping crane, West Indian manatee, and several species of sea turtles.
- *Essential fish habitat (EFH), especially intertidal wetlands.* Conversion of one EFH type to another should be done without adversely impacting various fish species. For example, conversion of shallow open water EFH to marsh EFH.
- *Cultural and historic resources.* Archeological sites and standing structures have been identified in the area, including properties eligible for or listed in the National Register of Historic Places, as well as potentially eligible sites and structures.

National Economic Development (NED) Planning

Hurricane and storm damage risk reduction measures were developed and screened using preliminary costs and benefits to identify a focused array of NED alternatives. In addition to the "No Action" alternative, the focused array contained three levee alignments in the Lake Charles area; three levee alignments around the towns of Abbeville, Delcambre, and/or Erath; and two stand-alone nonstructural alternatives.

NED Focused Array includes:

- No Action
- Lake Charles Eastbank
- Lake Charles Westbank Sulphur Extended
- Lake Charles Westbank Sulphur South
- 100-year Floodplain [(1% Annual Chance Exceedance (ACE)] Nonstructural Plan
- Delcambre/Erath
- Abbeville to Delcambre
- Abbeville
- Nonstructural Justified Reaches Plan

The assessment of economic feasibility for six independent structural measures was conducted in the focused array analysis. As a result of this additional evaluation, none of the structural levee alignments were found to be economically justified and none were carried into the final array. The evaluation of the focused array determined that the most cost-effective solution to reduce hurricane and storm surge flood-risk within the study area is through nonstructural measures. The No Action Plan, Plan 7 "Nonstructural - Justified Reaches Plan" (based on 11 economically justified reaches) and Plan 8 were carried into the final array with Plan 7 being selected as the NED TSP in the draft 2013 report.

After the release and receipt of comments on the December 2013 Initial Draft Report, structures in the 0-10-year floodplain were added to the structure inventory and additional economic calculations were performed to determine whether the addition of these repetitive flood risk structures resulted in a positive net NED benefits and has a positive benefit/cost ratio. The revised evaluation of nonstructural measures consisted of evaluating every structure in the revised inventory, with a FFE below the 100-year stage for water surface elevations (WSEs) prevailing in the year 2025 rather than the year 2075. The revised NED TSP will provide reduced flood risk for a total of 4,952 total impacted structures (based on expected 2025 conditions)

comprised of 4,219 residential structures, 396 commercial structures and public buildings, and 337 warehouses. The expected average annual net benefits are approximated at $231.6 million dollars, with $824,000,000 in first costs, and a benefit/cost ratio of 7.74:1. Note: Subsequent NEPA documents will analyze in detail site specific Project benefits and impacts as the nonstructural program is implemented.

A brief summary of the components of the NED TSP include:

1. Elevation of eligible residential structures. This measure requires lifting the entire structure or the habitable area to the predicted 2075, 100-year base flood elevation unless the required elevation is greater than a maximum of 13 feet above ground level.
2. Dry flood proofing of eligible non-residential structures (excluding large warehouses and industrial complexes). Dry flood proofing consists of sealing all areas below the flood protection level of a structure to make it watertight and ensure that floodwaters cannot get inside by making walls, doors, windows and other opening impermeable to water penetration.
3. Construction of flood proofing barriers or berms less than 6 feet in height around non-residential structures, primarily industrial complexes and warehouses. These measures are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements.
4. Floodplain Management Plans. The NFS is required to prepare a Floodplain Management Plan in coordination with USACE to maintain the integrity of the project; however the NFS should work with the governing bodies within the three parishes to ensure consistency with local development plans and regulations.
5. Adoption of more stringent local floodplain regulations. Although communities within the study area cannot change the minimum NFIP standards, the NFS should work with the local governments to adopt local standards that achieve higher levels of flood risk reduction, such as replacing elevation requirements based on the 100-year to the 500-year; Implementing a zero rise floodway; and adopting cumulative damages as the trigger for substantial damage determination.
6. Adoption of more restrictive parish and municipal building codes, land use & zoning regulations. and other developmental controls. Local governments within the floodplain should be encouraged to adopt and implement and enforce stricter building and housing code requirements, and land use and zoning regulations and other developmental controls aimed at reducing flood risk and flood damage.

National Ecosystem Restoration (NER) Planning

NER plan screening was based on monetary and non-monetary evaluations. Preliminary costs and benefits for marsh restoration, shoreline protection, chenier reforestation, oyster reef preservation, and water control were estimated. Screening criteria included planning constraints; support for objectives; measure effectiveness; and below average efficiency. Measures that did not meet the screening criteria were retained only in limited instances in which they supported critical adjacent features.

Alternative plans were created by combining measure types into comprehensive strategies. The measures include hydrologic and salinity control, marsh restoration, shoreline protection, and chenier reforestation. The NER focused array contains a "No Action" alternative and 27 other plans that were based on 8 restoration strategies.

NER Strategies:

- No Action
- Large Integrated Restoration
- Moderate Integrated Restoration (Hydrologic Emphasis)
- Moderate Integrated Restoration, including Gum Cove Lock
- Small Integrated Restoration
- Interior Perimeter Salinity Control
- Marsh and Shoreline (Minimal Hydrologic & Salinity Control)
- Entry Salinity Control

Scales and combinations of these strategies were developed resulting in 28 NER alternatives in the focused array. Benefits in the Calcasieu-Sabine Basin were considered separately from the Mermentau/Teche-Vermilion Basin. Benefits were also considered jointly as comprehensive plans. Alternatives were evaluated for cost effectiveness and incremental costs.

The NER TSP is "Small Integrated Restoration" known as the NER Plan CM-4 and consists of 51 ecosystem restoration features (9 marsh restoration features; 35 chenier reforestation features; 5 shoreline protection features; and 1 hydrologic/salinity control feature). The NER TSP is a cost-effective, comprehensive ecosystem restoration plan that addresses land loss and ecosystem degradation. The Plan is the least-cost comprehensive "best buy" plan which addresses the goals of minimizing land loss. The NER TSP contains features to restore 15,581 acres of wetlands; restore and protect 341 acres of designated critical habitat (for threatened piping plover and red knot); enhance plant productivity; and reinforce and protect critical landscape features. The Calcasieu Ship Channel Salinity Barrier Navigation Study is recommended as an additional long-range study. The NER Plan first construction cost estimate is ~$988,000,000. The Revised Draft Report provides greater detail for the NER features which are now recommended for construction.

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Appendices

INTRODUCTION

This revised Draft Integrated Feasibility Report and Environmental Impact Statement is the result of significant public and policy comments on the draft Southwest Coastal Louisiana Draft Integrated Feasibility Report and Programmatic Environmental Impact Statement released on December 13, 2013. These revisions include consideration of additional nonstructural flood risk reduction actions and development of a detailed and constructible ecosystem restoration plan.

Purpose of Action and Scope (*NEPA Required)

The low elevation and proximity of the Study Area to the Gulf of Mexico puts the unique environment and cultural heritage of southwest coastal Louisiana communities at risk of damages from storm surge flooding and coastal erosion. Land subsidence and rising sea level are expected to increase the potential for coastal flooding, shore erosion, saltwater intrusion, and loss of wetlands and chenier habitats. Through separate reciprocal authorizations, Congress authorized the investigation of alternatives to: (1) provide hurricane protection and storm damage reduction, and (2) significantly restore environmental conditions that existed prior to the large scale alteration of the natural ecosystem including the Chenier Plain in Calcasieu, Cameron, and Vermilion parishes in Louisiana. The intent is to develop potential solutions to these water resource problems. The impacts described for the National Economic Development (NED) hurricane and storm damage risk reduction objective are programmatic in nature and therefore additional National Environmental Policy Act (NEPA) documents will be prepared at a later date to further analyze in detail site specific project(s) impacts prior to implementation of the NER component of the Project. The National Ecosystem Restoration (NER) features have been developed to a feasibility level of design and are recommended as fully constructible.

Federal Objectives

The Federal objective of water and related land resources planning is to provide the greatest net contribution to NED consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. The ecosystem restoration objective is to contribute to NER by restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition.

1.0 PROJECT SETTING

This chapter describes the historic and existing conditions of the affected environment and forecasts the "future without-project conditions" which provides the basis for plan formulation. Additional impact analysis of important resources is provided in Appendix A.

1.1 Affected Environment (*NEPA Required)

Study Area

The study area (Figure 1-1) is located in southwest Louisiana and includes all of Calcasieu, Cameron, and Vermilion parishes encompassing approximately 4,700 square miles. Cameron Parish is located in the southwest corner of Louisiana. The southern boundary of the parish is the Gulf of Mexico. Eighty-two percent of Cameron Parish is coastal marshes. Geographically, it is one of the largest parishes in Louisiana. The parish is chiefly rural and the largest communities are Cameron and Hackberry. Cameron is located along LA-82, while Hackberry is located along LA-27. Other smaller communities include Creole, Johnsons Bayou, and Holly Beach. Calcasieu Parish is located due north of Cameron Parish. The town of Lake Charles is the parish seat, which is the largest urban area in the study area. Only a small portion of the parish is located in the coastal zone. Vermilion Parish is located due east of Cameron Parish. The southern boundary of the parish is the Gulf of Mexico. Large expanses of Vermilion Parish are open water (lakes, bays, and streams). Approximately 50 percent of the land is coastal marshes. The parish is chiefly rural and the town of Abbeville is the parish seat as well as the largest urban area in the parish. Other communities include Delcambre, Kaplan, and Gueydan, which are all located along LA-14 in the northern part of the study area. Pecan Island and Forked Island are smaller communities, both located along LA-82 in lower Vermilion Parish. Located




along LA-333, Intracoastal City is the nearest access to Vermilion Bay and the Gulf of Mexico in this region and supports the area's oil and shrimp industries.

Geomorphic and Physiographic Setting

The area is characterized by extensive coastal marshland interrupted by forests atop relict chenier ridges and natural ridges. The cheniers are unique geological features that are critical components of the ecology. Cheniers and natural ridges were formed over thousands of years by the deltaic processes of the Mississippi River and other streams. The chenier ridges run laterally to the modern shoreline and rise above the surrounding marshes by as little as a few inches or as much as 10 feet (Byrne et al. 1959). These ridges can range from 100 to 1,500 feet wide with some ridges extending along the coast for a distance of up to 30 miles. Cheniers were created during the Pleistocene by river sediments being pushed westward by shoreline currents in the Gulf of Mexico (Gould and McFarlan 1959). Natural ridges were formed by the repeated overbank flood sedimentation of rivers in southeast Louisiana (Fisk 1944). Principally, the rivers involved in creating these natural levees are past distributaries of the Mississippi River.

The main physiographic zones of the Chenier Plain include the Gulf Coast Marsh, Gulf Coast Prairies, and Forested Terraced Uplands. The Gulf Coast Marsh is at or near sea level and borders the Gulf of Mexico and most of the large lakes are in this area. The Gulf Coast Prairie extends from the central part of Vermilion and Cameron Parishes into the southern part of Calcasieu Parish; while the Forested Uplands, which occur at or near 25-foot elevation, are located in the northern part of Vermilion and Calcasieu Parishes. Louisiana's coastal prairies, once encompassing an estimated 2.5 million acres in the southwest portion of the state, now are considered critically imperiled with less than 600 acres remaining.

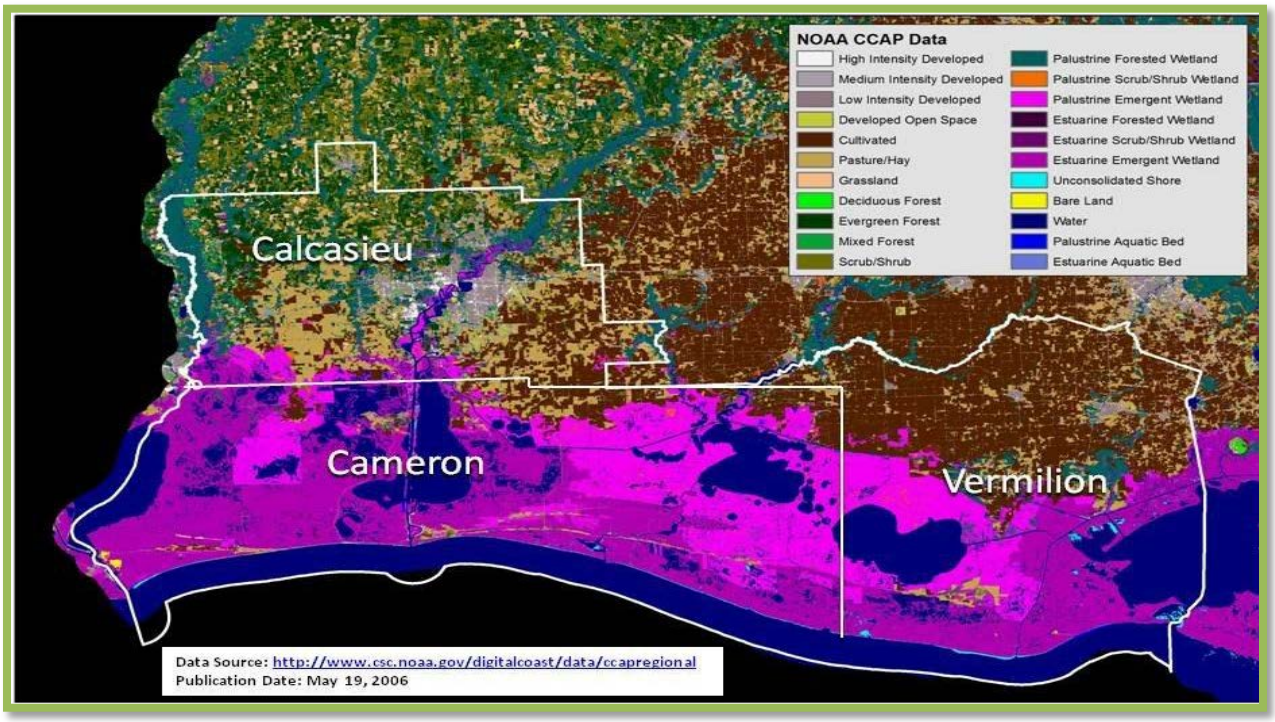

Figure 1-1: Study area map.

The relationship between the forested cheniers and the surrounding aquatic ecosystem is inextricably linked. Cheniers provide valuable habitat for wetland-dwelling animal species in the form of cover, food, and nesting. Additionally, cheniers offer a protective element to nearby wetlands by reducing wave energies and diverting water flow that can come ashore from tropical events. These remnant beachheads, although elevated, offer a unique and important habitat that is currently in a degraded form. Reforestation would help ensure the viability of the cheniers into the future thereby offering continued natural protection to sensitive wetland

areas as well as to other features identified for construction in the NER plan. Land cover classifications from the Louisiana Coastal Area (LCA) habitat dataset for calendar year 2000, the most recent data set available to the USGS, are presented in Table 1-1 and Appendix A. The 2000 LCA habitat data composition does not cover the portion of the study area north of the coastal zone (USGS 2013).

Table 1-1: Year 2000 area habitat classification.

Habitat Class	Acres	Percent of Project Area
Water	286,086	9.79%
Water - Fresh Zone	73,262	2.51%
Water - Intermediate Zone	84,736	2.90%
Water - Brackish Zone	49,896	1.71%
Water - Saline Zone	5,309	0.18%
Water - Swamp Zone	0	0.00%
Fresh Marsh	336,406	11.51%
Intermediate Marsh	310,577	10.62%
Brackish Marsh	177,369	6.07%
Saline Marsh	35,518	1.22%
Non-wetlands	15,651	0.54%
Wetland Forest	16,208	0.55%
Upland Forest	7,709	0.26%
Swamp	0	0.00%
Wetland Shrub/Scrub	17,076	0.58%
Upland Shrub/Scrub	10,745	0.37%
Agriculture/Pasture	67,842	2.32%
Developed	7,211	0.25%
Barren	9	0.00%
*Out of Analysis	1,421,582	48.63%
Total Acres	2,923,194	

*Out of analysis—this area, primarily north of the Coastal Zone, was not included in the original data set from which the data is derived.
(source: USGS Map ID USGS-NWRC 2014-11-0001 Map Date: October 18, 2013.)

Climate

The climate is subtropical marine with long humid summers and short moderate winters. The average temperatures range from 59 to 78°F; with August being the warmest and December the coolest. Average annual rainfall is 57 inches; with June the wettest and April the driest month (Source: http://www.srh.noaa.gov/lch/?n=KLCH, accessed August 30, 2013). During the summer, prevailing southerly winds produce conditions favorable for afternoon thundershowers. In the colder seasons, the area is subjected to frontal movements that produce squalls and sudden temperature drops. River fogs are prevalent in the winter and spring when the temperature of the major water bodies is somewhat colder than the air temperature. Since 1865 a total of 16 hurricanes have made landfall within 65 nautical miles of Lake Charles (source:http://csc.noaa.gov/hurricanes/#app=6078&7239-selectedIndex=0&3722-selectedIndex=0, accessed August 30, 2013).

1.2 Human Environment

Communities include the cities of Lake Charles and Sulphur; the towns of Vinton and Iowa in Calcasieu Parish; the towns of Cameron, Grand Lake, Hackberry, and Grand Chenier in Cameron Parish; and the city of Abbeville, the towns of Erath, Kaplan, and Pecan Island in Vermilion Parish; and the town of Delcambre in Vermilion and Iberia parishes. These parishes have historically suffered extensive damage from hurricanes and tropical storms due to insufficient hurricane and storm damage risk reduction features. The impact of

preparing for, mitigating, and recovering from these damages has placed a significant physical and emotional burden on both individuals and communities. Most recently, Hurricanes Rita (2005) and Ike (2008) caused significant damage to homes and businesses. In this section, socioeconomic and other social effects (OSE) data for Calcasieu, Cameron, and Vermilion Parishes provide a context from which to evaluate potential effects of the proposed action.

1.2.1 Population and Housing

Table 1-2 shows the population trend in the three-parish area from 1970 to 2012. Population increases between 2000 and 2010 reflect similar growth patterns state-wide over this period. Population in the three-parish area in 2012 was 259,918, although there was a decline of population, due in large part to impacts from tropical storms and hurricanes, in Cameron Parish from 2000 to 2012. It is probable that recovery requirements and updated FEMA base flood delineation following this series of storms had a more pronounced effect on redevelopment in predominantly coastal Cameron Parish. Significant elevation requirements in order to achieve FEMA compliance likely resulted in a northward population shift. Such a shift would be consistent with the observed population trend in Calcasieu Parish.

Table 1-2: Population in the study area.

Parish	1970	1980	1990	2000	2010	2012
Calcasieu	145,415	167,223	168,134	183,577	192,768	194,493
Cameron	8,194	9,336	9,260	9,991	6,839	6,702
Vermilion	43,071	28,458	50,055	54,014	57,999	58,723
Total	**196,680**	**205,017**	**227,449**	**247,582**	**257,606**	**259,918**

Sources: U. S. Census, 2010 and U.S. Census Abstract, 2013

The trend in household formation, shown in Table 1-3, parallels the growth in population. Most households are located in the metropolitan areas which include: Lake Charles in Calcasieu Parish; Cameron (which serves as the seat of government in Cameron Parish); and Abbeville located in Vermilion Parish.

Table 1-3: Households (in thousands) in the study area.

Parish	1970	1980	1990	2000	2010	2012
Calcasieu	42.1	56.8	60.4	68.6	70.6	72.2
Cameron	2.3	3.0	3.1	3.6	2.5	2.4
Vermilion	12.8	16.3	17.7	19.9	21.1	21.6
Total	**57.2**	**76.1**	**81.3**	**92.1**	**94.2**	**96.2**

Sources: U. S. Census, 2010 and U.S. Census Abstract, 2013

According to the Federal Emergency Management Agency (FEMA 2013), flood claims from all sources for the three-parish area between 1978 and 2012 totaled $420,900,000 (Table 1-4).

Table 1-4: Summary of flood claims data for the period 1978 to 2012.

Parish	Claims	Total Nominal Dollar Amount (in millions)	Average Amount per claim
Calcasieu	4,008	$132.0	$32,930
Cameron	3,061	$173.5	$56,679
Vermilion	3,218	$115.4	$35,860
Total	**10,287**	**$420.9**	**$41,823**

Note: Dollar amounts reflect the amount paid out at time of claim

1.2.2 Employment, Business, and Industrial Activity

Economic growth is highly dependent upon the major employment sectors. With the exception of the cities of Lake Charles, Sulphur, Abbeville, and Delcambre, the study area is sparsely populated. The area is rich in natural resources and industrial infrastructure. The economy of the coastal communities is centered around fishing, shrimping, and offshore oil services. The agricultural land located 30 to 40 miles inland is used for rice, sugar cane, and livestock production. The northern-most portion is heavily forested and supports a substantial timber industry. Lake Charles, which is the population center of the region, is the home of large oil refineries, petro-chemical plants, a deep-water port, McNeese State University, and casinos along the lakefront.

Table 1-5 shows the growth of non-farm employment over the last four decades. The leading employment sectors are education, healthcare, petroleum production, and petrochemical refining. Other significant employment sectors include education, manufacturing, accommodations and social services, and retail trade. Employment growth was steady from 1970 to 2012 for Calcasieu and Vermilion parishes, although employment in Cameron parish declined since 2000, and is reflected in the population estimates previously described.

Table 1-5: Non-farm employment in the study area (in thousands).

Parish	1970	1980	1990	2000	2010	2012
Calcasieu	41.1	67.0	69.0	84.6	87.9	93.3
Cameron	2.8	4.4	4.1	3.9	2.6	2.7
Vermilion	9.4	16.6	13.3	14.7	15.5	16.9
Total	53.3	88.0	86.4	103.2	106.0	112.9

Source: Moody's 2013

1.2.3 Public Facilities and Services

Public facilities and services have historically grown to meet population demands. The area includes a mixture of community centers, schools, hospitals, airports, colleges, and fire protection. The Port of Lake Charles is a key center for international trade, and is among the top 15 busiest ports in the nation. A total of 603 public and quasi-public buildings were specifically inventoried in 2012.

1.2.4 Transportation

The transportation infrastructure includes major roads, highways, railroads, and navigable waterways that have developed historically to meet the needs of the public. Interstate 10 (I-10), an east-west bi-coastal thoroughfare that connects Houston and Baton Rouge, crosses the northern part of the area and is a primary route for hurricane evacuation and post-storm emergency response. US-165, another evacuation and emergency response route, is located north of I-10. Most of I-10 is either at or just below the 100-year floodplain. Other major highways include US-13 and US-26, which run north-south and intersect I-10 in the northeastern portion of the parishes. Other modes of transportation include water transport along the Gulf Intracoastal Waterway (GIWW) and the Sabine and Calcasieu Rivers, all of which accommodate ocean-going vessel and barge traffic. Rail and aviation facilities are spread throughout. During Hurricanes Rita and Ike, portions of I-10 were inundated by a combination of storm surge and rainfall. This interfered with emergency service access and prevented local and regional residents from returning to their primary residences and businesses. This delay in repopulation results in additional emergency costs, due to the longer time periods required for sheltering residents until the area was made safe to return.

1.2.5 Community and Regional Growth (Income)

Community and regional growth primarily track population and employment trends that were described in the preceding sections. Table 1-6 shows per capita growth in income since 1990.

Table 1-6: Nominal Per capita income in the study area.

Parish	1990	2000	2010	2012
Calcasieu	$15,511	$23,034	$29,021	$34,577
Cameron	$13,001	$18,433	$20,739	$33,784
Vermilion	$12,343	$19,130	$23,091	$29,873

Note: Dollar amounts reflect the income in associated year prices

1.2.6 Tax Revenue and Property Values

Historically, damages from storm surge events have adversely impacted business and industrial activity, agricultural activity, and local employment and income, which then led to commensurate negative impacts to property values and the tax base upon which government revenues rely. As in other developed communities, the presence of high flood risk has reduced property values since the cost of repairing flood damages [whether directly by property owners or through claims made through the National Flood Insurance Program (NFIP) for which annual premiums are charged] increases the long-term cost of property ownership. Measurement of this loss is problematic since the market price of properties capture an extensive array of factors such that the contribution of flood risk to changes in market value cannot be directly ascertained. As described in detail on page 7 of the Economics Appendix, structure characteristics for 46,860 residential and 4,997 non-residential structures were collected to assist in evaluating the impacts of flood risk under existing and future conditions. As this data reflects, currently, the median depreciated replacement value of housing units is $115,684 (in 2012 price prices).

1.2.7 Community Cohesion

Community cohesion is based on the characteristics that keep the members of the group together long enough to establish meaningful interactions, common institutions, and agreed upon ways of behavior. These characteristics include race, education, income, ethnicity, religion, language, and mutual economic and social benefits. The area is comprised of communities with a long history and long-established public and social institutions including places of worship, schools, and community associations. In 2005 with Hurricane Rita, and again in 2008 with Hurricane Ike, communities in Calcasieu, Cameron, and Vermilion Parishes were inundated by storm surge. Due to the absence of flood risk reduction measures, and the resulting direct impacts to existing structures, local populations were forced to evacuate and/or relocate for significant time periods, thereby significantly disrupting temporarily, and in some instances, permanently, community cohesion throughout the study area.

1.2.8 Other Social Effects (OSE)

The Hazards and Vulnerability Research Institute at the University of South Carolina created an index that compares the social vulnerability of U.S. counties/parishes to environmental hazards. The variables included in the index are based on previous research which has found that certain characteristics (e.g., poverty, racial/ethnic composition, educational attainment, and proportion over the age of 65) contribute to a community's vulnerability when exposed to hazards. According to the Institute for Water Resources Other Social Effects handbook (USACE, 2008), the Social Vulnerability Index (SoVI®) is a valuable tool that can be used in the planning process to identify areas that are socially vulnerable and whose residents may be less able to withstand adverse impacts from hazards. The SoVI® was computed as a comparative measure of social vulnerability for all counties/parishes in the U.S., with higher scores indicating more social vulnerability than lower scores. Calcasieu Parish has a SoVI® 2006-10 score of -1.21 (0.28 national percentile), Cameron Parish has a SoVI® 2006-10 score of -3.59 (.08 national percentile), and Vermilion Parish has a SoVI® 2006-10 score of -0.04 (0.49 national percentile). Based on these scores, Calcasieu Parish is rated as more socially vulnerable than roughly 72 percent of counties/parishes in the U.S., Cameron Parish is rated as more socially vulnerable than about 92 percent of counties/parishes in the U.S., and Vermilion Parish is rated as more socially vulnerable than roughly 51 percent of counties/parishes in the U.S. By comparison, Orleans Parish, notorious for its enduring levels of high poverty, has a SoVI® 2005-09 score of -0.92 making it less socially vulnerable than 67 percent of counties/parishes in the nation. Hence, Cameron Parish is by far the most socially vulnerable to coastal storm damage consequences in the study area followed by Calcasieu Parish and

Vermilion Parish. is the least socially vulnerable in the area. However, all three parishes are ranked as being more socially vulnerable to coastal storm damage consequences than Orleans Parish.

1.2.9 Environmental Justice

The Environmental Justice (EJ) study area contains all Census Tracts and Census block groups located within Calcasieu, Cameron, and Vermilion parishes.

Table 1-7 shows the racial characteristics of the three parishes according to the 2010 U.S. Census. Overall, minority residents make up 29% of the population in Calcasieu, 4% of the population in Cameron and 20% of the population in Vermilion Parishes. According to the 2010 U.S. Census data, there are 42 block groups in Calcasieu Parish and 8 block groups in Vermilion Parish where 50 percent or more of the population identify themselves as part of a minority group. There are no block groups in Cameron Parish where more than one percent identify themselves as part of a minority group (Figure 1-2).

Table 1-7: Racial characteristics in the study area.

Parish	White	African American*	American Indian/Alaska Native*	Asian*	Hawaiian/Pacific Islander*	Total	Percent Minority**
Calcasieu	136,514	47,782	898	2,073	93	192,768	29%
Cameron	6,546	119	36	6	0	6,839	4%
Vermilion	46,922	8,286	209	1,160	5	57,999	20%

* 2010 Census / ** 2007 – 2011 Census

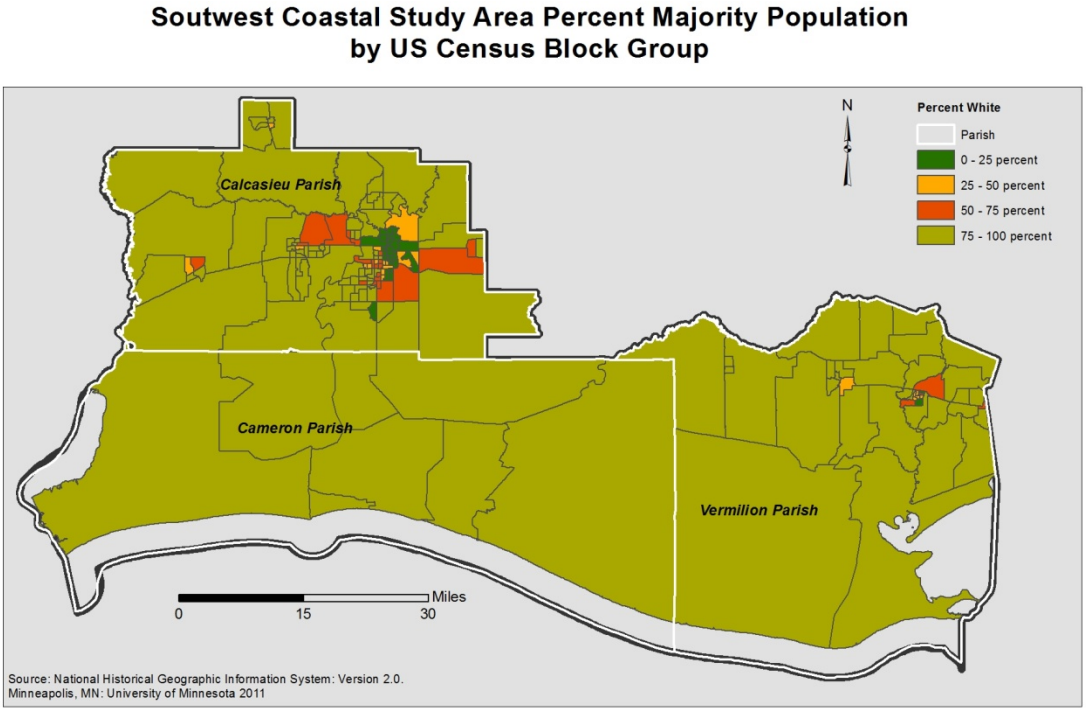

Figure 1-2: Racial majority by block group.

High poverty rates negatively impact the social welfare of residents and undermine the community's ability to provide assistance to residents in times of need. The 2007-2011 American Community Survey (ACS) data indicate that 9 percent of households in Calcasieu Parish, 5 percent in Cameron Parish, and 10 percent in

Vermilion Parish fell below the poverty line (Figure 1-3). The 2007-2011 Census American Community Survey data indicate that there are:

- 17 poverty areas and 2 extreme poverty areas (block groups) in Calcasieu Parish
- 0 poverty areas or extreme poverty areas (block groups) in Cameron Parish
- 7 poverty areas and 1 extreme poverty areas (block groups) in Vermilion Parish

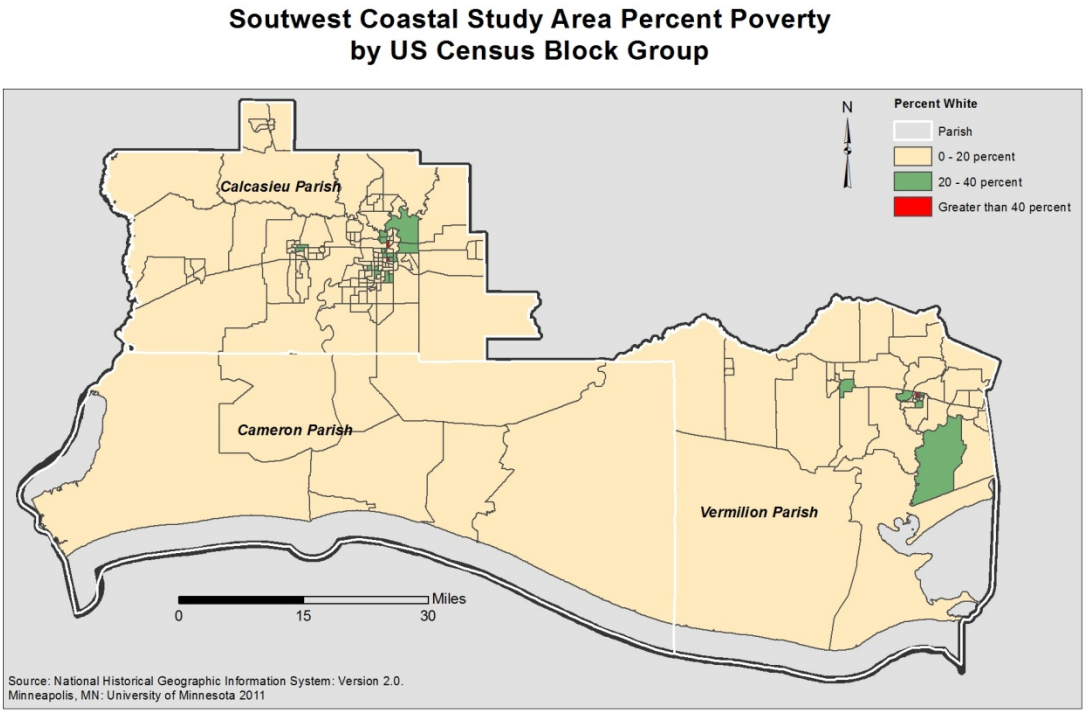

Figure 1-3: Percent population below poverty line by block group.

1.3 Water Environment (Hydrology and Hydraulics)

The two major hydrologic basins in the Chenier Plain are the Mermentau Basin and the Calcasieu-Sabine Basin (LCA, 2004). The Teche-Vermilion Basin is another significant hydrologic basin in the study area. The general location and major features/water bodies in each basin are described below. Figure 1-4 identifies major hydrologic features. For the most part areas below the GIWW are within the coastal zone.

Calcasieu-Sabine Basin - The Calcasieu-Sabine Basin lies in the western portion of the Chenier Plain in Cameron and Calcasieu Parishes. It is bounded to the east by LA-27, to the south by the Gulf of Mexico, and to the west by the Sabine River and Sabine Lake. The Basin is a shallow coastal wetland system with freshwater input at the north end, a north-south flow through Calcasieu and Sabine lakes, and some east west water movement through the GIWW and interior marsh canals (e.g., North Starks and South Starks canals on the Sabine National Wildlife Refuge). The dominant hydrologic features of the basin are the Calcasieu and Sabine Lakes, which are directly influenced by the Calcasieu, Sabine, and Neches Rivers. Navigation channels include the Sabine-Neches Waterway, and the Calcasieu River and Pass. Water control structures in the area include the Calcasieu Locks. Managed wetlands, which utilize natural and manmade features to regulate water level and quality, and marsh productivity, are a significant feature of the Calcasieu-Sabine Basin (LADNR 2002). The Calcasieu drainage basin north of the point where the Sabine River crosses the GIWW is 3,235 square miles. The Sabine drainage basin has a drainage area of 9,760 square miles. The headwaters start in northeastern Texas and the river runs about 150 miles before it meets the Louisiana-Texas state line, then

runs to the Gulf. The Toledo Bend Reservoir and Sabine Lake are the major hydrologic features of the Sabine Basin.

The GIWW from the Sabine River to the Calcasieu River is a 125 feet (ft) wide x 12 ft deep. Construction of the GIWW significantly altered regional hydrology by connecting the two major ship channels. Prior to the construction of the GIWW, the Calcasieu and Sabine estuaries were mostly distinct and were more influenced by the Calcasieu and Sabine rivers, respectively. The Gum Cove Ridge once separated the Sabine Basin from the Calcasieu Basin, with little water exchange between the basins. Removing the mouth bars and deepening the Calcasieu Ship Channel (CSC) and the Sabine-Neches channels, as well as the GIWW and interior canals bisecting the Gum Cove Ridge, made the region hydrologicaly indistinct, which caused water flow and salinity patterns of one basin to profoundly affect those patterns of the other basin. In addition to combining the two basins, the GIWW severed hydrologic connections (e.g., bayous and sheet flow) between the northern and southern portions of these basins, and channelized these freshwater flows directly to the Gulf of Mexico, thereby partially bypassing the southern marshes.

Mermentau Basin - The Mermentau Basin lies in the eastern portion of the Chenier Plain in Cameron and Vermilion Parishes. The Mermentau River Basin can be divided into three sub-basins: Upland, Lakes, and Chenier. The Upland Sub-basin covers an area of 3,683 square miles of predominantly agricultural land. The Lakes Sub-basin is delineated by the Freshwater Bayou Canal on the east, the limit of the coastal zone on the north, LA-27 on the west, and LA-82 on the south. LA-82 runs atop and between the Grand Chenier-Pecan Island ridge complex. The Chenier Sub-basin lies south of this ridge complex. The dominant hydrologic features of the Mermentau basin are the Grand and White Lakes and the Mermentau River. Navigation channels include the Mermentau Ship Channel. Various water control structures include the Freshwater Bayou Canal Lock, the Schooner Bayou Canal Structure, and the Catfish Point Control Structure.

Before human-induced hydrologic alterations from navigation channels in the early 1900s, the natural drainage in the Mermentau Basin was dominantly north-south through the Mermentau River, Freshwater Bayou, Bayou Lacassine, and Rollover Bayou. The eastern portion of the basin also drained in an easterly direction through Belle Isle and Schooner bayous. In addition, sheet flow over the marsh occurred between Grand Chenier and Pecan Island ridges, as well as to the west into the Calcasieu/Sabine Basin. Human activities related to wildlife management, navigation improvement, flood control, agriculture, and petrochemical exploitation have dramatically altered the hydrology of the Mermentau Basin. The net effect of these alterations is that drainage through the Lakes Sub-basin is now predominantly east-west and hydrologically isolated from the Chenier Sub-basin. The Lakes Sub-basin now functions more as a freshwater reservoir and less as a low-salinity estuary, its natural form (Gunter and Shell 1958; Morton 1973).

Teche/Vermilion Basin - The Teche/Vermilion Basin extends from Point Chevreuil to Freshwater Bayou Canal and includes East and West Cote Blanche Bays, Vermilion Bay, and the surrounding marshes. Navigation features include the Freshwater Bayou Canal Navigational Channel and the Leland Bowman Lock. The Basin has a drainage area of 3,040 square miles (LCA 2004). Only the western extent of this hydrologic basin lies within the authorized Southwest Coastal study area.

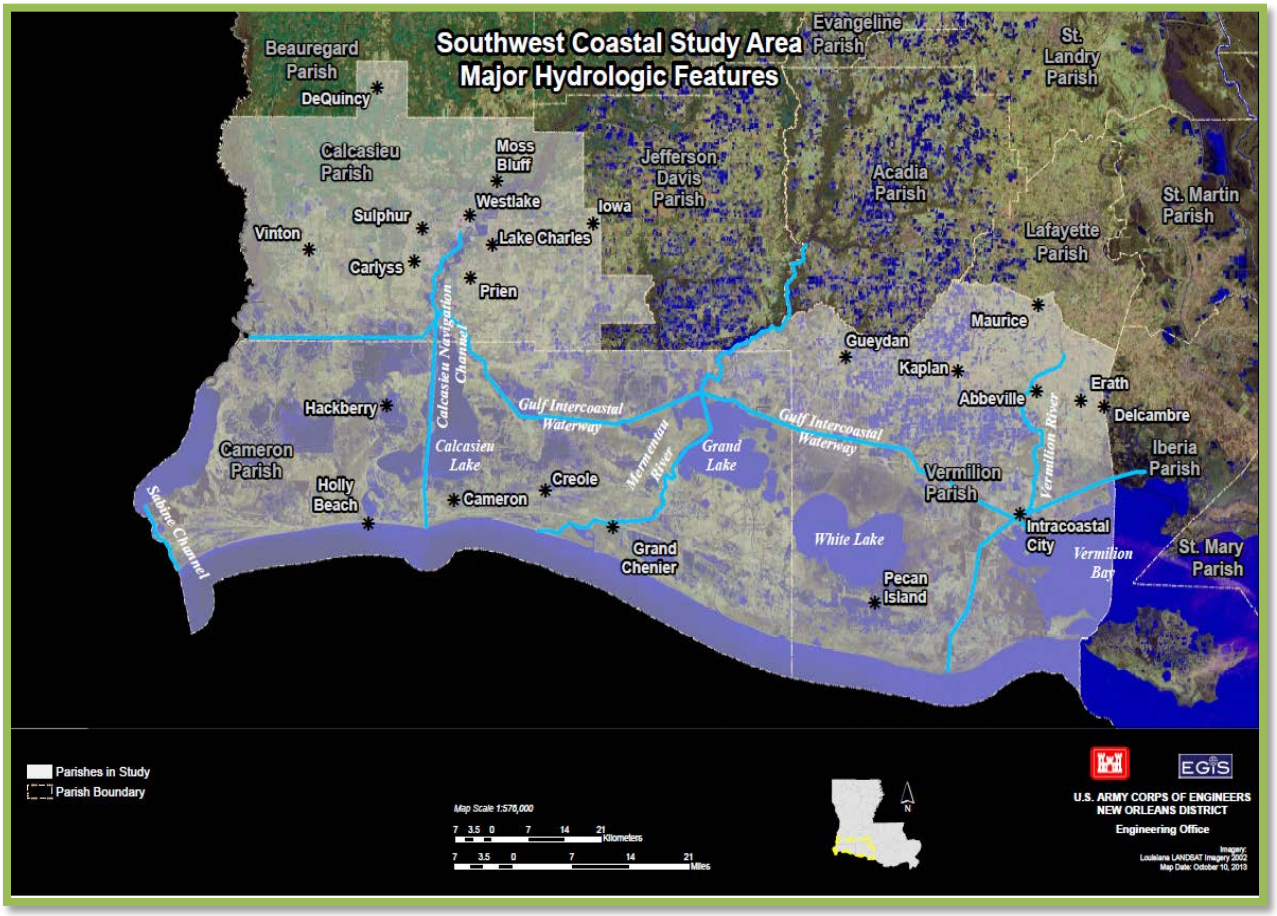

Figure 1-4: Major hydrologic features in the study area.

1.3.1 Water Stage Duration and Frequency

Normal astronomical tides are diurnal (one high tide and one low tide per day) and can have a spring range of as much as 2 ft. The mean tidal range is approximately 1.28 ft at Calcasieu Pass and 1.48 ft at Freshwater Canal. Amplitudes are influenced by tides, but are generally controlled by meteorological events. South winds drive water into the marshes.

1.3.2 Relative Sea Level Rise

In coastal Louisiana, relative sea level rise (RSLR) is the term applied to the difference between the change in eustatic (global) sea level and the change in land elevation. According to Intergovernmental Panel on Climate Change (IPCC 2007), the global mean sea level rose at an average rate of about 1.7 mm/yr during the 20th Century. Recent climate research has documented global warming during the 20th Century, and has predicted either continued or accelerated global warming for the 21st Century and possibly beyond (IPCC 2007).

Land elevation change can be positive (accreting) or negative (subsiding). Land elevations decrease due to natural causes, such as compaction and consolidation of Holocene deposits and faulting, and human influences such as sub-surface fluid extraction and drainage for agriculture, flood protection, and development. Forced drainage of wetlands results in lowering of the water table resulting in accelerated compaction and oxidation of organic material. Areas under forced drainage can be found throughout coastal Louisiana and the study area. Land elevations increase as a result of sediment accretion (riverine and littoral sources) and organic deposition from vegetation. Vertical accretion in most of the area, however, is insufficient to offset subsidence, causing an overall decrease in land elevations. The combination of subsidence and eustatic sea level rise is likely to cause the landward movement of marine conditions into estuaries, coastal wetlands, and fringing uplands (Day and Templet, 1989; Reid and Trexler 1992).

Subsidence Rates - Subsidence rates vary considerably across coastal Louisiana. A coast wide system for quantifying and predicting subsidence on a regional scale has not yet been established. Therefore, subsidence rates are estimated using a combination of benchmark leveling, tide gauge measurements, and radiometric dating of buried marsh horizons. The subsidence rate for most of the study area is considered low, at 0 to 1 ft/century; however, the subsidence rates in the Mermentau Basin for Hackberry Ridge, Big Lake, Cameron-Creole, Brown Lake, Hog Island Gully, and Mud Lake watersheds, all located within the study area, are considered intermediate, at 1.1 – 2 ft per century. Perry Ridge in the Calcasieu/Sabine Basin and Locust Island and Little Prairie in the Mermentau Basin are considered stable (Coast 2050, 2009).

Accretion Rates - Net accretion varies significantly on a local level and over time. Average measurements of accretion across the Louisiana coastal region indicate that current accretion rates are 0.7 to 0.8 cm per year (ERDC/EL TN-10-5). Since there is currently a lack of evidence to support applying a habitat specific accretion rate, a long-term accretion estimate of 0.7 cm per year captures the central tendency of all herbaceous marsh data that have been reviewed for the SWC analysis.

1.3.3 Storm Surge

While the study area has periodically experienced localized flooding from excessive rainfall events, the primary cause of the flooding events has been the storm surges from hurricanes and tropical storms. During the past eight years, the area has been greatly impacted by storm surges associated with three Category 2 or higher hurricanes (Lili, Rita, and Ike), which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana. Hurricane and storm surge also causes significant permanent damage to wetlands. Hurricane surge has formed ponds in stable, contiguous marsh areas and expanded existing, small ponds, as well as removed material in degrading marshes (Barras, 2009). Fresh and intermediate marshes appear to be more susceptible to surge impacts, as observed in Barras (2006).

1.3.4 Storms of Record

October 2002. Hurricane Lili was originally a Category 4 hurricane and first made landfall as a downgraded Category 2 hurricane near Intracoastal City, LA to the west. Wind gusts up to 61 mph were reported. Rainfall estimates were rather low at 5 inches, due to the rapid forward movement of the storm. Tide levels were 4 to 7 ft above normal, with many areas outside of the study area being flooded. The stage at Harvey Canal at Lapalco reached 9.84 ft National Geodetic Vertical Datum (NGVD) on October 5th.

September 2005. Hurricane Rita first made landfall just west of Johnson's Bayou, LA as a Category 3 hurricane after downgrading from a 180 mph Category 5 hurricane. The coastal communities of southwest Louisiana were all heavily damaged or totally destroyed by the 20-foot surge. The storm surge also completely overtopped the Calcasieu Lock structure. Many low lying areas in Lake Charles flooded.

September 2008. Hurricane Ike first made landfall near Galveston, Texas as a Category 2 hurricane with 110 mph winds on September 13, 2008. Although landfall was to the west in Texas, this storm caused extensive flooding due to storm surge created by the large wind field along the south central and southwest coastal parishes of Louisiana. The storm surge also completely overtopped the Calcasieu Lock structure.

1.3.5 Flow and Water Levels

The marsh area of southwest Louisiana extends northward and slightly beyond the GIWW. Rainfall runoff drains from the higher elevations in the north and is trapped in the marsh area to the south due to chenier ridges that parallel the coast. The natural drainage pattern prior to the construction of the GIWW was for rainfall in the basin to drain through the Mermentau River and empty into the Gulf of Mexico. However, some of that flow is now redistributed to the east and west along the GIWW. The Calcasieu Lock, Catfish Point Control Structure, Leland Bowman Lock, and Schooner Bayou Lock were created to allow for navigation and salinity control.

Land stewardship through hydrologic management and shoreline protection are the mainstays of coastal restoration in the Calcasieu-Sabine basin. Water control structures are operated both passively and actively. Virtually all hydrologic management focuses on controlling salinity and minimizing tidal fluctuations by constructing and operating levees, weirs, and a variety of gated structures. A 1990 inventory of such water control structures identified 174 individual structures in the interior and along the perimeter of the basin (LADNR 2002; Marcantel 1996).

The Cameron-Creole Watershed Project covers approximately 176 square miles in Cameron Parish. The area is bounded by the GIWW on the north; Calcasieu Lake and Calcasieu Pass on the west; LA-27, Little Chenier Ridge, and Creole Canal on the east; and the Gulf of Mexico and Mermentau River on the south. To counter this conversion of marsh to open water, the Cameron-Creole Watershed Project was initiated cooperatively by the Soil Conservation Service [Natural Resource Conservation Service (now NRCS)], Gulf Coast Soil and Water Conservation District, Cameron Parish Police Jury, Cameron Parish Gravity Drainage Districts 3 and 4, the Miami Corporation, and the United State Fish and Wildlife Service (USFWS), Sabine National Wildlife Refuge. The water control structures began operation in 1989 (LADNR 2002).

1.3.6 Water Quality and Salinity

Study area water quality is influenced by chenier plain elevations, surface water budget, land cover and use, chenier plain geomorphologic processes, and regional weather. The study area occupies most of the Louisiana chenier plain, and consists of low relief topography to the north and estuary to the south, with increasing estuary salinity southward. The area includes the Calcasieu and Mermentau River basins; the former is connected to the Gulf of Mexico via the Calcasieu ship channel, while the latter is maintained as freshwater environ via several water control structures (Rosen and Xu 2011). The area has experienced hydromodification via the construction of water control structures, canals, and embankments (Demcheck et al. 2004). Chemical transformations occurring in the estuary can be biologically mediated by estuary wetlands (Mitsch and Gosselink 2000); a diversity of wetland types exist within the study area which are affected by chenier plain geomorphology and anthropogenic factors (Visser et al. 2000). Weather patterns can affect study area marine influence, flow direction, water level, and wetlands biogeochemistry (Gosselink 1984). Timing and amount of precipitation can also affect water quality (Demcheck et al. 2004).

Literature Review: See Demcheck et al. (2004), Garrison (1997), Waldon (1996), Skrobialowski et al. (2004), Demcheck and Skrobialowski (2003), Macdonald et al. (2011), Rosen and Xu (2011), and Steyer et al. (2008) for study area water quality and salinity studies. In general, water quality concerns within the study area are related to urbanization in the parts of the study area where hurricane protection features are proposed, oil and gas activities and saltwater intrusion in the Calcasieu River basin, and agriculture in the Mermentau River basin.

Louisiana Water Quality Inventory: Historical (1998-2012) Clean Water Act Section 305(b) assessments of study area sub-segments were evaluated. For each sub-segment, an average designated use support value was calculated (0=always impaired, 1=unimpaired; see the unabridged report for methodology and details) . Long-term average support values reveal that impairments are most common in the uppermost sub-segments in the study area in the Calcasieu and Teche-Vermillion watersheds. The most commonly suspected causes of impairment included in the 305(b) assessments were low dissolved oxygen, elevated total suspended solids, mercury, elevated turbidity, nitrate/nitrite, carbofuran, and total phosphorus, while the most commonly suspected sources of impairment were unknown sources, agriculture, natural sources, atmospheric deposition, flow alteration, urban runoff, and on-site treatment systems.

In the most recent year 2012 305(b) assessment, the frequently cited suspected causes of impairment included fecal coliform, low dissolved oxygen, turbidity, mercury, total suspended solids, and carbofuran, while most frequently cited suspected sources of impairment included unknown sources, agriculture, natural sources, on-site treatment systems, atmospheric deposition, and drought-related impacts (LDEQ 2013).

1.4 Natural Environment

1.4.1 Sedimentation and Erosion

The study area is divided by the Sabine, Calcasieu, Mermentau, and Vermilion rivers which flow in a north-south direction. These rivers have been highly altered by the placement of locks and dams, dredged channels, manmade outlets to the Gulf, and bisected by the GIWW. These alterations influence the movement of sediment throughout the area. The rivers and interior lakes which they enter (Sabine, Calcasieu, and Grand) act as sediment sinks. Overbank deposition into adjacent marshes is minimal in these low flow rivers. Sediments in the interior lakes can be re-suspended and deposited in adjacent marshes during storm events and cold front passages. Extensive hydrologic alterations within the area (levees, channels, roads, locks, control structures, etc.) influence sediment movement throughout. Sediments in the rivers that make it to the coast are deposited at the mouths and generally move westward nourishing the beaches and marshes.

A significant source of sediment is the Atchafalaya River. Sediment travels westward from Atchafalaya Bay and the GIWW and enters the area through tidal exchange at the Gulf and from flooding during storm events. A large percentage of Atchafalaya River sediments are deposited along the Gulf shoreline in the vicinity of Freshwater Bayou as mudflats while coarser sediments continue westward along the shoreline.

The shorelines of most channels, lakes, and the Gulf are experiencing erosion and erosion rates are generally highest where the shorelines protrude into the lakes, focusing wave and current action. The Louisiana coast has approximately 350 miles of sandy shoreline along its barrier islands and gulf beaches; however, there are about 30,000 miles of land-water interface along bays, lakes, canals, and streams. Most of these shores consist of muddy shorelines and bank lines, and virtually all are eroding. In many instances, rims of firmer soil around lakes and bays, and natural levees along streams have eroded away leaving highly organic marsh soils directly exposed to open water wave attack. Examples include Redfish Point, Grassy Point, Umbrella Point, Short Point, and Commissary Point. High rates of Gulf shoreline erosion occur from the vicinity of Rollover Bayou, west to the Mermentau River. Accelerated shoreline loss occurs where erosion has caused Gulf, lake, and channel shorelines to intersect interior water bodies.

1.4.2 Soils, Water Bottoms and Prime and Unique Farmlands

Both hydric and non-hydric soils are found throughout the study area. The area consists generally of forested terrace uplands and Gulf Coast Prairies in the northern portions and Gulf Coast Marsh habitats in the southernmost portions. Predominate soils are described in Appendix A. The major water bottoms throughout include: Lake Charles, Prien Lake, Sabine Lake, Calcasieu Lake, Grand Lake, White Lake, and Vermilion Bay. There are numerous smaller lakes such as Sweet Lake, Mud Lake, Black Lake, Big Constance Lake, and Lake Misere. Rivers include the Calcasieu, Sabine, Mermentau, and Vermillion Rivers. A listing of the water bottoms is described in Appendix A.

Prime and Unique Farmlands: Prime farmlands are present and make up approximately 941,196 acres, or 34.3 percent of the soils; breakdown by parish is as follows: Calcasieu Parish is 479,426 acres, or 51 percent; Cameron Parish is 106,008 acres, or 11 percent; Vermilion Parish is 355,761 acres, or 38 percent. The majority of the Gulf Coast Marshes consists of wetland type soils and shorelines that are prone to frequent flooding and not suitable for agricultural use. Prime farmland is more predominant inland, and outside, of the Gulf Coast Marsh physiographic area. Prime farmland can also be found on natural ridge tops and cheniers (Hackberry loamy fine sand). Prime farmland soils are best suited for producing food, feed, forage, fiber, and oilseed crops, and possess qualities that are favorable for crop production using only acceptable farming methods (NRCS Soil Survey of Calcasieu Parish, dated June 1988). Several soil types exist that meet those qualities and are identified as prime farmlands.(See Appendix A). Urban areas, like Lake Charles and Abbeville, as well as industrial areas have excluded some prime farmlands from agricultural use and there is no unique farmland. Coordination with the NRCS is on-going.

1.4.3 Gulf Coastal Shorelines

Gulf coastal shorelines, located along the northern rim of the Gulf of Mexico, provide essential and critical shelter, nesting, feeding, roosting, cover, nursery, and other habitats and life requirements for fish and

wildlife. They function as the boundary between marine and estuarine ecosystems and provide protection to the estuarine wetlands, bays, and other inland habitats. Coastal shorelines, as well as other coastal landscape features such as shoals, coastal marshes, and forested wetlands, can provide a significant and potentially sustainable buffer from wind wave action and storm surge generated by tropical storms and hurricanes. Rapid deterioration of the barrier coast is resulting in a transformation of low-energy, semi-protected bays into high-energy, open marine environments (Stone et al. 2005). Numerical modeling by Stone et al. (2005) demonstrated that physical loss of the barrier system and marsh results in a considerable increase in modeled storm surge levels and wave heights. Geomorphic features such as coastal shorelines and barrier islands, as well as coastal marsh and other wetland land masses can block or channelize flows (Working Group for Post-Hurricane Planning for the Louisiana Coast 2006). The area's coastal shorelines are experiencing some of the highest land loss rates in the Nation, due to both natural and man-made factors (USACE 2004).

Barrier beach and surf, dune, supratidal and intertidal wetlands and swale habitats have undergone substantial loss due to oil and gas activities (e.g., pipeline construction), construction of navigation channels and jetties, subsidence, sea-level rise, and marine and wind-induced erosion. Recent estimates find Gulf shoreline recession rates vary from 8 ft per year near Cheniere Au Tigre to 52.9 ft per year near the center of the 76,000-acre Rockefeller Wildlife Refuge, located in eastern Cameron and western Vermilion Parishes which borders the Gulf of Mexico for 26.5 miles.

1.4.4 Vegetation Resources

The area consists of open water ponds and lakes, cheniers, Gulf shorelines, and freshwater, intermediate, brackish, and saline marsh. Table 1-8 compares habitat types pre- and post- Hurricane Rita.

Gulf Coast Prairie and Forested Terraced Uplands vegetation includes:

- Swamp, found in low-lying areas typically adjacent to waterways, is dominated by cypress and tupelo-gum.
- Riverine habitats along stream and river bottoms and bottomland forests are comprised of water tupelo, willow, sycamore, cottonwoods, green ash, pecan, elm, cherrybark oak, white oak; these are often interspersed with Chinese tallow. Depending upon the locations, riverine habitats grade into higher elevated and better drained areas comprised of oak-pine forests.
- Oak-pine forest types dominate the better drained areas especially surrounding Lake Charles and Sulfur and include longleaf pine, loblolly pine, slash pine, sweetgum, elm, southern red oak, water oak, black gum and Chinese tallow.
- Pasture and rangelands with mixtures of perennial grasses and legumes (e.g., bermundagrass, Pensacola bahiagrass, tall fescue, and white clover) comprise the majority of the outlying areas surrounding Abbeville, Erath, and Delcambre.

Gulf Coast Marsh consists of back barrier vegetated areas; cheniers; freshwater, intermediate, brackish, and saline marsh; interspersed with bayous, lakes, ponds and other waters some of which may include submerged aquatic vegetation (SAVs). Vegetation typically follows the salinity gradient (O'Neil 1949; Chabreck et al. 1972; Gosselink et al. 1979; Visser et al. (2000).

- Gulf shorelines vegetation includes sea-beach orach, sea rocket, pigweed, beach tea, salt grass, seaside heliotrope, common and sea purslane, marsh-hay cordgrass, and coastal dropsead (LCA 2004, Gosselink et al. 1979).
- Cheniers are live oak-hackberry forests with live oak and hackberry the dominant tree canopy species with other typical species including swamp red maple, toothache tree, green ash, American elm. Although this forest type is the typical habitat, some areas may be scrub thicket or grasslands (source: http://dnr.louisiana.gov/assets/docs/coastal/227-009-001NG-Chenier-Rpt-DNR.pdf accessed September 16, 2013; LADNR 2009).
- Marsh types: Visser et al. (2000), expanding on previous studies by Penfound and Hathaway (1938) and Chabreck (1970), classified freshwater marsh in the Chenier Plain as a combination of maidencane and

bulltongue arrowhead; intermediate marsh as sawgrass, saltmeadow cordgrass, and California bulrush; brackish marsh as saltmeadow cordgrass, chairmaker's bulrush, and sturdy bulrush; and saline marsh as smooth cordgrass, needlegrass rush, and saltgrass.

- SAVs: wild celery, duckweed, pickerelweed, sago pondweed, southern naiad.

Table 1-8: Habitat types by basin in acres. Square kilometers (km²) listed in parentheses.

Habitat Type	Calcasieu/Sabine Basin		Mermentau Basin		Teche/Vermilion Basin	
	2004	2005	2004	2005	2004	2005
Forested Wetlands	0.00 (0)	0.00 (0)	0.00 (0)	0.00 (0)	46,080 (186.5)	46,080 (186.5)
Other Land	46,080 (186.5)	45,4400 (183.9)	51,840 (209.8)	38,400 (155.4)	21,760 (88.1)	20,480 (82.9)
Freshwater Marsh	96,000 (388.5)	89,600 (362.6)	281,601 (1,139.6)	230,401 (932.4)	33,280 (134.68)	32,640 (132.1)
Intermediate Marsh	177,520 (694.1)	163,200 (660.5)	119,680 (484.3)	103,040 (417.0)	122,880 (497.3)	122,600 (492.1)
Brackish Marsh	81,280 (328.9)	78,720 (318.6)	60,800 (246.1)	55,680 (225.3)	82,560 (334.1)	80,640 (326.3)
Saline Marsh	8,960 (36.3)	8,960 (36.3)	26,240 (106.3)	25,600 (103.6)	5,120 (20.7)	5,120 (20.7)
Water	184,961 (748.5)	202,881 (821.0)	202,241 (818.4)	289,281 (1,170.7)	348,162 (1,408.9)	353,281 (1,429.7)
Totals	588,803 (2,382.8)	588,803 (2,382.8)	742,403 (3,004.4)	742,403 (3,004.4)	659,843 (2,670.3)	659,843 (2,670.3)

Land Loss – The process for wetland loss can start with the result of gradual decline of marsh vegetation due to inundation and saltwater intrusion eventually leading to complete loss of marsh vegetation or the result of storm surge events. As marsh vegetation is lost, underlying soils are more susceptible to erosion and are typically lost as well, leading to deeper water and precluding marsh regeneration. Significant accretion of sediments is then required in order for marsh habitat to reestablish. Perhaps the most serious and complex problem in the study area is the rate of land and habitat loss. The Louisiana coastal plain contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss in the nation (USACE 2004). The effects of recent hurricanes have accelerated marsh loss. Table 1-9 includes estimates of wetland loss attributed to the major hurricanes of 2004 to 2008 in the Chenier Plain and throughout coastal Louisiana.

Table 1-9: Wetland loss estimates in acres (km²) following hurricanes Katrina and Rita (2005) and Gustav and Ike (2008) by geographic province (Barras 2009).

Period	Storms	Chenier Plain	Marginal Delta Plain	Delta Plain	Coastal Louisiana
2004-2006	Katrina + Rita	-72,154 (-292)	-642 (-2.6)	-56,834 (-230)	-129,730 (-525)
2006-2008	Gustav + Ike	-34,347 (-139)	-14,579 (-59)	-30,641 (-124)	-79,815 (-323)
2004-2008	All storms	-106,750 (-432)	-15,320 (-62)	-87,475 (-354)	-209,545 (-848)

1.4.5 Rare, Unique, and Imperiled Vegetative Communities

The following rare, unique, and imperiled communities, documented by the Louisiana Natural Heritage Program (LNHP), are important in that they contribute to the diversity and stability of the coastal ecosystem. Table 1-10 displays information from the LNHP database identifying rare, unique or imperiled vegetative communities (LDWF 2013).

Table 1-10: LNHP rare, unique, or imperiled vegetative communities.

Vegetative Communities	Basins or Parish
Submergent Vascular Vegetation (Marine & Estuarine)	Waters of northern Gulf of Mexico, Vermilion-Teche, Mermentau, Calcasieu and Sabine
Salt Marsh	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Brackish Marsh	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Intermediate Marsh	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Coastal Prairie	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Flatwoods Ponds	Calcasieu Parish
Western Hillside Seepage Bogs	Calcasieu and Sabine
Scrub/Shrub Swamp	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Cypress Swamp	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Bottomland Hardwood Forest	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Bature	Vermilion-Teche
Live Oak Natural Levee Forest	Vermilion-Teche
Bayhead Swamp/Forested Seep	Calcasieu Parish
Pine Flatwoods	Calcasieu Parish
Western Longleaf Pine Savannah	Calcasieu Parish
Small Stream Forest	Calcasieu Parish
Coastal Dune Grassland	Mermentau, Calcasieu, Sabine
Coastal Dune Shrub Thicket	Mermentau, Cacasieu, Sabine
Coastal Live Oak-Hackberry Forest	Vermilion-Teche, Mermentau, Calcasieu and Sabine
Western Upland Longleaf Pine Forest	Calcasieu Parish
Western Xeric Sandhill Woodland	Calcasieu Parish
(source: http://www.wlf.louisiana.gov/wildlife/louisiana-natural-heritage-program)	

1.4.6 Wildlife Resources

Coastal and especially estuarine wildlife is taxonomically diverse with distributions shaped by landforms, climate, salinity, tides, vegetation, other animals and human activities (Day et al. 1989). Appendix A shows the status, functions of interest, trends, and projections from 1985 through 2050 for avifauna, furbearers, game mammals, and reptiles as adapted from the Coast 2050 report by LCWCRTF & WCRA (1999). Area estuarine wetlands, cheniers, and barrier habitats have historically provided many different species of birds and other wildlife with shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. These habitats provide neotropical migrants with essential staging and stopover habitat (after Stoffer and Zoller 2004, Zoller 2004). Cheniers attract thousands of trans-Gulf migrant birds during their peak migratory months of April to May and August through October. The majority of these birds fly to and from parts of Mexico, and the cheniers offer the birds an important stop-over on their migration. Millions of ducks and geese use the area from September through February. Over 300 species of birds have been recorded in the area, making this region a popular destination for visiting birders, wildlife photographers, and hunters. However, climate and seasonal availability of resources affect the ways estuaries are used by birds and other wildlife (Day et al. 1989). Vegetated habitats within urban and suburban areas, such as bottomland hardwood (BLH) and swamp habitats along streams, lakes, and other waterways, provide critical breeding bird habitats (Wakeley and Roberts 1996).

Among the several sources documenting Louisiana birds, Lowery (1974) and the US Forest Service (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed September 20, 2013) indicate the area supports shorebirds (e.g., piping plover, sandpipers, gulls, stilts, skimmers, and oystercatchers), ducks and geese (e.g., mottled duck, mallard, fulvous tree-duck, pintail, teal, wood duck, scaup, mergansers, and Canada goose); herons, egrets, ibis and cormorants; hawks and owls (e.g., bald eagle, osprey, and barred owl); belted kingfisher; woodpeckers and sapsuckers; marsh birds (e.g., rails and gallinules); and various songbirds (e.g., wrens, flycatchers, swallows, warblers, and vireos). Waterfowl, seabirds, coots, and rail populations are stable within the Calcasieu-Sabine and Mermentau basins [Appendix A (LCWCRTF & WCRA 1999)].

The bald eagle and brown pelican have increased in populations resulting in de-listing as endangered species. Colonial nesting waterbird rookeries (e.g., herons, egrets, ibis, night-herons, and roseate spoonbills) are found throughout and generally show stable or increasing populations [Appendix A (LCWCRTF & WCRA 1999)]. Habitat loss and fragmentation is among the most pervasive threats to the conservation of biological diversity (Rosenberg et al. 1997). Area BLH, swamp, and other riverine habitats provide travel corridors for birds and other wildlife connecting populations which have been effected by habitat loss and fragmentation. The greatest threat to birds throughout not only the area, but the entire North American continent, is habitat loss (American Bird Conservancy 2009).

Most estuarine mammals show distributions or behaviors that are related to salinity patterns (Day et al. 1989). Large herbivores and carnivores include manatee, coyote, red wolf, ringtail, and river otter; smaller herbivores include swamp rabbit, fulvous harvest mouse, eastern wood rat, and nutria (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed September 20, 2013). Populations of furbearers (nutria, muskrat, mink, otter, and raccoon) and game mammals (rabbits, squirrels, and white-tailed deer) have been stable or increasing [Appendix A (LCWCRTF & WCRA 1999)]. Prior to the introduction of nutria to Louisiana in 1930s (USGS 2000, Baroch et al. 2002), no invasive wildlife species were known to be present. Areas of extensive nutria damage, or "eat outs," alter the composition and habitat type of wetland communities (USGS, 2000). Aerial surveys estimated 80,000 acres of marsh in the State of Louisiana were damaged by nutria (Keddy et al. 2007).

A listing of the common species of amphibians and reptiles can be found in Appendix A. Little is known about amphibian or reptile populations with the exception of the American alligator. Since 1972, over 700,000 wild alligators have been harvested, over 5.2 million alligator eggs have been collected, and over 2.7 million farm raised alligators have been sold, bringing in an estimated $495,000,000 to the state of Louisiana [Louisiana Department of Wildlife and Fisheries (LDWF), 2006]. According to LDWF scientists, the alligator population dropped significantly between 2008 and 2009. In 2008, more than 43,000 alligator nests were found, while in 2009 only 24,500 nests were found, a 43 percent statewide decrease. This drop in alligator nests is probably the result of saltwater intrusion during Hurricanes Gustav and Ike. A similar trend occurred after Hurricanes Katrina and Rita, with alligator nests decreasing between the 2005 and 2006 surveys. However, the number of nests found increased significantly by 2007.

1.4.7 Aquatic and Fisheries Resources

The area contains a variety of aquatic habitats, including rivers, bayous, canals, lakes, ponds, shallow open water areas, the Gulf of Mexico, and estuarine marsh and embayments. Salinity and habitat structure (SAV, marsh, tidal creeks, deep water, oyster reefs, and benthic substrate) are the primary drivers that affect the distribution of fish and macrocrustaceans throughout the area with three general types: freshwater resident, estuarine resident, and transient marine species. Freshwater species, some of which may tolerate low salinities, generally live in the freshwater portions of the more interior and northern-most regions of the area. Resident species are generally smaller and do not commonly migrate very far. Marine transient species spend a portion of their life cycle in the estuary, generally spawning offshore or in high-salinity bays, and use coastal marshes as nursery areas (Herke 1971, 1995). Species typically found in freshwater areas include: spotted gar, bowfin, largemouth bass, channel catfish, crappie, and gizzard shad. Estuarine-dependent species typically include red and black drum, spotted seatrout, Gulf menhaden, and southern flounder. Typical marine species include king and Spanish mackerel, and cobia.

Plankton communities serve several important roles in coastal waters. Bacterioplankton are primarily decomposers; phytoplankton are the primary producers of the water column, and form the base of the estuarine food web; zooplankton provide the trophic link between the phytoplankton and the intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fish species (Day et al. 1989; Thompson and Forman 1987). Biological factors such as predation by nekton and ctenophores, duration of the larval stages of meroplankton, and changes in the aquatic environment brought by the zooplankton populations themselves are important biological factors in the regulation of zooplankton densities (Bouchard

and Turner 1976; Conner and Day 1987). Bouchard and Turner (1976) found that salinity largely influenced the distribution of zooplankton. Gillespie (1978) found spring zooplankton peaks were related to temperature. Conner and Day (1987) identified the following factors affecting zooplankton populations: tidal flushing, inflow of freshwater carrying organic detritus, river discharge, water depth, tidal changes, turbidity, and dissolved oxygen.

Gosselink et al. (1979) provide an extensive overview of benthic resources in the area. The bottom estuarine substrate or benthic zone regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is called a benthic effect (Day et al. 1989). Benthic communities do not have a static structure; rather, they provide a residence for many sessile, burrowing, crawling, and even swimming organisms. Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries and trophic relationships that occur in aquatic ecosystems (Day et al. 1989). Oysters and mussels from the epibenthic community provide commercial and recreational fisheries and create oyster reef habitats used by many marine and estuarine organisms. A discussion on estuarine benthic organisms and primary consumer groups is in Appendix A. A major link in the aquatic food web between plants and predators is formed by the conversion of plant material (formed in primary production) by benthic detritivores and herbivores to animal tissue (Cole 1975). The salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary (Mitsch and Gosselink 2000). In some cases, exported marsh detritus is more important than the phytoplankton based production to the estuary. Detritus export and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

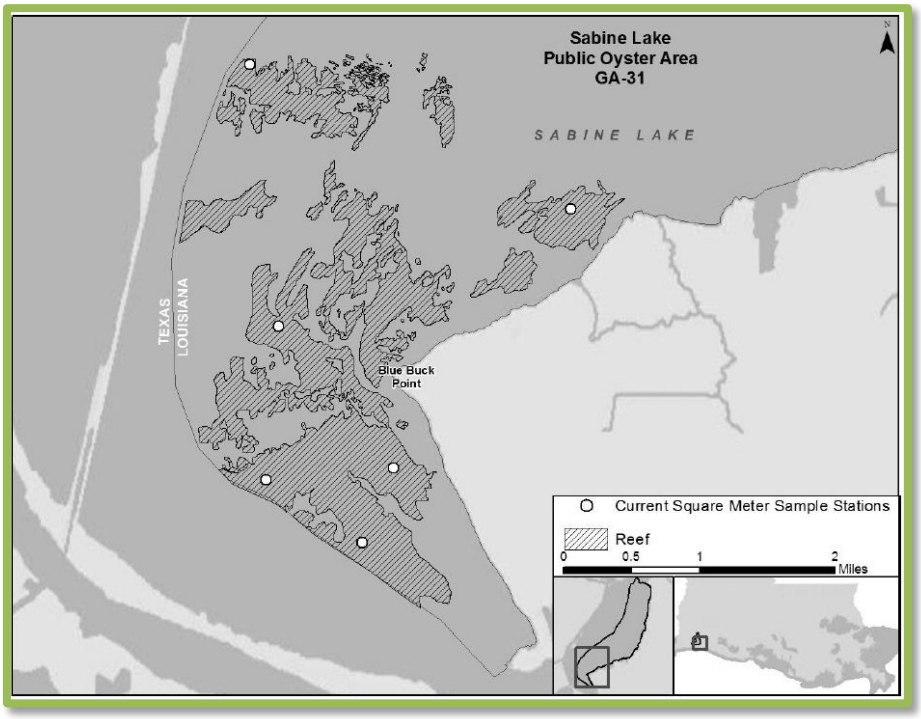

Figure 1-5: Oyster reefs in Sabine Lake.

The American oyster is a keystone estuarine species and has been identified as an ecosystem engineer (Dame 1996). Oyster reefs provide major structural components of estuaries and support more animal life than any other portion of the sea bottom (Bahr and Lanier 1981; Meyer and Townsend 2000; Nelson et al. 2004; Tolley and Volety 2005; Tolley et al. 2005; Boudreaux et al. 2006). The total number and densities of fish, invertebrate and algal species greatly increase in areas containing oyster reefs (Bahr & Lanier 1981). More than 300 marine invertebrate species may occupy an oyster reef at one time (Wells 1961). In addition to increasing species richness, the three-dimensional structure of the reef provides other services such as stabilizing and buffering shorelines from high wave energy (Smithsonian 2001). Because oysters are sessile and pump water through their bodies, they are recognized as good ecosystem monitors. Changes in ecosystem health can be noted over time scales varying from hours to years. Because oysters are continually submersed in environmental conditions, they actively contribute to water quality assessments (Smithsonian 2001). In addition, the chemistry of their shell can provide information on global changes in the environment (Surge et al. 2003). Accordingly, oysters have been used as monitors and indicators of stress in marine

ecosystems. Figure 1-5 shows the location of the oyster reefs Sabine Lake. Calcasieu Lake has been designated by the LDWF as a Public Oyster Tonging Area. More information on oysters including locations of oyster reefs in other areas can be found at the Louisiana Department of Wildlife and fisheries website (http://www.wlf.louisiana.gov/fishing/oyster-program). The Louisiana portion of Sabine Lake has approximately 34,067 water bottom acres. This area was cleared by LDHH in March of 2011 for harvesting, but LDWF has not opened a season on this area at this time.

Salinity and submerged vegetation affect the distribution of fish and macrocrustaceans throughout the area with three general types: freshwater, resident, and transient marine species. Freshwater species, some of which may tolerate low salinities, generally live in the freshwater portions of the more interior and northern-most regions of the area. Resident species are generally smaller and do not commonly migrate very far. Marine transient species spend a portion of their life cycle in the estuary, generally spawning offshore or in high-salinity bays, and use coastal marshes as nursery areas (Herke 1971, 1995). A description of species typically found in freshwater areas is included in Appendix A.

1.4.8 Essential Fish Habitat (EFH)

Figures displaying EFH for coastal migratory pelagics (king mackerel, Spanish mackerel, and cobia); shrimp (brown, white and pink shrimp); red drum; and stone crab, respectively within the area is provided in Appendix A. Table 1-11 list the EFH for life stages of species.

Table 1-11: EFH for life stages of EFH species.

EFH Requirements for Species Managed by the Gulf of Mexico Fishery Management Council: Ecoregion 4, Mississippi River Delta (South Pass) to Freeport, TX.			
Species	**Life Stage**	**System***	**EFH**
Brown shrimp	larvae/postlarvae	M/E	<82 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
	juvenile	E	<18 m; SAV, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
White shrimp	larvae/postlarvae	M/E	<82 m; planktonic, soft bottom, emergent marsh
	juvenile	E	<30 m; soft bottom, emergent marsh
Red drum	larvae/postlarvae	E	all estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	juvenile	M/E	GOM <5 m Vermilion Bay & E; all estuaries SAV, sand/shell/soft/hard bottom, emergent marsh
	adults	M/E	GOM 1-46 m Vermilion Bay & E; all estuaries SAV, pelagic, sand/shell/soft/hard bottom, emergent marsh
Lane snapper	larvae	E/M	4-132 m; reefs, SAV
	juvenile	E/M	<20 m; SAV, mangrove, reefs, sand/shell/soft bottom
Grey snapper	adult	E/M	0-180 m, emergent marsh, sand shell, soft bottom
Bull shark	neonate	M	Estuarine and nearshore waters Freeport to mouth of Sabine Lake; nearshore waters off west Cameron Parish
Atlantic sharpnose shark	neonate/juvenile/adult	M	All nearshore and offshore waters Freeport Tx, to the mouth of the Mississippi River

EFH Requirements for Species Managed by the Gulf of Mexico Fishery Management Council: Ecoregion 4, Mississippi River Delta (South Pass) to Freeport, TX.			
Species	**Life Stage**	**System***	**EFH**
Finetooth shark	juvenile/adult	E/M	Estuarine and nearshore waters E of Terrebonne Bay
Scalloped hammerhead	neonate	M	All nearshore waters to 30 fathoms; Galveston Bay, Vermillion Bay to West Bay, Tx
Bonnethead shark	juvenile/adult	M	inlets, estuaries; coastal waters; <25m; Louisiana to Texas

** E=estuarine, M=marine*

Personal communication NMFS January 23, 2014.

1.4.9 Threatened/Endangered Species and Other Protected Species of Concern

There are 11 threatened or endangered species (T&E), one candidate species known or believed to occur in the area (see Table 1-12) as well as critical wintering habitat for the piping plover and Sargassum critical habitat for loggerhead sea turtles. There are no threatened or endangered plants (personal communication with Ms. Brigette Firmin USFWS, September 20, 2013). A detailed description of T&E species and critical habitats is presented in Appendix A.

Table 1-12: Federally listed and candidate species within the area.

Species	Calcasieu Parish	Cameron Parish	Vermilion Parish
*Sprague's pipit (*Anthus spragueii*)	Candidate	Candidate	Candidate
Red-cockaded woodpecker (*Picoides borealis*)	Endangered		
Piping plover (*Charadrius melodus*)		Threatened Critical habitat	Threatened Critical habitat
Red knot (*Calidris canutus*)		Threatened	Threatened
**Whooping crane (*Grus americana*)			Threatened
West Indian manatee (*Trichechus manatus*)		Endangered	Endangered
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)		Threatened	Threatened
Green sea turtle (*Chelonia mydas*)		Threatened	Threatened
Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempi*)		Endangered	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)		Endangered	Endangered
Loggerhead sea turtle (*Caretta caretta*)		Endangered Critical habitat	Endangered Critical habitat

**Listed as a candidate species until a listing proposal can be prepared by USFWS*
***Designated non-essential experimental population*

Piping plovers winter in Louisiana but do not nest on the coast. Critical wintering habitat encompasses 24,950 acres along 342.5 miles of shoreline, which is most of the coast of Louisiana. Piping plovers arrive from their northern breeding grounds as early as late July and may be present in designated critical wintering habitat for 8 to 10 months of the year.

Loggerhead Critical Habitat (*Sargassum* habitat) exists in the southernmost (offshore) portion of the SWC project area. This critical habitat expands the entire length of the project (west to east) with the closest points ranging from approximately 4 miles to 9 miles offshore.

1.4.10 Historic and Cultural Resources

The cultural history of coastal southwest Louisiana is a very rich one, going back some 10,000 years or more. The general chronological sequence can be summarized as follows: Paleoindian (11,500 - 6,000 B.C.), Archaic (6,000 - 1,500 B.C.), Poverty Point (1,500 – 500 B.C.), Tchula (500 B.C. – A.D. 1), Marksville (A.D. 1 - 400), Baytown (A.D. 400 - 700), Coles Creek (A.D. 700 - 1200), and Mississippian (A.D. 1200 - 1700). The historic period begins at approximately A.D. 1700, and historic perspectives include the Attakapa Indians, first European settlement in Attakapa country, the Acadian migration, the Louisiana Purchase with the western boundary of the United States in dispute until 1819, the Civil War, postbellum period, and the early 20th century.

The NED alternatives are located within the Marginal Plain and the Pleistocene Prairie Terrace, while the NER alternatives are limited to the Marginal Plain. Archaeological sites in the southernmost portion of the area postdate the formation of the Marginal Plain (or Chenier Plain) at the end of the Pleistocene Epoch. It is likely a number of the standing structures identified as potential candidates for nonstructural measures will have a minimum age of 50 years and will not have been assessed for eligibility to the National Register of Historic Places. It is also likely that archaeological sites are located in the vicinity of standing structures that have been identified as potential candidates for nonstructural measures. Twenty-seven archaeological sites have been identified within a one-mile buffer of the NER alternatives. The recorded sites include one prehistoric site that has been determined potentially eligible for listing in the NRHP and eight archaeological sites, seven of which are prehistoric, that have been determined not eligible for listing in the NRHP. The remaining 18 have not been assessed. No previously recorded sites have been identified within the proposed borrow areas. Forty-eight historic standing structures have been recorded within the one-mile buffer, and additional standing structures that have a minimum age of 50 years have not been assessed for eligibility.

The above information is detailed in the draft *Cultural Resources Assessment and Research Design for the Southwest Coastal Louisiana Project, Calcasieu, Cameron, Iberia, Jefferson Davis, and Vermilion Parishes, Louisiana* on file with the Louisiana Division of Archaeology (Wells and Hill 2015). The USACE has elected to fulfill its obligations under Section 106 of the NHPA through the execution and implementation of a Programmatic Agreement as provided in 36 CFR Part 800.14(b).

1.4.11 Aesthetics and Visual Resources

Based on available aerial photography, the visual conditions have changed significantly over the past 20 years due to the growth of urban development and the loss or conversion of swamps into marsh, or open water areas. Comparisons between the 1992 and 2010 photography show that the same public thoroughfares that are in place today were in place then; however, the scenery has changed from natural to a developed state with residential, commercial, and industrial development dominating US 90, I-10, and the state and parish roads surrounding Sulphur and Lake Charles. The areas in Cameron and Vermillion Parish are still relatively rural, giving the viewer near unobstructed views of a native landscape that has remained aesthetically pleasing. Primary view sheds then, as they are today, were best taken from the local road system. There is one identified Scenic Stream, the Calcasieu River, located in the northeastern corner of Calcasieu Parish. The portion of Calcasieu River that qualifies as scenic stretches from the northeastern corner of Calcasieu Parish northeast into Allen Parish (approximately 34 miles).

Access to the area is in abundance with highways and byways crisscrossing the region along with local streets and neighborhoods in the more developed portions. Scenic Byways include the Creole Nature Trail; which traverses State and Parish Highways 82, 27, 384, 385, and 397. This Scenic Byway is both state and federally designated and also has an "All American Road" status, making it significant in culture, history, recreation, archeology, aesthetics, and tourism. Other Scenic Byways include the Zydeco Cajun Priairie Scenic Byway, located just north of Lafayette and the Jean Lafitte Scenic Byway, located just south of Lafayette. Both of these byways carry a state designation only, but are no less significant in their importance to the region in terms of tourism, scenic vistas, recreation, and the local economy.

1.4.12 Recreation Resources

Recreational features and opportunities vary throughout the coastal zone, habitat, and culture playing significant roles in the diversity of activities. From the games and competitions of Native Americans, to the influence of diverse immigrant cultures, traditional recreation in Louisiana has been a product of its people. Nearly 10,000 years ago, people began living off the ample resources of Louisiana. The means by which Louisiana's early residents lived, hunting and fishing for food, utilizing high ground for camps, and building vessels for transportation, shaped what is now recognized as traditional recreation in southern Louisiana.

State parks within the *Gulf Coast Prairie and Forested Terraced Uplands* physiographic regions include Palmetto Island and Sam Houston Jones parks. Eight boat launches are located within these regions. Access into the WMAs and refuges is generally by car or boat. Consumptive recreation includes hunting, fishing for freshwater and saltwater species, and trapping alligators and nutria. Non-consumptive recreation includes bird watching, sightseeing, boating, and environmental education/interpretation. Many of the parks offer hiking/biking trails, camping, and picnic shelters. Federal parks within or adjacent to the *Gulf Coast Marsh* physiographic region provide access to high quality recreational resources. From east to west, the region includes both state and NWR including: the 71,544-acre White Lake Wetlands Conservation Area, the 76,000-acre Rockefeller WR, the Lacassine NWR, Cameron Prairie NWR, and the 130,544-acre Sabine NWR. Nearly 450,000 people visited the NWR in 2012. Outside, but adjacent to the region, is Cypremont State Park, Shell Keys NWR, and Marsh Island WR.

In addition to the high quality recreational fishing and hunting in the parks in the Gulf Coast Marsh region, several lakes and inland marshes offer opportunities for hunting and catching both freshwater and saltwater species. Grand, White, and Calcasieu Lakes, and Vermillion Bay are prime fishing spots for recreational species such as redfish and speckled trout as well as flounder and brown and white shrimp. White Lake is a remote open lake and can only be accessed by the Schooner Bayou Canal, the old Intracoastal Canal north of Pecan Island or via the Superior Canal west of Pecan Island. The Calcasieu Lake area offers 10 of the 35 public or private boat launches in the area.

Bird watching is also an important recreational resource. A global initiative of BirdLife International, implemented by Audubon and local partners in the United States, the Important Bird Areas Program (IBAs) is an effort to identify and conserve areas that are vital to birds and other biodiversity. In the NER area, Audubon lists the entire Chenier Plain as a globally IBA (source: http://netapp.audubon.org/iba, accessed 25 September 2013). Many of the IBAs recognized are located within state or federally operated areas. Federal parks within the Chenier Plain that are globally IBAs include Lacassine NWR, Cameron Prairie NWR, and Sabine NWR. Also in the area is the Baton Rouge Audubon Society 40-acre Peveto Woods Sanctuary located along the Louisiana coast in Cameron Parish. The Peveto Woods Sanctuary site is the most heavily birded locale in Louisiana and was the first chenier sanctuary for migratory birds established in Louisiana. Each spring and fall, Peveto Woods hosts most migratory songbirds native to eastern North America (source: http://www.braudubon.org/peveto-woods-sanctuary.php, accessed 25 September 2013). The State of Louisiana owns and operates the White Lakes Conservation Area, Rockefeller WR, and the State Wildlife Refuge (SWR), all located in the Chenier Plain and all globally IBAs as is the Audubon/Paul J. Rainey Wildlife Sanctuary to the west and the Marsh Island Wildlife Refuge to the east. Finally, Palmetto Island State Park is an IBA just north of the SWR.

Designated within Gulf Marsh region is the Creole Nature Trail National Scenic Byway, a 105- mile driving and walking tour touching four state and NWRs and a bird sanctuary. Finally, public and private boat launches are located throughout the entire region.

1.5 Need for Action

The processes of sea level rise, subsidence, saltwater intrusion, and erosion of wetlands in southwest coastal Louisiana have caused significant adverse impacts, including increased rates of wetland loss and ecosystem degradation. Without action, this highly productive coastal ecosystem, composed of diverse habitats and wildlife, is not sustainable. Infrastructure constructed for access into and across the wetlands has modified the hydrology of the coastal zone, thus facilitating and accelerating saltwater intrusion and fragmentation, and

conversion of wetlands to open water. Hurricane surge has formed ponds in stable, contiguous marsh areas and expanded existing, small ponds, as well as removed material in degrading marshes (Barras, 2009). Fresh and intermediate marshes appear to be more susceptible to surge impacts, as observed in Barras (2006).

Land loss and ecosystem degradation threaten the continued productivity of the area's ecosystems, the economic viability of its industries, and the safety of its residents. The following valuable social and economic resources are at risk:

- Commercial harvest of fishery resources
- Rice, crawfish, and cattle farming
- Recreational saltwater and freshwater fisheries
- Ecotourism
- Oil and gas production
- Petrochemical industries
- Strategic petroleum reserve storage sites
- Storm damage risk reduction, including hurricane storm buffers
- Navigation corridors and port facilities for commerce and national defense, and
- Actual and intangible value of land passed down through generations.

During the NEPA scoping process, stakeholders noted the following problems related to saltwater intrusion:

- As the CSC widens and deepens, salinity levels increase after storm surge events and farmers have greater difficulty operating their rice farms.
- In the 2006 growing season, farmers were unable to plant because of high salinity levels caused by Hurricane Rita which overtopped local levees built in the 1940s or early 1950s.
- As a result of salinity encroachment in Calcasieu Lake, the Sabine Refuge now contains large open water areas.
- Saltwater intrusion is occurring in the Calcasieu and Mermentau Basins and is in turn negatively impacting the seafood industry. Ship channels in the Calcasieu and Sabine Rivers are allowing saltwater movement into the upper estuaries.

From 2002 through 2013, the area has been greatly impacted by storm surges associated with three Category 2 or higher hurricanes (Lili, Rita, and Ike) which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana. Hurricane surge also causes significant damage to wetlands. The breakup of marshes surrounding the towns and communities is allowing storm surge and inundation to more directly impact habitable areas. As a consequence, smaller storms are able to inflict significant flooding damages to residential and non-residential structures. As the coastal ecosystem continues to fragment, flooding losses are expected to increase, thus placing larger populations at risk.

1.5.1 Problems

The people, economy, unique environment and cultural heritage of southwest Louisiana are at risk due to storm surge flooding and wave impacts from tropical storms. The area's low elevation, proximity to the Gulf of Mexico, land subsidence, and rising sea level, are expected to exacerbate coastal flooding, shoreline erosion, saltwater intrusion, and loss of wetland and chenier habitats in the future. System-wide problems and opportunities were used to identify and define more geographically specific problems and opportunities. Problems include the following:

- Flooding from tidal surge and waves associated with tropical storms.
- Increased flood durations in wetlands, resulting in wetland loss.
- Erosion of channel banks and shorelines, resulting in wetland loss.
- Deforestation and mining of chenier ridges.

1.5.2 Significance of Loss of Southwest Coastal Louisiana's "Working Coast"

The area is uniquely suited to its current use of sheltering the infrastructure of the navigation, oil and gas, and seafood industries of the region. The 2012 State Master Plan and Coastal Protection and Restoration Authority Board of Louisiana describe the majority of the coast as privately owned; close working relationships with private landowners are essential, not only for their support but to gain from their knowledge about private coastal lands. (source: http://coastal.la.gov/a-common-vision/master-plan/principles/ accessed November 22, 2013).

- The loss of marsh and wetlands threatens the productivity of the region's coastal ecosystem, the economic viability of industries, and the safety of residents, a marine-resource based economy defined by the interactions of numerous stakeholders engaged in consumptive and non-consumptive uses of coastal resources.
- Southwest Louisiana's "Working Coast" is unique in its scope and scale, with extensive infrastructure needs to serve the navigation, oil and gas, and commercial and recreational fishing industries, which must be balanced and must exist in harmony with each other.
- The loss of marsh and wetlands would threaten nationally significant economic, historical, and cultural resources and have significant negative impacts on the navigation, oil and gas, and seafood industries, and the residents that service these industries.

Navigation

- Wetlands provide protection to several federal navigation projects, including the GIWW, the Calcasieu River and Pass (providing access to the Ports of Lake Charles and Cameron), Sabine Pass (providing access to Port Arthur, Texas), and Freshwater Bayou (providing access to the Port of Iberia). With the loss of wetlands, the sustainability of the Federal navigation system in the region becomes less reliable and more expensive.
- The Port of Lake Charles is a deepwater seaport, on the U.S. Gulf Coast. The Port is currently the 13th-busiest seaport in the U.S.
- The loss of wetlands will expose federal navigation channels, and the ports to which they provide access, to increased erosion/shoaling, especially during extreme weather events, and may force the relocation or abandonment of certain channels and port facilities that currently serve the transportation and oil and gas industry requirements of the region and nation.

Oil and Gas (O&G) Infrastructure

- Regional ports serve the area's vast network of offshore oil and gas facilities, including production facilities and an extensive network of pipelines that provide the U.S. with needed energy resources. The area is also home to three of the 11 liquefied natural gas import/export terminals in the U.S.
- The O&G industry encompasses production (active and passive), distribution of products from offshore/near shore sources throughout North America (via vast unseen pipeline distribution network), support service industry, and rig fabrication and service vessel building.
- The area provides O&G to both domestic and international markets through strategically laid pipelines. Even brief interruptions in service have significant impacts to the supply and pricing of gasoline and natural gas throughout the U.S.
- Erosion of wetlands could result in the displacement/damage of the region's strategic O&G industry infrastructure, especially the extensive near-shore pipeline network, resulting in disruption of service and increased repair and maintenance cost. Potential damage to the pipeline network could increase the risk of unintended releases of petroleum products and the resulting ecosystem damage.

Seafood

- Southwest Louisiana has large commercial and recreational fishing industries that are dependent on the region's wetlands.
- The fisheries industry encompasses commercial fishing harvesting, distribution, and processing, fisheries support industry, boat building, and recreation fishing/hunting support (marinas, fishing charter/guide services, camps, bait/tackle shops).

Social

- Developments in the coastal zone are primarily smaller communities that support resource extraction and harvests in the agricultural, energy, and fishing industries.

- While human populations in and near the wetland areas are low, Southwest Coastal Louisiana is a hub of activity supporting the numerous ports, waterways, oil and gas fields, rich fishing grounds, and other elements of a working coast.
- The impact of the loss of wetlands will be felt far beyond the industries directly impacted, with residents that serve these industries, especially the offshore oil and gas industry, being forced to abandon their communities and move further inland.

1.6 Opportunities

Opportunities to solve the problems include:

- Incorporate structural and nonstructural hurricane and storm surge reduction solutions to reduce the risk of damages and prevent loss of community cohesion (examples of how this can be accomplished include construction of levees, pump stations, interior drainage, elevating structures, or flood proofing).
- Improve internal system hydrology to restore wetlands (examples of how this can be accomplished include measures such as gates, weirs, or marsh restoration).
- Manage salinity levels to maintain fresh and intermediate marsh (examples of how this can be accomplished include water control structures or modifying hydrology).
- Reduce bank and shoreline erosion (examples of how this can be accomplished include rock armoring or breakwaters).
- Prevent loss of significant historic sites (examples of how this can be accomplished include levees, marsh restoration, or elevating structures).

1.7 Authorities

The study has both NED and NER components. This stems from two separate authorizations. The NED study was authorized for the Southwest Coastal Louisiana Feasibility Study based on language from the River and Harbor Act of 1962 and following the impact of Hurricane Rita in 2005.

> *"Surveys of the coastal areas of the United States and its possessions, including the shores of the Great Lakes, in the interest of beach erosion control, hurricane protection and related purposes: Provided, 'That surveys of particular areas shall be authorized by appropriate resolutions of either the Committee on Public Works of the United States Senate or the Committee on Public Works of the House of Representatives."*
> *And:*
>
> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that, in accordance with Section 110 of the River and Harbor Act of 1962, the Secretary of the Army is requested to survey the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes to include the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway."* (December 7, 2005 – Committee on Transportation and Infrastructure, U.S. House of Representatives, Resolution Docket 2747, Southwest Coastal Louisiana).

Investigation of the NER purpose was recommended in the 2005 Chief's Report for the LCA Ecosystem Restoration Program. The Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study was one of six large-scale restoration concepts that were purported to have the ability to "significantly restore environmental conditions that existed prior to large-scale alteration of the natural ecosystem" upon construction. The LCA program was authorized in Title VII of the Water Resources Development Act of 2007.

> *"SEC. 7003. LOUISIANA COASTAL AREA.*
> *(a) IN GENERAL. The Secretary may carry out a program for ecosystem restoration, Louisiana Coastal Area, Louisiana, substantially in accordance with the report of the Chief of Engineers, dated January 31, 2005."*

Additional guidance is identified in Section 5007 of Water Resource Development Act (WRDA) of 2007: Expedited Completion of Reports and Construction for Certain Projects. Guidance provided by the Director of Civil Works on December 19, 2008 states that "*the coastal restoration components proposed as part of the LCA Chenier Plain study will be evaluated as part of the Southwest Coastal Louisiana feasibility study.*"

1.8 Future Without Project Conditions

The second step in the Civil Works Planning process is to develop an inventory of the critical resources (physical, demographic, economic, social, natural etc.) relevant to the problems and opportunities under consideration in the planning area. Then a forecast of the inventory's condition at the future date of the period of analysis (2075) is performed. Those changes in conditions are determined by the impact of all on-going actions, manmade or natural, upon the resources if no alternatives are implemented as part of this evaluation. Section 1.1 described the existing conditions of the affected environment; this section forecasts and reflects the future conditions expected during the 50-year period of analysis if no action is taken. NEPA requires an analysis of the environmental effects from taking no action. This future condition without alternatives is considered the "future without project" conditions. However, the future without implementing an alternative is not without impacts from the preexisting on-going forces that affect the study area. Therefore, to be consistent with NEPA verbiage the following sections reflect the "impacts of no action", which for alternative analysis purposes are compared with the effects of implementing the proposed action or an alternative action. The difference between the impacts of taking an alternative action and the no-action conditions provides the basis from which alternative plans are measured. This analysis provides a benchmark, enabling decision makers to compare the magnitude of environmental effects of the action alternatives.

This section presents the future without project conditions for not implementing a Federal project or taking No Action. For aesthetic visual resources and noise there would be no direct, indirect, or cumulative impacts resulting from taking no action. As such, these resources are not discussed further in this section.

1.8.1 Human Environment

1.8.1.1 Population and Housing

Changes in population, households, and housing are expected to follow the growth in employment within the area. Recent trend analysis (Moody's Analytics 2008) indicates an increase of 15,000 residents and approximately 5,600 residential structures projected for the area which will impact estimates of employment, as described in the next section. Generally, the overall population is projected to increase. However, the Cameron Parish population is projected to continue its trend of decreasing since 2000 (Table 1-13). It is probable that refined building requirements and updated FEMA base flood delineation following the series of storms between 2000-2010 produced a more permanent effect on development in predominantly coastal Cameron Parish. Significant elevation requirements in order to achieve FEMA compliance likely place a significant constraint on future development.

Table 1-13: Projected parish population (in thousands).

Parish	Population		
	2020	2030	2080
Calcasieu	195.0	200	236.7
Cameron	6.6	6.6	3.9
Vermillion	59.9	63	76.8
Total	261.4	269.6	317.4

A single catastrophic storm surge event or multiple events could result in significant damage to economic assets including primarily residential, commercial, and industrial structures. Additionally, property owners could potentially incur higher insurance premiums offered by the National Flood Insurance Program (NFIP) should flood rate insurance maps (FIRM) be updated to reflect an increase in risk over time due to RSLR. The Biggert-Waters Flood Insurance Reform Act of 2012 puts in place a process to adjust flood insurance rates for primary residencies to be consistent with flood risk. Under the new legislation, rates for these properties will increase by 25% per year until premiums meet the full actuarial cost, attempting to move the NFIP toward risk-based pricing. The law also phases out subsidies for vacation and second homes, as well as businesses, severe repetitive loss properties, or substantially improved/damaged properties. Properties not currently insured by the NFIP or any lapsed policy also will be subject to full actuarial rates. The subsequent Homeowner Flood Insurance Affordability Act (HFIAA) of 2014 sets aside the immediate implementation of the Biggert-Waters Act provisions for currently insured property owners and also lengthens the period over

which insurance rates would be ultimately be adjusted. However, all properties covered by the Biggert-Waters Act will be subject to the appropriate conditions of the act, as amended by the HFIAA, upon a change in ownership. Since a significant portion of the study area lies within a FEMA designated floodplain these statutory provisions have potential significant ramifications with regard to the relative value, and affordability, of the housing stock in the area, as well as the long-term individual wealth of the population.

Future without project conditions include an increased potential for flood damage to economic assets due to relative sea level rise. As a consequence of this increased flood risk, property owners and the NFIP (if insured) over time would together incur increased costs to repair flood-damaged property. Additional costs to implement appropriate risk reduction measures to address potential increased flood risk would also be incurred. Such actions could include the migration (or displacement) of affected populations from areas exposed to high flood risk to areas with relatively lower flood risk. Migration out of the area could also result from the temporary or permanent relocation of businesses and employment opportunities.

1.8.1.2 Employment, Business, and Industrial Activity (including Agriculture)

Future without project conditions would include a higher potential for temporary interruption or permanent displacement of employment, business, and industrial activity as businesses temporarily or permanently relocate to areas with less storm damage risk. Growth in employment, business and industrial activity is expected to follow national economic trends to the extent that economic growth is dependent upon macroeconomic variables such as inflation, interest rates, and the business cycle. However, employment in this region is also partially dependent on the petroleum exploration, production, and refining industries, which do not necessarily correlate with national economic trends. Employment trends (Moody's Analytics 2008) suggests growth from 2012 to 2038 with an additional 6,880 jobs projected by the year 2038 (Table 1-14). Cameron Parish, employment is expected to stabilize at 2012 levels (Moody's Analytics 2008).

Table 1-14: Projected non-farm employment (in thousands).

Parish	2012	2020	2030	2038
Calcasieu	91.89	96.5	95.5	95.4
Cameron	2.69	2.8	2.7	2.7
Vermilion	16.54	17.7	18.4	19.9
Total	111.12	116.9	116.5	118.0
Source: Moody's Analytics				

One or more series of catastrophic storm surge events in the future could result in significant disruption to business and industrial activity that could adversely affect employment and population. Such catastrophic events causing significant damage to non-residential, commercial, and industrial structures would likely increase over time as a result of multiple factors such as RSLR and climate change (source: http://www.climatehotmap.org/global-warming-effects/economy.html accessed October 30, 2013). Additionally, business owners in these communities could potentially incur higher flood insurance premiums should the FIRMs be updated to reflect an increase in flood risk over time.

1.8.1.3 Public Facilities and Services

Future without project conditions would include a greater potential for permanent displacement of public facilities and services due to storm surge events. Public facilities and services are expected to grow with the needs of the population and would follow population growth trends. In addition to the existing 603 public and quasi-public buildings, an additional 193 such facilities are projected by 2080. These projected facilities are expected to be placed at elevations above the 100-year floodplain. Over time, all facilities would be more susceptible to damages resulting from future hurricane and storm surge events as RSLR occurs. The increased risk of damage to public facilities and the resulting temporary or potentially permanent relocation of these facilities would have a negative impact on services which would no longer be available either temporarily or permanently.

1.8.1.4 Transportation

Transportation infrastructure would be more susceptible to damages resulting from storm surge events due to expected RSLR. There would also be reduced access to infrastructure due to storm surge.

1.8.1.5 Community and Regional Growth

Income growth and associated community and regional growth are expected to follow trends in national income, local employment, household formation, and the demand for public facilities and services. There would also be a higher potential for unstable or disrupted community and regional growth due to increasing risk of damage from storm surge events.

1.8.1.6 Tax Revenues and Property Values

Future without project conditions would include lower tax revenues as property values decline due to higher risk of damage from storm surge events over time. The real estate market cycle is the primary factor in establishing existing and future property values at any point in time. However, over the period of analysis (50 years) changes in property values would be primarily reflective of the growth in income. As flood risk grows over time due to higher surge events as a feature of RSLR, the effects of higher flood risk would continue to suppress real estate market values for residential and non-residential properties. As in other coastal regions, higher flood risk would manifest itself in higher premiums for flood insurance under the NFIP: higher premiums are expected to increase the cost of property ownership and result in correspondingly lower market values. In extreme cases, such premiums are expected to rise to such high levels that the cost of flood insurance would become prohibitively expensive to some property owners. As a result, some properties would not be marketable and their values could be reduced to an extremely low level. To the extent that government assessments of these properties accurately reflect the diminished market values, the tax base could be reduced and property tax revenues could decline.

Some property owners would choose to reduce higher expected future flood risk through mitigation activities. These activities would primarily include, but are not limited to, structure elevation, flood-proofing of commercial structures, and relocation to less risky portions of the study area. Each of these mitigation efforts require substantial financial resources to implement, whether these costs are borne by the property owner or are supplemented, in whole or in part, by public assistance.

1.8.1.7 Community Cohesion

The area would become more susceptible to damage caused by storm surge events that is projected to increase over the period of analysis. The increased risk of damage to residential and non-residential structures and the resulting temporary and/or permanent relocation of populations would negatively affect the community cohesion in many communities. Additionally there would be a greater potential for reducing community cohesion if the civic infrastructure continues to be damaged as a result of storm surge events. Community cohesion may also be reduced if residents and businesses relocate to lower-risk areas.

1.8.1.8 Other Social Effects (OSE)

The area's social vulnerability is expected to increase over time if subsidence and sea level rise continue to increase, and the population in the study area increases as it is projected to do. The absolute number of socially vulnerable people (e.g., low-income, minority, less-educated, and over the age of 65) at risk for flood events will increase. This, in turn, may lead to an increased burden placed on local, state, and federal agencies to ensure that the most socially vulnerable populations have access to resources before, during, and after flood events.

1.8.1.9 Environmental Justice

Future without project conditions would include a higher potential for temporary displacement of minority and/or low-income populations because residents within the project area would remain vulnerable to flooding and may be forced to relocate to areas with risk reduction features in place. Storm surge increase due to subsidence and sea level rise will exacerbate their vulnerability to flooding. Low-income populations may also find it more difficult to bear the cost of evacuation. The future without condition would not contribute to any additional EJ issues when combined with other Federal, state, local, and private risk reduction efforts.

1.8.2 Water Environment

1.8.2.1 Relative Sea Level Rise

Sea level rise (SLR) conditions were simulated by incorporating the predicted subsidence levels into the initial water elevation parameter to capture the combined effects of subsidence and local SLR into a single RSLR value. For the 2025 and 2075 hydrologic simulations, RSLR values specific to each gage were added to the 2013 initial water surface elevations (WSE) to calculate the initial WSE appropriate for each year and SLR rate. SLR and RSLR data is listed in Table 1-15 and shown in Figure 1-6. Four gages were used for the entire RSLR analysis, however only the gage closest to the main area with potential benefits is shown.

Table 1-15: RSLR rise for the gage on the GIWW west of Calcasieu Lock.

Year and SLR Scenario	Calcasieu West RSLR increment (in feet)	Calcasieu West gage elevations (NAVD88 feet)
2025 Low SLR	0.16	0.78
2025 Intermediate SLR	0.22	0.84
2025 High SLR	0.40	1.02
2075 Low SLR	0.85	1.47
2075 Intermediate SLR	1.42	2.04
2075 High SLR	3.24	3.86

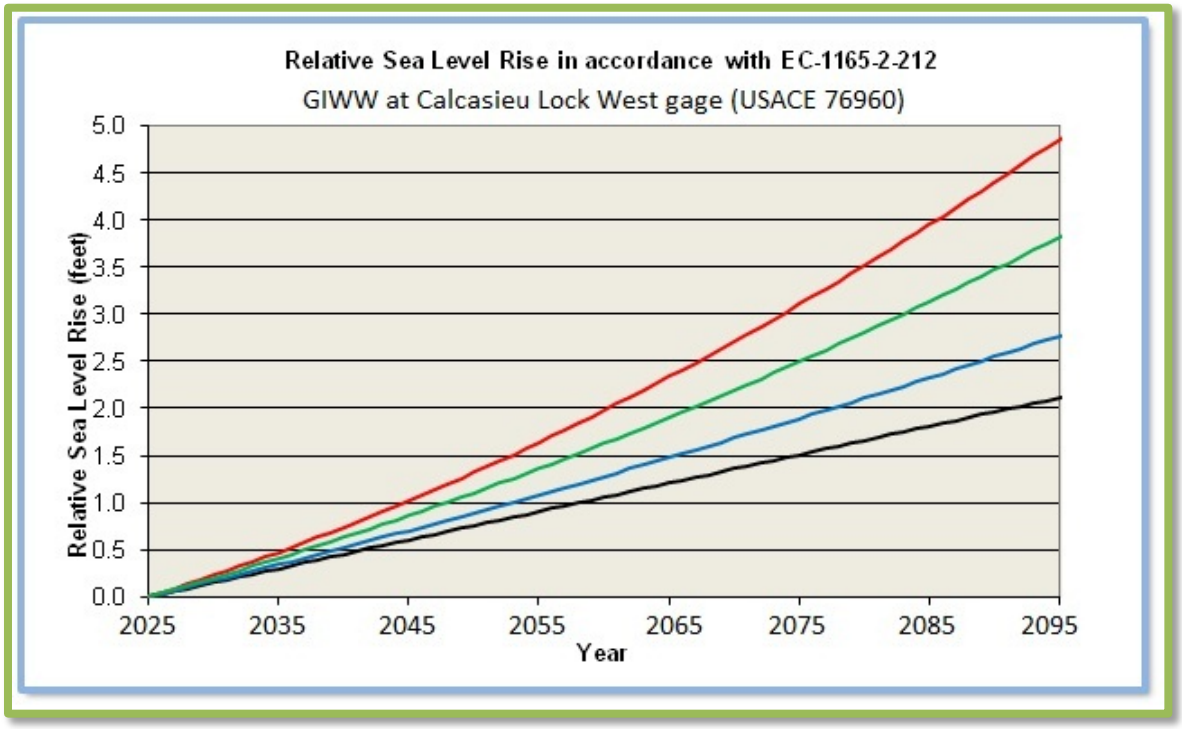

Figure 1-6: Relative sea level rise in the study area.
Black = extrapolation of historic rate. Blue = low RSLR.
Green = intermediate RSLR. Red = high RSLR.

1.8.2.2 Hydrology and Hydraulics

Using the "intermediate" rate of RSLR as a plan formulation assumption, in the immediate area of Lake Charles, 100-year [1% Annual Chance Exceedance (ACE)] frequency event water levels are estimated to rise between 0.47 ft and 1.19 ft between 2013 and 2075. In the surrounding marsh areas for all parishes, water levels are estimated to rise between 1.30 ft and 7.40 ft. For the areas along I-10 such as Welsh, Jennings, and

Crowley that are far away from any water source connected to the Gulf of Mexico, there is no estimated rise in water surface elevations. This data is shown in tables in the Engineering Report - Southwest Coastal Louisiana Explanation of FWOP Results at Appendix B. This analysis is based upon the intermediate rate of relative sea level rise. Adding marsh accretion raises water levels slightly in the marsh areas, while not impacting any NED areas.

1.8.2.3 Flow and Water Levels

Under the future without project condition there would be the continuation of the existing water flow and water level trends. As existing marsh fragments and is eventually converted to open water, the rainfall runoff from the north and the increasing RSLR would result in the area converting to greater expanses of fragmented marsh and open water. As sea levels rise, existing locks and control structures used for salinity control would be closed on a more frequent basis over time until they would be closed all the time to prevent saltwater intrusion. Natural drainage pattern flow paths would remain unchanged; however, as sea levels rise, drainage times would increase.

1.8.2.4 Water Quality and Salinity

There would be no direct impacts from implementing the No Action Alternative. Indirect impacts would include the continuation of existing water quality trends. Without the proposed project there would be an increased risk of flooding of structures within the study area, with drainage of floodwaters containing elevated nutrients, metals, and organics into water bodies connected to the Calcasieu, Mermentau, and Tech-Vermillion river basins. Without the proposed project, study area would still be affected by existing and proposed restoration measures, chenier geomorphologic processes, development (in particular, oil and gas development in the Calcasieu River basin and agriculture in the Mermentau River basin), and climate patterns (Mousavi et. al 2011)..

1.8.3 Natural Environment

1.8.3.1 Sedimentation and Erosion

Future without project conditions would include persistence of current sedimentation and erosion patterns. Relative sea level rise would expose additional shoreline areas to erosive forces into the foreseeable future. Existing hydrologic alterations would continue to affect water levels and salinities and continue influencing land loss at similar or increased rates. Table 1-16 displays the predicted acreage loss of different wetland types in southwest coastal Louisiana by the year 2050. Net marsh loss by 2050 is expected to be 97,505 acres (Coast 2050 Report, 1999).

Table 1-16: Predicted acreage loss of different wetland types in the study area.

SOUTHWEST COASTAL LOUISIANA	Fresh Marsh lost by 2050	Intermediate Marsh lost by 2050	Brackish Marsh lost by 2050	Saline Marsh lost by 2050	Net Marsh loss by 2050
Mermentau Basin	34,885	9,080	14,620	525	59,110
Calcasieu/Sabine Basin	2,640	11,555	23,770	430	38,395
Totals	37,525	20,635	38,390	955	97,505

1.8.3.2 Soils, Water Bottoms and Prime and Unique Farmlands

Future without project conditions would be the continuation of existing conditions with coastal shoreline recession, subsidence and land loss continuing at similar or increasing rates of change. As RSLR increases and areas become inundated by salt water, prime farmlands could be lost. As human populations and development increase, prime farmlands could be converted to suburban, urban, and industrial uses and areas available for agricultural use would decrease. Gulf shoreline recession rates, varying between 8 ft to 52.9 ft per

year, would result in Gulf shoreline rollover onto interior marshes and cheniers would continue to be lost throughout the study area due to subsidence and change in land use patterns from forested areas to agriculture and grazing pasture. Soils identified as prime farmlands on chenier ridge tops would be susceptible to flooding events and subsidence and could be lost as RSLR increases.

1.8.3.3 Gulf Coastal Shorelines

Future without project conditions would be the continuation of existing conditions with coastal shoreline recession, subsidence and land loss continuing at similar or increasing rates of change. The loss of these coastal shorelines would also adversely affect the extraordinary scenic, scientific, recreational, natural, historical, archeological, cultural, and economic importance of the coastal shorelines. The continued loss of coastal shorelines would result in the reduction and eventual loss of the natural protective storm buffering. Without the protective buffer provided by the coastal shorelines, interior estuarine wetlands would be at an increased risk to severe damage from tropical storm events. Continued shoreline recession, subsidence and land loss resulting in the movement of unstable sediments would undermine man-made structures, especially the extensive oil and gas pipelines and related structures in this "working coastline."

1.8.3.4 Vegetation Resources

Future without project conditions would be the continuation of existing conditions and factors driving trajectories of ecological change to area vegetation zones. Without an extensive ecosystem restoration plan, marsh habitat would continue to be restored through other restoration projects and programs such as those authorized for construction through CWPPRA, the Coastal Impact Assistance Program (CIAP), and LCA, but not on a large and broad enough scale to completely restore natural processes and features vital to the long-term sustainability of the watershed. Without action, the coastal vegetated resources would continue to decline, including bankline erosion and sloughing of the shoreline, and continued fragmentation and conversion of existing brackish and saline marsh to shallow open water habitats. Both human-induced impacts and natural processes would contribute to the continued loss of vegetated habitats, including continued shoreline erosion and subsidence, increased saltwater intrusion, increased water velocities, and increased herbivory.

Gulf Coast Prairie and Forested Terraced Uplands:

- Some unknown extent of existing riverine BLH and associated swamp habitats would be converted to more efficient water conveyance channels as human populations and development increase.
- Some unknown extent of existing pasture and rangelands would be converted to rural, suburban and urban human habitats, generally in the order presented, as human populations and development increase.

Gulf Coast Marshes

- Habitat switching would occur due to increasing sea level rise, subsidence, shoreline erosion and other land loss drivers.
- Gulf shoreline recession rates, varying between 8 ft to 52.9 ft per year, would result in Gulf shoreline rollover onto interior marshes thereby converting these existing habitats.
- Chenier ridge habitat has been lost throughout the southwest coastal area due to subsidence and change in land use patterns from forested areas to agriculture and grazing pasture. Other anthropogenic activities have affected the extent of chenier habitat such as sand mining though much of this activity has decreased significantly. The open areas on the chenier ridges would continue to be maintained as agricultural or pasture land hence native or invasive scrub shrub habitat would be limited.
- Inland ponds and lakes shoreline loss rates, varying between 3.6 ft and 9.3 ft, would result in conversion of existing salt, brackish, and intermediate/fresh marsh to shallow open water habitats.
- Habitat switching of interior marsh could result from saline intolerant dominant species to species that can tolerate higher salinities.
- SAVs could become lost due to erosive forces and increased sedimentation due to land loss.

1.8.3.5 Rare, Unique, and Imperiled Vegetative Communities

Existing conditions and trends of land loss are expected to continue resulting over time in the loss of these valuable vegetative communities. For example, without action, saltwater intrusion and drainage problems would continue, resulting in the conversion of freshwater marsh to intermediate and brackish marsh and eventual open water.

1.8.3.6 Wildlife Resources

Existing conditions and changes caused by ecosystem drivers would persist. RSLR, human encroachment and development and other factors would result in loss of existing wildlife estuarine, chenier, riverine, and oak-pine forest habitats. Increases in RSLR would increase saltwater intrusion and exacerbate ongoing conversion of estuarine wetlands to shallow open water. As habitat loss continues, migratory neotropic avian species would have less habitat for resting forcing them to fly further to suitable habitat. Flying longer distances to find suitable stopover habitat could result in an increase in mortality resulting in a corresponding reduction in overall species diversity and abundance. Most mammalian, amphibian, and reptilian species would migrate to more suitable habitats. Wildlife would benefit from restoration activities implemented by other programs such as CIAP, CWPPRA, and the beneficial use of dredged material; however these activities are not enough to keep up with the current trends in habitat loss and RSLR.

1.8.3.7 Aquatic and Fisheries Resources

Existing conditions and associated changes due to ecosystem drivers would likely persist into the future. Increases in RSLR would increase saltwater intrusion and exacerbate ongoing conversion of estuarine wetlands to shallow open water and loss of existing estuarine fish habitats. Increases in RSLR could exacerbate ongoing conversion of existing aquatic organism distributions from an estuarine-dependent to more marine-dependent distribution. As habitat loss continues, there would be a corresponding reduction in overall species diversity and abundance as well as loss of estuarine nursery, foraging, refugia, and other estuarine aquatic habitats. Aquatic and fisheries would benefit from restoration activities implemented by other programs such as CIAP, CWPPRA, beneficial use of dredged material; however these activities are not enough to keep up with the current trends in habitat loss and RSLR.

1.8.3.8 Essential Fish Habitat (EFH)

Existing trends and continued shoreline erosion, subsidence, and land loss would continue to convert existing estuarine EFH to marine and open water EFH types resulting in the loss of existing estuarine EFH but an increase in the other types.

1.8.3.9 Threatened/Endangered Species and Other Protected or Species of Concern

Land loss would directly reduce the availability of habitat for T&E species. Piping plover would lose access to some forage and roosting habitat as it shifts to shallow open water. As interior marshes are lost, shoreline retreat rates increase. The coastal habitat utilized by sea turtles would continue to be impacted from this accelerated shoreline retreat rate. The continued erosion of the Gulf coast shoreline would result in additional salt water intrusion into the interior wetlands area resulting in additional marsh loss. Conversely, the recently delisted brown pelicans would gain access to more shallow water foraging areas, resulting from the shoreline retreat. Indirect effects would be the continued reduction of piping plover critical wintering habitat due to coastal erosion. Without action there would be the continued degradation and loss of emergent wetland habitats used by many different fish and wildlife species for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The loss and deterioration of transitional wetland habitats over time could continue to indirectly affect, to an undetermined degree, all listed species that may potentially utilize the area including: Gulf sturgeon, piping plovers, green sea turtles, Kemp's ridley sea turtles, loggerhead sea turtles, hawksbill sea turtle, leatherback sea turtle, and the West Indian manatee. The recovery of some sensitive/delisted species such as brown pelican, bald eagle, and colonial nesting birds could be indirectly impacted if habitat loss goes unabated.

1.8.3.10 Historic and Cultural Resources

Effects upon historic and cultural resources in southwest Louisiana have resulted from both natural processes, such as redeposition, and human activities. Coastal environments are dynamic, and impacts to cultural and historic resources in the area would continue as a result of both natural processes and cultural modifications of the coastal environment of southwest Louisiana.

1.8.3.11 Recreation Resources

Recreational resources in the Louisiana coastal zone that would be most affected are those related to loss of wetlands/marshes and habitat diversity. Many recreational activities are based on aquatic resources and directly related to the habitat and species in an area.

Gulf Coast Prairie and Forested Terraced Uplands: Indirectly, recreational infrastructure would remain vulnerable to surges. Another major consequence of storm surge is land loss and the possible loss of facilities and infrastructure that support or are supported by recreational activities. Land loss can result in the loss of park land, boat launches, parking areas, access roads, as well as marinas and supply shops. In general, without continued comprehensive ecosystem restoration efforts across the study area, further degradation of area marshes would continue and its associated negative effects on recreational activities will increase. Additionally, saltwater intrusion and predicted RSLR will continue to cause land loss. As existing freshwater wetland/marsh areas convert to saltwater marsh, then to open water, the recreational opportunities will change accordingly.

Gulf Coast Marshes: Indirectly, the continued loss of wetlands/marshes and habitat diversity affects recreational opportunities. Storm surge and saltwater could influence freshwater forests and habitats and could reduce recreational resources (e.g., fishing, hunting, bird watching, and other). In general, further degradation of area marshes would continue and its associated negative effects on recreation activities would increase. As existing freshwater wetland/marsh areas convert to saltwater marsh, then to open water, the recreational opportunities would change accordingly. For example, fresh water fishing opportunities may be expected to become saltwater opportunities. If the expected peak and then decline of fishery production occurs in these open waters, then the associated marine-fishery recreational opportunities would also decline. As populations of migratory birds and other animals dependent on marsh and swamp decrease, again associated recreational opportunities, such as hunting and wildlife viewing, would decrease. There may be an economic loss felt by marinas and other shops, which may be two-fold. One is losing the actual facility or access to the facility, the other is change in opportunities. Habitat change and resulting changing recreation opportunities (i.e. fresh to marine) may, for example, severely impact a marina specializing in services to particular types of recreation (i.e. loss of freshwater opportunities).

1.9 Cumulative Impacts for Future Without Project Conditions

Cumulative impacts would be the incremental direct and indirect effects of not implementing proposed NED and NER efforts when added to other past, present and reasonably foreseeable future actions (40 CFR § 1508.7). These would include hurricane and storm damage risk reduction (HSDRR) projects and ecosystem restoration projects expected to be completed near and around the project areas. There is little published data with which to provide a quantitative comparison regarding HSDRR projects or ecosystem restoration projects in the SWC project area. Some information regarding such efforts:

- The 1990 Coastal Wetlands Coastal Wetlands Planning, Protection and Restoration Act, (CWPPRA; Public Law 101-646, Title III CWPPRA) has many different existing and authorized ecosystem restoration projects throughout coastal Louisiana, including the SWC project area (see http://lacoast.gov/new/Projects/List.aspx; accessed March 9, 2015), that would still be constructed despite the SWC NER Plan not being implemented. Generally these projects include marsh restoration, shoreline protection, vegetative planting, sediment trapping, hydrologic restoration and monitoring. Typical projects are in hundreds of acres size range. See description below:
- The 1998 *Coast 2050: Toward a Sustainable Coastal Louisiana* plan to address Louisiana's costal land loss and provide for a sustainable coastal ecosystem. This collective effort among Federal, State, and local governments was affirmed by the adoption of the plan by the Louisiana Coastal Wetlands Conservation

and Restoration Task Force and the Wetlands Conservation and Restoration Authority as their official restoration plan; transmission of this plan to the U.S. Department of Commerce by the State of Louisiana to incorporate it into the Louisiana Coastal Resources Program Guidelines; and resolutions of support from 20 coastal parish councils and police juries. This plan has been used by various federal, state, parish and local entities as a guide for specific projects. However, no projects have been authorized for construction under the Coast 2050 authorization.

- The authorized LCA, Louisiana Ecosystem Restoration Study (hereinafter "LCA Plan," USACE 2004) Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study, from which the present NER Plan authorization and project features were initially developed.
- Louisiana's Comprehensive Master Plan for a Sustainable Coast (hereinafter "2012 State Master Plan; CPRA 2012) http://sonris-www.dnr.state.la.us/dnrservices/redirectUrl.jsp?dID=4379731 describes not only proposed projects but cites existing projects
- In response to the 2010 Gulf of Mexico Deepwater Horizon oil spill and to help ensure the long-term restoration and recovery of the Gulf Coast region, the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act of 2012, or RESTORE Act.

CWPPRA: Since its inception, the CWPPRA program has authorized for construction 151 coastal restoration or protection projects, benefiting over 110,000 acres in Louisiana (source: http://lacoast.gov/new/About/#projects accessed October 22, 2013).

LCA Plan: In November 2007, Title VII of the Water Resources Development Act of 2007 (WRDA '07) became law, authorizing a $1.996 billion Louisiana Coastal Area (LCA) Program in accordance with the 2004 feasibility report and subsequently the 2005 LCA Chief's Report, which were developed in partnership with the State of Louisiana. The LCA program consists of three major types of projects: 1) barrier island restoration; 2) marsh creation or restoration; and 3) Mississippi River diversions. All three types of projects independently generate restoration benefits, but together they provide greater sustainability and resilience for the coastal ecosystem. In May 2014, the Water Resources Reform and Development Act of 2014 (WRRDA 2014) became law and Sec 7002 increased the WRDA 07 authorized amounts for 6 projects known as the LCA 6; Multipurpose Operation of Houma Navigation Lock and Convey Atchafalaya River Water; Terrebonne Basin Barrier Shoreline Restoration; Small Diversion at Convent Blind; Amite River Diversion Canal Modification; Medium Diversion at White Ditch from the WRDA 2007 amount of $543,600 to $1,627,000,000 for these 6 projects. In addition, WRRDA 2014 increased the WRDA 07 authorized amount for the Barataria Basin Barrier Shoreline (BBBS) Restoration project from the WRDA07 amount of $242,600,000 to $495,000,000. The LCA Program is intended to address the most critical near-term needs of coastal Louisiana through the construction of projects to arrest further wetland loss, which will allow for development of a more comprehensive solution to restore the ecosystem in the long-term. Fifteen projects and studies are considered near-term critical restoration features in the near-term plan.

On May 22, 2012, the Louisiana legislature unanimously approved the 2012 State Master Plan for a Sustainable Coast (State Master Plan), a $50 billion, 50-year plan to substantially increase flood protection for communities and create a sustainable coast. By executive order of the Governor of the State of Louisiana, all activities, studies, decisions, and commitments from this point forward by the State government will conform to and be consistent with the State Master Plan. As such, the State Master Plan is intended to guide State participation in future studies and investments in risk reduction and restoration projects in Louisiana, including those in collaboration with the Corps. The approval of the State Master Plan places the LCA program at a pivotal point. The Coastal Protection and Restoration Authority Board of Louisiana, on behalf of the State, has assessed all on-going and planned coastal ecosystem restoration studies and projects, including LCA projects, to ensure alignment with the State Master Plan. The State is working in partnership with the USACE on the Mississippi River Hydrodynamic and Delta Management study which will provide important scientific and engineering technical information necessary for developing diversions throughout the Mississippi River Delta.

2012 State Master Plan: The 2012 State Master Plan (CPRA 2012) states that more than 23 large-scale studies and planning efforts have been conducted for coastal Louisiana since the 1920s. The State developed and screened over 1,500 project ideas to develop a more manageable number of candidate projects. From this, the State evaluated 248 restoration projects, 33 structural and 116 conceptual nonstructural flood risk reduction projects. The State acknowledges that each project has its own timeline and budget. The 2012 State Master Plan indicates how the State of Louisiana would spend dollars they now have in hand as well as how they would use new dollars that are allocated for Louisiana's coast. The Master Plan will be updated in 2017, and some projects may be added or removed in this update process.

Deepwater Horizon RESTORE Act:
The Act was passed by Congress on June 29, 2012, and signed into law by President Obama on July 6, 2012 (http://www.restorethegulf.gov/sites/default/files/The%20Path%20Forward%20to%20Restoring%20the%20Gulf%20Coast%20-%20Gulf%20Restoration%20Council%20FINAL.pdf accessed November 22, 2013). The Act provides for planning and resources for a regional approach to the long term health of the natural ecosystems and economy of the Gulf Coast region. The Act sets forth the following framework for allocation of the Trust Fund (http://www.restorethegulf.gov/release/2012/11/30/gulf-coast-ecosystem-restoration-council-help-rebuild-gulf-coasts%E2%80%99-ecosystems-and accessed November 22, 2013):

- 35 percent equally divided among the five States for ecological restoration, economic development, and tourism promotion;
- 30 percent plus interest managed by the Council for ecosystem restoration under the Comprehensive Plan;
- 30 percent divided among the States according to a formula to implement State expenditure plans, which require approval of the Council;
- 2.5 percent plus interest for the Gulf Coast Ecosystem Restoration Science, Observation, Monitoring and Technology Program within the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA); and
- 2.5 percent plus interest allocated to the States for Centers of Excellence Research grants, which will each focus on science, technology, and monitoring related to Gulf restoration.

The Act requires the Initial Comprehensive Plan (Plan) to include "a list of projects and programs authorized prior to the date of enactment of [the Act] but not yet commenced, the completion of which would further the purposes and goals of [the Act]." The Department of Agriculture identifies 8 projects; U.S. Forest Service identifies 3 projects; Department of Commerce identifies 7; Department of Interior identifies 3 projects; Louisiana identifies 6 projects; USACE identifies 41 projects; EPA identifies 6 projects specific to Louisiana and 1 project Gulf-wide (http://www.restorethegulf.gov/sites/default/files/Authorized%20But%20Not%20Yet%20Commenced%20List_8-6-13_FINAL.pdf?utm_medium=email&utm_source=govdelivery accessed March 6, 2015).
The cumulative effects of not implementing the proposed action, not providing risk reduction for hurricane and storm surge damage, and not providing ecosystem restoration would be incrementally included with the direct and indirect effects of the above cited existing and authorized HSDRR and ecosystem restoration projects in the area.

Human Environment

- an estimated population of 225,000 and 15,000 residential structures in the study area in the year 2075;
- employment of 106,000 workers in the three-parish area in the year 2010; 1,580 non-residential structures in the study area by 2075; 808,414 acres of agricultural land within the three-parish area in 2009 projected 603 public and quasi-public buildings, and an additional 193 such facilities projected by 2080;
- transportation infrastructure would be more susceptible to damages resulting from storm surge events due to expected RSLR;
- reduced access to infrastructure due to storm surges;
- community and regional growth;
- tax revenues and property values;

- higher flood insurance premiums would be expected to increase the cost of property ownership and result in correspondingly lower market values;
- continued or increased risk of damage to residential and non-residential structures resulting in temporary and/or permanent relocation of populations would negatively affect the community cohesion in many communities;
- continued temporary displacement of minority and/or low-income populations because residents within the area would remain vulnerable to flooding and may be forced to relocate to areas with risk reduction features in place;
- continued higher flood risks would manifest itself in higher premiums for flood insurance under the NFIP;
- continued shoreline recession, subsidence, and land loss resulting in the movement of unstable sediments would undermine man-made structures, especially the extensive oil and gas pipelines and related structures in this "working coastline;"

Water Environment

- existing hydrologic alterations would continue to impact water levels and salinities and continue influencing land loss at similar or increased rates;
- as sea levels rise, natural drainage pattern flow paths would remain unchanged but drainage times would increase;
- continued salt water intrusion and inundation during hurricane and storm surge events;
- continued erosion by wave and current action resulting in continued shoreline erosion of most channels, lakes, and the Gulf;

Natural Environment

- continued loss of soil resources. The LCA Study (USACE, 2004) estimated coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year over the next 50 years. It is estimated that an additional net loss of 328,000 acres may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands. However, these wetland soil losses would be offset to some extent by restoration projects implemented through other programs;
- continued increases in RSLR which could increase saltwater intrusion and exacerbate ongoing conversion of existing estuarine wetlands to shallow open water; impacts to cultural and historic resources in the area would continue as a result of both natural processes and cultural modifications of the coastal environment of southwest Louisiana;
- recreational infrastructure and consumptive recreational opportunities would remain vulnerable to hurricanes and storm surges.
- continued conversion of existing vegetated wetlands used as foraging, nesting, and over-wintering habitat to open water habitats;
- reduction in overall species diversity and abundance as well as loss of estuarine nursery, foraging, refugia, and other estuarine aquatic habitats;
- continued bankline erosion and sloughing of the shoreline;
- continued encroachment of salinity in areas with brackish and freshwaters;
- continued habitat switching due to increasing RSLR, subsidence, shoreline erosion, and other land loss drivers;
- loss of habitat would further stress species that are dependent on these habitats for all or a part of their life cycle.

2.0 PLAN FORMULATION

Plan formulation supports USACE water resources development missions. A systematic and repeatable planning approach ensures sound decision making. The Principles and Guidelines describe the process for Federal water resource studies requiring formulation of alternative plans contributing to Federal objectives. This chapter reviews the process to identify the TSP. The chapter also shows work performed after public and agency comments on the first draft of the report released in December 2013.

Plans or alternatives are composed of measures. Measures consist of features which are structural elements that require construction or assembly and/or activities which are nonstructural actions implemented to address planning objectives. Each feature and/or activity represents a measure that can be implemented to address planning objectives at a specific geographic site.

This study considered measures consistent with NED and NER objectives. All measures were evaluated and screened for capability to meet objectives and avoid constraints, for engineering and economic feasibility, and to maximize benefits provided over the 50 year period of analysis from 2025 - 2075. Measures that warranted continued consideration and met the success thresholds were assembled into alternative plans. In the evaluation process, each alternative plan was required to meet study-specific minimum standards and qualifying criteria in order to merit further consideration. Each plan was evaluated individually to determine whether it qualified for additional consideration.

Risk Reduction

The term "100-year level (1% ACE) of risk reduction," refers to a level of reduced risk of hurricane and storm surge and wave driven flooding that the project area has a 1 percent chance of experiencing each year. The 1 percent chance is based on the combined chances of a storm of a certain size and intensity following a certain track. Different combinations of size, intensity, and track could result in a 100-year surge event. The 50-year level (2% ACE) of risk reduction refers to a level of reduced risk of hurricane and storm surge and wave driven flooding that the project area has a 2 percent chance of experiencing each year. The 200-year level (0.5% ACE) of risk reduction refers to a level of reduced risk of hurricane and storm surge and wave driven flooding that the project area has a 0.5 percent chance of experiencing each year.

2.1 Goals and Objectives

Generally, the planning goals of the NED Plan are to reduce damages associated with hurricane and coastal storm surge flooding. The NED storm damage risk reduction plans were formulated to achieve NED principles and objectives. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units, and are the direct net benefits that accrue in the planning area and the rest of the Nation.

The general planning goals of the NER Plan are to significantly and sustainably reduce land loss and coastal erosion in the study area, restore environmental conditions for the Chenier Plain ecosystem in SWC Louisiana, and evaluate a range of coastal restoration components to address a multitude of ecosystem problems. Plans were formulated to achieve NER principles and objectives. Contributions to NER are increases in the net quantity and/or quality of desired ecosystem resources, and are measured in the study area and nationwide.

The Project Delivery Team (PDT) developed the following planning objectives to apply to the entire study area over the 50-year planning horizon (2025-2075):

- NED Objective 1. Reduce the risk of damages and losses from hurricane and storm surge flooding.

- NER Objective 2. Manage tidal flows to improve drainage, and prevent salinity from exceeding 2 parts per thousand (ppt) for fresh marsh and 6 ppt for intermediate marsh.

- NER Objective 3. Increase wetland productivity in fresh and intermediate marshes to maintain function by reducing the time water levels exceed marsh surfaces.

- NER Objective 4. Reduce shoreline erosion and stabilize canal banks to protect adjacent wetlands.

- NER Objective 5. Restore landscapes, including marsh, shoreline, and cheniers to maintain their function as wildlife habitat and improve their ability to serve as protective barriers.

2.2 Constraints

The NED and NER plans are limited by the following constraints that are to be avoided or minimized:

- **Commercial navigation.** The Calcasieu and Sabine Ship Channels and the GIWW carry significant commercial navigation traffic. Measures that would cause shipping delays would result in negative NED impacts. In addition, the ability of authorized navigation projects to fulfill their purpose, such as the operation of locks along the GIWW, may be impacted by project features.
- **Federally listed threatened and endangered species and their critical habitats.** Construction schedules may be restricted due to threatened and endangered species such as piping plover, Gulf sturgeon, red-cockaded woodpecker, red knot, whooping crane, West Indian manatee, and several species of sea turtles.
- **Essential fish habitat (EFH), especially intertidal wetlands.** Conversion of one EFH type to another should be done without adversely impacting various fish species.
- **Historic and cultural resources.** Ninety-nine archeological sites were preliminarily identified within a one-mile buffer of the initial array of NED and NER alternatives, including one historic site ("Arcade Theater") listed on the NRHP and six potentially eligible prehistoric sites. Twelve historic properties listed on the NRHP have been identified within the one-mile buffer, including the Charpentier (Lake Charles) Historic District, as well as four eligible standing structures. Hundreds of standing structures in the area have a minimum age of 50 years and have not been assessed for eligibility.

2.3 Study Authorizations

2.3.1 NED Study Authorization

A survey of the coast of Louisiana in Cameron, Calcasieu, and Vermilion Parishes, with particular reference to the advisability of providing hurricane protection and storm damage reduction and related purposes, including the feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway was authorized by a Resolution of the Committee on Transportation and Infrastructure, U.S. House of Representatives, Docket 2747, on December 7, 2005.

CEMVN initiated a Section 905(b) reconnaissance study in April 2006. NED alternatives to mitigate for hurricane-induced damages within Calcasieu, Cameron, and Vermilion Parishes were formulated through a series of planning meetings with the State of Louisiana, local parishes, and other stakeholders. The following three structural alternatives were initially determined to be economically justified with benefit/cost ratios greater than 1.0:

- Armored 12-foot earthen levee that allows for overtopping constructed along the GIWW alignment on the south side across Calcasieu, Cameron, and Vermilion parishes (height and alignment specified in the study resolution), with control structures constructed across waterways.
- Non-armored 12-foot earthen levee that allows for overtopping constructed along the north side of the GIWW providing storm damage risk reduction to the Lake Charles area.
- Non-armored 12-foot earthen levee that allows for overtopping constructed along the north side of the GIWW providing storm damage risk reduction to the Abbeville area.

2.3.2 NER Study Authorization

The 2004 Louisiana Coastal Area Ecosystem Restoration Study Report and Programmatic Environmental Impact Statement (2004 LCA Study) was developed to identify cost-effective, near-term (ten year implementation period) restoration features to reverse the degradation trend of the coastal ecosystem of Louisiana. The Near-Term Plan that resulted from the 2004 LCA Study focused on restoration strategies that would reintroduce historical flows of river water, nutrients, and sediments; restore hydrology to minimize

saltwater intrusion and maintain structural integrity of coastal ecosystems. The 2004 LCA Study identified critical projects, multiple programmatic authorizations, and ten additional required feasibility studies for LCA. The Report of the Chief of Engineers dated 31 January 2005 (2005 Chief's Report) approved the Near-Term Plan substantially in accordance with the 2004 LCA Study. Title VII of the Water Resources Development Act of 2007 (WRDA 2007) (Public Law 110-114) authorized an ecosystem restoration Program for the Louisiana Coastal Area substantially in accordance with the Near-Term Plan.

The Chenier Plain Freshwater Management and Allocation Reassessment Study (Chenier Plain Study), recommended in the 2005 Chief's Report was one of six large-scale restoration concepts that were purported to have the ability to "significantly restore environmental conditions that existed prior to large-scale alteration of the natural ecosystem" upon construction. WRDA 2007 authorizes fifteen near-term features to address critical restoration needs of coastal Louisiana, demonstration projects, a beneficial use of dredged material program, project modifications, and a science and technology program. Guidance provided by the Director of Civil Works on December 19, 2008 states that "*the coastal restoration components proposed as part of the LCA Chenier Plain study will be evaluated as part of the Southwest Coastal Louisiana feasibility study*".

A Feasibility Cost Share Agreement between USACE and the CPRAB as the non-Federal Sponsor was executed on January 14, 2009 for the study and analysis of the NED and NER study alternatives.

2.4 Prior Studies

Table 2-1 lists relevant reports and studies that were considered in the development of the NED and NER plans.

Table 2-1: Relevant prior studies, reports, programs, and projects for the SWC Louisiana feasibility study.

Prior Studies, Reports, Programs, and Water Projects	Parish	Potential Data Source	Consistency	Source of Measures
Planning Studies				
Coast 2050 Plan, 1999	All	✓	✓	
LCA, Louisiana Ecosystem Restoration Study, 2004	All	✓	✓	✓
Louisiana's Comprehensive Master Plan for a Sustainable Coast,-2012	All	✓	✓	✓
Louisiana Coastal Protection and Restoration (LACPR) Technical Report, 2009	All	✓	✓	✓
Calcasieu River Basin Feasibility Study (Draft)	Calcasieu	✓		
Calcasieu River and Pass, Louisiana, Dredged Material Management Plan and Supplemental EIS	Calcasieu, Cameron	✓	✓	✓
Federal Laws and Programs				
CWPPRA 1990	All	✓	✓	✓
USACE Continuing Authorities Program (WRDA Sec. 204), 1996	All			✓
CIAP, 2001 & 2005	All	✓		✓
Second Emergency Supplemental Appropriations Act to Meet the Immediate Needs Arising from the Consequences of Hurricane Katrina, 2005 (Public Law 109-062)	N/A	✓	✓	
Department of Defense, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, and Pandemic Influenza Act, 2006 (Public Law 109-148)	N/A	✓	✓	
State Laws and Programs				
Louisiana Coastal Wetlands Conservation, Restoration and Management Act, 1989	All		✓	
Act 8 of the Louisiana Legislature First Extraordinary Session of 2005	All	✓	✓	

Prior Studies, Reports, Programs, and Water Projects	Parish	Potential Data Source	Consistency	Source of Measures
Parish Coastal Wetlands Restoration Program (Christmas Tree Program)	All	✓		
Vegetation Planting Program	All	✓		
Ecosystem Restoration Projects By Funding Source				
CWPPRA Projects	All	✓	✓	
CIAP Projects	All	✓	✓	
State Projects	All	✓	✓	
WRDA Section 204/1135 Projects	All	✓	✓	
Federal Emergency Management Agency Projects	All	✓	✓	
Federal Navigation Projects				
Bayou Teche and Vermilion River	Vermilion		✓	
Freshwater Bayou and Freshwater Bayou Lock	Vermilion	✓	✓	
GIWW	All	✓	✓	
Calcasieu River, Pass and Bar Channel	Calcasieu, Cameron	✓	✓	
Mermentau River	Cameron	✓	✓	
Sabine-Neches Waterway	Calcasieu, Cameron	✓	✓	

2.5 NED Alternative Formulation

A broader description of the process used to formulate the initial array is captured in Table C-3 in Appendix C. Early modeling was performed to determine where flood damage potential exists in the study area. Figure 2-1 depicts red dots that represent structures within the structure inventory that are included within the 100-year floodplain and thus, are at risk of hurricane or storm-induced flood damages. At-risk structures are concentrated in several areas where levee systems could potentially reduce risk. The remainder of the study area (outside of Lake Charles, Delcambre, Abbeville, and Erath) is less densely populated and at-risk structures are dispersed over large areas. Therefore, nonstructural measures were considered for these less populated areas.

To assess the benefits of any structural, or nonstructural, alternative, measure, or feature the preventable physical damages to existing residential, commercial, industrial, and public buildings and facilities were considered. There are other physical damages, and/or disruptions, associated with broadly dispersed physical infrastructure and natural resources, that may be integral to economic sectors, such as oil and gas production (pipelines, production facilities,…) or agriculture (livestock, field crops,…). However, because no assurance of reduction in damage or associated loss of productivity can be achieved through the application of the measures and features available, these damages could not be included.

For this study, the structure inventory was supplemented with additional residential and non-residential properties that are expected to be placed in service in the future under without project conditions. These supplemental properties generically represent "future growth" in the study area with respect to economic assets. Flood plain regulations, mandated by the NFIP and executed through ordinances, building codes and permits, require that the first floor elevation of any new structure be placed at or above the base flood elevation as indicated by the corresponding FIRM. Therefore, while structures that are expected to be placed into service in the future are included in the structure inventory, their exposure to flood risk is significantly less than many structures found in the inventory under existing conditions.

The reduction in expected future damages to the physical facilities and industrial facilities in the study area, including oil and gas facilities, were considered as an NED benefit for BCR computations. To achieve this,

direct telephone contact was initiated to all of 71 owners/operators of industrial facilities in the area requesting information relating to the replacement cost of at-risk facility components and associated depth-percent-damage relationships. Of these 71 inquiries, 44 were successful in obtaining data that is required in the economic analysis. However, no information was provided by remaining 27 owners/operators. Lacking these data, no speculative estimation of depth-damage relationships to these facilities were made and as a result, the structure inventory used to evaluate damages and benefits for levee plans does not include these facilities.

Plan Development Strategies. Prior to developing specific measures and features for alternative formulation, the PDT identified two broad categories to address study goals: a comprehensive levee plan and a comprehensive nonstructural plan. The reconnaissance report recommendation (12-foot levee along the GIWW) was also used as a starting point to achieve study objectives.

- **Armored 12-foot levee along the GIWW (Reconnaissance Report Recommendation).** Study authority requires assessing the "feasibility of constructing an armored 12-foot levee along the Gulf Intracoastal Waterway." This 122-mile levee was determined to be marginally justified in the 2007 reconnaissance report. Nonstructural measures would be applied to communities south of the GIWW, including Cameron, Hackberry, Holly Beach, Creole, Grand Chenier, Pecan Island, and Intracoastal City. This plan is not included in the 2012 State of Louisiana Comprehensive Master Plan for a Sustainable Coast (State Master Plan).

- **Comprehensive Levee Plan.** Individual levees would be built around the largest population centers, and nonstructural measures would be applied in all other areas. Levees could be located around the areas of Lake Charles, Abbeville (including Erath and Delcambre), Kaplan, and Gueydan. The Lake Charles metropolitan area is the largest urban center with a population of approximately 194,000 (U.S. Census, 2009). From west to east, the communities of Gueydan, Kaplan, Abbeville, Erath, and Delcambre are located in northern Vermilion Parish along Highway 14 and have estimated populations of 1,600, 5,200, 12,300, 2,200, and 2,200, respectively (U.S. Census, 2010). The State Master Plan includes plans for levees in the greater Lake Charles and Abbeville areas. Plans for levees around Kaplan and Gueydan are included in the LACPR study.

- **Comprehensive Nonstructural Plan.** Nonstructural measures were considered as alternatives that could be implemented in the entire study. Owners of eligible residential and commercial structures (including public buildings but excluding warehouses and industrial facilities) would participate in implementing measures such as structure elevating, flood proofing, and berms. Property acquisition may also be considered if circumstances warrant.

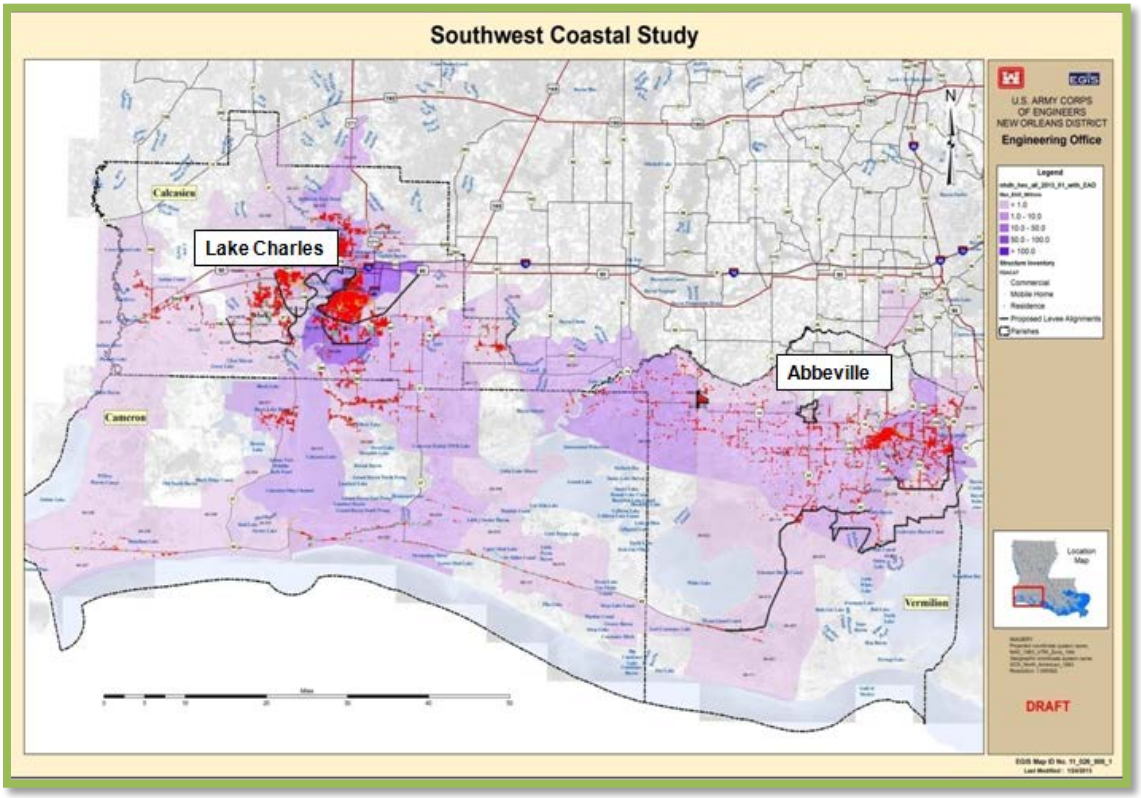

Figure 2-1: Structure inventory and density.

2.5.1 NED Measures (*NEPA Required)

Ten NED measures were developed from various sources including the PDT and the State Master Plan.

Table 2-2: Potential NED measures.

Structural Measures	Nonstructural Measures
Earthen Levees	Elevation-in-Place
Floodgates	Property Acquisition
Floodwalls	Flood proofing
Pumps	Berms
Highway Armoring	Floodplain Management Plans, Public Information Campaigns, local government building and zoning code requirements, developmental controls, restrictive covenants, etc.

Structural and nonstructural measures were evaluated to form comprehensive risk reduction plans for the entire study area. North of the GIWW, combinations of structural and nonstructural measures were based on existing plans (i.e., Southwest Coastal Reconnaissance Study, LACPR, State Master Plan, and the Vermilion Parish Hurricane Protection Plan). South of the GIWW, structural plans were not technically feasible because of broadly dispersed (rural) populations.

2.5.2 Initial Array of NED Alternative Plans (*NEPA Required)

The following 15 hurricane and storm damage risk reduction alternatives were identified for further analysis:

Table 2-3: NED initial array of alternatives.

Independent Variations	
Armored 12-Foot Levee Along the Length of the GIWW	
Gueydan Ring Levee	
Kaplan Ring Levee	
Louisiana Highway 330/82 Armoring	
Nonstructural Measures	
Lake Charles Levee Variations	**Abbeville Levee Variations**
Lake Charles – Southern (east and west)	Abbeville Marsh/Upland Interface
Lake Charles – Southern/Eastern only	Abbeville along GIWW
Lake Charles – Southern/Western only	Abbeville along LA Highway 330
Lake Charles – Northern (east and west)	Abbeville (shortened variation) – Excludes Erath and Delcambre
Lake Charles – Northern (east only)	
Lake Charles – Northern (west only)	

The PDT used the following assumptions to create a screening process for the initial array of the 15 NED alternatives.

- Ninety hydrologic reaches characterized by unique relationships between storm surge elevations and frequencies were identified. Of these 90 reaches, only 63 were shown to include economic assets that were subject to inundation damages.
- An inventory of structure values, types, and first floor elevations was compiled for all residential and non-residential structures in the study area which totaled approximately of 52,000 structures. These included industrial structures for which owners/operators provided information with respect to the vulnerability of damageable property. Warehouses were considered at this stage for the structural plans only, but were included in a subsequent detailed analysis of nonstructural plans.
- A range of low and high costs were developed for the structural features considered.
- Without-action damage estimates were developed and multiplied by a rule of thumb based on the reciprocal of interest and amortization (in this case 20) and used as a surrogate for potential benefits. These values were then used to determine the level of construction costs that could be supported. Stage-probability curves were calculated using HEC-RAS (for rainfall) and ADCIRC (surge) model results. They represent 2012 existing conditions.
- An estimating approach was used to determine the potential first construction cost that could be supported by the potential project benefits expressed as an expected annual value. The amortization factor for a Federal discount rate of 3.5 percent is 0.04263. The inverse of that number (23.5) was used as a multiplying factor to develop the initial estimate. However, this figure is a rough estimate of total project costs that could be supported, rather than project first costs. The PDT rounded the factor to 20.0 to account for additional non-construction components of total project costs (interest during construction, O&M, engineering and design, and supervision and administration costs).
- The difference between the benefits and costs represents net benefits.
- Simplifying assumptions were made:
  - No induced damages from flooding outside levees. No damages from waves.
  - Structural alternatives would eliminate all potential surge or rainfall damages for events between 25 and 200 years, which represent events dominated by storm rather than predominantly rainfall flooding. Net benefits less than zero were used to screen alignments.
- Intermediate RSLR was used for future conditions.
- Under without-project conditions, structures at or below the 10-year stage are considered to be repetitively-flooded properties in the evaluation of both structural and nonstructural plans. Therefore, the structure inventory used in the economic analysis (for both structural and nonstructural plans) reset these properties to an elevation beyond the limits of the 100-year floodplain.

- For levee plans that provide flood risk reduction up to the base flood elevation for a 100-year event (1% ACE), few if any benefits would accrue to these structures. Therefore, their addition to the structure inventory has a minor impact on BCR estimates.

2.5.2.1 Initial NED Alternative Plan Screening Considerations

Results of how the 15 initial NED alternatives were assessed and eliminated are presented in Table 2-4. The complete set of structural plans evaluated at this level of screening is described in Table C-4 of Appendix C.

Table 2-4: NED initial screening.

Feature Name (ID)	Levee Length (miles)	Best Estimate Benefits x 20 in mil $[1]	"Low Cost Scenario" Levee + Pumps in mil $[2, 3]	"High Cost Scenario" Levee + Pumps in mil $[4]	Are best estimate benefits x 20 greater than "Low" costs?	Are best estimate benefits x 20 greater than "High" costs?	Screening Decision
Armored 12-ft Levee along the GIWW (per study authority and Recon Alt S-1)	122	1,835	3,372	4,714	No	No	Eliminated; not enough benefits (once repetitive damages removed) to justify structural solution cost.
Gueydan Ring Levee	6	8	120	180	No	No	Eliminated; damages would have to increase by orders of magnitude to justify structural solution cost.
Kaplan Ring Levee	11	0.7	215	325	No	No	Eliminated; damages would have to increase by orders of magnitude to justify structural solution cost.
Louisiana Highway 333/82 Armoring	29	N/A	551	841	N/A	N/A	Eliminated; not enough damages to justify structural solution cost
Abbeville Levee along the Marsh/Upland Interface	33	441	990	1,320	No	No	Eliminated; not enough damages to justify structural solution cost[5]
Abbeville Levee along Highway 330	13	336	275	405	Yes	No	Although benefits are less than high cost estimates, they are within a margin of error. Consider further for reformulation.

1: Multiplication by "20" represents the amortization factor over 50 years based on existing and future-without project expected annual flood damage (EAD). First screening used unadjusted inventory; rainfall, and frequent and repetitive damages were not removed. Damages didn't account for industrial structures or future RSLR. Second screening refined the damages to eliminate frequent, repetitive damages. Based on the results from the Morganza to the Gulf of Mexico study, adjustment for RSLR estimated that damages would increase by 50% over existing damages.

2: "Low" levee cost used $21,000,000/mile armored and $19,000,000/mile unarmored (grass only). The unarmored cost is based on indexing the LACPR estimates to current levels. Assuming the existing ground elevation is +5-feet, a 12-foot levee elevation equals +17-feet; with contingency, the cost per mile would be about $15,500,000 for the levee only. It would be around $18,600,000 including engineering and design, and supervision and administration (rounded to $19,000,000 per mile). Additional cost of $2,000,000 per mile for armoring.

3: Pumping costs for the alternatives based on what was developed for LACPR. Pumping costs for GIWW alignment based on the sum of the largest Lake Charles and Abbeville ring levees.

Other studies: Morganza 35-yr levees cost over $60,000,000 per mile for 10- to 20-ft levees (total cost including structures, mitigation, E&D, S&A, etc). Morganza to the Gulf of Mexico 100-yr levees costs over $100,000,000 per mile for 15- to 26.5-ft levees (total cost including structures, mitigation, E&D, S&A, etc.). Southwest Coastal Reconnaissance Study used $14,000,000 to $20,000,000 per mile but these values were considered extremely low. After initial screening, 10 hurricane and storm surge damage reduction alternatives remained.

4: "High" levee cost used $32,000,000 per mile armored; $29,000,000 per mile un-armored (grass only). High costs based on 50% increase over Low costs rounded up to nearest million.

5: Although this particular alternative was screened, its value as a set of smaller individual levees was evaluated for Abbeville and Delcambre. The incrementalized alternatives were made a part of the focused array.

The screening removed all alternatives with net benefits of less than zero including the following:

- **Armored 12-foot levee along the GIWW:** Eliminated from further consideration because potential benefits do not justify estimated costs.
- **Kaplan and Gueydan ring levees:** Eliminated from further consideration. Benefits were an order of magnitude less than the costs and as a result only nonstructural measures were evaluated.
- **Louisiana Highway 333/82 armoring:** Eliminated from further consideration. Since NED benefits are unclear and the highway is maintained by the Louisiana Department of Transportation and Development, it may be more cost effective for the State to construct this measure.
- **Abbeville Levee along the Marsh/Upland Interface:** Eliminated from further consideration because potential benefits do not justify estimated costs.

2.5.3 Focused Array of NED Alternative Plans (*NEPA Required)

The initial screening left 10 alternatives (the focused array) that warranted additional evaluation. (see Table 2-5) A full description of all features and screening is available in Appendix C.

Table 2-5: Initial alternatives that comprise the NED focused array

Independent Variations
Nonstructural Measures
Abbeville Levee Variations
Abbeville along GIWW
Abbeville along LA Hwy 330
Abbeville (shortened variation) – Excludes Erath and Delcambre
Lake Charles Levee Variations
Lake Charles – Southern (east and west)
Lake Charles – Southern/Eastern only
Lake Charles – Southern/Western only
Lake Charles – Northern (east and west)
Lake Charles – Northern (east only)
Lake Charles – Northern (west only)

2.5.3.1 Evaluation of Focused Array & Refinement of Array to 6 NED Structural Alternatives

The PDT assessed the focused array of alternatives and as a result, some levee alignments were incrementalized and developed into new alternatives. Although some Abbeville structural alternatives have little to zero marginal benefits, the PDT considered whether a set of smaller individual levees for Abbeville and Delcambre could provide a more cost-effective solution. Since levees around rural areas tend to drive down benefits significantly, the PDT developed smaller, incrementalized alternatives that showed the potential for higher benefits and lower costs for the more densely populated areas. Additionally, since a structural solution for Abbeville is included in the State Master Plan, new configurations of the Abbeville levee were developed for additional analysis.

Benefits for the east Lake Charles levees outweigh costs, but for the western Lake Charles levees, costs outweigh benefits. As a combined set of structural features, the east and west Lake Charles levees only had marginal benefits to justify costs, but since the PDT felt new levee alignments could be drawn to better focus on more densely populated areas and since a 500-year structural solution for Lake Charles is included in the State Master Plan, reconfigured Lake Charles west levees were carried forward.

These steps allowed the PDT to identify levee alignments that would more precisely target populated areas adjacent to Lake Charles and Abbeville because only the largest population centers had the potential benefit-cost ratio to support structural measures. Three alignments were drawn at a small scale, using existing USACE maps and Google Maps, to protect major residential neighborhoods, while minimizing crossings that would result in major real estate, relocation, and other costs such as pipelines, major roadways, and industrial

areas. The alignments depicted in the graphics below comprise the focused array (along with no action and the nonstructural plan) and were carried forward for additional analysis. Figures 2-2, 2-3, and 2-4 show the locations of the proposed alignments with respect to Lake Charles, Abbeville, Delcambre, and Erath.

The focused array thus consists of the alternative plans listed below. Each structural plan was evaluated at three levels of risk reduction [50-year (2% ACE), 100-year (1% ACE), 200-year (0.5% ACE) levels] along the same alignment during these comparisons.

Plan 0: No Action
Plan 1: Lake Charles Eastbank Levee
Plan 2: Lake Charles Westbank/Sulphur Extended Levee
Plan 3: Lake Charles Westbank/Sulphur South Levee
Plan 4: Delcambre/Erath Levee
Plan 5: Abbeville Levee
Plan 6: Abbeville to Delcambre Along Hwy 330 Levee
Plan 7: Nonstructural Measures

2.5.4 Evaluation of 6 NED Structural Alternative Plans

Ninety hydrologic reaches throughout the study area were developed and characterized by unique relationships between storm surge elevations and frequency. With-project damages were developed for the base and future conditions utilizing existing data, current and future without-project damages, and parametric costs. The alternatives were screened based on the 50 year (2% ACE), 100 year (1% ACE), and 200 year (0.5% ACE) levels of risk reduction.

Using the damage probability relationship from the HEC-FDA model for the six structural alternatives in the reaches receiving damage, it was estimated that a 50 year (2% ACE) project, would eliminate damages for the 25 and 50 year events. The 100 year (1% ACE) project would eliminate damages for the 25, 50 and 100 year events and the 200 year (0.5% ACE) project would eliminate damages for the 25, 50, 100 and 200 year events. The six alternatives would not eliminate damages from rainfall for more frequent events (1 and 10 year events) because limited topographic relief results in rainfall driven flooding that structural protection measure cannot prevent at higher frequency events.

A percentage was applied to the overall benefits by reach for each of the six structural alternatives to reflect the estimated percentage of the total structures in a reach that are receiving risk reduction from each alternative. For example, approximately 40 percent of the residential and non-residential structures in reach XA-305 lie behind the proposed levee alignment. Therefore, the estimated total benefits calculated for that reach are multiplied by 40 percent to determine the benefits for the Abbeville to Delcambre alternative for reach XA-305. This methodology was applied to all proposed alternatives.

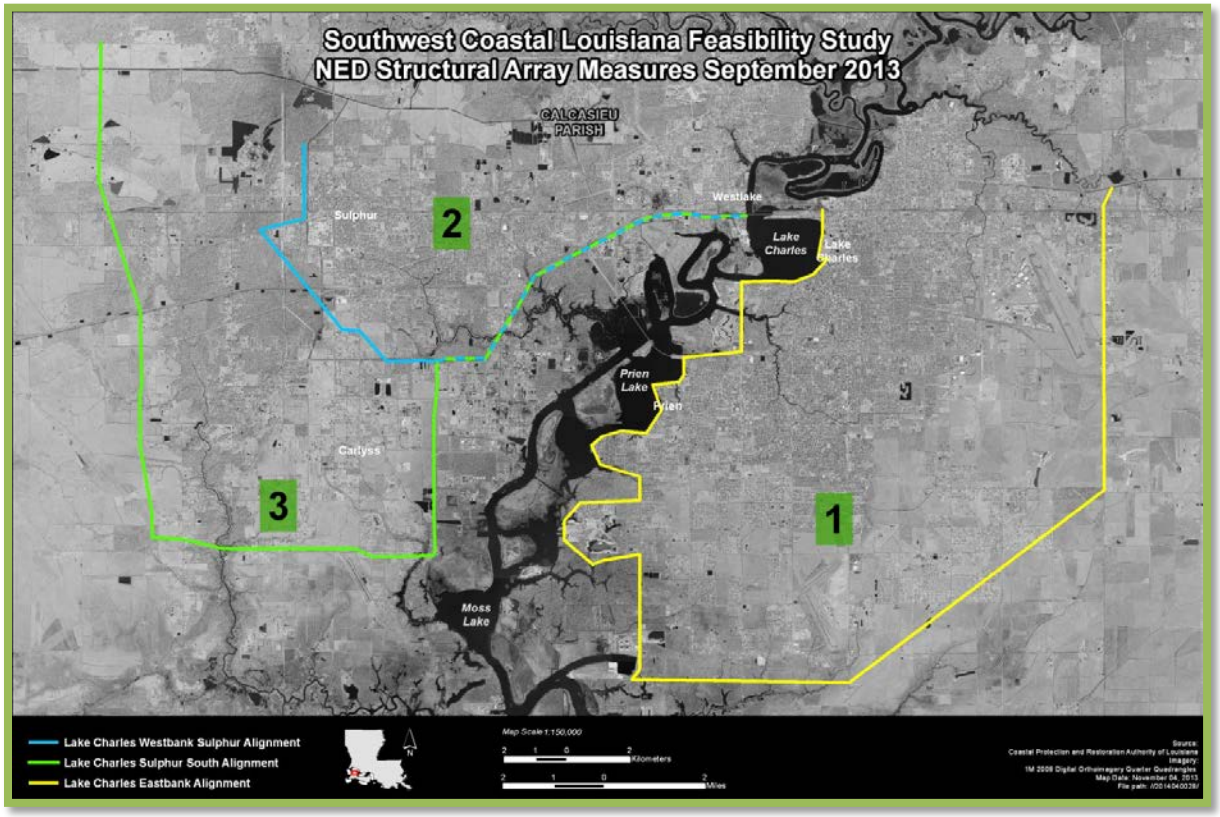

Figure 2-2: Lake Charles conceptual structural alignments.

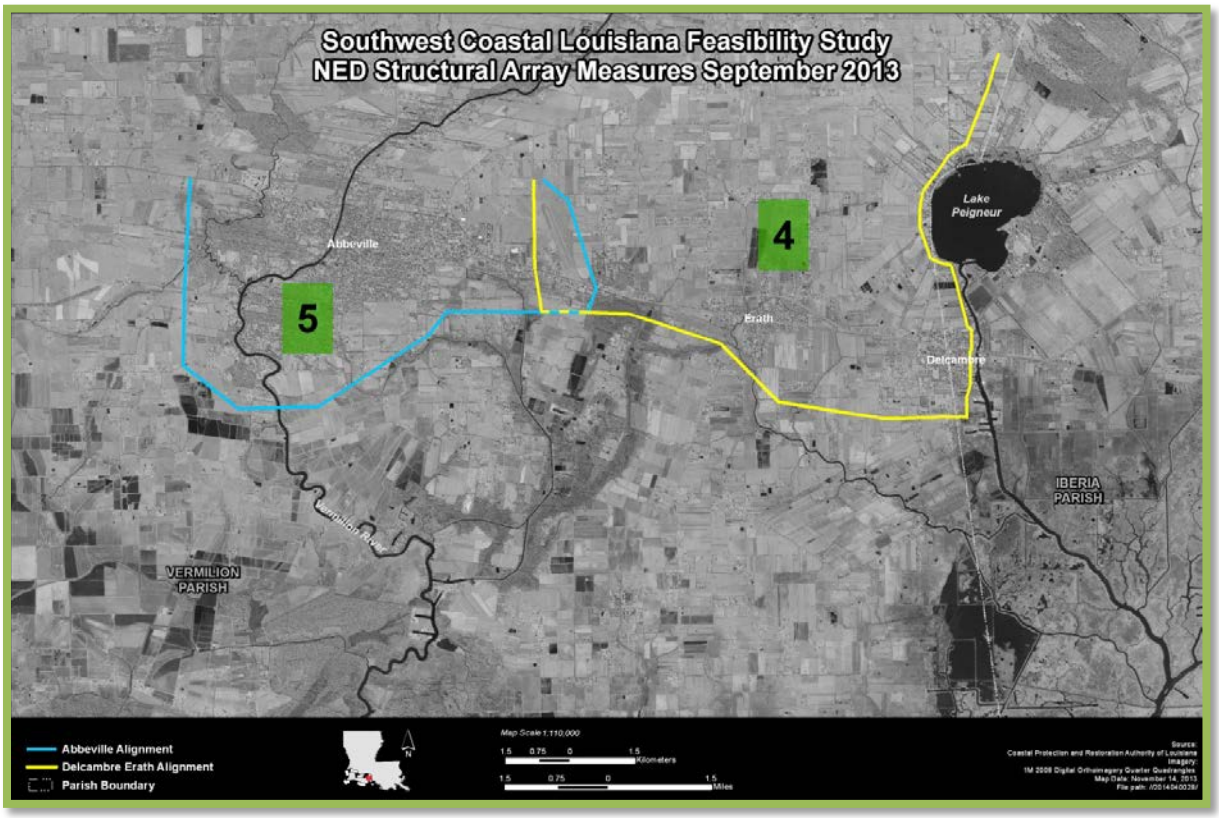

Figure 2-3: Abbeville, Delcambre, and Erath conceptual structural alignments.

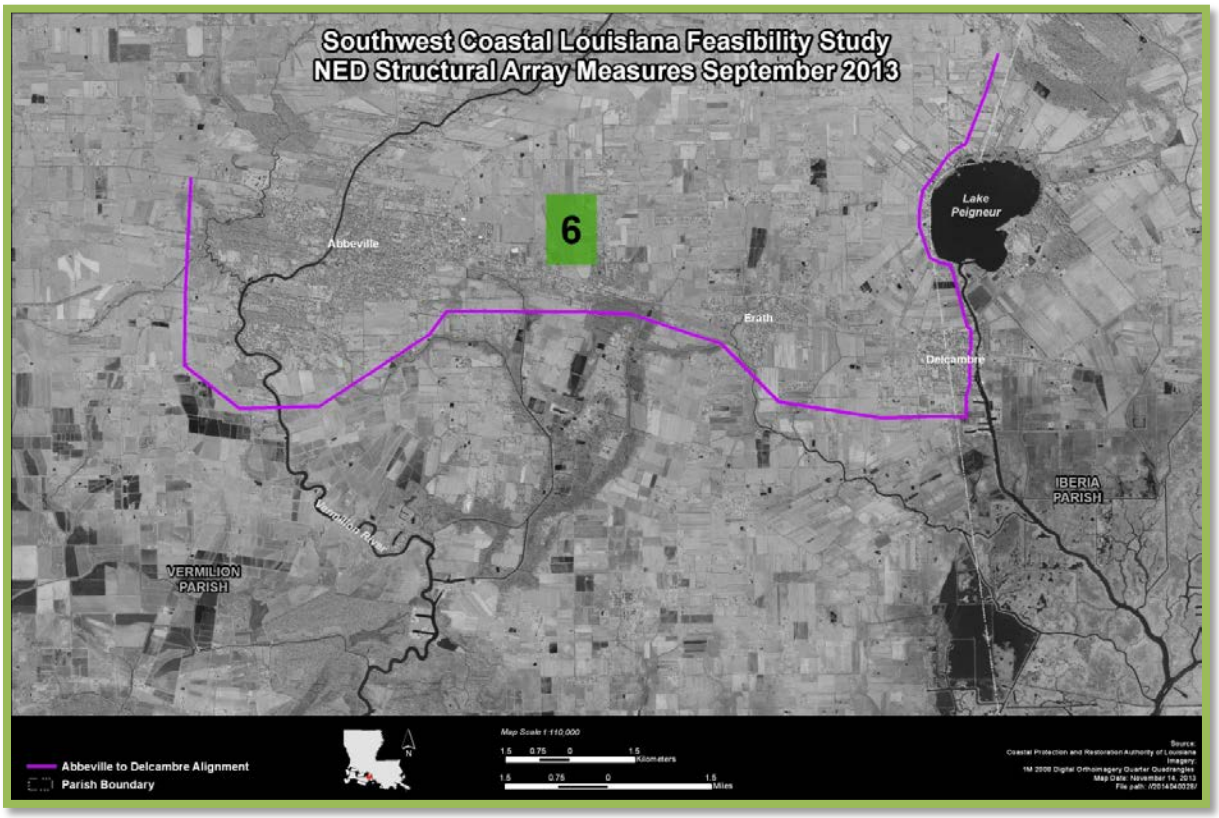

Figure 2-4: Abbeville to Delcambre combined conceptual structural alignment.

2.5.4.1 Economic Analysis of NED Structural Alternative Plans

A benefit/cost analysis was conducted to evaluate the economic feasibility of each of the structural plans. Expected annual benefits for 2025 and 2075 were converted to an equivalent annual value using the previous FY14 Federal interest rate, 3.5 percent, and a 50-year period of analysis. Total cost and estimated annual costs for the project alternatives included the construction costs, and operation and maintenance costs for the three levels of risk reduction. Construction costs, along with the schedule of expenditures, were used to determine the interest during construction and gross investment cost at the end of the installation period. For the purposes of this study, construction was assumed to begin in 2017 and continue through 2024 with additional levee lifts (to maintain levee height due to sinking and subsidence) beginning in 2067 and construction ending six to seven years later. The first levee lifts would be overbuilt and allowed to settle for several years before the latter levee lift is added for each alternative. Later levee lifts would account for the relative sea level rise and subsidence that is projected to occur throughout the period of analysis.

Tables 2-6 through 2-8 show the first construction costs; average annual costs, average annual benefits; benefit/cost ratios; and net benefits for each alternative in the focused array. As shown in the tables, the Lake Charles Eastbank alternative was the only one with a justified benefit/cost ratio (value >1.0). The Lake Charles Eastbank alternative was justified at each level of protection. The highest net benefits were for the Lake Charles Eastbank alternative at the 100 year (1% ACE) level of protection.

Table 2-6: Economic analysis of alternatives with 50-year (2% ACE) level risk reduction.

Alternatives	First Costs (in Mil $)	Average Annual Costs (in Mil $)	Average Annual Benefits (in Mil $)	Benefit/Cost Ratio	Net Benefits (in Mil $)
Plan 1: Lake Charles Eastbank*	779.4	35.8	37.6	1.05	1.9
Plan 2: Lake Charles Westbank - Sulphur Extended	142.8	6.5	1.4	0.22	-5.0
Plan 3: Lake Charles Westbank - Sulphur South	456.3	20.7	3.0	0.14	-17.7
Plan 4: Delcambre/Erath	359.4	15.5	11.1	0.72	-4.4
Plan 5: Abbeville	286.0	12.9	2.6	0.20	-10.3
Plan 6: Abbeville to Delcambre Along Hwy 330	628.5	27.8	19.4	0.70	-8.4

Table 2-7: Economic analysis of alternatives with 100-year (1% ACE) level risk reduction.

Alternatives	First Costs (Mil $)	Average Annual Costs (Mil $)	Average Annual Benefits (Mil $)	Benefit/Cost Ratio	Net Benefits (Mil $)
Plan 1: Lake Charles Eastbank*	979.1	43.9	50.7	1.16	6.8
Plan 2: Lake Charles Westbank Sulphur Extended	199.3	8.6	3.3	0.39	-5.2
Plan 3: Lake Charles Westbank Sulphur South	629.1	27.6	7.2	0.26	-20.4
Plan 4: Delcambre/Erath	470.8	20.3	14.5	0.72	-5.8
Plan 5: Abbeville	344.1	15.4	7.2	0.47	-8.2
Plan 6: Abbeville to Delcambre Along Hwy 330	784.2	34.4	27.1	0.79	-7.3

Table 2-8: Economic analysis of alternatives with 200-year (0.5% ACE) level risk reduction.

Alternatives	First Costs (Mil $)	Average Annual Costs (Mil $)	Average Annual Benefits (Mil $)	Benefit/Cost Ratio	Net Benefits (Mil $)
Plan 1: Lake Charles Eastbank*	1,224.1	54.2	61.1	1.13	6.9
Plan 2: Lake Charles Westbank Sulphur Extended	327.1	13.9	5.5	0.39	-8.4
Plan 3: Lake Charles Westbank Sulphur South	883.9	38	12.5	0.33	-25.5
Plan 4: Delcambre/Erath	589.5	25.4	17	0.67	-8.5
Plan 5: Abbeville	447.7	19.9	9.7	0.49	-10.2
Plan 6: Abbeville to Delcambre Along Hwy 330	1,000	43.6	32.5	0.75	-11.1

* Although preliminary assessments identified a positive benefit/cost ratio for this alignment, further analysis described in section 2.5.7 revealed a negative benefit/cost ratio.

2.5.5 Nonstructural Plan Evaluation

The following nonstructural measures were evaluated:

- Elevation of residential structures to predicted 2075, 100-year base flood elevation unless the required elevation is greater than a maximum of 13 feet above ground level.
- Acquisition/buyout of residential structures that would require elevation over 13. Property owners would receive fair market value for the property acquired.
- Flood proofing of non-residential and public structures (excluding industrial buildings and warehouses) for flood depths not greater than three feet above the adjacent ground

2.5.6 Economic Analysis of NED Nonstructural Alternative Plans (Initial Draft Report)

The total number of structures inventoried in 2012 (defined by the footprint of the 2075, 500-year (0.05% ACE) floodplain) is approximately 52,000. The number of expected at-risk structures in the 100-year (1% ACE) floodplain, in the base-year 2025 including those captured by RSLR, totaled 23,161 residential, commercial, and public buildings (but excluding warehouses and industrial buildings) with a First Floor Elevation (FFE) below the 100-year stage.

Nonstructural plans were initially evaluated using 90 hydrologic reaches within the study area as the unit of analysis. Structures were included in the inventory if their FFE fell below the expected 2075, 100-year (1% ACE) floodplain and evaluated for potential damages over the 50-year period of analysis. Benefits and costs were calculated on a reach-by-reach basis. Economic justification of each reach was determined by a comparison of average annual benefits to average annual costs. Reaches with a benefit/cost ratio greater than 1.0 were carried forward for additional consideration. Justification was determined by comparing expected annual benefits to expected annual costs. Net benefits were calculated by subtracting the expected annual costs from expected annual benefits. The initial analysis found that 11 of 90 reaches were economically justified as shown in Figure 2-5. Table 2-9 identifies costs, benefits, and benefit/cost ratios for each of the justified reaches. The data extracted from the justified reaches demonstrates the Federal interest in a nonstructural plan and provides definition of the potential magnitude of the plan.

Analysis found that 11 of the 90 hydrologic reaches had a benefit/cost ratio of 1.0 or greater and were economically justified. Ratios for the other 79 reaches fall at or below unity. The combined expected annual benefits for the justified reaches, hereafter referred to as the **Nonstructural - Justified Reaches Plan (Plan 7)**, was estimated at $20.67 million assuming 100% property owner participation, the total cost for implementing a nonstructural alternative based solely on the justified reaches is approximately $388 million. The corresponding average annual cost is approximately $16.5 million; with net benefits of $4.17 million resulting in a benefit/cost ratio of 1.25. As a result, benefits and costs were calculated on a reach-by-reach basis. The results of this screening analysis demonstrated that there is a Federal interest in implementing nonstructural alternatives which warranted a more focused analysis to consider only those structures within the 2075, 100-year floodplain. From this effort, Plan 8 evolved.

This more focused evaluation of the economic feasibility of nonstructural measures was also conducted for all structures within the 2075, 100-year (1% ACE) floodplain, irrespective of their location within a reach. This assessment is referred to as the **Nonstructural - 100-year Floodplain Plan (Plan 8)**. The total expected annual benefits for addressing all of the structures within the 2075, 100-year (1% ACE) floodplain are $74.6 million. The total cost for implementing the nonstructural alternative throughout the 2075, 100-year (1% ACE) floodplain is approximately $3.2 billion. The corresponding average annual cost is approximately $138.2 million. After evaluating the entire 90 reach study area, (Plan 8), it was determined that the benefit/cost ratio for addressing all structures within the 100-year floodplain was 0.54.

Table 2-9: Initially justified nonstructural reaches.

Reach	Total Cost (in Th $)	Number of Structures in Reach	Average Annual Cost (in Th $)	Equivalent Annual Benefits (in Th $)	Benefit/Cost Ratio	Net Benefits (in Th $)
SA-033-RL(76)	8,466	77	361	369	1.01	3
SA-034(79)	9,591	122	409	622	1.51	208
SA-048(106)	34,647	389	1,477	2,022	1.36	532
SA-070-S(139)	13,687	134	583	934	1.59	345
SA-091(187)	12,896	169	550	1,362	2.46	802
SA-112(250)	10,177	148	434	573	1.31	132
XA-306(280)	296,306	2,860	12,632	14,691	1.15	1,958
XA-324(337)	1,232	7	53	66	1.26	13
XA-327(346)	114	1	5	8	1.66	3
XA-336(373)	583	5	25	131	5.22	105
XA-341(388)	341	3	15	36	2.44	21

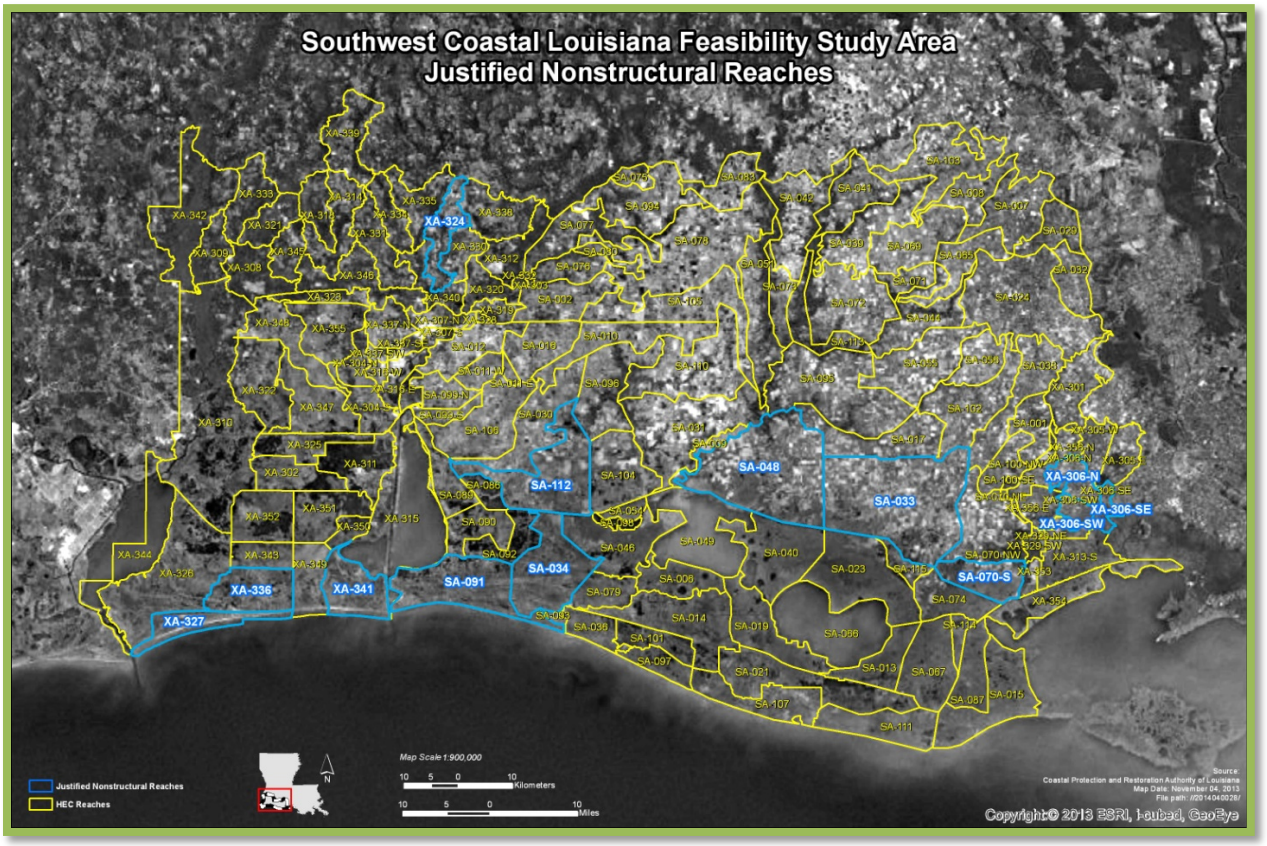

Figure 2-5: Nonstructural reaches with justified benefit/cost ratios.

2.5.7 Net Benefits of the Focused Array of NED Alternative Plans

See Table 2-10 for a summary of the net benefits of the structural alternatives, as well as the benefits for the 100-year level of risk reduction nonstructural alternatives. The two nonstructural plans considered any

structure with a FFE below the 2075 100-year (1% ACE) stage. This was done to correspond with FEMA regulations that require new development to FFE higher than the 100 year (1% ACE) floodplain.

Table 2-10: Net NED benefits.

Alternatives	50 year (Mil $)	100 year (Mil $)	200 year (Mil $)
Plan 1: Lake Charles Eastbank#	1.9	6.8	6.9
Plan 2: Lake Charles Westbank Sulphur Extended	-5.0	-5.2	-8.4
Plan 3: Lake Charles Westbank Sulphur South	-17.7	-20.4	-25.5
Plan 4: Delcambre/Erath	-4.4	-5.8	-8.5
Plan 5: Abbeville to Delcambre	-8.4	-7.3	-11.1
Plan 6: Abbeville	-10.3	-8.2	-10.2
Plan 7: Nonstructural -Justified Reaches Plan	N/A	4.3	N/A
Plan 8: Nonstructural - 100-Year Floodplain Plan	N/A	-64.3	N/A

See additional considerations in the following section

Additional Structural Evaluation

The assessment of economic feasibility for six independent structural measures was conducted in the focused array analysis. Initial results of the assessment show that only one structural alternative economically justified: the Lake Charles Eastbank Levee Alternative, Plan 1. However, at the time of the assessment an estimate of mitigation costs (costs each structural alternative must account for due to unavoidable habitat impacts) had not been calculated for the levee alternatives. With mitigation costs of approximately $100,000,000 included for each alternative, the 100-year (1% ACE) level of risk reduction yielded a benefit/cost ratio of 1.01 and the 200-year (0.5% ACE) level of risk reduction yielded a benefit/cost ratio of 1.04 (adding the mitigation costs made the 50-year (2% ACE) level of risk reduction not economically justified).

In addition, prior to the completion of the initial draft report additional assessment of the 100-year (1% ACE) and 200-year (0.5% ACE) Lake Charles levee alignments was conducted to evaluate the potential for any other viable levee design scales (75-year (1.5% ACE), 125-year (0.8% ACE). This additional investigation exposed an anomaly in the structure inventory database. The structure inventory used to calculate benefits for this alternative was modified to adjust the first-floor elevation for a single commercial structure that was incorrectly placed within the 100-year (1% ACE) floodplain. This structure would otherwise account for an unusually high percentage of damages and benefits in initial evaluations. Once this adjustment was completed, the benefit/cost ratio for Plan 1 fell to 0.61 for the 100-year (1% ACE) level of risk reduction and to 0.30 for the 200-year (0.5% ACE) level of risk reduction. As a result of this additional evaluation, none of the structural levee alignments were found to be economically justified and none were carried into the final array.

2.5.8 Final Array of NED Alternative Plans Presented in the Initial Draft Report

The evaluation of the focused array determined that the most cost-effective solution to reduce hurricane and storm surge flood-risk within the study area is through nonstructural measures. Two alternative nonstructural plans plus the No Action Plan were carried forward for the NED final array. One was Plan 7, Nonstructural - Justified Reaches Plan, based on only the 11 economically justified reaches. A second, designated Plan 8, Nonstructural - 100-year Floodplain Plan, was considered by the team to represent a potentially reasonable alternative based on the incremental presence of relatively high flood risk structures (100-Year floodplain) that exist throughout the study area irrespective of location within a defined reach. The results of the initial analysis demonstrated that there is a Federal interest in implementing nonstructural alternatives and also indicated that a more focused analysis may produce an optimization of the achievable net benefits.

2.5.9 Summary of Accounts & Comparison of Alternative Plans in the Initial Draft Report

To facilitate alternatives evaluation and comparison of the alternatives, the 1983 Principles and Guidelines lay out four Federal Accounts that are used to assess the effects of alternatives. The accounts are National Economic Development (NED), Environmental Quality (EQ), Other Social Effects (OSE), and Regional Economic Development (RED).

- The NED account displays changes in the economic value of the national output of goods and services. The 1983 Principles and Guidelines require the identification of an NED plan from among the alternatives.
- The EQ account displays non-monetary effects on significant natural and cultural resources.
- The RED account registers changes in the distribution of economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.
- The OSE account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

2.5.10 Final Array of NED Plans As Presented in the Initial Draft Report

Plan 0: **No Action.** No NED benefits would be associated with the No Action alternative. There would continue to be adverse impacts to the EQ account as salinity levels increase in the area and existing wetlands continue to degrade and disappear. These impacts will continue to affect residents and infrastructure through the encroachment of open water (OSE). Reducing the protective wetlands in the area could have negative effects to RED by impacting major oil refineries, shipping channels, and industrial uses in the study area.

Plan 7: **Nonstructural - Justified Reaches Plan (TSP).** This plan provides positive net NED benefits and has a positive benefit/cost ratio. Impacts to EQ would be minimal as no significant features would be constructed and structures to be elevated, acquired, or flood proofed already exist. Effects to RED would be beneficial due to the implementation of risk reduction features and the resulting reduction in risk of hurricane and storm-surge related damages to those structures located within the identified reaches which ultimately benefit by the risk reduction measures. Regarding OSE, depending on the manner in which the nonstructural measures would be implemented, there could be an improvement in the area of social vulnerability for populations benefiting from the nonstructural measures. That notwithstanding, the potential for inundation and other storm-related damages will continue unabated for structures that are not addressed under this alternative. Implementing this alternative would not address the most populated communities.

Plan 8: **Nonstructural - 100-Year Floodplain Plan.** This plan provides negative net NED benefits and has a negative benefit/cost ratio. However, it is recognized that there are significant individual increments of positive net benefit throughout the study area. Impacts to EQ would be minimal as no significant features would be built and structures to be elevated, acquired, or flood proofed already exist. Effects to RED would be beneficial due to the implementation of risk reduction features and the resulting reduction in risk of hurricane and storm-surge related damages to those structures benefiting by the risk reduction measures. Regarding OSE, depending on the manner in which the nonstructural measures would be implemented, there could be an improvement in the area of social vulnerability for the larger population that would benefit from the nonstructural measures. That notwithstanding, the potential for inundation and other storm-related damages will continue unabated for structures that are not addressed under this alternative. This alternative does address the most populated communities.

2.5.11 Identification of NED TSP (Plan 7) Presented in the Initial Draft Report

The preliminary NED TSP in the initial draft report was Plan 7 (Nonstructural Justified Reaches). Plan 7 and Plan 8 were both based on structures located within the 2075, 100-year (1% ACE) floodplain and were carried forward, however only Plan 7 was economically justified. Plan 7 applied nonstructural measures (i.e.

structure raising, flood-proofing, and property buy-outs) to structures within the 11 justified reaches and consisted of elevation of existing residential structures or acquisition of properties that require significant elevation, and flood proofing measures for non-residential structures for at-risk properties within the 2075, 100-year (1% ACE) floodplain. The initial basis for the selection of Plan 7 as the original TSP was the number of structures and cost identified in the 11 justified reaches. The preliminary estimated cost of Plan 7 as presented in the initial draft report is $388,000,000 for nonstructural measures benefiting 3,915 structures.

2.6 Nonstructural Plan Evaluation Conducted after Release of the Initial Draft Report

After the release and receipt of comments on the December 2013 Initial Draft Report, structures in the 0-10-year floodplain were added to the structure inventory and additional economic calculations were performed to determine whether the addition of these repetitive flood risk structures resulted in a positive net NED benefits and has a positive benefit/cost ratio. This NED Plan is referred to as the "Nonstructural 0-25 Year Floodplain Plan." Although the NED plan with the greatest net benefits had been identified as a nonstructural option, the economic model was rerun using this updated inventory to determine whether this inventory could support a justified structural alternative. The best performing structural alternative, Plan 1, still failed to demonstrate a positive benefit/cost ratio. The benefit/cost ratio for this plan was determined to be 0.84 for the 50-year (2% ACE) plan; 0.996 for the 100-year (1% ACE) plan; and 0.93 for the 200-year (0.5% ACE) plan.

The revised evaluation of nonstructural measures consisted of evaluating every structure in the revised inventory, with a FFE below the 100-year stage for water surface elevations (WSEs) prevailing in the year 2025 rather than the year 2075. Warehouses were also added to the structure inventory for benefit evaluation where small berms of floodwalls less than 6 ft in height represented the most appropriate nonstructural measure to reduce flood risk. While RSLR is expected to raise the 100-year stage throughout the 50 year period of analysis and bring the FFEs for other structures into the 100-year floodplain, economic benefits for implementing such plans (for structures forecast to be at risk by 2075 in the 2025 base year) are heavily discounted and were generally found to lack economic justification.

Next, using the inventory of structures with FFEs identified within the 2025 100-year floodplain, the nonstructural analysis was stratified on the basis of flood zones. Structures located in between the 0-25-year flood zones were deemed to be exposed to the highest level of flood risk and were considered the first increment. The second increment consists of structures with FFEs higher than the 25-year stage, but lower than or equal to the 50-year stage. The third increment encompasses all remaining structures located within the 100-year floodplain. This analysis created refined incremental variations of the previously assessed Plan 8 which was now divided into separate flood zone benefit categories.

The economic appendix (Appendix D) describes the specific methodology used to evaluate specific increments of the new nonstructural TSP ("Modified Plan 8") within the 100-year floodplain so that net benefits could be optimized. These increments differentiated structures between the 0-25-year; 25-50-year; and 50-100-year floodplains.

Table 2-11 shows the results of this analysis. Net benefits remain positive for the first two increments (0-25 year and 25-50 year) and support the Federal interest for subsequent implementation. In contrast, net benefits for the 50-100-year increment are negative due to the fact that properties within these flood plains do not suffer the same magnitude of inundation as structures grouped into the 0-25 and 25-50-year increments. Given the high fixed costs of elevating a structure, the accrued benefits were insufficient to compensate for the high mobilization costs.

Table 2-11: Optimized Net NED benefits.

Optimized Net Benefit Analysis FY15 Price Level; 3.375% Discount Rate ($1,000s)			
Floodplain Increments	0–25-Year	25–50-Year	50–100-Year
First Cost	$824,025.22	$581,538.88	$915,876.78
Project Benefits	$265,963.65	$24,976.54	$17,239.18
Avg. Annual Cost	$34,342.49	$24,236.68	$38,171.09
Net Benefits	$231,621.16	$739.86	$(20,931.92)
B/C Ratio	7.74	1.03	0.45

In sum, the highest level of net benefits are associated with the **new NED TSP** known as **Modified Plan 8** which is based on the 0-25 Year Floodplain and which implements nonstructural measures to only those structures with FFEs between the 0-25-year flood stage in year 2025. While it is possible that an additional recommendation could be made to add in the 25-50-year increment since it does have positive net benefits, the recommendation for the Nonstructural 0-25 Year Floodplain Plan focuses the Federal investment on the most at-risk properties in the study area. It also indicates a clean break between increments due to the large disparity between the benefit/cost ratios. The **new TSP** (**Modified Plan 8**) as recommended in this Report replaces in its entirety, the previous TSP (Plan 7) as set forth in the December 2013 Initial Draft report. The current TSP is described in detail in Section 2.7 below and in Appendix L.

2.7 Description of the new NED Tentatively Selected Plan (Modified Plan 8).

1. Elevation of eligible residential structures. The term "Base Flood" is defined by the National Flood Insurance Program (NFIP) as the "flood having a 1% chance of being exceeded in any given year and is also called the 100 year flood." For the purposes of this Study this base flood elevation has been forecast into the future based on anticipated hydrologic conditions in the year 2075. This measure requires lifting the entire structure or the habitable area to the predicted 2075, 100-year base flood elevation unless the required elevation is greater than a maximum of 13 feet above ground level. The following process shall apply to property owners who are willing and eligible to participate in the elevation Program:
    - Property owner shall complete an application for structure elevation which must be signed by all owners and lien-holders of the property and structure);
    - Property must meet all eligibility criteria;
    - Property owner shall submit proof of ownership and a current Elevation Certificate;
    - The property has clear title and title research is completed;
    - Site inspection is conducted:
        - Phase I HTRW/Asbestos investigation is completed. The property must be certified as "clean" by the appropriate State office before any Project funds may be expended. All asbestos must be abated and disposed of properly;
        - A determination of suitability for elevation is made.
    - Elevation Agreement and Residential Structure Elevation Covenant Running With The Land are executed and recorded in the public records of the Parish in which the property is located.
    - Elevation of the structure is completed.

2. Dry flood proofing of eligible non-residential structures (excluding large warehouses and industrial complexes)*. Dry flood proofing consists of sealing all areas below the flood protection level of a structure to make it watertight and ensure that floodwaters cannot get inside by making walls, doors, windows and other opening impermeable to water penetration. Walls are coated with sealants, waterproofing compounds, or plastic sheeting is placed around the walls and covered, and back-flow from water and sewer lines prevention mechanisms such as drain plugs, standpipes, grinder pumps and back-up valves are installed. Common flood proofing measures include:

- Backflow valves;
- Closures on doors, windows, stairwells and vents--they may be temporary or permanent;
- Elevating structures via landfill, walls, posts, piers, jacks and beams;
- Rearranging or protecting damageable property--e.g., relocate or raise utilities;
- Sump pumps and sub-drains;
- Water resistant material; metal windows, doors and jambs; waterproof adhesives; sealants and floor drains.

*The following process will apply to property owners willing to dry-flood proof their structures for flood risk reduction.

- Property owner shall complete an application for dry flood proofing which must be signed by all owners and lien-holders of the property and structure);
- Property owner shall submit proof of ownership and a current Elevation Certificate;
- Site inspection is conducted;
    - Phase I HTRW/Asbestos investigation must be performed concurrently with the verification of application. The property must be certified as "clean" by the appropriate State office before any Project funds may be expended. All asbestos must be abated and disposed of properly. Asbestos impacted by flood proofing is removed at Project cost, while HTRW impacted by flood proofing must be remediated by the property owner prior to the initiation of the flood proofing work;
    - A determination of suitability for dry flood proofing for flood risk reduction is made;
- Some form of easement or developmental control agreement shall be required to be executed by the property owner and recorded in the public records of the parish where the property is located to prohibit future alteration of the dry flood proofing measures.
- Each structure that is dry flood proofed must have an approved sanitary disposal system and be in compliance with local and state health codes.
- The structure will be dry flood proofed.

3. Construction of flood proofing barriers or berms less than 6 feet in height around non-residential structures, primarily industrial complexes and warehouses*. These measures are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements. Barrier or berms can be constructed of earth, concrete, masonry or steel and placed around a single structure or a contiguous group of structures.

*The following process will apply to property owners willing to have barriers less than 6 feet in height constructed around the structure(s) for flood risk reduction.

- Property owner shall complete an application which must be signed by all owners and lien-holders of the property and structure);
- Property owner shall submit proof of ownership and a current Elevation Certificate;
- Site inspection is conducted;

- Phase I HTRW/Asbestos investigation must be performed concurrently with the verification of application. The property must be certified as "clean" by the appropriate State office before any Project funds may be expended. All asbestos must be abated and disposed of properly. Asbestos impacted by flood proofing is removed at Project cost, while HTRW impacted by flood proofing must be remediated by the property owner prior to the initiation of the flood proofing work;
- A determination of suitability for the construction of small barriers for flood risk reduction is made;

- Some form of easement or developmental control agreement shall be required to be executed by the property owner and recorded in the public records of the parish where the property is located to prohibit future alteration of the barriers/berms constructed to reduce the risk of flooding .
- Each structure that is dry flood proofed must have an approved sanitary disposal system and be in compliance with local and state health codes.
- A barrier or berm of a height not to exceed 6 feet will be constructed around the structure(s).

4. Floodplain Management Plans. The NFS for the SWC Project is required to prepare a Floodplain Management Plan in coordination with USACE to maintain the integrity of the USACE Project. The NFS should use best efforts to work with the governing bodies within the three parishes to ensure consistency with local development plans and regulations across the Study Area.

5. Adoption of more stringent local floodplain regulations. Floodplain regulation and floodplain management are based in the NFIP which requires minimum standards of floodplain management and floodplain regulation for participating communities. Although communities within the SWC study area cannot change the minimum NFIP standards, local governments can adopt local standards that achieve higher levels of flood risk reduction, such as:
   - Replace elevation requirements based on the 100-year to the 500-year;
   - Implement a zero rise floodway; and
   - Adopt cumulative damages as the trigger for substantial damage determination.

6. Adoption of more restrictive parish and municipal building codes, land use & zoning regulations. and other developmental controls. Local governments within the floodplain should be encouraged to adopt and implement and enforce stricter building and housing code requirements, and land use and zoning regulations and other developmental controls aimed at reducing flood risk and flood damage. Examples include, restrictions on where new development may occur, minimum elevations for habitable first floors, requiring suitable anchorage to prevent flotation of buildings during floods; establishing minimum protection elevations for the first floors of structures; requiring electrical outlets and mechanical equipment to be above regulatory flood levels or be appropriately flood-proofed; restricting the use of materials that deteriorate when wetted; requiring adequate structural designs that can withstand the effects of water pressure and flood velocities; requiring the repair of flood- damaged structures in a manner that will ensure the safety of occupants and prevent blight.

2.7.1 Details of Residential Structure Elevation Program.

Participation in the Residential Non-Structural Program is primarily voluntary in nature. However, for properties that meet certain criteria, eminent domain authority will be utilized as warranted for acquisition of the land and structure and demolition of the structure.

Involuntary Participation.

Structures that meet criteria established by the Program for involuntary participation must be elevated or acquired; below is the criteria that will be used to determine structure inclusion in the Involuntary Program:

1. The structure is designated a "Severe Repetitive Loss" property in accordance with FEMA criteria (i.e. at least 4 NFIP payouts including building and contents of over $5,000 each payout with a cumulative payout total of over $20,000 OR is a residential property for which at least 2 separate claims payments (building only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both of the above, at least 2 of the claims must have occurred within any 10-year period and must be greater than 10 days apart. Currently there are:
    a. 358 residential properties meet the severe repetitive loss criteria.
    b. 7 commercial properties meet the severe repetitive loss criteria.
    c. 1 warehouse meets the severe repetitive loss criteria.

2. The structure is located in a Regulatory Floodway as established by FEMA. A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. 28 properties currently meet the regulatory floodway location criteria.

3. The structure constitutes a danger to public safety in that the un-remediated condition of the structure poses a substantial and certain risk of harm, death, injury or property damage if the structure ("At-risk Structure") is subjected to the forces, conditions, and risks typically associated with hurricanes and tropical storms and storm surge flooding. A non-exhaustive list of conditions that may warrant the condemnation of an At-risk Structure include: structures located in high hazard and repetitive loss areas, floodways or floodplains that are at significant risk of collapse or actual failure if exposed to the impacts of hurricanes, tropical storms and associated storm surge, flooding, wave action, winds and erosion. At-risk structures may include structures that are in a dilapidated, unsafe, and uninhabitable condition including but not limited to, structures that have severely cracked, collapsed or unsound foundations; structures with visible damage to or cracking in load bearing and masonry walls; structures with corroded, distressed, or defective steel or wood framings; structures with significant water and/or insect damage; structures with significant roof damage; structures with other structural defects that render it unsuitable for elevation; structures that have substantial damage such that the cost of restoring the structure to its before-damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred.

Some or all of these criteria may be modified or eliminated and additional criteria may be added as the Implementation Plan is finalized. If a property owner owns a structure that is included in the Involuntary Program, the Non-Federal Sponsor will use its eminent domain authority to acquire the property and relocate the occupant. Landowners and tenants of structures that are identified as Involuntary Program participants may be eligible for certain benefits in accordance with Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs of 1970, Public Law 91-646, 84 Stat. 1894 (42 U.S.C. 4601), as amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV of Public Law 100-17, 101 Stat. 246-256**;** 49 Code of Federal Regulations 24; and HUD Handbook 1378.

Voluntary Participation.

Residential structures that are eligible for elevation (and willing property owners) must meet the following eligibility criteria:

1. The property owner is willing to participate in the nonstructural program;
2. The structure is in a decent, safe, and sanitary condition and is otherwise suitable for human habitation;
3. The property has clear title;

4. The structure can be elevated to meet the required Base Flood Elevation so that the habitable floors are raised to levels which will protect the residential structures from storm surge flooding to reduce future losses from the likelihood of the 100-Year Flood Event to the extent practicable. However, in no event will a structure be raised greater than 13 ft above the ground level;
5. The structure and/or land is not contaminated with hazardous, toxic, or radioactive waste or materials;
6. The property owner is willing to execute a Flood Proofing Agreement and a Residential Structure Elevation Covenant Running with the Land;
7. Based on a visual assessment, the structure does not have signs of significant structural defects, distress, or failure (i.e., no evidence of extensive corrosion of steel framing or concrete; no substantial water or insect damage to wood framing and no framing that is in obvious need of extensive repair or replacement; no major settlement, cracking, buckling, or collapse of the foundation; no critical damage to load bearing or masonry walls; no major unrepaired roof leaks, etc.);
8. The property owner does not owe taxes or other debts to any state or local governmental entity or to the Federal government;
9. The property is located in a community/parish that participates in the National Flood Insurance Program and the property owner has a current Elevation Certificate;
10. The property owner has not previously received any disaster assistance for the elevation of the structure;
11. The structure complies with the building code and floodplain management codes under which the structure was originally permitted;
12. The property owner is willing to expend costs that *may* be necessary in connection with the elevation of the structure which are not eligible costs that are covered by the program;
13. There are no special considerations or unique circumstances which prohibit elevation.

Note: Tenants who reside in structures being elevated may be eligible for certain benefits in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and federally Assisted Programs of 1970, Public Law 91-646, 84 Stat. 1894 (42 U.S.C. 4601), as amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV of Public Law 100-17, 101 Stat. 246-256**;** 49 Code of Federal Regulations 24; and HUD Handbook 1378.

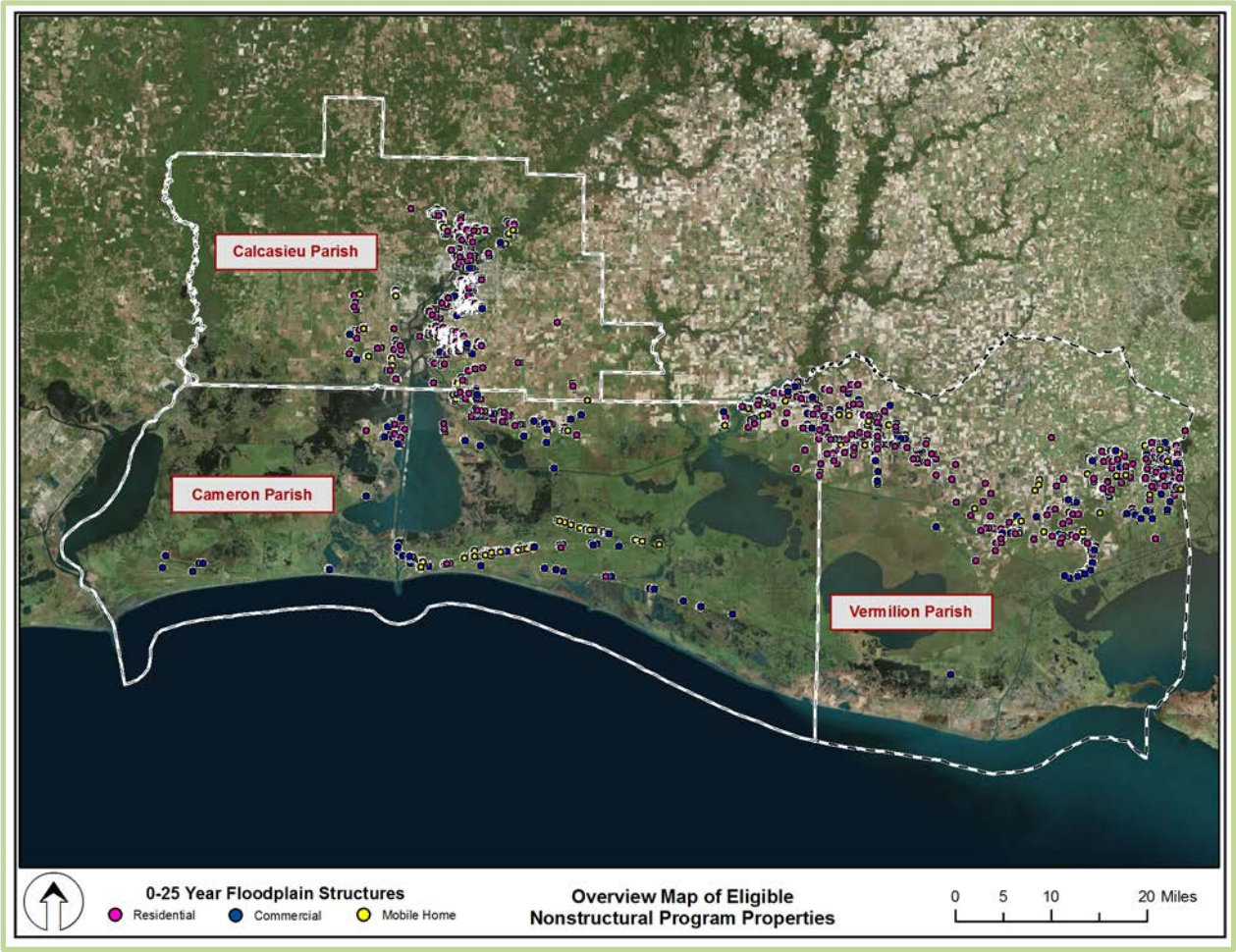

Figure 2-6: Eligible structures in the 0-25-year floodplain.

2.7 NER Alternative Plan Formulation

The Louisiana Chenier Plain extends from the western bank of Freshwater Bayou westward to the Louisiana-Texas border in Sabine lake, and from the marsh areas just north of the GIWW south to the Gulf of Mexico in Calcasieu, Cameron, and Vermilion parishes. Coastal erosion in the Chenier Plain accounts for approximately 20 percent of the land loss in Louisiana. The January 31, 2005 Chief's Report for the ecosystem restoration of the LCA suggested reducing wetlands losses by 50 percent as a possible desirable outcome from restoration efforts, including the development of a comprehensive restoration plan for the Chenier Plain ecosystem. The entire study area (see Figure 2-7) was considered for NER plan formulation. Although a significant portion of the area within the Coastal Zone Management Area has already received funding from other sources to address coastal land loss (Figure 2-7), this study does consider overlapping features in those areas.

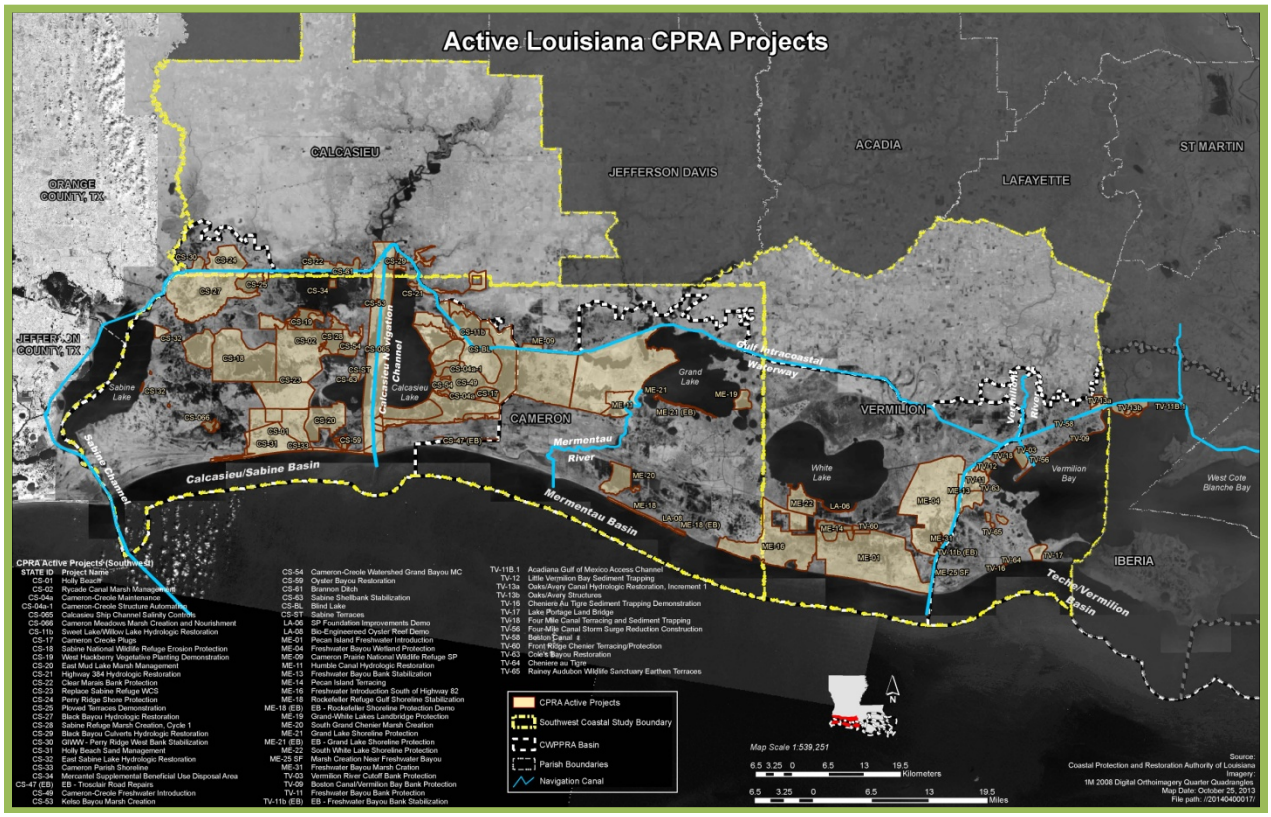

Figure 2-7: Restoration projects in the study area.

The principle areas of focus for the LCA plan formulation are the Calcasieu-Sabine Basin located between the GIWW and the Gulf of Mexico, primarily in the vicinity of Calcasieu and Sabine Lake and the Mermentau/Teche-Vermilion Basins between the GIWW and Gulf of Mexico, Vermilion Bay, and LA-27 to the west.

As part of the adaptive management and project planning process, a conceptual ecological model ("CEM") (Appendix A; Annex L) was developed to help explain the general functional relationships among the essential components of the Southwest Coastal Louisiana area. CEMs are a means of:

(1) Simplifying complex ecological relationships by organizing information and clearly depicting system components and interactions;
(2) Integrating to more comprehensively implicit ecosystem dynamics;
(3) Aids in identifying which species will show ecosystem response;
(4) Interpreting and tracking changes in restoration/management targets; and
(5) Communicating these findings in multiple formats.

This CEM assists with identifying those aspects where the project can effect change. Specifically, the CEM identifies those major stressors, ecosystem drivers, and critical thresholds of ecological processes and attributes of the natural system likely to respond to restoration features. The project CEM was used to assist in identifying problems and opportunities, refining project objectives and restoration management actions, selecting those attributes to be used as performance measures, modeling for alternative analysis, and monitoring for project success. The project CEM represents the current understanding of these factors and will be updated and modified, as necessary, as new information becomes available to assist with developing adaptive management and monitoring during project planning and implementation.

The CEM (Figure 2-8) was developed in conjunction with the USACE Engineering Research and Development Center (ERDC)and identified five drivers, seven ecological stressors, and four ecological effects. The most serious problem is the rate of land and habitat loss.

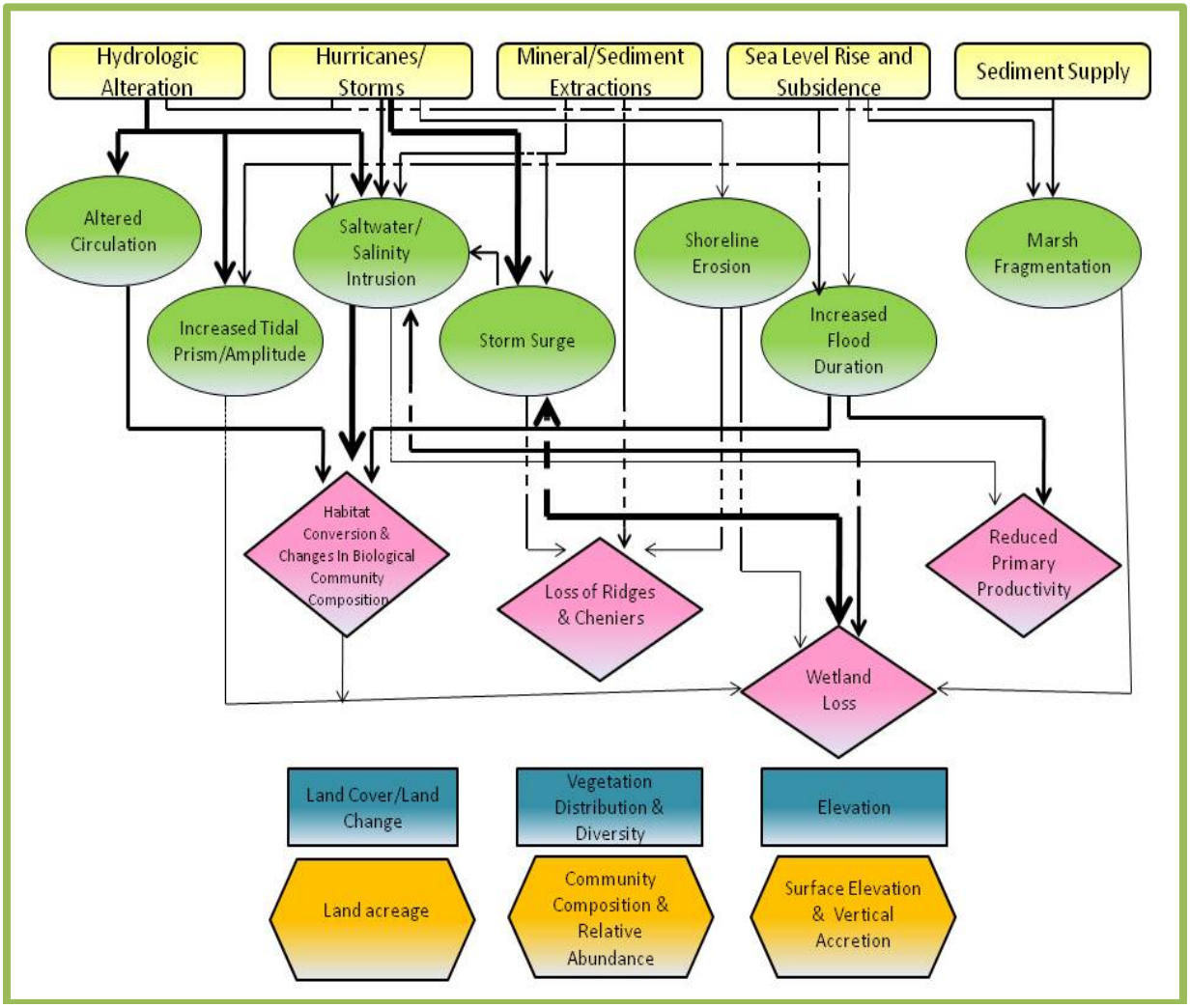

Figure 2-8: Conceptual ecological model.

2.7.1 NER Measures (*NEPA Required)

The PDT used a number of prior studies and reports to identify potential measures and screening criteria, including Federal projects authorized or constructed by the CWPPRA program; the USACE Continuing Authorities Program; the LCA Ecosystem Restoration Study (USACE 2004); and the LACPR Study (USACE 2009); 2012 State Master Plan, and the U.S. Department of Interior's CIAP.

The PDT recommended five measures to meet the NER goals and objectives:

1. **Marsh restoration.** Consists of marsh restoration and/or nourishment to increase land coverage in the area, and improve terrestrial wildlife habitat, hydrology, water quality, and fish nurseries. Vegetative plantings and herbivory control were deemed unnecessary for this feature.
2. **Bank and shoreline protection/stabilization.** Protection/stabilization features to reduce the rate of erosion at canal banks and shorelines in critical areas and to improve hydrology.
3. **Hydrologic and salinity control structures.** Control structures to manage water flow and minimize saltwater intrusion into marshes.

4. **Chenier reforestation.** Reforestation to restore native trees to the Chenier ecosystem, and reduce land loss rates and control for invasive plant and animal species.
5. **Oyster reef preservation** To restore and preserve these native features, and reduce shoreline erosion rates.

2.7.1.1 Initial Screening of NER Measures

Initial data collection included over 200 features which were mostly basin and/or location specific, but some applied to the overall study area. The first screening removed features that did not address project goals and objectives. The marsh restoration and shoreline protection/stabilization features were evaluated with the Wetland Value Assessment (WVA) model, and compared to costs to evaluate cost-effectiveness. Measures that were not cost-effective were eliminated unless the location served a critical geomorphologic function.

Measures were screened using the following criteria:

- **Constraints and Goals.** Measures that were not expected to be sustainable were eliminated such as marsh restoration measures located in currently open water areas where water depth is greater than 2 feet or in high subsidence areas along with chenier reforestation in locations with elevations less than 5 feet and areas with high shoreline erosion rates.
- **Objectives.** These criteria served as verification of previous screenings, to ensure that the measures being considered for inclusion were applicable to SWC objectives. Each of the measures was found to support the relevant objective. For example marsh restoration measures were eliminated if they did not support any critical landscape features.
- **Effectiveness.** Measures which were more effective in meeting the objectives were carried forward. In areas where marsh is deteriorating and shoreline protection, marsh restoration, or hydrologic and salinity control measures could potentially benefit the areas, the measure that would most benefit the area was retained, and the others were screened. Oyster reef preservation measures were all considered to be effective measures.. These thresholds were qualitatively developed by the PDT to establish a minimum criterion for success, to eliminate features that were not worth the Federal investment, and to avoid creating a grossly over-manipulated system.
- **Efficiency.** The final criteria compared cost per acre within the measure categories. If two measures produced the same benefits but one was less expensive to construct, the cheaper option was carried forward. For example, the West Cove marsh restoration measures were eliminated because the Mud Lake measure would provide restoration at a cheaper cost. Additionally, marsh restoration measures that benefitted more than 100 acres were more cost-effective (efficient) than those with a benefit of less than 100 acres, due to economies of scale with the costs of mobilization and demobilization.

The results of the NER screening evaluation are presented in Table 2-12.

Table 2-12: NER screening evaluation.

Screening Criteria		Application to Each NER Measure Category				
		Marsh Restoration	**Bank and Shoreline Protection/ Stabilization**	**Chenier Reforestation**	**Hydrologic & Salinity Control**	**Oyster Reef Preservation**
Constraints and Goals	Measure violates one of the study planning constraints or goals.	Features that are not sustainable do not meet the sustainability goal and were eliminated e.g. marsh areas where water depth is > 2 feet or local subsidence is high.	None of the shoreline stabilization features were eliminated.	Features that did not meet the sustainability goal were eliminated. Elevations < 5 ft NAVD 88 and areas exposed to high rates of shoreline erosion were screened.	None of the hydrologic or salinity control features were eliminated.	None of these features were eliminated.
Objectives	Measure does not address one or more of the study planning objectives.	All marsh restoration measures meet Objective 5. No marsh restoration features were eliminated.	All shoreline protection/stabilization measures meet Objective 4. No shoreline stabilization features were eliminated.	All Chenier reforestation measures meet Objective 5. No Chenier features were eliminated.	All hydrologic and salinity control measures meet Objective 2. No control features were eliminated.	All measures meet Objective 5. No oyster reef preservation features were eliminated.
Effectiveness	Measure found to be ineffective.	Marsh restoration features were more effective in areas with severe marsh degradation. Shoreline protection features were more effective in areas with existing marsh that was subjected to erosion from adjacent waterways.		Features were eliminated where existing canopy coverage deemed substantially intact (i.e., >50%) or if the presence of development would prohibit reforestation.	A small number of hydrologic and salinity control features were eliminated as ineffective because they did not exhibit large-scale hydrologic benefits to wetlands in the Chenier Plain.	None of the oyster reef preservation features were eliminated Reef restoration is an effective method of using natural barriers against storm surges and saltwater intrusion.
Efficiency	Measure found to have below average efficiency.	The average cost of all marsh and shoreline features based on the initial evaluation was approximately $125,000/net acre. Features were considered inefficient and eliminated if they had greater than average cost/net acre. Features that are considered critical components of the system were not eliminated Features that are located adjacent to significant resources, such as Cheniers and wildlife refuges were also not eliminated. Marsh restoration or shoreline protection/ stabilization measures producing or protecting less than 100 net acres were considered to be inefficient.		All Chenier reforestation features were found to be relatively cost efficient in comparison to each other.	All control features were found to be relatively cost efficient in comparison to each other.	All reef preservation features were found to be relatively cost efficient in comparison to each other.

After the initial screening there were too many potential combinations of features for the PDT to effectively assess and evaluate, therefore, the PDT developed an additional methodology through *plan development strategies* to further screen features and develop an initial array of alternatives.

2.7.2 Initial Array of NER Alternative Plans categorized by measure type (*NEPA Required)

Individual features were developed for each of the 5 NER measures and formed into 5 separate plans. Each was based on the measure type and the associated features for that particular measure. In keeping with the overall study purpose of addressing ecosystem degradation in the entire Chenier Plain, one integrated restoration plan was developed that integrated all of the measure types across all basins. Because the coastal zone is the area in greatest need of environmental restoration, the locations for the implementation of all of the five measures types being considered are located south of the GIWW.

- **Hydrologic and Salinity Control Plan.** This plan contains 49 hydrologic and salinity control features.
- **Marsh Restoration Plan.** This plan contains 52 marsh restoration and/or nourishment features.
- **Shoreline Protection/Stabilization Plan**. This plan contains 50 bank and shoreline protection features.
- **Chenier Reforestation Plan**. This plan contains 35 reforestation features (with invasive species control).
- **Oyster Reef Preservation Plan.** This plan contains 10 oyster reef preservation features.
- **Integrated Restoration Across Basins Plan**. This plan consists of features from all five measure categories. It contains a variety of basin-specific and study area-wide features.

2.7.2.1 Screening of the Initial Array of NER Alternative Plans

Another screening (outlined below and more fully explained in Figure C-1 and Tables C-9, C-10, and C-11 of Appendix C) was conducted and more features were removed from further consideration. Land loss analyses were conducted by the U.S. Geological Survey (USGS) to assess whether an area is experiencing high land loss and in critical need of ecosystem restoration.

The following additional screening criteria were applied to the remaining features:

- **Reinforcement of Critical Landscape Features**. Features on or adjacent to a landscape feature designated as critical.
- **Reinforcement of Critical Infrastructure**. Features that restore wetlands from open water and that protect the continuity and function of critical infrastructure.
- **Synergy with Other Projects**. Features that protect or contribute to the benefits of other projects.
- **Scarcity/Diversity**. Features that reduce the loss of freshwater marsh(considered imperiled by the Louisiana Natural Heritage Program).
- **Robustness/Sustainability**. Features that are attached to land that will persist through the period of analysis.
- **Implementability Issues**. Features with no serious impediment precluding its timely implementation.

Features were subjected to more detailed analysis and WVAs were conducted using all available data (such as State Master Plan analyses) and assumptions based on professional experience and knowledge. The results of the WVAs were combined with cost estimates to select cost-effective features. The following plan features were screened (with more information available in Appendix C):

- **Marsh Restoration.** Marshes that reinforce critical geomorphic land forms (i.e., lake rims, navigation banklines, gulf shoreline), which would protect interior reaches, were given greater priority than interior marshes.
- **Bank and Shoreline Protection/Stabilization.** A single shoreline protection/stabilization feature consisting of: a foreshore rock dike along the toe of the Cameron-Creole levee, was eliminated due to lack of marsh between the proposed rock dike and the levee. Stabilization at this location did not supply many NER benefits and therefore the feature was removed from further consideration.
- **Hydrologic and Salinity Control.** A WVA analysis was not completed because the model cannot adequately describe the benefits of these features across such a large area. In general, the features that were carried forward were those that had larger-scale benefits, such as those that helped maintain greater than 500 net acres as determined by the State Master Plan models.
- **Chenier Reforestation.** Although strategic project areas to reforest cheniers were identified and evaluated, due to the relative affordability of this measure type no specific features were screened. It was

decided that all chenier reforestation features would move forward as part of a consolidated chenier reforestation program.

- **Sabine Lake Oyster Reef Preservation.** Several oyster reef projects were removed from further consideration due to very modest benefits and existing or planned funding through other programs. The PDT determined that the Sabine Lake Oyster Reef, should be preserved because its 3-dimensional structure provides valuable habitat for various fisheries species and it also provides some hydrologic benefits to the remainder of Sabine Lake. The feature carried forward consists of protecting, and preserving the Sabine Lake Oyster Reef by prohibiting the harvesting of oysters from the reef.

NER Alternative Plan Evaluation. The NER features that were eliminated in the secondary screening reduced the overall size of the initial array of alternative plans. The comprehensive effects of these alternatives (including the "No Action" alternative) were estimated using the State Master Plan models (i.e., Wetland Morphology, Eco-Hydrology, Vegetation, and various land loss analysis and hydrodynamic models). The outputs of these models supply the data for subsequent analysis using the WVA model. Hydrodynamic modeling using the MIKE FLOOD model was used concurrently to evaluate the restoration alternatives and help refine the features included in the alternatives (specifically the type, size, and operation of the hydrologic and salinity control features). Results from the additional models indicated that the NER objectives could not be met through the implementation of single-measure alternative plans and as a result, the single measure plans were eliminated. The Integrated Restoration Across Basins alternative was the only plan capable of meeting the study goals and objectives and was carried forward. Variations of the Integrated Restoration Across Basins alternative were developed in the formulation of the focused array to more thoroughly address study area problems.

2.7.3 Focused Array of NER Alternative Plans

Using seven restoration strategies (set forth below) developed from the findings from the initial array, plus the "No Action" alternative, a focused array of 27 alternative plans (Table 2-14) was developed containing different combinations of the features. The restoration strategies were applied both comprehensively across basins and individually to the Calcasieu-Sabine Basin and Mermentau/Teche-Vermilion Basin. Plans that were derived from the State Master Plan are identified with "SMP". The PDT also determined that a Calcasieu Ship Channel (CSC) Salinity Control Structure was worth evaluating as a stand-alone strategy/alternative.

The locations of the NER focused array of alternative plans are: (1) the Calcasieu-Sabine Basin between the GIWW and the Gulf of Mexico and primarily in the vicinity of Calcasieu Lake and (2) the Mermentau/Teche-Vermilion Basins which are primarily clustered south of Grand and White Lakes, and in the area surrounding Freshwater Bayou.

For analysis purposes, each alternative plan was divided into two geographic parts. Plans denoted with a "C" contain features located in the Calcasieu-Sabine Basin. Plans denoted with an "M" contain features located in the Mermentau and Teche-Vermilion Basins. The CSC Salinity Control Structure is the sole component of the seventh restoration strategy and a standalone alternative designated as Plan "A". CSC Salinity Control Structure (Plan "A") is also combinable with any plan containing a Calcasieu-Sabine Basin, or "C" component. Collectively, all of the features for each basin that comprise a restoration strategy are considered unique alternatives. Descriptions of each restoration strategy are presented below.

A listing of the specific features that are contained within each restoration strategy can be found in Table 2-13. Unique alternatives were generated based on restoration strategy and basin location.

NER Strategies

Strategy 0: **No Action Plan.**

Strategy 1: **Large Integrated Restoration (SMP).** The results of the State Master Plan Models were used to select only those hydrologic and salinity control features that showed the greatest benefits. For marsh restoration, features were selected that would best reinforce critical landscape features, with particular emphasis on areas that are exposed to saltwater, tidal, and wave action. Bank and shoreline protection/stabilization features were retained that protected the areas of greatest erosion. Strategy 1 is composed of 6 hydrologic and salinity control features, 19 marsh restoration features, 7 bank and shoreline protection/stabilization features, and all chenier reforestation features.

Strategy 2: **Moderate Integrated Restoration (Hydrologic Emphasis) (SMP).** This restoration strategy has less investment in marsh restoration and bank and shoreline protection/stabilization features, but retains the same level of hydrologic and salinity control features as Strategy 1 due to the philosophy that hydrologic restoration is of great importance to the Chenier Plain. Marsh restoration features were focused on areas of critical importance for restoration. Bank and shoreline protection/stabilization features that protected the areas of greatest erosion were retained. Strategy 2 is composed of 6 hydrologic and salinity control features, 13 marsh restoration features, 4 bank and shoreline protection/stabilization features, and all chenier reforestation features.

Strategy 3: **Moderate Integrated Restoration, Including Gum Cove (SMP).** This Strategy is identical to Strategy 2 except it includes the Gum Cove Lock feature. Strategy 3 was formulated to investigate the hydrologic restoration benefits and cost-effectiveness of the Gum Cove Lock combined with the Calcasieu Ship Channel Salinity Control Structure. Strategy 3 is composed of 6 hydrologic and salinity control features, 13 marsh restoration features, 4 bank and shoreline protection/stabilization features, and all chenier reforestation features.

Strategy 4: **Small Integrated Restoration (SMP).** The focus of Strategy 4 is to use a minimal range of features focused at stabilizing perimeter geomorphology. This Strategy includes marsh restoration and bank and shoreline protection/stabilization features that could reinforce perimeters. Strategy 4 is composed of 2 hydrologic and salinity control features, 9 marsh restoration features, 2 bank and shoreline protection/stabilization features, and all chenier reforestation features.

Strategy 5: **Interior Perimeter Salinity Control.** The focus of Strategy 5 is the control of salinity levels within the interior areas of the Calcasieu-Sabine basin and the Cameron-Creole Watershed. There are no hydrologic and salinity control structures at the main passes, with the expectation that salinity control around the perimeter of Calcasieu Lake and the GIWW could result in lower salinities in the interior marshes at a lower cost than entry salinity control. Strategy 5 includes those marsh restoration and bank and shoreline protection/stabilization features that could reinforce perimeters. Strategy 5 is composed of 6 hydrologic and salinity control features, 9 marsh restoration features, 2 bank and shoreline protection/stabilization features, and all chenier reforestation features.

Strategy 6: **Marsh and Shoreline (Minimal Hydrologic & Salinity Control).** Strategy 6 includes minimal hydrologic and salinity control features and focuses on restoring marsh and protecting/stabilizing shorelines. Strategy 6 was formulated to evaluate the effectiveness of ecosystem restoration with the existing salinity regime and is composed of 5 hydrologic and salinity control features, 18 marsh restoration features, 5 bank and shoreline protection/stabilization features, and all chenier reforestation features.

Strategy 7: **Entry Salinity Control (Stand-alone measure).** Strategy 7 would manage salinity introduced through the CSC into Calcasieu Lake and surrounding wetlands through a CSC Salinity Control Structure (Plan "A"). It is combinable with Calcasieu alternatives and is also evaluated as a stand-alone plan.

Table 2-13: Features within each Restoration Strategy

Feature Location: Mermentau Basin / Calcasieu Basin		No Action	Strategy 1/1A	Strategy 2/2A	Strategy 3/3A	Strategy 4/4A	Strategy 5	Strategy 6	Strategy 7 (or A)
Measure	Feature		Large Integrated Restoration across Basins	Moderate Integrated Restoration across Basins	Moderate Integrated Restoration + Gum Cove	Small Integrated Restoration	Interior Perimeter Salinity Control	Marsh & Shoreline Focus	Entry Salinity Control
Hydrologic & Salinity Control									
	7#	0	0/X	0/X	0/X	0/X	0	0	X
	13*	0	0	0	0	0	0	0	0
	17a-c*	0	0	0	0	0	0	0	0
	48	0	0	0	0	0	0	0	0
	74a	0	X	X	X	X	X	X	0
	407	0	0	0	X	0	X	0	0
Marsh Restoration									
	3a1	0	0	0	0	X	X	0	0
	3c1	0	X	X	X	X	X	X	0
	3c2	0	X	X	X	0	0	X	0
	3c3	0	X	X	X	0	0	X	0
	3c4	0	X	X	X	0	0	X	0
	3c5	0	X	X	X	0	0	X	0
	47a1	0	X	X	X	X	X	X	0
	47a2	0	X	X	X	X	X	X	0
	47c1	0	X	X	X	X	X	X	0
	47c2	0	X	0	0	0	0	X	0
	124a	0	X	0	0	0	0	X	0
	124b	0	X	0	0	0	0	X	0
	124c	0	X	X	X	X	X	X	0
	124d	0	X	X	X	X	X	X	0
	127c1	0	X	0	0	0	0	X	0
	127c2	0	X	X	X	0	0	X	0
	127c3	0	X	X	X	X	X	X	0
	306a1	0	X	X	X	X	X	X	0
	306a2	0	X	0	0	0	0	X	0
Shoreline Protection/Stabilization									
	5a	0	X	X	X	X	X	X	0
	6b1	0	X	X	X	X	X	X	0
	6b2	0	X	X	X	X	X	X	0
	6b3	0	X	X	X	X	X	X	0
	16b	0	X	0	0	X	X	0	0
	99a	0	X	0	0	0	0	X	0
	113b2	0	X	0	0	0	0	0	0
Chenier Reforestation (both basins)									
	CR	0	X	X	X	X	X	X	0

Feature 7 functions both as a stand-alone Strategy/Alternative and an additive feature. *Following refinement of the benefit assessment as a result of technical comments, these features were found to lack positive outputs and were dropped from all plans. Note: Green cells denote features found in the Calcasieu Basin. Blue cells denote features in the Mermentau Basin. An 'X' in a cell indicates the feature is a component of the strategy while a '0' indicates it is not a component of the strategy.

2.7.4 Comparison of the Focused Array of NER Alternative Plans

The calculated WVA benefits are measured in average annual habitat units (net AAHUs) and cost estimates were examined using the Institute for Water Resources Planning Suite (IWR Plan), the results of which helped guide the identification of a TSP. The State Master Plan Models were used to compare benefits among alternatives in acres and AAHUs, and compared them to the Future Without Project (FWOP) Alternative. The WVA analysis used to generate the benefits in AAHUs has six variables that must be projected into the future for the FWOP and Future With Project (FWP) alternatives.

The focused array of alternatives consists of alternative plans that align with a restoration strategy and contain the features the PDT identified as most supportive of achieving the goals of that restoration strategy. For the focused array of alternatives, the State Master Plan modeling effort was used with input from the Eco-hydrology module to estimate land and water changes. The alternatives were run under the Intermediate RSLR scenario to predict salinity, water levels, and flows. The results of this modeling effort were input into the Vegetation and Wetland Morphology modules of the State Master Plan modeling system to predict wetland loss and other trends over time. The State Master Plan model included accretion and subsidence projections. For marsh restoration and shoreline protection/stabilization projects, the WVA analysis process used inputs from these models, and was performed using basic assumptions from the CWPPRA program.

Table 2-14: NER Focused array of Alternative Plans

Alternative Plan/ Strategy#	IWR label	ALTERNATIVE PLAN NAME
A	A	Entry Salinity Control
C-1	C1	Calcasieu Large Integrated Restoration
M-1	M1	Mermentau Large Integrated Restoration
CA-1	C1A	Calcasieu Large Integrated Restoration w/ Entry Salinity Control
CM-1	C1+M1	Comprehensive Large Integrated Restoration
CMA-1	C1A+M1	Comprehensive Large Integrated Restoration w/ Entry Salinity Control
C-2	C2	Calcasieu Moderate Integrated Restoration
M-2	M2	Mermentau Moderate Integrated Restoration
CA-2	C2A	Calcasieu Moderate Integrated Restoration w/ Entry Salinity Control
CM-2	C2+M2	Comprehensive Moderate Integrated Restoration
CMA-2	C2A+M2	Comprehensive Moderate Integrated Restoration w/ Entry Salinity Control
C-3	C3	Calcasieu Moderate Integrated Restoration
M-3	M3	Mermentau Moderate Integrated Restoration
CA-3	C3A	Calcasieu Moderate Integrated Restoration w/ Gum Cove & Entry Salinity Control
CM-3	C3+M3	Comprehensive Moderate Integrated Restoration
CMA-3	C3A+M3	Comprehensive Moderate Integrated Restoration w/ Gum Cove & Entry Salinity Control
C-4	C4	Calcasieu Small Integrated Restoration
M-4	M4	Mermentau Small Integrated Restoration
CA-4	C4A	Calcasieu Small Integrated Restoration w/ Entry Salinity Control
CM-4	C4+M4	Comprehensive Small Integrated Restoration
CMA-4	C4A+M4	Comprehensive Small Integrated Restoration w/ Entry Salinity Control
C-5	C5	Calcasieu Interior Perimeter Salinity Control
M-5	M5	Mermentau Interior Perimeter Salinity Control
CM-5	C5+M5	Comprehensive Interior Perimeter Salinity Control
C-6	C6	Calcasieu Marsh & Shoreline
M-6	M6	Mermentau Marsh & Shoreline
CM-6	C6+M6	Comprehensive Marsh & Shoreline

Alternative plans are delineated by Strategy, geographic location (C=Calcasieu, M= Mermentau), and the potential inclusion of the CSC Salinity Control Structure (Plan "A").

2.7.4.1 Cost Estimates

The construction cost and schedule estimates were developed from similar projects in the Southwest Coastal Louisiana study area (such as through the CWPPRA program), with input as needed from other recent projects coast-wide. This includes mobilization and demobilization costs, price per cubic yard of dredged material or per ton of rock, depending on the measure type, and other line items as appropriate. The maintenance schedule for shoreline protection/stabilization was based on anticipated settlement rates calculated from the existing nearby geotechnical data, as available, and similar projects in the vicinity. The renourishment schedule for the marsh restoration features was developed through an optimization process by which the total costs and benefits for different maintenance schedules were considered at five-year intervals. This process determined that a 30-year renourishment cycle optimized costs per unit benefit (in average annual acres AAA). Costs for hydrologic and salinity control features were calculated, along with the features from the State Master Plan. The costs of alternative plans are the sums of the costs of the individual features (see Table 2-15). While some cost-savings may be realized through synergistic execution of adjacent or nearby project features, for a conservative cost estimate this synergy was not assumed. Since the NER plan is intended to reasonably maximize environmental benefits, and since NER planning promotes the avoidance of environmental features that require mitigation, any features that would require mitigation were screened from further consideration and no costs for unavoidable wetland impacts have been factored into the preliminary cost estimates. All restoration features in the various alternatives have been designed to not require mitigation. Preliminary high and low cost estimates for plans that contain Plan "A" (CSC Salinity Control Structure) were developed as starting points to account for potential navigation impacts.

Table 2-15: NER Cost Estimates and Benefits

Plan #	Cost $ Low Nav	Cost $ High Nav	AAA's
CMA-1	3,049,836,909	3,104,429,860	29,070
CM-1	2,465,675,681	2,465,675,681	23,101
CA-1	1,591,668,028	1,646,260,979	12,844
C-1	1,007,506,800	1,007,506,800	6,875
M-1	1,458,168,881	1,458,168,881	16,226
CMA-2	2,390,030,484	2,444,623,435	25,187
CM-2	1,901,658,190	1,901,658,190	19,218
CA-2	1,495,879,094	1,550,472,045	13,898
C-2	1,007,506,800	1,007,506,800	7,929
M-2	894,151,390	894,151,390	11,289
CMA-3	2,697,850,484	2,752,443,435	18,959
CM-3	2,113,689,256	2,113,689,256	12,990
CA-3	1,803,699,094	1,858,292,045	7,982
C-3	1,219,537,866	1,219,537,866	2,013
M-3	894,151,390	894,151,390	10,977
CMA-4	1,903,984,167	1,958,577,118	22,508
CM-4	1,319,822,939	1,319,822,939	16,539
CA-4	1,041,573,707	1,096,166,658	11,005
C-4	457,412,479	457,412,479	5,036
M-4	862,410,460	862,410,460	11,503
CM-5	1,664,058,939	1,664,058,939	15,537
C-5	801,648,479	801,648,479	4,457
M-5	862,410,460	862,410,460	11,080
CM-6	2,321,547,245	2,321,547,245	23,026
C-6	1,005,766,800	1,005,766,800	9,240
M-6	1,315,780,445	1,315,780,445	13,786
A	584,161,228	638,754,179	5,969

- Price level for feature costs – June 2013 and Discount rate of 3.5% (FY 2014) for navigation delays

2.7.4.2 CE/ICA Results

The focused array of alternative NER plans were compared considering cost effectiveness and incremental cost analysis (CE/ICA) to inform environmental investment decision making. Cost effectiveness is determined based upon a finding that no other plan provides a higher output level of acres restored for the same or less cost. Incremental cost analysis is the determination of the greatest increase in output (acres restored) for the least increase in cost. Use of these tools helps decision makers determine the most desirable level of outputs (restored acres) compared to costs.

In the CE/ICA analysis shown in Figure 2-9, a Rough Order of Magnitude (ROM) average annual cost of $10,000,000 was added to plans that include CSC Salinity Control Structure (Plan "A") to represent the potentially high navigation impact cost resulting from the operable closure structure. The cost in this analysis represents traffic delays to all 2011 deep draft traffic in the CSC. All alternatives with Plan "A" were run through CE/ICA both with and without the structure in place in order to isolate the relative performance of the structure. Plans in red are best-buys and those in blue are cost-effective.

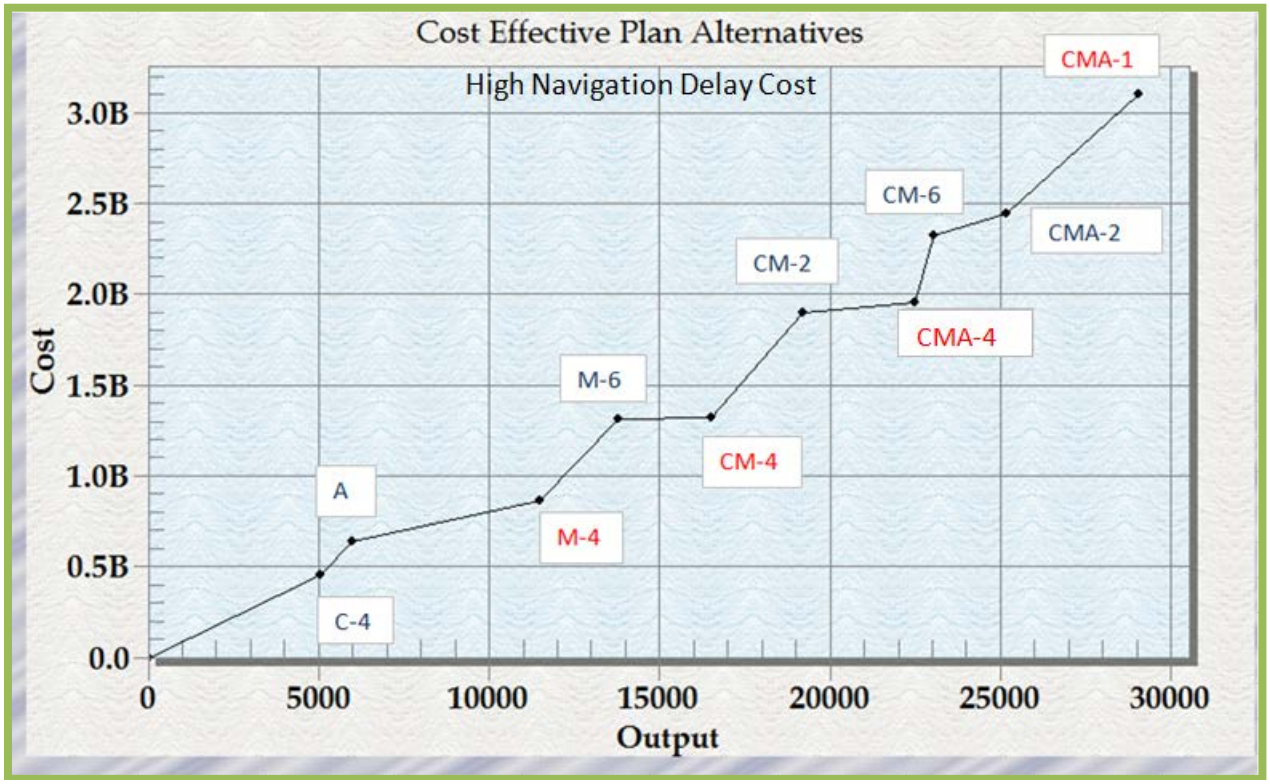

Figure 2-9: CE/ICA analysis using high navigation cost.

The second CE/ICA analysis is shown in Figure 2-10. Identical sets of plans were run, but they used a lower ROM average annual cost of $7,672,500 to represent navigation delay costs caused by the CSC Salinity Control Structure. The lower cost accounts for delays to vessels that transited on the CSC in 2011 with drafts between 15 and 35 feet. The purpose of using this lower cost estimate is to represent an operating scheme that would allow the CSC Salinity Control Structure to remain open during high tide, which is when the deepest draft vessels transit. Thus, a minimum representation of the impact of the structure closure is to add traffic delays for only non-deep-draft vessels. The cost does not include tug assistance costs or any other ancillary impacts of a closure of the CSC Salinity Control Structure. In both analyses, in order to be consistent with the cost provided for the measures, the average annual cost was converted to a present value of

$179,963,228. This present value cost was added to the cost of the plans that contain the CSC Salinity Control Structure, which includes any Plan with an "A" designation.

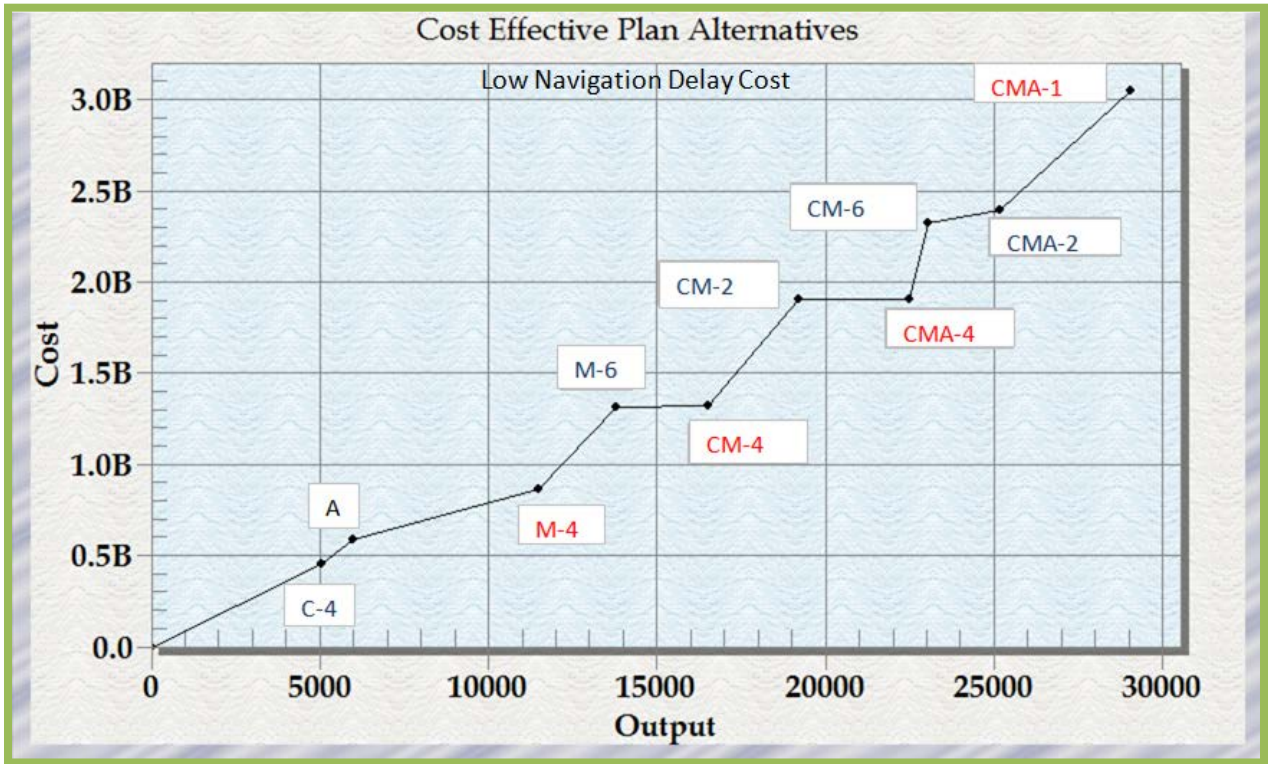

Figure 2-10: CE/ICA analysis using low navigation cost.

For all focused array alternatives, the number of hydrologic and salinity control structures, marsh restoration features, and bank and shoreline protection/stabilization features varied depending on the plan scale and restoration strategy. The plans were estimated to produce between 5,000 and 29,000 AAAs, and their costs range from $500,000,000 to over $3,000,000,000.

The CSC Salinity Control Structure (Plan "A") Considerations

As part of the evaluation, plans with and without the CSC Salinity Control Structure were compared. The salinity control structure could potentially provide significant environmental benefits (5,700 AAAs) even as a stand-alone plan (Plan "A"). The applications of both low and high preliminary rough order of magnitude estimates of navigation impacts indicated the salinity control structure to be potentially cost-effective. However, Best-Buy plans that contain the CSC salinity control structure, (which includes any Plan with an "A" designation), are significantly more expensive than plans without the CSC structure. Other cost-effective and Best-Buy comprehensive plans containing the CSC structureexist only on the upper most portion of the cost efficient frontier.

When the CSC structure is evaluated as a stand-alone plan, it is anticipated that a more detailed level of analysis would reveal higher navigation impact costs. As a result, the CSC structure as a stand-alone alternative, does not indicate that it could be a Best-Buy plan or be selected as the TSP and may in fact fall completely out of consideration should costs be found to be higher than what was estimated by the PDT and fed into the IWR planning suite.

However, if additional benefits beyond the current TSP are desired, alternatives that include the CSC structure are worth considering. In the long-term there is a good chance that the addition of the CSC

structure could provide the next best increment of benefit, even if costs are found to be higher. In the end, the only Best Buy plans that produce greater benefits than the identified TSP are those which include the CSC salinity cntrol structure as a component.

2.7.5 Final Array of NER Alternative Plans (*NEPA Required)

The final array is comprised of the No Action Plan, Plan M-4, and Plan CM-4. The IWR analysis indicates that the only Best Buy plans that do not contain the CSC salinity control structure are plans M-4 and CM-4. Since the negative effects of the CSC structure to navigation are a study constraint and due to the significant cost of the CSC structure, those Best Buy plans on the upper portion of the cost-efficient frontier were dropped from the final array. The components of the final array plans are presented in the table below. Plan M-4 features are those that are located in the Mermentau/Teche-Vermilion basin. Plan CM-4 consists of all the features listed in Table 2-16.

Table 2-16: Features of the NER Final Array Alternative Plans

Basin (Final Array Plan Name)	Category	Feature	Description
Mermentau/Teche-Vermilion (Plan M-4)	Hydrologic/ Salinity Control	13	Little Pecan Bayou Saltwater Sill. Construction of a rock weir with a crest (top) elevation of -3.1 ft and an opening of 60 ft at a bottom invert of -11.1 ft.
	Marsh Restoration	47a1	Marsh restoration using dredged material south of Hwy 82 about 4.5 miles west of Grand Chenier. 933 marsh acres would be restored and 88 acres would be nourished from 3M cubic yards of dredged material with one future renourishment cycle.
		47a2	Marsh restoration using dredged material south of Hwy 82 about 4.5 miles west of Grand Chenier. 1,297 marsh acres would be restored and 126 acres would be nourished from 8.8M cubic yards of dredged material with one future renourishment cycle.
		47c1	Marsh restoration using dredged material south of Hwy 82 about 4.5 miles west of Grand Chenier. 1,304 marsh acres would be restored and 4 acres would be nourished from 8.6M cubic yards of dredged material with one future renourishment cycle.
		127c3	Marsh restoration at Pecan Island west of the Freshwater Bayou Canal and about 5 miles north of the Freshwater Bayou locks. 832 marsh acres would be restored and 62 acres would be nourished from 7.3M cubic yards of dredged material with one future renourishment cycle.
		306a1	Rainey marsh restoration at Christian Marsh east of the Freshwater Bayou Canal and about 5 miles north of the Freshwater Bayou locks. 627 marsh acres would be restored and 1,269 acres would be nourished from 8.1M cubic yards of dredged material with one future renourishment cycle.
	Shoreline Protection/ Stabilization	6b1	Gulf shoreline protection/stabilization from Calcasieu River to Freshwater Bayou. 11.1 miles of shore protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore with geotextile fabric and stone built to an 18 ft crest width. The breakwater would protect 2,140 acres of existing marsh.
		6b2	Gulf shoreline protection/stabilization from Calcasieu River to Freshwater Bayou. 8.1 miles of shore protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore with geotextile fabric and stone built to an 18 ft crest width. The breakwater would protect 1,583 acres of existing marsh.
		6b3	Gulf shoreline protection/stabilization from Calcasieu River to Freshwater Bayou. 7.2 miles of shore protection consisting of a reef breakwater with a

			lightweight aggregate core. Located ~150 ft offshore with geotextile fabric and stone built to an 18 ft crest width. The breakwater would protect 1,098 acres of existing marsh.
		16b	Fortify Freshwater Bayou. bank with 15.4 miles of rock revetment at three critical spots to prevent breaching. Revetment would be built to +4 ft with a 4 ft crown. Two maintenance lifts will be required. The breakwater would protect 662 acres of existing marsh.
	Chenier Reforestation	CR	Replant 13 chenier locations. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated.
Calcasieu/ Sabine (Plan CM-4) (Includes all features in Plan M-4)	Hydrologic/ Salinity Control	74a	Cameron-Creole Spillway. Located at the breach in the levee south of Lambert Bayou. The canal would act as a drainage manifold. The outfall channel into Calcasieu Lake would be rock-lined for scour protection and built to +4 ft.
	Marsh Restoration	3a1	Beneficial use of dredged material from the Calcasieu Ship Channel. Adjacent to the south shore of the GIWW west of the ship channel near Black Lake. 599 marsh acres would be restored from 5.3M cubic yards of dredged material with one future renourishment cycle.
		3c1	Beneficial use of dredged material from the Calcasieu Ship Channel. Adjacent to the east rim of Calcasieu Lake within the Cameron-Creole Watershed. 1,765 marsh acres would be restored and 450 acres would be nourished from 10.2M cubic yards of dredged material with one future renourishment cycle.
		124c	Marsh restoration at Mud Lake. Located adjacent and north of Highway 82 and east of Mud Lake. 1,908 marsh acres would be restored and 734 acres would be nourished from 11.1M cubic yards of dredged material with one future renourishment cycle.
		124d	Beneficial use of dredged material from the Calcasieu Ship Channel for marsh restoration at Mud Lake. Located west of the Calcasieu Ship Channel and adjacent to the southern rim of West Cove. 159 marsh acres would be restored and 448 acres would be nourished from 1.4M cubic yards of dredged material with one future renourishment cycle.
	Shoreline Protection/ Stabilization	5a	Holly Beach Shoreline Stabilization Breakwaters. Construction of approximately 8.7 miles of rock and low action breakwaters and is a continuation of existing breakwaters. Crown elevation of +1.5 ft with a crown width of 30 ft. Two maintenance lifts will be required. The breakwater would protect 158 acres of inter-tidal habitat.
	Chenier Reforestation	CR	Replant 22 chenier locations. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated.
	Oyster Reef Preservation	ORP	Preservation of a large oyster reef in Sabine Lake through the enforcement of oyster dredging restrictions.

Plan 0: **No Action.** As detailed in Chapter 1, under this alternative, no ecosystem restoration would take place. Coastal wetlands would continue to degrade and disappear, further weakening the coastal landscape resulting in significant impacts to important habitats. Infrastructure, populations, industry, and businesses would continue to become vulnerable to the increased effects of storm surge and RSLR through the loss of a protective wetland buffer.

Plan M4: **Mermentau Small Integrated Restoration.** This alternative was formulated for NER so it does not have specific NED or RED benefits calculated. Effects to EQ would increase for this alternative but only for the Mermentau Basin. Positive effects to OSE are expected through the restoration of wetland habitat and its associated benefits to plant and wildlife species, salinity reduction, and improvement to the coastal landscape.

Plan CM-4: **Comprehensive Small Integrated Restoration (Tentatively Selected Plan).** This alternative was formulated for NER. It does not have specific NED or RED benefits calculated. Effects to EQ would increase for the alternative across the Calcasieu and Mermentau Basins. Positive effects to OSE are expected through the restoration of wetland habitat and its associated benefits to plant and wildlife species, salinity reduction, and

improvement to the coastal landscape. This alternative offers the most cost-effective and comprehensive benefit.

2.8 Summary of Accounts and Comparison of Alternatives

To facilitate alternatives evaluation and comparison, the 1983 Principles and Guidelines set up four Federal Accounts to assess the effects of alternatives. The accounts are National Economic Development (NED), Environmental Quality (EQ), Other Social Effects (OSE), and Regional Economic Development (RED).

- The NED account displays changes in the economic value of the national output of goods and services. The 1983 Principles and Guidelines require identification of an NED plan from among the alternatives.
- The EQ account displays non-monetary effects on significant natural and cultural resources.
- The RED account registers changes in the distribution of economic activity that result from each alternative plan. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.
- The OSE account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

NER TSP

The Corps objective in ecosystem restoration planning is to contribute to NER. Contributions to NER (NER outputs) are increases in the net quantity and/or quality of desired ecosystem resources. The TSP must be shown to be preferable to taking no action (if no action is not recommended) or implementing any of the other alternatives considered during the planning process. For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. The TSP must be shown to be cost-effective and justified to achieve the desired level of output.

Plan 0: **No Action.** As detailed in Chapter 1, under this alternative, no ecosystem restoration would take place. Coastal wetlands would continue to degrade and disappear, further weakening the coastal landscape resulting in significant impacts to important habitats. Infrastructure, populations, industry, and businesses would continue to become vulnerable to the increased effects of storm surge and relative sea-level rise (RSLR) through the loss of a protective wetland buffer.

Plan M4: **Mermentau Small Integrated Restoration.** This alternative was formulated for NER so specific NED or RED benefits were not calculated. Effects to EQ are increased but only for the Mermentau Basin. Positive effects to OSE are expected through the restoration of wetland habitat and its associated benefits to plant and wildlife species, salinity reduction, and improvement to the coastal landscape.

Plan CM-4: **Comprehensive Small Integrated Restoration (TSP).** This alternative was formulated for NER so specific NED or RED benefits were not calculated. Effects to EQ increase only in the Calcasieu and Mermentau Basins. Positive effects to OSE are expected through the restoration of wetland habitat and its associated benefits to plant and wildlife species, salinity reduction, and improvement to the coastal landscape. This alternative provides the most cost-effective and comprehensive benefit.

2.8.1 Additional Evaluation in Response to Comments

Technical comments received during public and agency review of the initial draft report resulted in several changes to the original TSP. Technical reviewers recommended removal of the Sabine Lake Oyster Reef Preservation feature since there is no cost for its implementation, it lacks quantifiable benefits, and it can be handled administratively by the agency in charge of its management. Comments also resulted in the formal recommendation that the CSC structure be addressed in a long-term study because there are too many uncertainties about its potential effect on salinity and its potential impacts to navigation. It also needs complex and detailed hydrodynamic and navigation economics modeling that the SWC study effort is not scoped to support at this time.

The inputs to the IWR Planning Suite were refined utilizing annualized costs as well as annualized habitat units from an updated and certified version of the WVA model. These values were developed and additional analysis of the NER focused array of alternatives was completed based on the refinements in benefits and costs for all features in each alternative. This effort helped identify features that fell short of initial benefits projections. For example, the Little Pecan Bayou Saltwater Sill (Feature 13) had significantly fewer benefits than originally projected based on the refined analysis and was therefore removed as a component from all alternatives. The focused array of alternatives was re-run in IWR without Feature 13 and based on the adjustments to annualized benefits and costs. The outputs from these adjustments are presented below (see Table 2-17 and Figure 2-11).

Table 2-17: NER cost efficient alternative plan comparison.

Plan Name	Total Cost x 1,000	Annual Cost	AAHUs	Cost/AAHU	Cost Effective Status
CMA-1	$2,742,583	$117,534,339	10,543	$260,133	Best Buy
CM-1	$2,137,807	$91,750,472	9,548	$223,901	Best Buy
CM-6	$2,009,393	$86,265,228	9,333	$215,299	Best Buy
CM-3	$1,855,589	$79,110,630	8,218	$225,795	Yes
CM-2	$1,571,945	$67,017,839	8,038	$195,564	Best Buy
CM-5	$1,447,594	$61,716,322	6,080	$238,091	Yes
CM-4	$1,197,757	$49,623,531	5,901	$202,975	Yes
C-1	$821,105	$34,998,133	4,682	$175,374	Best Buy
C-2	$736,060	$31,372,342	4,242	$173,517	Best Buy
C-5	$666,997	$28,427,927	2,533	$263,322	Yes
C-4	$383,353	$16,335,136	2,353	$162,920	Best Buy
No Action Plan	$0	$0	0	$0	Best Buy

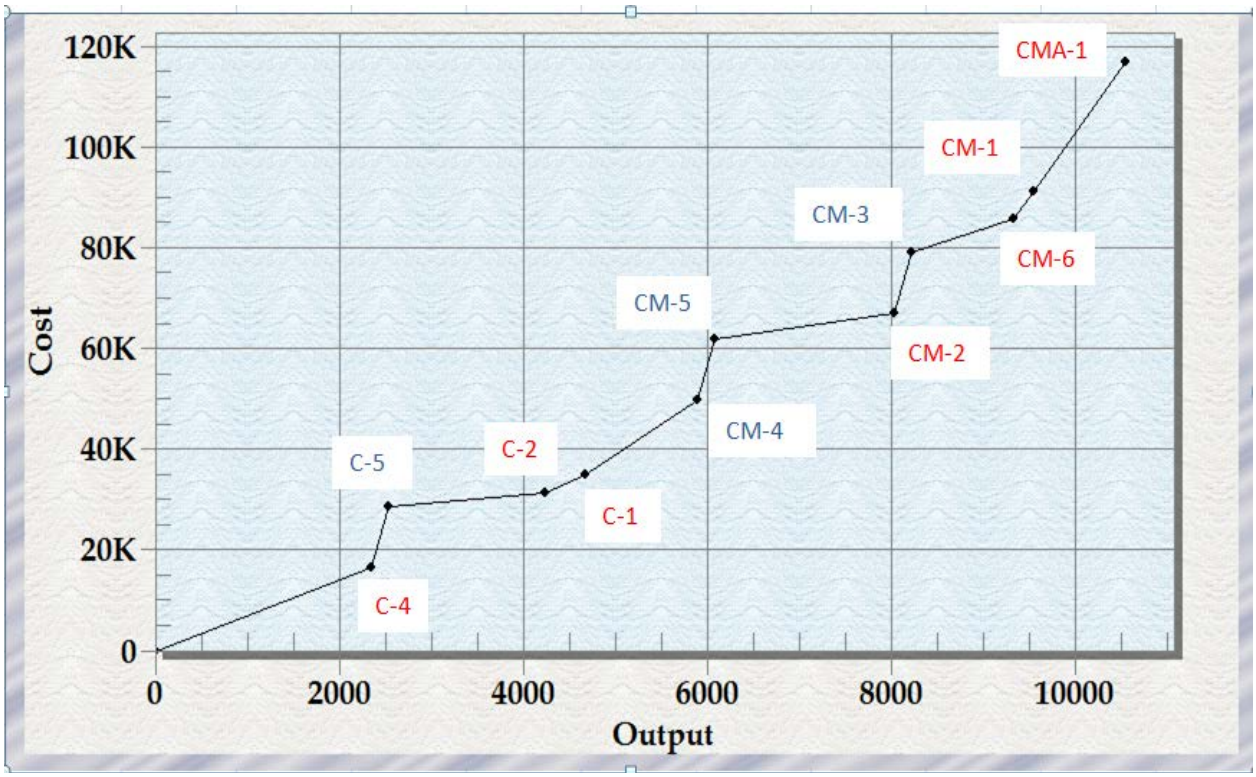

Figure 2-11: CE/ICA analysis using updated annualized costs and benefits.

2.9 Update of the NER TSP

The relative ranking of alternatives to one another as expressed in the first IWR runs was altered with the updated set of outputs. Plan A did not perform as a cost efficient plan in the refined IWR runs despite continuing to demonstrate the potential to deliver a relatively significant magnitude of benefits (975 AAHU's).

Alternative Plan CM-4, although not a Best Buy plan in the refined IWR run, is the first cost-effective plan that is comprehensive (covers both the Calcasieu/Sabine and Mermentau/Teche-Vermilion basins). Based on the data presented in Table 2-17 the financial investment required to select the first comprehensive Best Buy plan, CM-2, represents an additional cost of over $400M. Additionally, in direct comparison with the Best Buy plan CM-2, CM-4 produces 73.4 percent of those benefits at 74.0 percent of the cost. This proportionality demonstrates that the two plans are virtually identical in efficiency. For these reasons, the PDT maintains that the lower cost plan, Plan CM-4 is the TSP.

Description of the NER TSP:

- **Marsh Restoration.** Nine marsh restoration and nourishment features consist of delivering sediments to former marsh areas and eroding marsh areas (minimum of 100 acres efficiency criteria) that have water levels of less than two feet and that have been optimized to preserve or restore critical geomorphologic features to restore vegetated wetlands. This involves excavation of significant quantities and delivery of borrow material to restoration sites through designated corridors. Some restoration sites may require containment to hold sediments in place. Details for each of the restoration sites and their borrow source can be found in Appendix A and Appendix K. The marsh restoration locations include: (a) three areas on the south side of LA-82 approximately 4.5 miles west of Grand Chenier; (b) Pecan Island west of the Freshwater Bayou Canal approximately 5 miles north of the Freshwater Bayou locks; (c) Christian Marsh located east of Freshwater Bayou Canal and approximately 5 miles north of Freshwater Bayou locks; (d) southern shoreline of GIWW west of the CSC near Black Lake; (e) eastern rim of Calcasieu Lake within the Cameron-Creole Watershed; (f) east of Mud Lake and north of Highway 82; (g) Mud Lake west of Calcasieu Ship Channel adjacent to southern rim of West Cove. Dredged material sources would be the CSC and the Gulf of Mexico.
  A table summarizing details of these features is included at Table 2-18a. Construction of marsh restoration would typically involve placement of dedicated borrow material by hydraulic dredging. Placement would generally involve over placement of material to achieve a typical marsh elevation of approximately +1.5 feet NAVD88 (or as dictated by adjacent marsh elevation) following post construction settlement. As necessary earthen containment dikes would be employed to efficiently achieve the desired initial construction elevation. Dikes would be breached following construction to allow dewatering and settlement to the final target marsh elevation. All marsh restoration locations would have one future re-nourishment cycle. Subsequent marsh renourishment would employ similar techniques and specifications as developed for the initial construction. For a detailed description of each of the proposed marsh restoration projects see Appendix K. See also Appendix A, Annex V for information concerning corresponding marsh restoration project borrow sources.
- **Shoreline Protection/Stabilization.** The five Gulf shoreline protection/stabilization features span approximately 252,000 linear ft and would be used to reduce erosion of canal banks and shorelines in critical areas in order to protect adjacent wetlands and critical geomorphic features. Multiple locations of Gulf of Mexico shoreline from the Calcasieu River to Freshwater Bayou consist of reef breakwaters with lightweight aggregate core would be located approximately 150' offshore with geotextile fabric and stone built to an 18 ft crest width. In addition, approximately 13.4 miles of rock revetment built to +3 feet NAVD88 with a 4 ft crown would be placed at three locations to fortify spoil banks of the GIWW and Freshwater Bayou. Two future maintenance lifts would be required. Rock and breakwaters would also be placed at Holly Beach as a continuation of existing breakwaters; two future maintenance lifts would be required. Details of these features are included in Table 2-18b.

- **Hydrologic and Salinity Control.** The hydrologic and salinity control feature is the Cameron-Creole Spillway structure south of Lambert Bayou. It would serve as a drainage manifold and the outfall channel into Calcasieu Lake would be rock-lined for scour protection and built to +2 ft. This feature would regulate the flow of water in certain areas and inhibit salinity intrusion above a certain threshold. The Master Plan model used to evaluate hydro/salinity measure #74a needs additional refinement to properly evaluate the benefits over the 6,651-acre area of influence. The modeling indicated a slight decrease in acreage under the FWP condition (0.8 % reduction), but indicated a positive benefit in habitat quality (267 AAHU). Therefore it would be prudent to examine this measure in more detail as the study progresses. Since the net benefit is an overall increase in habitat quality, no mitigation is proposed at this time, until more detailed modeling can be conducted. Details of this feature are included in Table 2-18c.
- **Chenier Reforestation.** Chenier restoration consists of replanting of 435 seedlings per acre at 10' x 10' spacing, in 35 Chenier locations on 1,400 acres in Cameron and Vermilion parishes. Invasive species control and eradication are also included. Details of these features are included in Table 2-18d.
- The **CSC Salinity Barrier Navigation Study** is recommended as an additional long-range study feature to adequately account for potential environmental benefits, navigation impacts, and engineering.
- The NER plan first construction cost estimate is $987,738,000.

2.10 NER TSP Feature Details

Table 2-18a. Details of the marsh restoration features of the TSP (See Appendix K for fact sheets and maps detailing each NER TSP marsh restoration feature. See also Appendix A, Annex V for corresponding maps illustrating proposed borrow locations).

Measure Number	Measure Name	Basin	Marsh Type	Acres Created	Acres Nourished	Total Acres	Net Benefits (acres)	Benefits (AAHU)	Borrow Volume (cy)	Borrow Area (acres)	Borrow Renourishment Volume (cy)
3a1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	Calcasieu	Brackish	599	-	599	454	191	5,339,286	139	1,000,000
3c1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	Calcasieu	Brackish	1,765	450	2,215	1,451	654	10,199,098	314	5,600,000
47a1	Marsh Restoration Using Dredged Material South of Highway 82	Mermentau	Brackish	933	88	1,021	895	272	3,022,782	1,716	1,500,000
47a2	Marsh Restoration Using Dredged Material South of Highway 82	Mermentau	Brackish	1,297	126	1,423	1,218	381	8,831,084	1,716	1,500,000
47c1	Marsh Restoration Using Dredged Material South of Highway 82	Mermentau	Brackish	1,304	4	1,308	1,135	353	8,557,120	1,716	1,800,000
124c	Marsh Creation at Mud Lake	Calcasieu	Saline	1,908	734	2,642	1,915	740	11,129,437	531	4,700,000
124d	Marsh Creation at Mud Lake	Calcasieu	Brackish	159	448	607	168	4	1,420,943	378	1,200,000
127c3	Marsh Restoration at Pecan Island	Mermentau	Brackish	832	62	894	735	241	7,301,057	3,950	781,000
306a1	Rainey Marsh Restoration Southwest Portion (Christian Marsh)	Mermentau	Brackish	627	1,269	1,896	743	645	8,128,181	3,950	3,500,000

(Table 2-18a continued)

Measure Number	Measure Name	State Water Bottoms (permanent) impact	Floatation Footprint (acres)	Disposal Footprint (acres)	Dike Footprint (feet)	Dike Footprint (acres)	State Water Bottoms (temporary impact)	Dredge Pipeline Route (ft)	Dredge Pipeline Route (acres)	Piping Plover Critical Habitat (acres)
3a1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	139	132	0	44,700	30.8	0	43,942	30	0
3c1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	314	182	0	92,500	63.7	0	61,497	42	0
47a1	Marsh Restoration Using Dredged Material South of Highway 82	1,716	47	0	68,300	47.0	0	35,519	24	0.14
47a2	Marsh Restoration Using Dredged Material South of Highway 82	1,716	47	0	41,000	28.2	0	30,898	21	0.14
47c1	Marsh Restoration Using Dredged Material South of Highway 82	1,716	47	0	35,200	24.2	0	29,858	21	0.14
124c	Marsh Creation at Mud Lake	531	30	0	52,600	36.2	0	10,836	7	0.34
124d	Marsh Creation at Mud Lake	314	182	0	32,500	22.4	0	21,452	15	0
127c3	Marsh Restoration at Pecan Island	3,950	110	0	46,000	31.7	0	37,074	26	0
306a1	Rainey Marsh Restoration Southwest Portion (Christian Marsh)	3,950	178	0	108,000	74.4	0	59,731	41	0

Table 2-18b. Details of the shoreline protection features of the TSP (See Appendix K for fact sheets and maps detailing each NER TSP shoreline protection feature).

Measure Number	Measure Name	Basin	Marsh Type	Net Benefits (acres)	Benefits (AAHU)	Shoreline Feature Length (ft)	Rock (tons)	Grade Rock (lbs)	Geotextile Fabric (sq yds)	Lightweight Aggregate (tons)	1st Maintenance Lift (tons)	2nd Maintenance Lift (tons)
5a	Holly Beach Shoreline Stabilization – Breakwaters	Calcasieu	Saline	26	56	46,014	860,540	250	386,460	0	129,081	86,054
6b1	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	Mermentau	Brackish	2140	625	58,293	868,480	250	447,830	479,150	86,848	0
6b2	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	Mermentau	Brackish	1583	466	42,883	687,140	250	363,270	357,010	68,714	0
6b3	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	Mermentau	Brackish	1098	312	33,355	561,530	250	244,205	279,030	56,153	0
16b	Fortify Spoil Banks of the GIWW and Freshwater Bayou	Mermentau	Brackish	662	156	70,983	617,640	250	516,860	0	92,646	61,764

(Table 2-18b continued)

Measure Number	Measure Name	State Water Bottoms (permanent)	Breakwater Footprint	Floatation Footprint (acres)	Disposal Footprint (acres)	State Water Bottoms (temporary)	Critical Habitat (acres)	Staging Area (acres)	Crown Elevation (feet NAVD88)	Crown Width (feet)	Slopes	Aprons
5a	Holly Beach Shoreline Stabilization – Breakwaters	57.4	57.4	479	462	941	0	0	3.50	24	2:1	10-ft front & 6-ft back
6b1	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	65.9	65.9	725	711	1436	0	21	3.25	18	2:1	10-ft front & 6-ft back
6b2	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	40.2	40.2	507	497	1004	0	21	3.25	18	2:1	10-ft front & 6-ft back
6b3	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	37.8	37.8	372	289	661	0	21	3.25	18	2:1	10-ft front & 6-ft back
16b	Fortify Spoil Banks of the GIWW and Freshwater Bayou	77.1	77.1	358	0	0	0	0	3.00	4	4:1	none

Table 2-18c. Details of the hydrologic & salinity control feature of the TSP (see Appendix K for fact sheet and map detailing the NER TSP hydrologic and salinity control feature).

Measure Number	Measure Name	Basin	Marsh Type	Net Benefits (acres)	Benefits (AAHU)	Area of Influence (acres)	Rock (tons)	Grade Rock (lbs)	Geotextile Fabric (sq yds)	Floatation Footprint (acres)	Disposal Footprint (acres)	State Water Bottoms (Permanent)	State Water Bottoms (Temporary)	Critical Habitat (acres)	Staging Area (acres)
74a	Cameron Spillway Structure at East Calcasieu Lake	Calcasieu	Brackish	-56*	267*	6,651	47,800	250	13,600	104	104	3	104	0	0

* The Master Plan model used to evaluate hydro/salinity measure #74a needs additional refinement to properly evaluate the benefits over the 6,651-acre area of influence.

Table 2-18d. Details of the chenier reforestation features of the TSP (see Appendix K for fact sheets and maps detailing the NER TSP chenier reforestation features).

Measure Number	Measure Name	Net Benefits (acres)	Benefits (AAHU)	Species	Total Fence Length (feet)	Fence Height (feet)	Planting Density (#/acre)	Spacing (feet)	Survival (percent)	Equipment Access Corridor (feet)	Equipment Access Corridor (acres)	State Water Bottoms (permanent)	State Water Bottoms (temporary)	Critical Habitat (acres)	Staging Area (acres)
CR (total)	Chenier Reforestation	1,413	538	Live Oak; Hackberry	150,000	7.5	435	10 x 10	57%	13,867	10	0	0	0	0

2.11 Views of the Non-Federal Sponsor

CPRAB recognizes the importance of hurricane and storm surge risk reduction and ecosystem restoration in the study area as evidenced by the fact that the 2012 State Master Plan includes this study. Implementation of the NED Plan would provide hurricane and storm surge risk reduction to eligible properties within the study area. The NER Plan would help to restore, and protect the critical Chenier Plain providing multiple environmental benefits to southwest coastal Louisiana. CPRAB and numerous local stakeholders participated with CEMVN in the PDT process and have given input to develop the various measures and alternatives to formulate the plans. CPRAB currently has expressed no objection to the features of the NER and NED plans, and both plans are consistent with the State Master Plan. However, CPRAB continues to support construction of structural risk reduction features like levees across the study area as the most efficient way to reduce flood damage risks to residents of the study area.




3.0 ENVIRONMENTAL CONSEQUENCES (*NEPA REQUIRED)

This chapter describes the environmental consequences associated with the alternatives for the nonstructural Hurricane and Storm Damage Risk Reduction (HSDRR**)** NED plans and the ecosystem restoration NER plans. The impacts of the NED plans described here are programmatic in nature. Subsequent NEPA documents will analyze in detail site specific NED project(s) impacts prior to implementation. The impacts of the NER plan features described herein and in Appendix A are assessed at a full feasibility-level to be recommended for construction. Fact sheets for the NER features can be found in Appendix K.

3.1 The Human Environment

The following evaluation of impacts to the human environment does not include those that would be associated with large-scale acquisition of properties associated with implementation of the NED plan. Acquisitions of this magnitude, although not contemplated at this time, could have significant impacts in each of the socioeconomic resource areas covered in this section. Changes to the impacts analysis made necessary by ongoing development of the NED implementation plan will be addressed prior to implementation in future NEPA documents. Therefore, the conclusions contained herein as it relates to the NED plan, are subject to change pending the development of further information with respect to the scale of potential acquisitions. In absence of this information a qualitative evaluation in a worst case scenario will be developed as part of further refinement of the programmatic EIS.

3.1.1 Population and Housing

HSDRR (NED) Plan

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

Direct impacts include the potential for damage to structures, landscaping and driveways while the structure is being elevated. There would also be potential inconvenience to residents having to move and store their personal possessions and relocate to a temporary residence while their residences are being elevated as well as impede access to the residence during the time the residence is being elevated. Temporary relocation of individuals and families could entail different travel routes through unfamiliar areas, longer commute times to work, school, and other destinations for typical life activities (e.g., shopping, doctor and dentist visits, etc.). The change in commute times could be a positive or negative impact, since the relocation could temporarily move individuals and families either closer or farther away from their destinations. The scope of the acquisition component is unknown, but would result in a displacement of persons, voluntary or not. Displacement would not likely result in a net change of population to the study area, but could result in changes to the populations of individual communities and neighborhoods within and potentially outside the study area. Furthermore, displaced residents could experience different and longer routes travel routes through unfamiliar areas, longer commute times to work, school, and other destinations for typical life activities (e.g., shopping, doctor and dentist visits, etc.).

Indirect Impacts would include reduced flood risk from the surges associated with tropical events for population and housing in the 25-year floodplain of the study area. The reduction in flood risk would lead to greater stability and sustainability of population and housing resources. However, if a residence is elevated, access to the elevated residences could be more difficult, especially for the elderly and physically handicapped, even if retrofitted with elevator and other devises. Additional indirect impacts would be the different visual appearance of neighborhoods and communities with a few elevated structures located within a community of nearby structures that are not elevated. There could also be a potential drainage issues, especially related to construction of berms. There is also a potential that existing landscaping around residential structures could be damaged and require restoration.

Alternative – Nonstructural 100-year Floodplain (Plan 8)

The impacts from this alternative are similar but for the most part greater than the impacts from the Nonstructural 0-25 Year Floodplain Plan (TSP) alternative because of the larger numbers of structures that would be included in the program. This is true for all resources hence a discussion of impacts will not be added to each of the following resource unless there is a significant reason for it to be addressed separately in that resource. The scale of the differences would vary by resource.




Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

Restoration features would have no direct impacts on population and housing. Indirect impacts would include decreasing the rate of shoreline erosion, thereby, preserving the temporary population of the Holly Beach camp community located along the shoreline of the Gulf of Mexico in the Calcasieu Basin.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)

Impacts are the same as the Mermentau Basin (MB) component of the TSP.

3.1.2 Employment, Business, and Industrial Activity (Including Agriculture)

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

There would be direct impacts associated with the flood proofing of businesses and the construction of berms in the nonstructural plan. If commercial structures are flood proofed, businesses could potentially either shut down or relocate temporarily while the measure is being applied, which could lead to a loss of revenue, change in business clients to other more available businesses, as well as a loss of wages to employees. Also, the construction of berms around warehouses could temporarily and intermittently impede access to the warehouses during construction and cause drainage issues for adjacent areas and structures. There is a potential that existing landscaping around businesses and warehouses could be damaged and require restoration. The scope of acquisitions for commercial structures is currently unknown. There may not be any such structures that meet the criteria for acquisitions. In the event that a commercial structure is acquired, it is possible that the business could choose to cease operations, resulting in the loss of jobs that it provided, thereby adversely affecting employment in the area. Also, if a business relocates outside of the community, it could face the inconvenience of having to establish itself in a new area as well as longer travel distances and increased transportation costs to move the business products to markets. This inconvenience could take the form of a marketing campaign to raise awareness of the new location, which could result in an expense to the business over and above what would normally be spent. Also, some businesses could relocate beyond what some employees would consider an acceptable commuting distance. This impact could reduce employment or redistribute it, depending on whether these workers find other employment. Furthermore, customers could face the inconvenience of longer commute times and distances if a business they patronize either closes or relocates.

Indirect Impacts would include reduced flood risk from the surges associated with tropical events for employment, business, and industrial activity in the 25-year floodplain of the study area. Also, some businesses could potentially lose customers as a result of residents relocating farther away due to their homes being acquired, while other businesses could gain customers as residents relocate closer to them.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

Restoration features would have no direct or indirect impacts on employment, business, and industrial activity.

Alternative - Mermentau Small Integrated Restoration Plan

Impacts are the same as the MB component of the TSP.

3.1.3 Public Facilities and Services

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

There would be direct impacts associated with nonstructural alternative for the public facilities and services in the area. If public facilities are flood proofed by the government, then public services could be interrupted as they close or are relocated to temporary locations. Public facilities are not within the scope of potential acquisitions, unless life safety issues are found.

Indirect impacts for the nonstructural alternative would include reduced flood risk from the surges associated with tropical events for public facilities and services located in the 25-year floodplain of the study area. Also, due to the relocations of residents due to the acquisitions of homes, some public schools could gain students, while others could lose students. Other direct and indirect impacts would be similar to those described in sections 3.1.1 and 3.1.2.

Ecosystem Restoration (NER) Plans
Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)
Restoration features would have no direct, indirect, or cumulative impacts on public facilities or services.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as MB component of the TSP.

3.1.4 Transportation

HSDRR (NED) Plans
Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
Direct impacts associated with the nonstructural alternative for transportation would include temporary and intermittent delays, disruption of traffic movement, congestion of roads, re-routing of vehicles and pedestrians. Local parking access to businesses could also be affected by construction vehicles and crews.

Indirect impacts would include the additional wear and tear on roads, especially local roads, caused by large trucks transporting construction materials, as well as reduced parking. There would also be greater noise and dust generated by construction vehicles. However, best construction management practices would be utilized to ensure the safety of construction workers, residents, and employees during construction of the non-structural alternatives.

Ecosystem Restoration (NER) Plans
Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)
There would be no direct impacts on transportation. Indirect impacts would include the additional wear and tear on roads, especially local roads, caused by large trucks transporting construction materials. Also, impacts include mitigating the wave action that Highway 27 is routinely subject to, thereby reducing the frequency and intensity of the damages it sustains.

Alternative - Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the TSP.

3.1.5 Community and Regional Growth

HSDRR (NED) Plan
Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
Direct impacts would include a temporary monetary stimulus to the region due to spending associated with the construction activities in the area. This stimulus would be temporary but increase the region's income for as long as the spending continued. Also, some communities within the study area could gain residents as a result of relocations resulting from acquisitions, while other communities could lose some residents. For the study area as a whole, relocations would likely take place within the overall study area, resulting in little if any change.

Indirect impacts would include reduced flood risk for those low-lying structures within communities from the surges associated with tropical events, thus preserving growth opportunities for communities in the region.

Ecosystem Restoration (NER) Plans
Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

Restoration features of this alternative would have no direct or indirect impacts on community and regional growth other than the temporary monetary stimulus associated with construction activities, as described for the NED plan.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as MB component of the TSP.

3.1.6 Tax Revenues and Property Values

HSDRR (NED) Plan

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
For the nonstructural plan, parish sales tax revenue would likely increase during the implementation of nonstructural measures as a result of the influx of workers from outside of the study area. Also, the acquisition and demolition of structures would decrease the property tax base of the cities and parishes in which they are located.

Indirect impacts could include an increase in tax revenue and property values due to the increased risk reduction from flooding for residential properties and businesses in the 25-year floodplain.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)
There would be no direct effects to tax revenues and property taxes with this alternative. Indirect effects would include the prevention of land loss, which could result in localized positive effects of maintaining tax revenues and property values.

Alternative - Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the TSP.

3.1.7 Other Social Effects (OSE)

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
A summary of OSE is presented in the Table 3-1. These include reduction in risks associated with damages from tropical/hurricane storm surge events to housing units, public facilities, and commercial structures located within reaches where the TSP is implemented, as well as improvement in the health and safety of those residents living within these and surrounding areas. Depending on participation rates, the overall social vulnerability of all three parishes could be reduced, and thus, the potential for long-term growth and sustainability could be enhanced. These areas would be at a reduced risk of incurring costs associated with clean-up, debris removal, and building and infrastructure repair as a result of flood events.

Table 3-1: Summary of Other Social Effects.

OSE Alternative Evaluation				
Social Factors and Metrics	**Nonstructural Measures**	**CM-4**	**M4**	**No Action**
	DL / FE	DL / FE	DL / FE	DL / FE
Physical Health/Safety	1/2	1/1	0/0	-1/-2
Regional Healthcare	1/2	1/1	0/0	0/-2
Employment Opportunities	1/3	0/0	0/0	-1/-3
Community Cohesion	1/2	0/0	0/0	-1/-1
Vulnerable Groups	1/1	1/1	0/0	-1/-2

Residents of Study Area	1/1	1/1	0/0	-1/-2
Recreational Activities	1/2	1/2	0/1	-1/-2
Impacts are in comparison to the Without Project Condition DL = impacts to daily life when there is no storm/flooding FE = impacts during a storm/flood event Scores range from -3 (significant negative impact) to +3 (significant positive impact)				

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

This alternative would reduce the risks associated with habitat damage via saltwater intrusion, shoreline retreat, and loss of geomorphologic infrastructure. The area's social vulnerability would be reduced under this alternative via improved leisure and recreation opportunities, access to health and safety facilities, economic vitality, and reduced stress. Thus, the potential for long-term growth and sustainability would be enhanced.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4) Impacts are the same as the MB component of the TSP.

3.1.8 Community Cohesion

HSDRR (NED) Plan

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

Direct impacts that would disrupt community cohesion, temporarily, include the noise and fugitive dust from construction activities, the temporary displacement and relocation of residents during construction, and disruption of businesses during construction. Furthermore, non-residential structures that serve as meeting places for the community could become temporarily unavailable during the floodproofing process. Residents whose homes are acquired either on a voluntary or involuntary basis could permanently relocate outside of their community, thereby disrupting the resident's "sense of belonging" to their neighborhood, their level of commitment to the community, and their attachment to their neighbors, groups and institutions due to the greater traveling time and distance and their ability or willingness to engage in the same patterns of social interactions in the community that prevailed before the acquisitions occurred.

Indirect impacts for the nonstructural plan would include reduced flood risk for lower-lying structures within communities from the surges associated with tropical events, thus preserving community cohesion in the region. Other indirect impacts include changes to pedestrian and handicap access not only to homes, but also to community facilities affected by non-structural alternatives.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

There would be no direct impacts on community cohesion. Indirect impacts would include maintaining the integrity of the coastal landscape that supports ecosystem services that in turn supports human population and activities.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)

Impacts are the same as the MB component of the TSP.

3.1.9 Environmental Justice

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

An environmental justice (EJ) analysis was conducted which focused on the potential for disproportionately high and adverse impacts to minority and low-income populations during the construction and normal operation of the proposed risk-reduction system. Environmental Justice communities, as defined by minority composition and percent of population existing at or below the federal poverty level, have been identified within the project area.

As discussed in greater detail in Appendix A, Annex O, low-income and minority populations within the project area were assessed using up-to-date economic statistics, aerial photographs and U.S. Census Bureau 2007-2011 American Community Survey (ACS) estimates. The potential impacts to minority and low income populations would be similar to those identified in the project area. In light of the presence of EJ communities in the project area, as the NED implementation process is further assessed, prior to implementation, additional EJ-related analysis will be performed to ensure adequate consideration of the potential for EJ-related impacts across the project area.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

Many of the areas are sparsely populated or devoid of permanent structures and/or population. Construction of control structures to reduce saltwater intrusion and tidal influx would temporarily impact leisure and recreation at any nearby camps or designated fishing and hunting spots. Access to some areas due to marsh restoration and nourishment activities may be temporarily interrupted. Impacts due to shoreline protection construction would also be temporary. The long-term benefits of salinity control, marsh restoration, shoreline protection, bank stabilization, and chenier reforestation would improve wetland habitat which would subsequently improve leisure and recreation opportunities. If this alternative encourages regional economic growth, any additional jobs created may benefit minority and/or low-income groups living within the project area. Temporary impacts from construction activities due to increased turbidity, noise, and access interruption are compensated for by the opportunity for long-term positive cumulative impacts as other restoration programs improve the habitat and sustainability of coastal Louisiana.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)

Impacts are the same as the MB component of the TSP.

3.2 Water Environment (Hydrology and Hydraulics)

3.2.1 Flow and Water Levels

HSDRR (NED) Plan

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

Potential direct and indirect impacts to flow and water depend on the method used.

1. Raising structures with pilings or buyout could increase storage capacity and lower surge elevations for those structures not elevated.
2. Raising structures with earthen mounds, floodproofing, or individual berms could decrease storage capacity and raise the surge elevations for those structures that are not elevated.
3. Raising structures with a cinderblock chain wall would have similar impacts as existing conditions on storage capacity and surge elevations since it would mimic existing conditions of the structure.

The total level of impact would be relatively minor and would be dependent on the combination of non-structural methods used and the participation rate in the program

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: General flow patterns would not change.
- *Marsh Restoration*: Existing water in fragmented marsh and shallow open water areas would be converted to marsh habitat. This change would not cause water levels in adjacent lakes to change. Flows would generally overflow restored and nourished marsh areas without major changes.
- *Shoreline Protection*: Segmented breakwaters along the Gulf would dissipate the high energy Gulf waves without changing water levels or flows. Rather, these structures would provide conditions conducive to land building behind them. Interior shoreline protection measures will not alter flows or water levels. Rather, these structures will reduce erosion caused by waves.
- *Cheniers*: No direct or indirect impacts.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as MB component of TSP.

3.2.2 Water Quality and Salinity

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
Direct impacts would primarily be associated with construction for the raising and flood-proofing of structures, as well as construction of small berms around warehouses. Construction impacts to runoff would be minimized through implementation of a Stormwater Pollution Prevention Plan (SWPPP) (USEPA 2012).

Indirect Impacts: Raising and flood-proofing of structures, as well as protecting warehouses with berms, would prevent their being flooded, which would reduce water quality impacts with comparison to future without project conditions.

Indirect impacts include raising and flood-proofing of structures, as well as protecting warehouses with berms, would prevent their being flooded, which would reduce water quality impacts with comparison to future without project conditions.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)
Direct impacts of ecosystem restoration features would convert existing open water, wetland, and low-quality chenier habitat to marsh, improved chenier habitat, hydrologic/salinity control, and shoreline protection features. Because rock, fill, and construction materials for proposed hydrologic/salinity control and shoreline protection features are anticipated to be free of contaminants, discharge of these materials into existing adjacent waters would not be expected to result in adverse effects to aquatic organisms. Material proposed for construction of marsh and chenier restoration features would be evaluated to determine suitability for placement in the aquatic environment in accordance with Clean Water Act Section 404(b)(1).

Indirect impacts of ecosystem restoration features could lead to water quality improvements through the restoration and protection of wetland and chenier habitat. The hydrologic/salinity control feature is expected to aid in reducing salinities in Cameron Parish, the benefits of which are largely unknown, as area wetlands have likely adapted to existing salinity patterns. The feature may also contribute to salinity stratification, similar to the MRGO closure (Swarzenski et al. 2013, in preparation).

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as the MB component of the TSP.

3.3 Natural Environment

3.3.1 Sedimentation and Erosion

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
There would be no direct or indirect impacts.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: Hydro/salinity measure Calcasieu/Sabine Basin (CB) #74a is proposed as a spillway structure on the east side of Calcasieu Lake. The proposed action would evacuate storm surge from wetlands behind the Cameron-Creole levee. The measure would not be used to manage daily tidal exchange from Calcasieu Lake. The structure dimensions are 204 feet wide by 600 feet in length, and would directly impact approximately 3 acres of water bottoms in Calcasieu Lake. Sediment transport at the salinity control structure site would likely remain unaffected, as it would only be operational during storm surge events for

increased drainage capacity for the Cameron-Creole Watershed. This would not affect sediment delivery to the coast. This water control structure would likely lead to minimal local reduced water levels landward of the Cameron-Creole levee through improved drainage from storm surge. The rock lining in the outfall channel would minimize increased erosion from operation.

- *Marsh Restoration*: Increased marsh surface area would increase sediment entrapment when marshes are flooded (e.g., tidal and storm surge). Restored marsh would reduce fetch over open water areas thereby reducing wind generated waves and subsequent erosion.
- *Shoreline Protection*: Sedimentation patterns in the vicinity of the features would be altered. Sediment deposition and/or erosion would occur depending on the hydrodynamics at the site. For example, the location and orientation of individual features could cause erosion and/or sediment accretion. Shoreline erosion adjacent to the features would likely be reduced. Longshore sediment transport in the vicinity of the shoreline protection features in the Gulf of Mexico may result in the accumulation of sediment behind breakwater features, creating groins or tombolos.
- *Cheniers*: Tree roots bind sediments together and would likely reduce erosion of cheniers if they are overtopped in storms or by relative sea level rise.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as the MB component of the TSP.

3.3.2 Soils, Water Bottoms, and Prime and Unique Farmlands

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
Nonstructural components would have no direct impacts on soils, prime and unique farmlands, or water bottoms. However, a beneficial indirect impact through potential property acquisition could result in soils being returned to "green space" and soils that are prime and unique farmlands could become available for agriculture and pastureland (i.e., structures, including slab foundations, would be removed from the area).

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: Hydro/salinity measure Calcasieu/Sabine Basin (CB) #74a is proposed as a spillway structure on the east side of Calcasieu Lake. The proposed action would evacuate storm surge from wetlands behind the Cameron-Creole levee. The measure would not be used to manage daily tidal exchange from Calcasieu Lake. The structure dimensions are 204 feet wide by 1,509 feet long, and would directly impact approximately 3 acres of water bottoms in Calcasieu Lake. The dredging of a floatation canal would directly impact 104 acres of water bottoms, but the impacts would be temporary as the canals would be refilled at the completion of use in accordance with standard best management practices.. Bancker and Clovelly muck hydric soils are most common in the wetlands behind the Cameron-Creole levee, as well as along the East Calcasieu Lake shore. The use of the proposed spillway channel to control or remove storm surge from the wetlands could slow or prevent further erosion and provide a beneficial impact to hydric soils and wetlands adjacent to East Calcasieu Lake. The closest identified soils to East Calcasieu Lake and the proposed H/S #74a measure that are classified as prime farmlands consist primarily of Hackberry loamy fine sand (Hb) and Judice silty clay loam (Ju) on chenier ridge tops. Prime farmlands would not be directly impacted by the construction or use of the spillway channel, but could benefit indirectly by the prevention of future soil and land losses attributed to storm surges.
- *Marsh Restoration*: would include the beneficial use of dredged material from the Calcasieu Ship Channel and the Gulf of Mexico (Gulf) for the restoration and nourishment of marsh. Hydric soils in the marsh restoration areas consist primarily of Bancker muck, Creole mucky clay, Scatlake mucky clay, Larose mucky clay; and less frequently Allemands mucky peat, Clovelly muck, and Mermentau clay (Table 3-2).

Table 3-2: Hydric soils in marsh restoration areas.

Soil Association	Acres

Allemands mucky peat (AE)	40
Bancker muck (BA)	4,747
Clovelly muck (CO)	142
Creole mucky clay (CR)	3,481
Larose mucky clay (LR)	503
Mermentau clay (MM and ME)	24
Scatlake mucky clay (SC)	1,327

Impacts to hydric soils from the restoration and nourishment of marsh would be beneficial. As marsh is restored, hydric soils would increase and become more stable. Soils associated with prime and unique farmlands are most common on chenier ridges, and none of these soils were identified in the marsh restoration areas. There would be no direct impacts to prime and unique farmlands as a result of the restoration and nourishment of marsh areas. The restoration and nourishment of marsh could result in an indirect impact that could be beneficial to soils identified as prime and unique farmlands. The restoration of marsh would contribute to flood attenuation from small storm events and could prevent future loss of prime and unique farmland soils that may be present on nearby chenier ridges. Direct impacts to water bottoms in the marsh restoration footprints (Calcasieu Basin over 6,000 acres and Mermantau Basin over almost 6,550 acres created or nourished), containment dikes, flotation canals and borrow areas would result in the loss of existing bottom habitat. The containment dikes would naturally degrade over time, resulting in the temporary loss of approximately 359 acres of bottom habitat. Borrow areas to provide sediment for the restoration and nourishment of the marsh areas would result in direct impacts to approximately 7,000 acres of bottom habitat. Table 2-18 (Chapter 2) provides a full listing of each feature with total quantities of impacts to bottom habitat..

- *Shoreline Protection*: The 5a: Holly Beach Shoreline Stabilization – Breakwaters measure would include placement of rock breakwaters, resulting in direct impacts to approximately 46,000 linear feet of water bottoms in the Gulf of Mexico. The Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou measures would be constructed in three segments (6b1, 6b2, and 6b3), resulting in direct impacts to approximately 139,400 linear feet of water bottoms in the Gulf of Mexico. Measure 16b: Fortify Spoil Banks of GIWW and Freshwater Bayou would consist of bankline protection with rock dikes along three separate reaches of Freshwater Bayou, resulting in direct impacts to approximately 81,500 linear feet of water bottoms in Freshwater Bayou. In all shoreline protection measures, soft surface water bottoms would be replaced with rock resulting in indirect impacts to aquatic habitat along the shorelines. Hydric soils could be directly impacted during the placement of stone breakwaters and rock dikes, but long term indirect impacts would include the prevention of further erosion and loss of these soils, and potentially an increase in hydric soils along the Gulf shoreline. Soils associated with prime and unique farmlands are most common on chenier ridges, and none of these soils were identified in the vicinity of the Gulf shoreline restoration or Freshwater Bayou features. Approximately 549 acres of Hackberry loamy fine sand, classified as a prime farmland soil, is located along the shoreline adjacent to the Holly Beach shoreline stabilization feature. The 549 acres of prime farmland soils along the shoreline at Holly Beach would not be directly impacted by the placement of the rock breakwaters, nor would any other prime and unique farmlands be directly impacted or removed from agriculture use by the shoreline protection feature of the TSP. Indirect impacts to the 549 acres of Hackberry loamy fine sand resulting from the shoreline stabilization feature at Holly Beach would include a reduction in erosion and loss of the prime farmlands. Over time, tomobolo or sandbars could form between the breakwaters and existing beach resulting in the direct conversion of water bottom habitat. The dredging of floatation canals and associated disposal areas would result in temporary direct impacts to 4,042 acres of bottom habitat. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Cheniers*: A total of 578 acres of hydric soils were identified along the cheniers. Reforestation of the cheniers would stabilize soils and could prevent future erosion and loss of hydric soils. Therefore, the direct and indirect impacts to hydric soils on the cheniers would be beneficial. No water bottoms were identified on the cheniers, so there would be no direct or indirect impacts to water bottoms as a result of chenier reforestation. Soils that are suitable for agriculture and pastureland in the Chenier Plains are most commonly located on the chenier ridges. Approximately 514 acres of soils classified as prime farmlands,

consisting entirely of Hackberry loamy fine sand, are present along the chenier ridges that are proposed for reforestation under this alternative. The reforestation of the chenier ridges would remove these areas and identified prime farmlands from future agricultural use. In compliance with the Farmland Protection Policy Act (FPPA), the USACE consulted with the Department of Agriculture – Natural Resources Conservation Service (NRCS) to determine the precise acreage of prime and unique farmlands that would be impacted. It was determined that the proposed activities would not irreversibly impact prime farmlands and is exempt from the rules and regulations of the FPPA, Subtitle I of Title XV, Section 1539 – 1549 (NRCS letter dated December 13, 2013).An additional positive impact resulting from the chenier restoration measure is the stabilization of soils in the cheniers. This impact would indirectly benefit water bottom habitat through the reduction of sedimentation, as less material would be washing into the water column. Table 2-18 (Chapter 2) provides a full listing of feature quantities.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as the MB part of the TSP.

3.3.3 Coastal Shorelines

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
No impacts as the NED areas are located far removed from the Gulf coastal shoreline.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: No impacts.
- *Marsh Restoration*: Only measure 124c: Marsh Creation at Mud Lake would occur in proximity to the Gulf shoreline. Construction of this measure would require dredged material to be pumped across the shoreline from the Gulf borrow site to the marsh restoration sites resulting in only temporary and minor disturbance to the shoreline resources expected from this construction activity.
- *Shoreline Protection*: Proposed segmented breakwaters are expected to eliminate or substantially reduce erosion of the gulf shoreline, but would not directly affect hydrology or salinity levels since the openings between the breakwater segments would allow free passage of water. Indirectly, the breakwaters would maintain existing salinity and hydrology in the marshes and water bodies behind the shoreline, which could otherwise be altered by continued erosion. In the MB there are numerous canals and natural bayous and ponds that lie behind the gulf shoreline. Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou measures (6b1, 6b2, and 6b3) would prevent new openings from forming between the Gulf and these water bodies.
- *Cheniers*: Several of the chenier restoration projects would occur in close proximity to the Gulf shoreline. It is possible that some construction equipment may be delivered by barge from the Gulf to access the chenier ridges to perform restoration activities. In such cases, there would be minor, localized, temporary adverse impacts, including loss of vegetation cover and displacement of shoreline sediments.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Direct and Indirect Impacts: Impacts same as MB impacts of TSP.

3.3.4 Vegetation Resources

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
The area identified as the nonstructural component of the TSP would not significantly impact existing vegetation resources as any construction would be to previously disturbed areas. There is a risk that specific methods at specific locations could impact wetlands on that site but these methods and locations combinations would be avoided where practicable.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)
The TSP would restore/nourish/protect a total of about 7,315 acres in the CB; and 16,868 acres in the MB. See Table 2-18a-d for all quantities related to TSP.

- *Hydro/Salinity*: Measure #74a in the CB. The Master Plan model used to evaluate measure #74a needs additional refinement to properly evaluate the benefits over the 6,651-acre area of influence. The modeling indicated a slight decrease in acreage under the FWP condition (0.8 % reduction), but indicated a positive benefit in habitat quality (267 AAHU). Therefore it would be prudent to examine this measure in more detail as the study progresses. Since the net benefit is an overall increase in habitat quality, no mitigation is proposed at this time, until more detailed modeling can be conducted. The measure would indirectly benefit vegetation by reducing the exposure to higher salinity waters associated with storm surge that overtops the Cameron-Creole levee, thereby providing for a more stable system.
- *Marsh Restoration*: These measures would restore and/or nourish a net total of 8,714 acres overall, with approximately 1,915 acres of saline marsh and 2,073 acres of brackish marsh in the CB and 4,726 acres of brackish marsh in the MB. Of these totals approximately 9 acres of saline marsh and 10 acres of brackish marsh would be impacted in the CB, and approximately 67 acres of brackish marsh would temporarily be impacted in the MB from access required for borrow deposition. Restored/nourished marsh would regenerate and revegetate naturally from seed sources and vegetative sources in the area and contribute to reducing the overall habitat fragmentation in the area as well as provide many different species of fish and wildlife with shelter, nesting, feeding, roosting, cover, nursery, and other life requirements habitat. These marsh habitats would also provide neotropical migrants with essential staging and stopover habitat (after Stoffer and Zoller 2004, Zoller 2004). Based on previous coastal restoration actions, it is expected that invasive species would not occur on restored coastal marsh platforms unless the elevation of the marsh platform is too high (i.e., upland-like conditions). Implementation of hydro/salinity measures could result in a conversion of some existing marsh types to a fresher marsh type over time. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Shoreline Protection*: These measures would protect a net total of 5,509 overall with approximately 26 acres of barrier island habitat in the CB, and 4,847 acres of saline marsh and 662 acres of brackish marsh in the MB. These shoreline protection measures would restore an important geomorphic framework for preventing further fragmentation and loss of interior wetlands used as habitat by many different species of fish and wildlife. Table 2-18 (Chapter 2)provides a full listing of each feature with quantities.
- *Cheniers*: Measures would reforest chenier forests and improve a net total of 1,413 acres overall with 1,131 acres of reforested habitat in the CB and 282 acres of reforested habitat in MB. The proposed reforestation would provide critical stopover habitat for migratory neotropical birds. Typical invasive plants that may be eliminated or controlled but are not limited to this list are Chinese tallow, Chinese privet, cogon grass, Johnsongrass, Japanese privet, Japanese honeysuckle, common ragweed, rescuegrass, sticky chickweed, purple nutsedge, and mimosa trees. However, invasive species are presently limited on the cheniers due to ongoing farming activities. Table 2-18 (Chapter 2)provides a full listing of each feature with quantities.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)Impacts are the same as the MB component of the TSP.

3.3.5 Wildlife Resources

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
No significant impacts on most wildlife resources except for human commensal wildlife (e.g., rats, mice, pigeons, etc.) that thrive in association with human habitations, which typically disrupt the natural habitats. There could be benefits to wildlife if enough structures on land contiguous with each other were bought out and allowed to return to a natural state and if that area was contiguous with an adjacent wildlife corridor.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: The loss of fresh marsh attributed to salinity intrusion from daily tidal movement as projected within areas controlled by the proposed structure (measure 74a) would be reduced, helping to preserve the existing marsh in the area and the wildlife populations dependent on this habitat type. This measure would result in the preservation of habitat for several species of wildlife including migratory and resident waterfowl, shorebirds, wading birds, and furbearers. No adverse impacts to wildlife are anticipated from installation of this structure.
- *Marsh Restoration*: Approximately 2,523 acres of open water would be converted to brackish marsh, and 1,908 acres to saline marsh in the CB, and approximately 4,148 acres of open water would be converted to brackish marsh in the MB. Additional nourishment could occur adjacent to the marsh restoration sites. The proposed restoration/nourishment in these basins would result in improved habitat conditions for several species of wildlife including migratory and resident waterfowl, shorebirds, wading birds, and furbearers. Migratory waterfowl utilizing the area would benefit from a greater food supply resulting from the increased abundance and diversity of emergent and submerged species. Habitat for the resident mottled duck would also improve considerably as the marsh platform would provide more desirable nesting habitat. Intertidal marsh and marsh edge would also provide increased foraging opportunities for shorebirds and wading birds. Small fishes and crustaceans are often found in greater densities along vegetated marsh edge (Castellanos and Rozas 2001, Rozas and Minello 2001), and many of those species are important prey items for wading birds such as the great blue heron, little blue heron, great egret, black-crowned night-heron, and snowy egret. Mudflats and shallow water habitat restored by the deposition of dredged material would provide increased foraging opportunities for shorebirds such as least sandpipers, killdeer, and the American avocet. Those species feed on tiny invertebrates and crustaceans found on mudflats which are exposed at low tide and in shallow-water areas of the appropriate depth. Furbearers (such as nutria and muskrat) which feed on vegetation would benefit from the increased marsh acreage in the project area. Representative furbearers such as the mink, river otter, and raccoon have a diverse diet and feed on many different species of fishes and crustaceans. Those species often feed along vegetated shorelines which provide cover for many of their prey species. The loss of open water habitat with construction of these features would not be expected to adversely affect species that currently utilize these habitats as there is ample open water habitat in the basins. Wildlife species currently utilizing the shallow open water and vegetated shorelines in the project area are highly mobile and/or suited to semi-aquatic life and should not be affected during construction. Measures for reducing entrapment of sea turtles and Gulf sturgeon would be implemented. These measures can be found in Appendix A and no indirect impacts are anticipated. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Shoreline Protection*: The installation of 180,545 linear ft of segmented offshore breakwaters and about 71,000 linear ft of rock revetment would work to protect the marshes behind these structures from wave induced erosion and help maintain wildlife populations dependent on this habitat type. Some existing wildlife habitat would be converted to rock revetment habitat thereby reducing the available wetland habitat for wildlife species and also resulting in the demise of more immobile wildlife species. However, these impacts would result in a minimal overall impact to wildlife populations in the area and would work to protect the adjacent habitat these species depend on for survival that could be lost in the future if the revetment was not installed. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Cheniers*: Approximately 1,132 acres of existing chenier habitat in the CB and 282 acres of existing chenier habitat in the MB would undergo invasive species control and reforestation with construction of the proposed action. Implementation of these measures would increase the diversity of the existing habitat and the quality of the available foraging, resting and nesting habitat necessary for numerous terrestrial and avian wildlife species and essential for neotropical migrants. Construction would be minimally invasive (no earthwork is required) and some species may temporarily avoid these project features during construction, but would quickly return once construction is complete. Table 2-18 (Chapter 2) provides a full listing of feature quantities.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)

Impacts to wildlife resources would be similar to those discussed for the NER TSP except to a lesser extent.

3.3.6 Fisheries and Aquatic Resources

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

The nonstructural features should have no impact to these resources depending on the methods used. Direct and indirect impacts to these resources will be refined when the actual method of nonstructural and number of structures are examined in future NEPA documents.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: The CB component (#74a) as presently described would convert approximately 3 acres of open water benthic habitat and 0.25 acres of marsh into a rock structure, part of this structure would be out of the water and would be completely unavailable for fisheries use. The majority of the open water area is now listed as public oyster seed ground. Direct effects on benthic habitat from the measure includes covering and smothering of benthic organisms including oysters by the placement of rock. There would be a short term direct adverse impact to benthic species as well as the habitat of other aquatic species as 104 acres of water bottom is deepened and then refilled for the floatation channels. There could be direct mortality or injury of fisheries and benthic species due to both the digging and relocating of the material and burial of species that have colonized the area during the work. During construction of project features, there would be short-term indirect adverse impacts to plankton, benthic populations and fisheries species due to increases in turbidity, low dissolved oxygen, and introduction of sediments into shallow open water areas. Filter feeding species would be impacted due to clogging of the gills which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate due to turbidity. Mobile species would attempt to move from the area of influence.
- *Marsh Restoration*: Impacts in the construction footprint (CB over 6,000 acres and MB over 6,500 acres restored or nourished), and construction activities using earthen materials to create wetland could include the elimination of benthic and fishery habitat. There also could be direct mortality or injury of fisheries and benthic species due to burial or increased turbidity. Approximately 8,390 acres are identified for borrow (831 acres from Calcasieu Ship Channel, 6,197 acres from the Gulf) which would cause the conversion of shallow open water habitats to less valuable deep water borrow areas. Depending on the depth of the borrow area, this deeper water habitat could provide a refuge during extreme water temperature spikes. In addition there would be a short term direct adverse impact to benthic species as well as the habitat of other aquatic species as 955 acres of water bottom is deepened and then refilled for the floatation channels. There could be direct mortality or injury of fisheries and benthic species due to both the digging and relocating of the material and burial of species that have colonized the area during the work. Improved marsh habitats and increased SAV could have positive indirect impacts on juvenile fishes, shrimp, crabs, and other species by increasing food and cover if they are able to access the area. The conversion of open water to marsh is generally considered a benefit to aquatic species. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Shoreline Protection*: Impacts in the construction footprint (CB/57.4 and MB/143.9 acres of segmented offshore break water) would include the elimination of benthic and fishery habitat and would cause the conversion of sandy shallow open water habitats to rock habitat which will only partially be submerged. Additionally 77.1 acres of shallow mud bottom would be converted to rock with the MB components in Freshwater Bayou. There would be a short term direct adverse impact to benthic species as well as the habitat of other aquatic species as 2,441 acres of water bottom is deepened and then refilled for the floatation channels. There could be direct mortality or injury of fisheries and benthic species due to both the digging and relocating of the material and burial of species that have colonized the area during the work. During construction of project features, there would be short-term indirect adverse impacts to plankton, benthic populations and fisheries species due to increases in turbidity, and low dissolved oxygen. Filter feeding species would be impacted due to clogging of the gills which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate due to turbidity. Mobile species would attempt to move from the area of influence. Rock substrate is known to

provide benefits to some aquatic species by providing them a refuge from predation. They also provide a hard substrate for oyster spat to settle on. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.

- *Cheniers*: Reforesting chenier ridges would have no direct, indirect, or cumulative impacts.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts are the same as the MB component of the TSP.

3.3.7 Essential Fish Habitat (EFH)

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
No significant impact to these resources is expected. There is a risk that certain methods at certain locations could impact wetland EFH but these method and location combinations would be avoided where practicable.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: Measure #74a in the CB would directly impact water bottom EFH by converting approximately 3 acres into rocky bottom and 0.25 acres of marsh EFH into a rock structure. Rock is not considered EFH in coastal Louisiana. In addition there would be a short term direct adverse impact to water bottom EFH as 104 acres of water bottom is deepened and then refilled for the floatation channels. Over the project life 56 acres of marsh EFH is predicted (Master Plan Model) to be converted into open water/mud bottom EFH due to this measure.
- *Marsh Restoration*: Both the CB and MB components would convert open water (combination of estuarine mud bottoms EFH) to marsh (marsh edge, SAV, marsh ponds, and inner marsh EFH). In addition there would be a short term direct adverse impact to estuarine mud bottoms and oyster reefs EFH as 955 acres of water bottom is deepened and then refilled for the floatation channels. Construction activities using earthen materials to create marsh could bury EFH substrates or temporarily change environmental conditions, including turbidity and salinity, in the water column. The project would increase SAV and adjacent intertidal marsh vegetation (marsh restoration areas) in some areas. The CB components and MB components will nourish existing marsh and terraces. This will be a long term indirect positive impact to marsh (marsh edge, SAV, marsh ponds, and inner marsh EFH). Approximately 9,100 acres are identified for borrow (3,300 acres from Calcasieu Ship Channel, 5,800 acres from the Gulf for the CB). If the dredged material from the ship channel is obtained during maintenance events there would be no additional EFH impacts. Borrow in the Gulf would convert Gulf water EFH to deeper Gulf water EFH. Some offshore borrow areas could refill with material over time. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Shoreline Protection*: Both the CB and MB components would convert open water (combination of estuarine mud bottoms, Gulf waters, marsh edge, offshore, beach, coastal, and sand EFH) to rock which is not considered EFH in coastal Louisiana. In addition there would be a short term direct adverse impact to the aforementioned EFH as 2,441 acres of water bottom is deepened and then refilled for the floatation channels. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Cheniers*: Reforesting chenier ridges would have no direct, indirect, or cumulative impacts on EFH.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts same as the MB component of TSP.

3.3.8 Threatened and Endangered Species, and Other Protected, Species of Concern

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
This alternative would have no effect on the red-cockaded woodpecker (RCW) and minimal indirect impacts on species of concern within the project area. Direct impacts would be avoided in accordance with the Endangered Species Act (ESA), Bald and Golden Eagle Protection Act (BGEPA) and Migratory Bird Treaty

Act (MBTA) by the use of best management practices (BMPs) (see Appendix A) and recommendations from USFWS. Depending on final designs of the NED TSP, potential minimal indirect impacts could occur to the candidate species, Sprague's pipit. These impacts could include the temporary displacement of any birds that may be present due to construction activity and noise. However, impacts to this species would be avoided, minimized and reduced to the maximum extent practicable and mitigated as necessary.

Species of Concern: Depending on final designs of the NED TSP, there could be a potential for minimal indirect impacts to colonial nesting water birds. These impacts could include the temporary displacement of any birds that may be present due to construction activity and noise. It is assumed the birds would relocate to adjacent foraging/roosting grounds. Nesting birds would not be impacted as no work would take place within a rookery. Additionally, during nesting season, work would be required to take place outside of the USFWS and LDWF-declared buffer zones (Appendix A, Annex K). Work within the buffer zones may only take place during non-nesting season (September 1 to February 15). There would be no impacts to the bald eagle as no known nests are located near any project features. If an eagle's nest is found within the project area, a no-work zone would be implemented (Appendix A, Annex K).

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

Based on review of existing data, it is the opinion of CEMVN that implementation of this alternative is not likely to adversely affect the piping plover and piping plover critical habitat, red knot, West Indian manatee, Gulf sturgeon, loggerhead and Kemps Ridley sea turtles; and would have no effect on the green, leatherback, and hawksbill sea turtles or loggerhead critical habitat. Furthermore, direct impacts to species of concern would be avoided in accordance with the BGEPA, MBTA, and the Marine Mammal Protection Act (MMPA) by the use of BMPs (see Appendix A) and recommendations from USFWS and NMFS. All indirect impacts would be avoided, minimized and reduced to the maximum extent practicable and mitigated as necessary. Further consultation would occur as features are implemented if construction has not been conducted within one year of signing the ROD.

- *Hydro/Salinity*: No anticipated impacts to T&E species.
- *Marsh Restoration*: Potential temporary minimal indirect impacts to the piping plover, red knot, West Indian manatee, Gulf sturgeon and all sea turtles identified in Appendix A. Temporary construction related impacts would result from noise, turbulence and the presence of workers in the marsh restoration sites, access routes and borrow sites and would likely result in species avoiding areas temporarily. In addition critical habitat for piping plover will be temporarily impacted by the dredge pipeline coming in from the Gulf where it crosses the beach. Timing of placement and removal will be coordinated with USFWS. Loggerhead critical habitat would not be impacted as the borrow sites are within approximately 3 miles offshore. Beneficial impacts would be the increase in wetland habitat which is utilized by whooping cranes. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Shoreline Protection*: Potential indirect impacts to the West Indian manatee, Gulf sturgeon and all sea turtles listed in Appendix A, Annex K would be temporary and minimal. Temporary construction related impacts would be due to noise, turbulence and mere presence of workers in the marsh restoration sites, access routes and borrow sites and would likely result in the species avoiding the area temporarily. Permanent impacts would be the hindrance of access by sea turtles, to thousands of linear feet of shoreline. However, sea turtles do not typically use the beaches of Louisiana and it is assumed that they could easily go around the breakwater as it would not be contiguous. Loggerhead critical habitat would not be impacted as the shoreline protection features are approximately 150 feet from the shore. Indirect beneficial impacts would be the protection of thousands of linear feet of shoreline which is designated piping plover critical habitat and also used by the red knot. Table 2-18 (Chapter 2) provides a full listing of each feature with quantities.
- *Cheniers*: There could be minimal indirect impacts to Sprague's pipits if reforestation occurs on grasslands. It is assumed that the birds would relocate to adjacent or nearby suitable foraging/roosting area. Table 2-18 (Chapter 2) provides a full listing of feature quantities.

Species of Concern:

- Potential for minimal indirect impacts to colonial nesting water birds. Impacts could include disturbance of roosting or foraging birds due to construction activity and noise. It is anticipated nesting birds would not be impacted as no work would take place within a rookery. Additionally, during nesting season, work would be required to take place outside of the USFWS and LDWF declared buffer zones (Appendix A). Work within buffer zones may only take place during non-nesting season (September 1 to February 15). In addition to these potential adverse impacts, marsh restoration would beneficially impact colonial nesting water birds by providing additional foraging grounds.
- No impacts to the bald eagle, as no known nests are located near any project features. If an eagle's nest is found within the project area, a no-work zone must be implemented.
- Bottlenose dolphins could be found in the vicinity of these features, but, by utilizing measures for reducing entrapment of this species found in Appendix A, no indirect impacts are anticipated.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)

Impacts to T&E resources would be similar to those discussed for the NER TSP except to a lesser extent.

3.3.9 Cultural and Historic Resources

The following alternatives have the potential to impact cultural resources, and CEMVN has determined that cultural resource investigations and consultation would be required prior to implementing the recommended plans in order to assess potential impacts to historic properties. The CEMVN will seek to identify ways to avoid, minimize, and/or mitigate impacts to historic properties and resources of religious and cultural significance to Tribes that have the potential to be impacted by the proposed action. The USACE has elected to fulfill its obligations under Section 106 of the NHPA through the execution and implementation of a Programmatic Agreement as provided in 36 CFR Part 800.14(b). Information provided below is detailed in the draft *Cultural Resources Assessment and Research Design for the Southwest Coastal Louisiana Project, Calcasieu, Cameron, Iberia, Jefferson Davis, and Vermilion Parishes, Louisiana* (Wells and Hill 2015) on file with the Louisiana Division of Archaeology.

HSDRR (NED) Plan

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)

There is the potential for direct and indirect impacts to previously recorded archaeological sites and standing structures with a minimum age of 50 years, as well as any unrecorded sites and/or standing structures that may be identified during subsequent cultural resource investigations cultural resource investigation.

Approximately 4,952 standing structures located within the 0-25 year flood plain have been identified as candidates for nonstructural measures. It is possible that among the standing structures selected for nonstructural measures there will be structures that are either listed in or eligible for listing in the National Register of Historic Places (NRHP) or have a minimum age of 50 years and have not been assessed for eligibility. Sixteen historic properties have been identified in the study area, including 12 that are listed in the National Register of Historic Places (NRHP).

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

CB - There is the potential for direct and indirect impacts to eight previously recorded archaeological sites and 17 standing structures with a minimum age of 50 years that have not been assessed for eligibility, as well as any unrecorded sites and/or standing structures that may be identified during the cultural resource investigation. The previously recorded sites include one that has been determined not eligible for NRHP listing. The remaining seven have not been assessed. Of the eight previously recorded sites, three have prehistoric components, and five have historic components.

- *Hydro/Salinity*: No previously recorded sites or standing structures have been identified within a one-mile buffer of the proposed measure (74a).

- *Marsh Restoration*: One prehistoric site of unknown eligibility has been identified within a one-mile buffer of the proposed measures (3a1, 3c1, 124c, 124d). No previously recorded standing structures have been identified within a one-mile buffer of the measures. No previously recorded sites have been identified within the proposed borrow areas.
- *Shoreline Protection*: One historic site, determined not eligible for listing in the NRHP, has been identified within a one-mile buffer of the measure (5a). Four previously recorded standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility.
- *Cheniers*: Two prehistoric sites and four historic sites have been identified within a one-mile buffer of the measures (510a, 510b, 510d), none of which have been assessed. There are 13 previously recorded standing structures within a one-mile buffer 50 years or older that have not been assessed for eligibility.

MB - There is the potential for direct and indirect impacts to 19 previously recorded archaeological sites and 31 standing structures with a minimum age of 50 years that have not been assessed for eligibility, as well as any unrecorded sites and/or standing structures that may be identified during the cultural resource investigation. The previously recorded sites include one potentially eligible for listing in the NRHP and seven that have been determined not eligible for listing in the NRHP. The remaining 11 have not been assessed. Of the 19 sites, all have prehistoric components, and one has a historic component.

- *Marsh Restoration*: Nine prehistoric sites have been identified within a one-mile buffer of the proposed measures (47a1, 47a2, 47c1, 127c3, 306a1), one of which has been identified as potentially eligible for listing in the NRHP and two that have been determined not eligible for listing in the NRHP. The remaining six have not been assessed. Sixteen standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility. No previously recorded sites have been identified within the proposed borrow areas.
- *Shoreline Protection*: Eight prehistoric sites have been identified within a one-mile buffer of the proposed measures (16b, 6b1, 6b2, 6b3), four of which have been determined not eligible for listing in the NRHP. The remaining four have not been assessed. No previously recorded standing structures have been identified within a one-mile buffer of the proposed measure.
- *Cheniers*: Eleven prehistoric sites, one with a historic component, has been identified within a one-mile buffer of the proposed measures (416, 509c, 509d). One site has been identified as potentially eligible for listing in the NRHP and three have been determined not eligible for listing. The remaining seven have not been assessed. Thirty-one standing structures within the one-mile buffer have a minimum age of 50 years and have not been assessed for eligibility.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts would be the same as those described for the MB component of the TSP.

3.3.10 Aesthetics (Visual Resources)

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
The TSP would have minimal impacts on visual resources. Elevating homes would not impact view sheds into any surrounding areas. In cases where a home or land buyout may take place this could indirectly impact visual resources by removing a viewer from a given area. In areas where there is public access from a street or roadway, these nonstructural elements would not change the view shed. Houses being raised are currently present, their elevation would change, but the site is still occupied either way. In the case of a home buyout, if a home is removed and open land is created, this could be considered as a benefit to drivers looking for natural scenery or a loss to an established neighborhood.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: In terms of technical significance, reducing the residence time of saline water and increasing wetland productivity would most certainly benefit visual resources. In areas influenced by this measure, marshes would improve in quality relative to No Action, better maintaining the texture, color,

and framing elements of the landscape. Greater habitat diversity would be preserved, supporting a greater variety of fauna to areas to serve as focal points of life. In terms of public and institutional significance, the hydro/salinity measures will positively benefit areas in Cameron Parish along the Creole Nature Trail Scenic Byway and All American Road. Projects along LA-27 and LA-82 will be visible to travelers on the scenic byway.

- *Marsh Restoration*: This element would not be all that different from the definitions listed under Hydro/Salinity. The areas of significance, in terms of what Hydro/Salinity goals are meant to achieve, are almost exactly the same as they relate to Visual Resources. The primary difference is in how the marsh is restored. With the use of beneficial use dredge material from CSC, where impacts will be minimal, visual resources will be greatly and positively impacted. Those areas along the Creole Nature Trail will positively impact the byway creating enhanced view sheds for travelers. Other areas, such as those located along the Intracoastal Waterway and Freshwater Bayou have less visual significance because those areas are remote with limited access. Construction of marsh habitat may have temporary negative impact to the Aesthetic resources in the project area. Initial construction of the marsh will temporarily alter open water to bare mud flats, which may be considered aesthetically unpleasant. With dewatering and natural colonization of marsh plants, it will take approximately five years before the marsh becomes established with vegetation.
- *Shoreline Protection*: These elements have public visual significance and their protection and restoration would improve Louisiana's shoreline. Visually, manmade measures like breakwaters would not have positive effects on the viewscape of undeveloped and natural beach. Measures such as this are necessary to ensure that the beach remains as it is. Many of these areas are remote and public access is very limited.
- *Cheniers*: Visually, these features are the most significant of any other in the study area. Cheniers aid in the form and function of developing the design elements of the landscape. As small hillocks or ridges, they offer the variation in terrain that makes the view shed interesting and memorable. They offer islands of oasis for different plant materials to develop and add texture and color to the land. In most cases, they allow taller trees to grow in a region which adds the necessary framing elements to the landscape to give it artistic quality and character. Most of the designated chenier restoration features are located directly adjacent to the Creole Nature Trail and would drastically and positively add to design elements already described under marsh restoration and hydro/salinity.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts would be the same as those described for the MB component of the TSP.

3.3.11 Recreation

HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
A direct impact of acquiring structures is potentially reducing the number of recreational camps. On the other hand, vacated sites would become open space that could be used recreationally. There are no direct impacts from structure elevation on recreational resources. A direct impact from floodproofing park buildings is the recreational use will be temporarily unavailable during floodproofing work. An indirect impact of elevating structures on building costs of future recreational camps could result in fewer camps being constructed.

Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

- *Hydro/Salinity*: Direct impacts include restricting boaters' access to recreational resources in the area during construction activities. By reducing saltwater intrusion into adjacent wetlands, levels of recreational fishing and hunting should be maintained and even improved as wetland acreages increase.
- *Marsh Restoration*: Any direct impacts to recreational fishing, hunting, and other recreational resources would be temporary and occur during construction. Recreationalists may have to circumvent a marsh restoration project area when traveling to a destination due to construction limiting or delaying access. In general, measures that create marsh habitat and improve hydrology of wetlands are more likely to improve recreational fishing opportunities by enhancing the sustainability of productive nursery habitats.

- *Shoreline Protection*: Any direct impacts to recreational fishing and hunting would be temporary and occur during construction activities. Shoreline protection projects should help protect recreational resource lands from effects of coastal storm surge and minimize the loss of valuable fishery habitat.
- *Cheniers*: Restoration of natural ridges would improve bank stabilization and potentially provide additional habitat for deer, small game and birds, which could be beneficial for hunting and bird watching. Restored ridges would also enhance protection of adjacent swamps and marshes during coastal storms, which could also potentially benefit recreational resources and infrastructure such as boat launches.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts would be the same as those described for MB component of the TSP. Appendix A (Annex N: Recreation) provides more details on direct, indirect and cumulative impacts of the TSP and the Mermentau Small Integrated Restoration Alternative on these resources.

3.4 Cumulative Impacts

3.4.1 HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
Cumulative impacts are the effects on the environment that result from the incremental impact of the proposed project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from actions that individually are minor, but collectively result in significant actions taking place over time (Section 1508.7 40 CFR Parts 1500-1508). For example, the incremental impacts of emergent wetland restoration at several localized areas could significantly modify an entire basin's habitat diversity. A determination was made utilizing CEQ's 11-step cumulative effects analysis process.

3.4.2 HSDRR (NED) Plans

Alternative - Nonstructural 0-25 Year Floodplain Plan (TSP)
Cumulative impacts would be the incremental direct and indirect effects on each significant resource described above, caused by implementing proposed nonstructural flood risk management measures, including elevating 4,219 residential structures, floodproofing 396 non-residential structures and public buildings, and building berms or floodwalls around 337 warehouses, and acquiring structures that meet eligibility criteria. These incremental impacts would be in addition to the direct and indirect impacts attributable to other existing and authorized for construction non-structural HSDRRS existing and authorized for construction projects throughout the Sabine, Calcasieu, Mermentau, and Teche-Vermilon basins; the State and the Nation. Presently, there are very few large-scale plans that have nonstructural components. However, the National Nonstructural / Flood Proofing Committee (http://www.nwd-mr.usace.army.mil/rcc/MRFTF/docs/USACE-NFPC%20Nonstructural%20Measures%20Definitions.pdf; accessed March 12, 2015) provide the following:

> *Nonstructural flood risk management measures are proven methods and techniques for reducing flood risk and flood damages incurred within floodplains. Thousands of structures across the nation are subject to reduced risk and damages or no risk and no damage due to implementation of nonstructural measures. Besides being very effective for both short and long term flood risk and flood damage reduction, nonstructural measures can be very cost effective when compared to structural measures.*

The 2012 Coastal Master Plan recommends a comprehensive nonstructural program as part of our strategy to reduce the flood risk for Louisiana citizens. Nonstructural projects include raising a building's elevation, flood proofing structures, and voluntary acquisition or relocation. These measures are key components of protecting communities through a "multiple lines of defense approach" (http://coastal.la.gov/project-content/ccrp/; accessed March 12, 2013).

The impact Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA) program (http://www.fema.gov/hazard-mitigation-assistance) grants programs provide funding for eligible

mitigation activities that reduce disaster losses and protect life and property from future disaster damages. Currently, FEMA administers the following HMA grant programs:

- Hazard Mitigation Grant Program (HMGP) assists in implementing long-term hazard mitigation measures following Presidential disaster declarations. Funding is available to implement projects in accordance with State, Tribal, and local priorities.
- Pre-Disaster Mitigation (PDM) provides funds for hazard mitigation planning and to implement mitigation projects before disasters. The program goal is to reduce overall risk to the population and structures, while at the same time, also reducing reliance on Federal funding from disaster declarations.
- Flood Mitigation Assistance (FMA) provides annual funds so that measures can be taken to reduce or eliminate risk of flood damage to buildings insured under the National Flood Insurance Program (NFIP).

3.4.3 Ecosystem Restoration (NER) Plans

Alternative - Comprehensive Small Integrated Restoration Plan (Plan CM-4) (TSP)

Cumulative impacts would primarily relate to the incremental impact of all past, present, and future actions affecting multiple resources. The incremental effects of the project would enhance aquatic resources when combined with other Federal, state, local, and private restoration efforts. Cumulative impacts would be the incremental direct and indirect effects on each significant resource described above of positively influencing over 6,000 acres of wetlands impacted by saltwater intrusion and inundation via hydrology/salinity control structures; restoring and nourishing over 12,500 acres of brackish and saline marshes; protecting over 5,500 acres (over 250,000 linear feet) of shoreline; and reforesting over 1,400 acres of forested chenier habitat. Incremental effects would be in addition to the direct and indirect effects of other ecosystem restoration efforts in the Sabine, Calcasieu, Mermentau, and Teche-Vermilion basins; the State and other ongoing and completed ecosystem restoration projects, including:

- CWPPRA program - 151 restoration/protection projects benefiting over 110,000 acres.
- LCA Program - the USACE and the State will continue the Mississippi River Hydro/Delta Management Feasibility Study. The State has declined to participate in the LCA BUDMAT program; however, other non-federal cost share sponsors are interested.
- The 2012 State Master Plan (CPRA 2012) - evaluated 248 restoration projects, 33 structural and 116 conceptual nonstructural flood risk reduction projects. Each project has its own timeline and budget.
- There are various other restoration programs, including those using funds from the 2010 BP oil spill.
- The EPA, reporting on the Nation, states the number of restoration projects grows yearly. Current Federal initiatives call for a wide range of restoration actions, including improving or restoring 25,000 miles of stream corridor; achieving a net increase of 100,000 acres of wetlands each year (source: http://water.epa.gov/type/wetlands/restore/principles.cfm; accessed March 12, 2015). Some other large scale ecosystem restoration projects include Chesapeake Bay, the Everglades, California Bay Delta, the Platte River Basin and the Upper Mississippi River System (Doyle and Drew 2008).

Cumulative impacts would include the incremental impacts of the proposed action on visual resources of acres of marsh, wetland, and chenier ridge in the project area and other areas throughout the basin, Louisiana, and the Nation being converted or restored from open water back to land mass. Replenishment of the land would convert existing view sheds of open water into marsh, wetland, or a variety of landscape types that frame large bodies of open water and use the basic design elements of form, line, texture, color, and repetition to create an aesthetically pleasing view shed.

Similar projects across Southern Louisiana (which include Louisiana coastal restoration projects) include a number of diversion projects, marsh, and swamp restoration and nourishment, and shoreline protection; CWPPRA projects that include diversions, marsh restoration, shoreline protection, and siphons; lock replacement projects; and operation and maintenance projects, like that found at Bonnet Carre' Spillway. Other similar projects can be found throughout the nation as both public and private responsibilities. Past, present, and future projects of this type are necessary to both maintain existing marsh levels and build up future levels, thereby diminishing open water areas and creating land mass.

Other Gulf shore protection and restoration projects have been constructed along the Gulf shoreline through other funding sources. Segmented breakwaters have been constructed under at least two separate projects to the west of the proposed Holly Beach Shoreline Stabilization (5a) measure. The proposed breakwater would provide shoreline protection from the eastern end of the existing breakwaters eastward to the Calcasieu Pass jetty and compliment that existing project. The shoreline where the proposed Holly Beach measure would be built has been nourished with material dredged from the bottom of the Gulf of Mexico to help ensure that shoreline erosion did not compromise Louisiana Highways 27/82. Rock and rip/rap has also been placed at critical locations where shoreline erosion has threatened the highway. The proposed Holly Beach measure is compatible with and would augment these prior efforts. There have been proposals to construct shore protection measures along the Gulf where the proposed Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b1, 6b2, and 6b3) measures are located, but no projects have been built.

Recreation: Temporary negative impacts of restoration activities due to construction activities, increased turbidity and possible boating access issues are mediated by the presence of other productive and popular recreation areas throughout the coastal region of Louisiana. Long-term positive cumulative impacts are expected to occur as restorations measures help protect recreational resource lands from effects of coastal storm surge while improving recreational opportunities by enhancing the sustainability of valuable nursery habitats.

Alternative – Mermentau Small Integrated Restoration Plan (Plan M4)
Impacts would be the same as described for the Mermentau Basin component of the TSP.

3.5 Relationship between Local Short-Term uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

NEPA Section 102(2)(c)(iv) and 40 CFR 1502.16 requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. This section describes how the TSP would affect the short-term use and the long-term productivity of the environment. For the TSP, "short-term" refers to the temporary phase of construction of the proposed project, while "long-term" refers to the operational life of the proposed project and beyond.

The NER TSP would result in short-term construction-related impacts within parts of the project area and would include to some extent interference with local traffic, minor limited air emissions, and increases in ambient noise levels, disturbance of fisheries and wildlife, increased turbidity levels, lower dissolved oxygen, and disturbance of recreational and commercial fisheries. These impacts would be temporary and would occur only during construction, and are not expected to alter the long-term productivity of the natural environment.

The NER TSP would assist the long-term productivity of the ecological community in three basins by improving water quality, nutrients, and sediments. This would facilitate the growth and productivity of marsh and the invertebrates, fish, and wildlife that use marsh. The NER TSP would enhance the long-term productivity of natural communities throughout the region. These long-term beneficial effects would outweigh the environmental impacts resulting primarily from project construction. The quantity and quality of wetland habitat and fish populations would benefit. These improvements in productivity would beneficially impact long-term commercial and recreational fishing in the study region.

3.6 Mitigation

Mitigation measures avoid, minimize, or compensate for adverse impacts to environmental resources. The appropriate application of mitigation is to formulate a project that first avoids adverse impacts, then minimizes adverse impacts, and lastly, compensates for unavoidable impacts. The impacts described here for the NED plan are programmatic in nature. Subsequent NEPA documents would evaluate the need for mitigation on site specific NED project(s) impacts before implementation. At this point, no impacts from the NER plan have been identified that would require compensatory mitigation. In addition, no wildlife

mitigation would be required at this time. Direct impacts would be avoided in accordance with the ESA, MMPA, BGEPA, and the MBTA by the use of BMP (see Appendix A) and recommendations from USFWS and NMFS. Depending on final designs, potential minimal indirect impacts could occur to the candidate species, Sprague's pipit, and direct impact to critical habitat for piping plover. To reduce fisheries impacts any clearing and snagging would adhere to the Stream Obstruction and Removal Guidelines (1983). Air quality and noise impacts can be reduced by using heavy machinery fitted with approved muffling devices that reduce noise, vibration, and emissions. A cultural resource monitoring program is recommended during implementation. Monitoring would consist of having a qualified archaeologist present during the clearing and snagging process. The purpose of the monitoring is to assure that no previously known or unknown archaeological sites are impacted during the work.

4.0 TENTATIVELY SELECTED PLAN (*NEPA REQUIRED)

The NED Tentatively Selected Plan (TSP) is the Nonstructural 0-25 Year Floodplain Plan.

The NER TSP is Alternative Plan CM-4.

4.1 The National Economic Development (NED) Plan

4.1.1 Description of the NED TSP

The NED TSP (Nonstructural 0-25 Year Floodplain Plan a/k/a "Modified Plan 8") consists of the following measures. See Appendix "L" entitled "Draft Implementation Plan" for additional details on the nonstructural plan and methods of implementation.

1. Elevation of eligible residential structures. The term "base flood" is defined by the National Flood Insurance Program as the "flood having a 1% chance of being exceeded in any given year and is also called the 100 year flood." For the purposes of this study, this base flood elevation has been forecast into the future based on anticipated hydrologic conditions in the year 2075. This measure requires lifting the entire structure or the habitable area to the predicted 2075, 100-year base flood elevation unless the required elevation is greater than a maximum of 13 feet above ground level. The following process shall apply to property owners who are willing and eligible to participate in the elevation program:
   - Property owner shall complete an application for structure elevation which must be signed by all owners and lien-holders of the property and structure;
   - Property must meet all eligibility criteria (See below);
   - Property owner shall submit proof of ownership and a current Elevation Certificate;
   - The property has clear title and title research is completed;
   - Site inspection is conducted:
     - Phase I HTRW/Asbestos investigation is completed. The property must be certified as "clean" by the appropriate State office before any project funds may be expended. All asbestos must be abated and disposed of properly;
     - A determination of suitability for elevation is made.
   - Elevation Agreement and Residential Structure Elevation Covenant Running With The Land are executed and recorded in the public records of the parish in which the property is located.
   - Elevation of the structure is completed and final inspection is conducted and work is accepted by property owner.

2. Dry flood proofing of eligible non-residential structures (excluding large warehouses and industrial complexes) Dry flood proofing consists of sealing all areas below the flood protection level of a non-residential structure to make it watertight and ensure that floodwaters cannot get inside by making walls, doors, windows and other opening impermeable to water penetration. Walls are coated with sealants, waterproofing compounds, or plastic sheeting is placed around the walls and covered. Back-flow from water and sewer lines prevention mechanisms such as drain plugs, standpipes, grinder pumps, floor drains, and back-up valves can be installed. This measure is viable for appropriate structures if design flood depths are generally less than three feet. Hydrodynamic forces would also be a consideration. For structures with crawlspaces, the only effective way to dry flood proof is to make the first floor impermeable to the passage of floodwater. The following process will apply to participating property owners:

   - Property owner shall complete an application for dry flood proofing which must be signed by all owners and lien-holders of the property and structure);
   - Property owner shall submit proof of ownership and a current Elevation Certificate;
   - Site inspection is conducted;




- Phase I HTRW/Asbestos investigation must be performed concurrently with the verification of application. The property must be certified as "clean" by the appropriate State office before any project funds may be expended. All asbestos must be abated and disposed of properly. Asbestos impacted by flood proofing is removed at project cost, while HTRW impacted by flood proofing must be remediated by the property owner prior to the initiation of the flood proofing work;
- A determination that the flood proofing as proposed is made.

- Some form of easement or developmental control agreement shall be required to be executed by the property owner and recorded in the public records of the parish where the property is located to prohibit future alteration of the flood proofing work performed on the structure(s).
- Each structure that is dry flood proofed must have an approved sanitary disposal system and be in compliance with local and state health codes.
- Flood proofing work on each structure is completed and final inspection is conducted and work is accepted by property owner.

3. Construction of flood proofing barriers or berms less than 6 feet in height around non-residential structures, primarily industrial complexes and warehouses. These measures are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements. Barrier or berms can be constructed of earth, concrete, masonry or steel and placed around a single structure or a contiguous group of structures. It should be noted that some local governments may have adopted floodplain management rules that exceed the minimum requirements of the NFIP, and may limit the ability of certain flood-proofing measures to be constructed if effects of the flood-proofing measure (i.e., small berms, barriers, or floodwalls) create the potential for drainage problems by displacing flood storage, elevating buildings on fill, requiring significant tree removal, etc. The following process will apply to property owners willing to dry-flood proof their structures and/or to have barriers constructed for flood risk reduction.
   - Property owner shall complete an application for dry flood proofing which must be signed by all owners and lien-holders of the property and structure);
   - Property owner shall submit proof of ownership and a current Elevation Certificate;
   - Site inspection is conducted;
     - Phase I HTRW/Asbestos investigation must be performed concurrently with the verification of application. The property must be certified as "clean" by the appropriate State office before any project funds may be expended. All asbestos must be abated and disposed of properly. Asbestos impacted by flood proofing is removed at project cost, while HTRW impacted by flood proofing must be remediated by the property owner prior to the initiation of the flood proofing work;
     - A determination of the construction of small barriers for flood risk reduction is made;
   - Some form of easement or developmental control agreement shall be required to be executed by the property owner and recorded in the public records of the parish where the property is located to prohibit future alteration of the barriers constructed to reduce the risk of flooding .
   - Each structure that is dry flood proofed must have an approved sanitary disposal system and be in compliance with local and state health codes.
   - A barrier or berm of a height not to exceed 6 feet may be constructed around the structure(s) and final inspection is conducted and work is accepted by property owner.

4. Floodplain Management Plans. The NFS is required to prepare a Floodplain Management Plan in coordination with USACE to maintain the integrity of the project. The NFS should use best efforts to work with the governing bodies within the three parishes to ensure consistency with local development plans and building code and floodplain regulations.

5. Adoption of more stringent local floodplain regulations. Floodplain regulation and floodplain management are based in the NFIP which requires minimum standards of floodplain management and floodplain regulation for participating communities. Although communities within the SWC study area cannot change the minimum NFIP standards, the NFS can encourage and work with local governments to adopt local standards that achieve higher levels of flood risk reduction, such as:
   - Replace elevation requirements based on the 100-year to the 500-year;
   - Implement a zero rise floodway; and
   - Adopt cumulative damages as the trigger for substantial damage determination.

6. Adoption of more restrictive parish and municipal building codes, land use & zoning regulations. and other developmental controls. Local governments within the floodplain should be encouraged by the NFS to adopt, implement, and enforce stricter building and housing code requirements, land use and zoning regulations and other developmental controls aimed at reducing flood risk and flood damage. Examples include, restrictions on where new development may occur, minimum elevations for habitable first floors, requiring suitable anchorage to prevent flotation of buildings during floods; establishing minimum protection elevations for the first floors of structures; requiring electrical outlets and mechanical equipment to be above regulatory flood levels or be appropriately flood-proofed; restricting the use of materials that deteriorate when wetted; requiring adequate structural designs that can withstand the effects of water pressure and flood velocities; requiring the repair of flood- damaged structures in a manner that will ensure the safety of occupants and prevent blight.

4.1.2 Details of Residential Structure Elevation Program.

Structures with first-floor elevations below the 2025 25-year (4% ACE) water surface elevation (BFE) were eligible to be raised to the year 2075 100-year (1% ACE) BFE. This evaluation was incrementalized by also evaluating the structures within the 25-50 year (4-2% ACE) floodplain and the 50-100 year (2-1% ACE) floodplain. This measure requires lifting the entire structure or the habitable area to the predicted 2075, 100-year base flood elevation unless the required elevation is greater than a maximum of 13 feet above ground level. Velocity and hydrodynamic forces of storm surge and flooding also have to be considered. The most common methods of elevation are: (1) elevating on open foundations such as piers, columns, posts, or piles; (2) elevating on continuous foundation walls; (3) elevating by extending the walls or by moving the living space to an upper floor; and (4) elevating on fill. Eligible structures will be elevated to meet the predicted 2075 100-year base flood elevation, so that the Participation in the Residential Non-Structural Program is primarily voluntary in nature. However, for properties that meet certain criteria, eminent domain authority will be utilized as warranted for acquisition of the land and structure and demolition of the structure. See Appendix "L" entitled "Draft Implementation Plan" for additional details on the nonstructural plan and methods of implementation.

4.1.2.1 Involuntary Participation.

Structures that meet criteria established by the program for involuntary participation must be elevated or acquired. The following are criteria that will be used to determine structure inclusion in the Involuntary Program:

1. The structure is designated a "Severe Repetitive Loss" property in accordance with FEMA criteria (i.e. at least 4 NFIP payouts including building and contents of over $5,000 each payout with a cumulative payout total of over $20,000 OR is a residential property for which at least 2 separate claims payments (building only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building. For both of the above, at least 2 of the claims must have occurred within any 10-year period and must be greater than 10 days apart. Currently there are:
   a. 358 residential properties meet the severe repetitive loss criteria.
   b. 7 commercial properties meet the severe repetitive loss criteria.

c. 1 warehouse meets the severe repetitive loss criteria.

2. The structure is located in a Regulatory Floodway as established by FEMA. A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. There are 28 properties that currently meet the regulatory floodway location criteria.
3. The structure constitutes a threat or danger to public safety in that the un-remediated condition of the structure ("At-risk Structure") poses a substantial and certain risk of harm, death, injury or property damage if the structure is subjected to the forces, conditions, and risks typically associated with hurricanes and tropical storms and storm surge flooding. At-risk Structure that may warrant condemnation include structures located in high hazard and repetitive loss areas, floodways or floodplains and that are at significant risk of collapse or failure if exposed to the impacts of hurricanes, tropical storms and associated storm surge, flooding, wave action, winds and erosion. At-risk structures may include structures that are in a dilapidated, unsafe, and uninhabitable condition including but not limited to, structures that have severely cracked, collapsed or unsound foundations; structures with visible damage to or cracking in load bearing and masonry walls; structures with corroded, distressed, or defective steel or wood framings; structures with significant water and/or insect damage; structures with significant roof damage; structures with other structural defects that render it unsuitable for elevation; structures that have substantial damage such that the cost of restoring the structure to its before-damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred.

Some or all of these criteria may be modified or eliminated and additional criteria may be added as the Implementation Plan is finalized. If a property owner owns a structure that is included in the Involuntary Program, the Non-Federal Sponsor will use its eminent domain authority to acquire the property and relocate the occupant. Landowners and tenants of structures that are identified as Involuntary Program participants may be eligible for certain benefits in accordance with Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs of 1970, Public Law 91-646, 84 Stat. 1894 (42 U.S.C. 4601), as amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV of Public Law 100-17, 101 Stat. 246-256**;** 49 Code of Federal Regulations 24; and HUD Handbook 1378.

4.1.2.2 Voluntary Participation.

Residential structures that are eligible for elevation (and willing property owners) must meet the following eligibility criteria:

1. The property owner is willing to participate in the nonstructural program;
2. The structure is in a safe, decent, and sanitary condition and is otherwise suitable for human habitation;
3. The property has clear title;
4. The structure can be elevated to meet the required base flood elevation so that the habitable floors are raised to levels which will protect the residential structures from storm surge flooding to reduce future losses from the likelihood of the 100-Year Flood Event to the extent practicable. However, in no event will a structure be raised greater than 13 ft above the ground level;
5. The structure and/or land is not contaminated with hazardous, toxic, or radioactive waste or materials;
6. The property owner is willing to execute a Flood Proofing Agreement and a Residential Structure Elevation Covenant Running with the Land;
7. Based on a visual assessment, the structure does not have signs of significant structural defects, distress, or failure (i.e., no evidence of extensive corrosion of steel framing or concrete; no substantial water or insect damage to wood framing or framing that is in obvious need of major repair or

replacement; no major settlement, cracking, buckling, or collapse of the foundation; no critical damage to load bearing or masonry walls; no major unrepaired roof leaks, etc.);
8. The property owner does not owe taxes or other debts to any state or local governmental entity or to the Federal government;
9. The property is located in a community/parish that participates in the National Flood Insurance Program and the property owner has a current Elevation Certificate;
10. The property owner has not previously received any disaster assistance for the elevation of the structure;
11. The structure complies with the building code and floodplain management codes under which the structure was originally permitted;
12. The property owner is willing to expend costs that may be necessary in connection with the elevation of the structure which are not eligible costs that are covered by the program;
13. There are no special considerations or unique circumstances which prohibit elevation.

Note: Tenants who reside in structures being elevated may be eligible for certain benefits in accordance with Uniform Relocation Assistance and Real Property Acquisition Policies for Federal and Federally Assisted Programs of 1970, Public Law 91-646, 84 Stat. 1894 (42 U.S.C. 4601), as amended by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV of Public Law 100-17, 101 Stat. 246-256**;** 49 Code of Federal Regulations 24; and HUD Handbook 1378.

4.1.3 Hydrologic and Economic Evaluation of the new NED TSP (Modified Plan 8)

Hydrologic and economic models were run to determine the inundation effects of storms on residential, commercial, and industrial properties. Hydrologic modeling provided the existing and future hydrologic conditions needed to assess storm surge-related damages. The modeling identified 90 hydrologic reaches which are characterized by unique relationships between storm surge elevations and frequency. (Figure 4-1) An inventory of structure values, types, and first floor elevations was compiled for all structures in the 90 reaches which identified approximately 52,000 structures. Approximately 49,321 structures are located within the 100-year (1% ACE) floodplain and the results of storm surge modeling, a flood damage analysis model was used to estimate economic damages under the "No-Action" alternative and the potential benefits resulting from the implementation of nonstructural measures. The TSP (Plan 7) contained in the December 2013 draft report recommended nonstructural measures for residential and non-residential structures in the 100-year (1% ACE) floodplain within 11 justified reaches.

The NED TSP (Modified Plan 8) has been substantially revised using the 2025 conditions as the base flood criteria instead of 2075 conditions and properties in the 0-25-year (0-4% ACE) floodplain. The new NED TSP provides for greater net benefits and addresses the structures in most immediate need of flood damage reduction. The economic evaluation employed several assumptions regarding the nonstructural action to be taken for any given structure. Residential structures with first-floor elevations below the 2025 25-year (4% ACE) water surface elevation (BFE) were eligible to be raised to the year 2075 100-year (1% ACE) BFE. This evaluation was incrementalized by also evaluating the structures within the 25-50 year (4-2% ACE) floodplain and the 50-100 year (2-1% ACE) floodplain. Project costs and benefits were calculated on the basis of voluntary participation in the nonstructural plan unless certain criteria were met for a given structure. However, should participation be less than 100%, then both benefits and costs are expected to decline in similar proportion such that the benefit/cost ratio would remain unchanged for this plan. In addition, due to the lack of any economically justified structural alternatives there are no viable options to achieve greater positive net benefits.

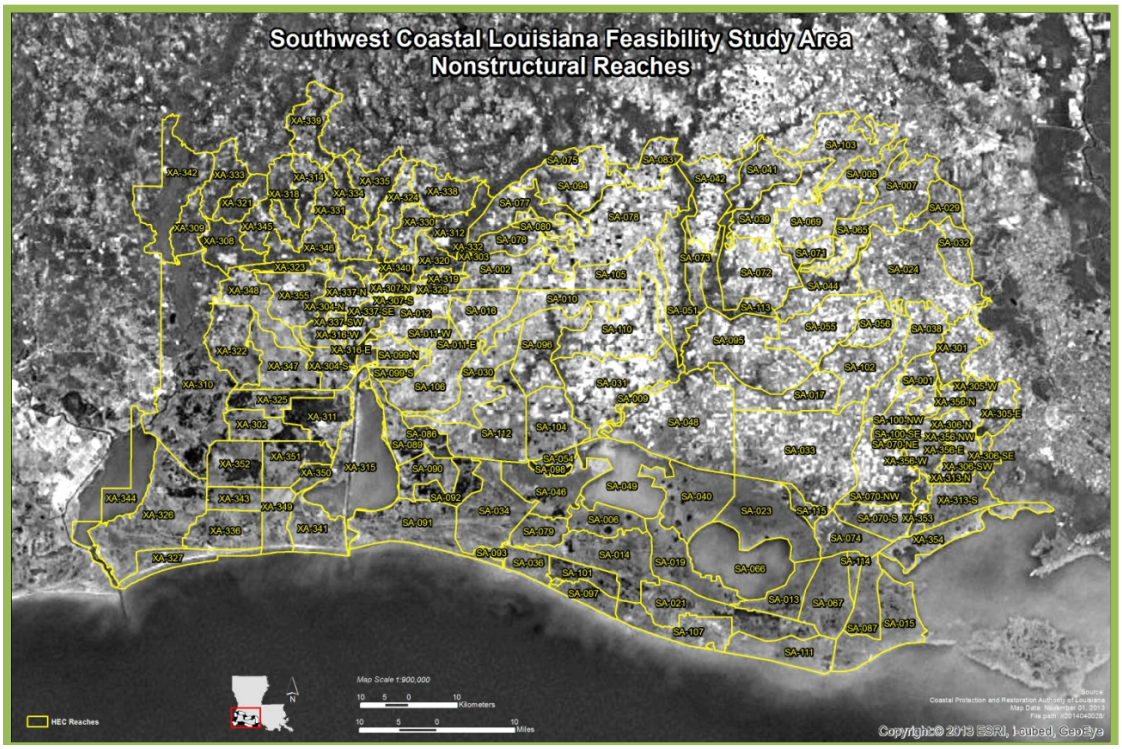

Figure 4-1: Hydrologic reaches in the study area.

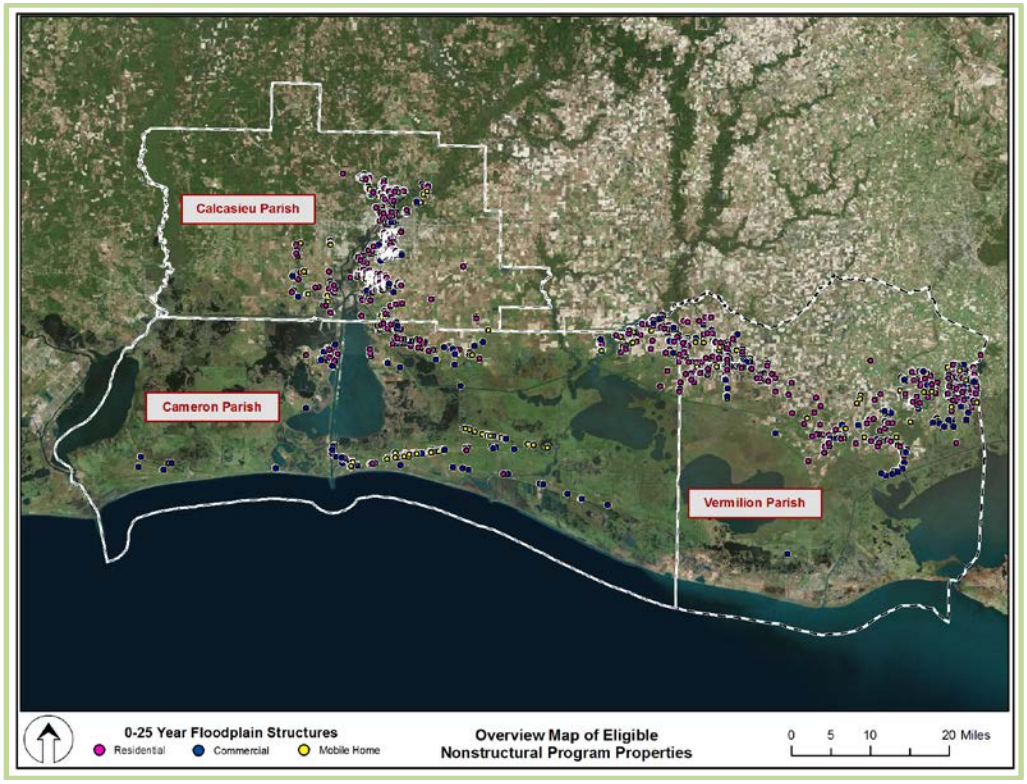

Figure 4-2: Eligible structures in the 0-25-year floodplain.

The expected annual benefits for addressing all the structures within the 0-25 year (0-4% ACE) floodplain are approximately $266 million. The total cost for implementing the nonstructural alternative is slightly over $824 million and the corresponding average annual cost is approximately $34.3 million. USACE will continue to

refine the NED TSP analyses relating to environmental justice and community cohesion, and the requirements of Executive Order 12898 will be fully complied with and incorporated.

4.1.4 NED Mitigation

Since the application of all non-structural measures involve existing developed properties there is a low expected impact to wetland habitats as a result of the implementation of a nonstructural program and every attempt would be made to avoid wetland habitats. Therefore, mitigation for unavoidable impacts from the NED plan implementation is not anticipated to be necessary.

4.1.5 NED Adaptive Management and Monitoring

Mitigation is not anticipated to be necessary for the NED TSP and as a result adaptive management will not be necessary.

4.1.6 NED Operation, Maintenance, Repair, Rehabilitation and Replacement

The NFS is required to prepare a Floodplain Management Plan in coordination with USACE to maintain the integrity of the USACE Project. In addition, the NFS should be required to work with the applicable local governments to help them adopt local standards that achieve higher levels of flood risk reduction, such as replace elevation requirements based on the 100-year to the 500-year and implementing a zero rise floodway; and adopting cumulative damages as the trigger for substantial damage determination. Further, the NFS should use best efforts to work with the governing bodies within the three parishes to ensure consistency with local development plans and regulations. Guidelines developed by the USACE Nonstructural Flood Proofing Committee indicate that the NFS is responsible for working with the local governmental entities that are charged with enforcement of applicable building, housing, and other codes to ensure that the flood proofed structure is maintained in a condition that is consistent with the purposes and intent of the NED plan and the integrity of the nonstructural program. The structure owner is responsible for maintaining the structural integrity of building upon final inspection and acceptance of the flood proofed structure.

4.1.7 NED Risk and Uncertainty Analysis

Risk and uncertainty are intrinsic in water resources planning and design. This section describes various categories of risk and uncertainty pertinent to the study. Risk and uncertainty will be further considered on the selected alternative during feasibility-level design and analysis.

Environmental Factors

Relative Sea Level Rise (RSLR): There is uncertainty about how much sea level change would occur in the region. An assessment of RSLR was included in plan formulation. The evaluation of RSLR is documented in the Engineering Report and will be refined during feasibility design. Calculations based on EC 1165-2-212 determined that the low, intermediate and high rates of RSLR at 2075 will be 1.47 ft, 2.04 ft, and 3.86 ft higher than current levels respectively (Table 4-1). The intermediate rate was used for models and assessing alternatives.

Table 4-1: Sea level and relative sea level rise values.

Year and SLR Scenario	SLR (NAVD88 ft)	RSLR (NAVD88 ft)
2025 Low SLR	0.16	0.78
2025 Intermediate SLR	0.22	0.84
2025 High SLR	0.40	1.02
2075 Low SLR	0.85	1.47
2075 Intermediate SLR	1.42	2.04
2075 High SLR	3.24	3.86

RSLR could impact the benefits achieved by the TSP. Because the NED Plan was developed using the intermediate RSLR rate, the TSP would provide fewer benefits than anticipated should the low RSLR rate result and more benefits with the high RSLR rate. With the high RSLR rate, the nonstructural component would be less effective because structures would have to be raised to a height that would increase their risk from wind damage during a storm.

Storms: Uncertainty with regard to the size and frequency of storms and meteorological events, such as El Nino and La Nina, cannot be predicted over a set period of time. The storm record is constantly being updated and a large storm such as Hurricane Rita or a slow moving storm such as Hurricane Isaac can alter the expected return period for other storms. To reduce the uncertainties of storm events, storms with varying degrees of size, intensity, and path were included in the modeling. By using a long-term record of different storm scenarios, the effects of such storms were incorporated into the modeling to reduce the uncertainty in the determination of project benefits (see Engineering Report, Appendix B).

If pronounced effects regarding RLSR or climate non-stationary occur, the nonstructural program can be adaptive and make adjustments to design criteria and structures potentially recommended for inclusion in the program. This is achievable because the implementation of a broad regional nonstructural program, as well as evidence of a greater-than-predicted rate of RSLR and/or coastal storm damages, would be distributed over time. If these effects occur, the floodplain definitions would change, design criteria would be adapted, more structures would be identified as at risk, and meet the justification criteria for the nonstructural program. Conversely, some structures that were already elevated would return to the risk pool earlier than forecast. However, this would also be a time distributed effect and identification of greater than expected RSLR would correspond to immediate or total loss of forecast benefits.

Modeling Factors

ADCIRC and HEC-RAS models appear to provide a specific response on the NED TSP in any given scenario; however it is only a representative point of reference in a complex system. While the analysis is enhanced by the models, application of the models can introduce error and uncertainty. Calibration and verification efforts are employed so that the models more closely replicate observed changes or at least provide insight into the limitations of the model. Models are limited by basic, underlying assumptions and uncertainties. Some of the simplifying assumptions include the model parameters. Another uncertainty is that a limited number of storm scenarios are modeled. It is assumed that various storm scenarios over a number of years will represent a much higher indicator of the ability for nonstructural solutions to appropriately avoid or minimize surge related damages from major storm events. Models use available historic data to extrapolate future storm conditions and frequency. The size and frequency of storms included are based on statistical analysis but do not account for meteorological changes that can increase or decrease storms over a period of several years. The models do not account for the potential of increased frequency and intensity of storms due to climate change.

Economic Factors

There is an economic risk in under or overestimating the future benefits associated with the project alternatives. The with-project damages and overall benefits associated with the alternatives were estimated based on the existing and future without-project damages. For structural features, this could potentially result in the feature not being economically justified or preliminary estimates of the benefit/cost ratios being overstated. However, no structural features are part of the TSP.

The Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) Version 1.2.5b was used to calculate the damages for the without project existing and future conditions. Economic and engineering inputs were used to calculate damages for without project existing conditions (2012), the project base year (2025), and the end of the period of analysis (2075). In an evaluation performed on the nonstructural plan, the most significant factor was the use of the base year risk condition rather than the end year condition to determine the eligibility of structures for the application of nonstructural measures. Increases in relative stage elevation for various base year risk conditions result in greater numbers of structures (incurring damages that

exceed remediation costs) introduced into the risk pool, both spatially and for any given event probability. For the study end year risk conditions, increased stage conditions translate into an increase in structures in the risk pool. However, the additional damages incurred by those structures over the period of analysis are nominal in comparison to their remediation costs given that a change in the stage associated with the .01 ACE is, on average, only 2 ft. The evaluation of residual risk associated with structures that are not in the 100-year floodplain under 2025 hydrologic conditions, but are under 2075 conditions, is expanded upon in Appendix D – Economics.

For the NED TSP, the PDT assumed a 100% participation rate which is intended to serve as an upper limit to the Federal investment in nonstructural measures. It is recognized that likely participation in any nonstructural risk reduction program would not reach 100%. Reasons of locality preference, community-wide participation trends, economic constraints for willing participants, risk tolerance, ability to affordably mitigate or self mitigate risks, structural eligibility, issues related to insurability, and the nature of future storm events are some of the factors that may influence participation. Conversely, the nonstructural plan should highlight the benefits of participation such as long-term flood risk reduction and damages, and beneficial impacts to market value and insurability. If the NED Plan is funded on the basis of 100% participation, but the actual participation is less, the uncommitted funds would not be expended. It is expected that a sensitivity analysis of the BCRs for varying levels of participation would result in no significant change. Non-participating property owners would be randomly selected to reduce the participation rate, the effect of which would be to reduce benefits and costs, on average, by constant degrees. As a result, net benefits for the NED TSP remain positive and the BCR unchanged.

The uncertainty surrounding each of the economic and engineering variables and a probability distribution was entered into the model to quantify the uncertainty associated with the key economic variables. The number of years that stages were recorded at a given gage was entered to quantify the hydrologic uncertainty or error surrounding the stage-probability relationships. The nonstructural costs were estimated based on the number of structures within the 25-year (4% ACE) floodplain in the 2025 base year. Relative sea level rise prior to the base year significantly effects the determination of the number of structures that would be eligible for application of nonstructural measures. This means that uncertainty in the projected rate of future RSLR translates directly to uncertainty as to how many structures would be included in the TSP.

The TSP reduces flood risks for only those structures in the 0-25-year floodplain, which total 4,952. An additional 10,715 structures are present in the 25-100 year (4% - 1% ACE) floodplain within the study area. However, implementation of the NED TSP reduces damages within the floodplain by 86 percent, suggesting a highly effective plan and a significant reduction in residual risk. Most damages occurring within the 100-year floodplain occur in the 0-25-year floodplain increment, thereby accounting for most benefits. From the standpoint of public safety, the NED Plan is not expected to have a large and widespread impact. For those residents that may participate in elevating their residences, the probability is that their degree of risk aversion is not expected to change as a result of this nonstructural measure, and evacuation behavior would be the same under both without- and with-project conditions.

4.1.8 NED Real Estate Requirements

Costs for the nonstructural features were included as construction costs and not as separable real estate acquisition costs. In addition, a Chart of Accounts which captures the administrative costs associated with the nonstructural plan implementation is included in the Real Estate Plan (Appendix E). A maximum of 4,952 structures are eligible for inclusion in the nonstructural program. Additional discussion of the real estate requirements for NED program features can be found in the Real Estate Plan (Appendix E). The NFS would be responsible for acquiring all necessary real estate interests including the use of eminent domain when necessary under established criteria.

4.1.9 Summary of Environmental Consequences of NED Plan

The NED plan avoids and minimizes negative environmental impacts to the maximum extent practicable or would seek to mitigate impacts to significant resources. The initial evaluation indicates that there is low

likelihood of impacts requiring mitigation. This evaluation will be refined as each eligible structure is evaluated for a particular nonstructural measure. Changes between the initial TSP and the revised TSP are described in the table below.

Table 4-2: NED Feature Costs and Benefits.

Plan	Recommendation	1st Draft Report	2nd Final Report	Difference
NED	Eligibility	11 Justified Reaches	Justified Floodplains	---
	Eligible Floodplain	2075 100-Year	2025 0-25-Year	---
	Eligible Structures	3,915	4,952	+1,037
	Benefit/Cost Ratio	1.25:1	7.74:1	+6.49
	First Construction Cost	$388,000,000	$824,000,000	+$436,000,000

4.2 National Ecosystem Restoration (NER) Plan

4.2.1 Description of the NER TSP (Plan CM-4)

The NER TSP (Alternative CM-4) consists of a broad range of ecosystem restoration measures including marsh restoration features (which involves hydraulic dredging and placing of sediments), a hydrology and salinity control structure, shoreline protection/stabilization features, and chenier reforestation. The Calcasieu Ship Channel Salinity Barrier Navigation Study is also recommended as an additional long-range study feature to adequately account for potential environmental benefits, navigation impacts, and engineering. The NER TSP features comprise an integrated comprehensive restoration plan that would have synergy with other ecosystem restoration projects and would facilitate hydrologic and geomorphic stability and resilience. Each restoration feature, with its associated benefits and estimated costs are identified in Table 4-3. A full listing of each feature in the NER TSP was presented Tables 2-18a-d in Chapter 2.

The restoration features included in the TSP (together with their benefits and impacts) are constructible and no longer programmatic prior to implementation. The construction costs and benefits for all NER features in the TSP are depicted in Table 4-3.

Table 4-3: NER Feature Construction Costs and Benefits.

Category	ID	Description	Initial Construct-ion Cost	Pre-liminary RE Cost	Net Acres	Net AAHUs
Marsh Restoration	47a1	Marsh restoration using dredged material south of LA-82.	$32,698,038	$720,000	895	272
	47a2	Marsh restoration using dredged material south of LA-82.	$73,725,657	$1,006,000	1,218	381
	47c1	Marsh restoration using dredged material south of LA-82.	$70,993,097	$925,000	1,135	353
	127c3	Marsh restoration at Pecan Island, west of the Freshwater Bayou Canal.	$84,352,747	$658,000	735	241
	306a1	Rainey marsh restoration at Christian Marsh, east of the Freshwater Bayou Canal.	$97,159,850	$1,348,000	743	645
Shoreline Protection/ Stabilization	6b1	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou.	$104,780,685	$0 (Public Lands)	2,140	625
	6b2	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou.	$76,571,740	$0 (Public Lands)	1,583	466
	6b3	Gulf shore protection/stabilization from Calcasieu River to Freshwater	$68,096,051	$0 (Public Lands)	1,098	312

		Bayou.				
	16b	Fortify spoil banks of Freshwater Bayou.	$67,773,307	$0 (Public Lands)	662	156
Chenier Re-forestation	CR	13 separate chenier locations would be replanted.	$49,523	$747,000	282	96.3
Hydrologic/ Salinity Control	74a*	Cameron-Creole Spillway.	$4,328,000	$0 (Public Lands)	(56)	267
Marsh Restoration	3a1	Beneficial use of dredged material from the Calcasieu Ship Channel.	$66,576,486	$430,000	454	191
	3c1	Beneficial use of dredged material from the Calcasieu Ship Channel.	$117,802,030	$368,000 (Some Public Lands)	1,451	654
	124c	Marsh restoration at Mud Lake.	$65,163,555	$1,871,000	1,915	740
	124d	Marsh restoration at Mud Lake. renourishment cycle.	$13,826,622	$434,000	168	4
Shoreline Protection/ Stabilization	5a	Holly Beach Shoreline Stabilization Breakwaters.	$43,644,018	$0 (Public Lands)	26	56
Chenier Re-forestation	CR	22 separate chenier locations would be replanted.	$196,778	$2,854,000	1,132	442
TOTALS			$987,738,000	$11,361,000	15,581	5,901

* 74a requires additional modeling and study to fully understand the impacts of the feature.

The full benefits for all feature types recommended in the TSP are presented below.

Table 4-4: NER Plan Features.

Restoration Measure	Number of Features	Net Acres	AAHUs	Parishes	Initial Cost
Marsh Restoration	9	8,714	3,481	Calcasieu, Cameron, Vermilion	$572,300,000
Hydrology/Salinity Control	1	(56)	267	Cameron	$4,330,000
Shoreline Protection/Stabilization	5	5,509	1,615	Cameron, Vermilion	$256,085,000
Chenier Reforestation	35	1,414	538	Cameron, Vermilion	$250,000
Total	**51***	**15,581**	**5,901**	**---**	**~$987,738,000**

**The Calcasieu Ship Channel Salinity Barrier is recommended for additional study*

Each of the marsh restoration features involves delivering sediments to open water or eroding marsh areas (minimum of 100 acres) that have water levels of less than two feet and that have been optimized to preserve or restore critical geomorphologic features to create new vegetated wetlands. The marsh restoration locations include: (a) three areas on the south side of LA-82 approximately 4.5 miles west of Grand Chenier; (b) Pecan Island west of the Freshwater Bayou Canal approximately 5 miles north of the Freshwater Bayou locks; (c) Christian Marsh located east of Freshwater Bayou Canal and approximately 5 miles north of Freshwater Bayou locks; (d) southern shoreline of GIWW west of Calcasieu Ship Channel near Black Lake; (e) eastern rim of Calcasieu Lake within the Cameron-Creole Watershed; (f) east of Mud Lake and north of Highway 82; (g) Mud Lake west of Calcasieu Ship Channel adjacent to southern rim of West Cove. Dredged material

sources would be the Calcasieu Ship Channel and the Gulf of Mexico. All marsh restoration locations would have one future re-nourishment cycle. A 30-year renourishment interval was chosen as the best balance between cost, net acres, and AAHUs. The costs are included in the OMRR&R estimates and would be the responsibility of the Non-Federal Sponsor. Adaptive management techniques would be used to adjust the projected interval, either sooner or later than the 30-years, based on actual loss rates after construction. (See Appendix A for Adaptive Management and Monitoring)

The hydrologic and salinity control feature consists of the Cameron-Creole Spillway structure south of Lambert Bayou, would serve as a drainage manifold and the outfall channel into Calcasieu Lake, and would be rock-lined for scour protection and built to +2 feet. This feature is designed to regulate the flow of water in certain areas, to inhibit salinity intrusion above a certain threshold, and to increase wetland productivity. The five shoreline protection/stabilization features, which span approximately 252,000 linear feet, would be used to reduce erosion of canal banks and shorelines in critical areas in order to protect adjacent wetlands and critical geomorphic features.

Chenier restoration consists of replanting of 435 seedlings per acre at 10' x 10' spacing, in 35 chenier locations on over 1,400 acres in Cameron and Vermilion parishes. Areas eligible for chenier restoration consist of areas greater than five feet in elevation and with low shoreline erosion rates, provided the existing canopy coverage is less than 50% unless nearby development would prevent achieving study objectives.

Figures 4-3a and 4-3b depict the NER TSP features. Figure 4-4 depicts planned restoration activities in the study area through various programs.

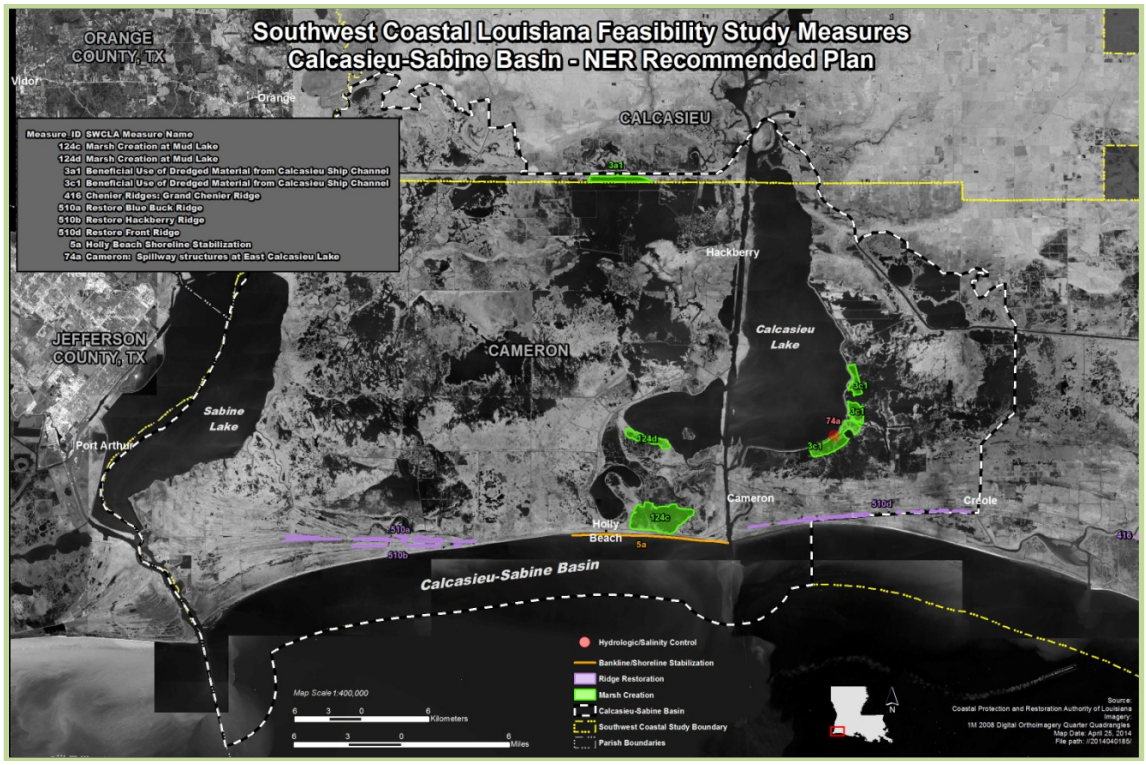

Figure 4-3a: NER TSP features (Calcasieu-Sabine Basin).

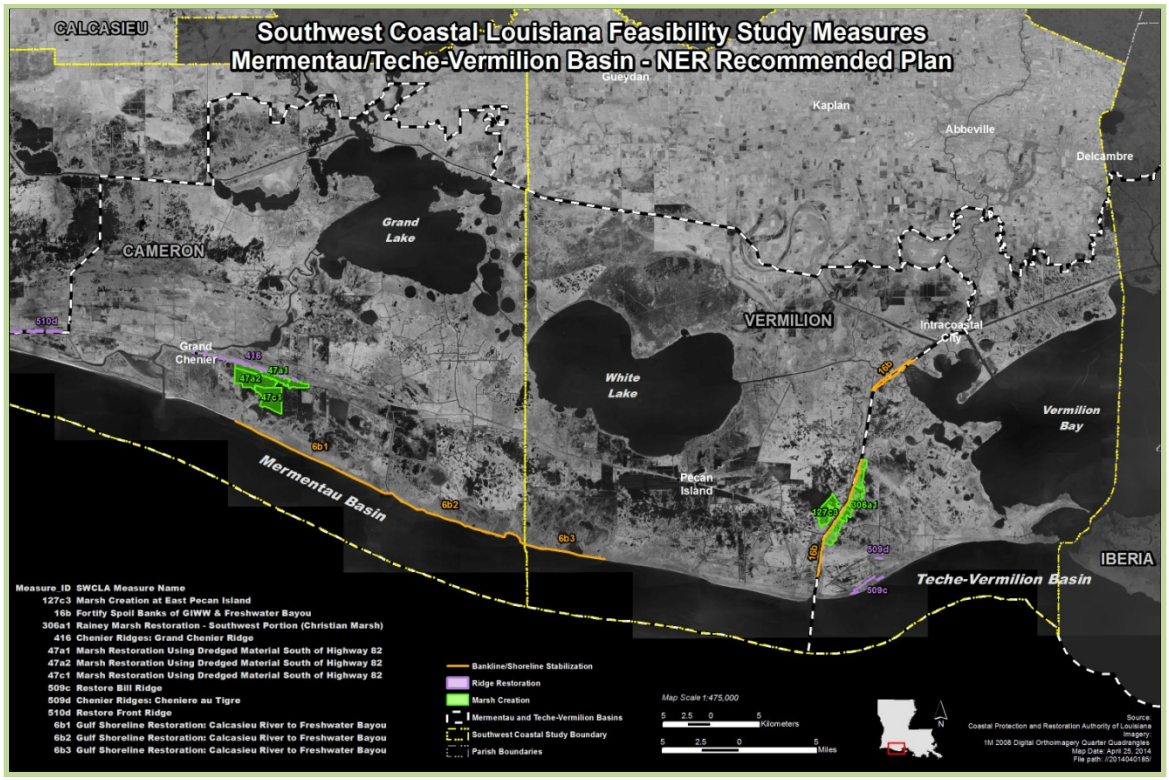

Figure 4-3b: NER TSP features (Mermentau/Teche-Vermilion Basin).

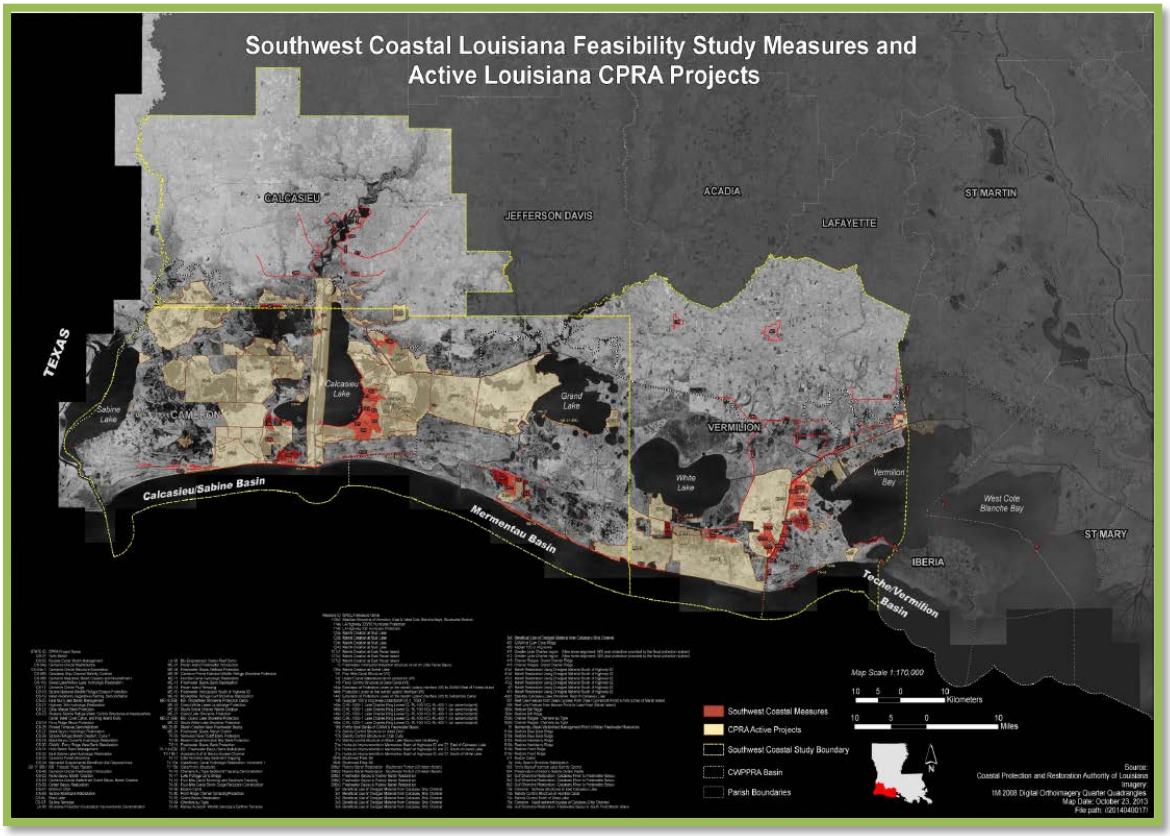

Figure 4-4: Ecosystem restoration activities in the study area.

4.2.2 Adaptive Management and Monitoring (AM&M)

The AM&M plan describes the monitoring to be used to evaluate the progress made towards meeting project goals and objectives, and is contained in Appendix A. The plan describes the organizational structure for the AM&M process, the Conceptual Ecological Model, key uncertainties, and provides potential Adaptive Management/contingency actions that may be needed to ensure success. The level of detail in the AM&M plan is based on currently available data and will be refined further in subsequent design phases. For cost estimating purposes, 3% of the total project costs are projected for AM&M costs based on the monitoring needed to measure ecological success and the identified risks and uncertainties.

4.2.3 NER Plan Operation, Maintenance, Repair, Rehabilitation and Replacement

OMRR&R for the NER TSP consists of marsh renourishment through the periodic addition of dredged sediment to maintain wetland elevations, future lifts and additions of material for rock and/or rip-rap features, and maintenance, repair and replacement of the hydrologic/salinity control features. The estimated annual OMRR&R cost for the NER features is $6,186,000, which will be refined during the design phase. The NFS shall commence OMRR&R once USACE issues a notice of construction completion together with the OMRR&R Manual to the NFS.

4.2.4 Risk and Uncertainty Analysis

Risk and uncertainty are intrinsic factors in water resource plans. This section describes risk and uncertainty categories pertinent to the study.

Environmental Factors

Relative Sea Level Rise: An assessment of RSLR was included in plan formulation and alternatives analysis; however there is uncertainty about how much sea level change may occur. Higher than estimated RSLR could cause salt water intrusion further into the Calcasieu and Sabine estuaries, causing significant changes to lower salinity wetlands. An assessment of RSLR was included in plan formulation and alternatives analysis. Higher RSLR would also result in higher water levels which would increase erosion rates and increase loss of wetlands. However, improved cohesiveness across the system should also result in a broader near-term increase in ecosystem resilience, not just for those restored wetlands, even in the face of a higher RSLR. Values for the RSLR rates were previously presented in Table 4-1. A graphic of the projected rates is also presented in Figure 1-7 in Chapter 1. RSLR could impact the benefits of the NER TSP. Because the features were developed using the intermediate RSLR rate, the TSP would provide more benefits than anticipated if the lower RSLR rate occurs and less benefits if the higher RSLR rate occurs. With the high rate the marsh restoration and shoreline protection/stabilization features would be less effective because they could be overwhelmed by water levels and this could increase their vulnerability. For the NER H&S feature, any increase in RSLR beyond what was analyzed could mean decreased effectiveness in controlling salinities because it is possible the structure could be flanked by elevated water surfaces across the low-lying topography. There is an upper limit of the range of water levels that can be controlled by the H&S structure since marsh elevations are so low. This is a risk to the effectiveness of the NER TSP but this situation would also imply that landscape-level inundation would be so great that engineered or designed features could no longer control how, when, or where water moves throughout the study area.

Storms: Risks associated with the TSP relate to possible extreme weather events. Uncertainty about the size or frequency of storms and climate events, such as El Nino cannot be predicted over a set period of time. Storm events can cause significant damage to wetlands. Intact habitats are more resilient against the effects of storm surge and associated flooding, salinity spikes, and tidal scour, though some storm damages may be unavoidable.

4.2.5 Real Estate Requirements

The Real Estate Plan (Appendix E) describes real estate requirements and costs for the NER project features. Additional identification of all of the real property interests and estates required for implementation of the

NER TSP would be considered during the future implementation efforts. Locations of the TSP alternatives were used to prepare preliminary cost estimates, but detailed information on right-of-way required for access, borrow, staging, and other project features has not yet been developed. The Real Estate Plan and cost estimates will be refined during the design phase. The NER Plan requires an estimated 25,619 acres of real estate acquisition from 158 landowners. Fact sheet maps for NER features have been prepared to show required project rights-of-way, including access, borrow, staging, and other project features (see Appendix K for more information).

The majority of the NER features are located on privately owned land and would require the acquisition of a standard Fee, Excluding Minerals (With Restriction of Use of Surface) estate. A Request to Deviate from Fee Acquisition and Request for Approval of a Non-Standard Estate will be prepared and submitted as an independent document for this project. For the purposes of this report, it is stated that fee simple title would be acquired for the NER project features. Project features on Federal lands would require a Special Use Permit from the USFWS. A standard Temporary Work Area Easement would be acquired for staging areas. A standard perpetual Utility and/or Pipeline Easement would be acquired for transport of dredged materials. A Perpetual Access Easement (Non-Material Deviation from Standard Estate) would be acquired over privately owned access areas. More detailed information regarding real estate acquisition for the NER TSP is found in Appendix E.

4.2.6 Summary of Environmental Consequences of NER Plan

Restoration and protection/stabilization features for the NER plan are designed to be self-mitigating and would not require compensation. Table 4-5 depicts the changes between the initial NER TSP contained in the December 2013 Initial draft report and the revised NER TSP contained herein.

Table 4-5: NER changes between the 1st TSP and the 2nd TSP.

Plan	Recommendation	1st Draft Report (12/2013)	2nd Draft Report (3/2015)	Difference
NER	Marsh Features (Acres/AAHUs)	9 (8,714/N/A)	9 (8,714/3,481)	N/A
	Hydrology/Salinity Control Features (Acres/AAHUs)	2 (6,092/N/A)	1 (-56/267)	-1
	Shoreline Protection/Stabilization Features (Acres/AAHUs)	5 (5,509/N/A)	5 (5,509/1,615)	N/A
	Oyster Reef Preservation Features (Acres/AAHUs)	1 (N/A/N/A)	Removed	Feature removed
	Chenier Features (Acres/AAHUs)	22 (1,413/N/A)	35 (1,414/538)	+13 (sites added)
	First Construction Cost	$992,000,000	$987,738,000	-$4,262,000
	Fully Funded Cost	$1,128,386,000	$1,197,757,000	+$69,371,000

**The Calcasieu Ship Channel Salinity Barrier is recommended for additional study. Hydrology/Salinity Control Feature requires additional modeling and study to understand the benefits/impacts of the feature. Additional NEPA would be completed prior to implementation*

4.2.7 Significance of Benefits for the NER Plan

The NER plan would benefit a total of 15,581 net acres (Table 4-3) and be synergistic with the existing and authorized restoration projects identified in Figure 4-3. The significance of benefits for the NER Plan is substantially greater than just the net acres restored and/or protected. Compared to the "No Action Alternative", implementing the marsh restoration, chenier reforestation, shoreline protection/stabilization, and hydro/salinity control feature of the NER plan would result in positive effects on resources which are institutionally, technically, and publicly significant. Restoration of the global, national, state, and locally significant resources within the area would contribute to the unique services, functions and values provided by these resources.

Coastal Louisiana is a unique ecosystem which is losing land at an estimated rate between 20 and 50 square miles a year (USGS 1995, USGS 2011). Approximately 1,900 square miles of coastal habitat was lost between 1932 and 2010 (USGS 2011). Approximately 104,171 acres of marsh is projected to be lost by 2075, 2083 acres annually. Restoring fresh, intermediate, brackish, and saline estuarine marshes within a framework of hydro/salinity control, marsh restoration, and shoreline protection/stabilization features would interact to provide benefits greater than the sum of their parts. Together these features would help regulate fresh and saltwater flows, protecting against substrate erosion and provide important transitional estuarine habitat between upland and marine environments.

Implementation of the NER Plan would reduce habitat degradation and land loss, along with reestablishing replenishing processes contributing to plant production and vertical maintenance necessary for a stable ecosystem. Restoring estuarine marsh habitats for wildlife, finfish, shellfish, and other aquatic organisms would provide habitats used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. Threatened and endangered species, such as piping plover, sea turtles, and species of interest such as the brown pelican and bald eagle would benefit from the restoration of scarce important estuarine habitats. The shoreline protection features would restore and protect approximately 341 acres of designated critical habitat for the threatened piping plover and important habitat for the threatened rufa red knot.

There would also be increases in estuarine EFH including: estuarine mud bottoms; marsh ponds, inner marsh and marsh edge; SAV; beach; tidal creeks; and marsh/water interface associated with the restoration of transitional estuarine habitat between upland and marine environments. This would result in restored EFH for federally-managed species such as brown and white shrimp, red drum, Spanish mackerel, King mackerel, and cobia. Increases in available EFH would result in more opportunities for recreational and commercial fisheries. Restoring the rare and imperiled chenier forest would provide stopover habitat for migrating neotropical birds. Benefits of the NER plan would include a decrease in inter- and intra-specific competition between resident and migratory fish and wildlife species for decreasing estuarine resources.

Restoring this unique estuarine ecosystem would not only increase productivity and benefit the ecologic system, but also protect the significant scientific, recreational, aesthetic, historic, and publicly significant features within the area. Restored marsh would provide a natural storm protective buffer and reduce shoreline recession and the movement of unstable sediments. Reforesting the chenier ridges would maintain the uniqueness of this ecosystem, reduce the scarcity of this habitat, as well as contribute to species richness and biodiversity produced by the system. The vegetative communities that would be restored by the NER plan would provide protection against erosion and contribute food and structure for cover, nesting, and nursery habitat for wildlife and fish.

4.3 Implementation Requirements

Preconstruction engineering and design, and construction will follow USACE regulations and standards. Lands, easements, right-of-ways, relocations and borrow/disposal areas (LERRDs) are an NFS obligation (see Appendix E). A preliminary description of the NFS obligations for both the NER and the NED Plans are set forth below; however the items of the NFS's obligations may be refined as the Project is implemented.

4.4 Cost Sharing and Non-Federal Sponsor Responsibilities

The CPRAB is anticipated to be the NFS for the planning, design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project. The cost share for the planning, design, and construction is 65% Federal and 35% non-Federal. Federal implementation of the project is subject to the NFS agreeing to comply with applicable Federal laws and policies.

4.4.1 Cost Apportionment

The OMRR&R costs for the NER TSP are estimated at $6,186,000, and total estimated interest during construction for NER is $30,743,000 at 2014 price levels (see Table 4-6). Because implementation of the

nonstructural plan would occur on an individual structure by structure basis with construction occurring within less than one year, there is no interest accruing during construction associated with that plan.

Table 4-6 TSP summary.

	Storm Damage Risk Reduction (NED)	Ecosystem Restoration (NER)	Total
First Cost	$824,000,000	$987,738,000	$1,811,738,000
Average Annual Cost	$34,342,000	$48,633,000	$82,975,000
Average Annual Benefits	$265,964,000	5,901 (AAHU's)	
Net Benefit	$231,621,000	15,581 (Net Acres)	
BCR	7.74	N/A	

Table 4-7: Cost apportionment of the TSPs (NED and NER)*.

	Storm Damage Risk Reduction (NED)	Ecosystem Restoration (NER)	Total	Federal	Non-Federal
PED[1]	$---	$59,264,000	$59,264,000	$38,522,000	$20,742,000
Construction	$824,000,000[6]	$987,738,000	$1,811,738,000	$1,177,630,000	$634,108,000
Interest During Construction[2]	$---	$30,743,000	$30,743,000	$19,983,000	$10,760,000
Lands, Easements, & ROW	$---	$11,361,000	$11,361,000	$--[5]	$11,361,000
Construction Management[3]	$---	$79,019,000	$79,019,000	$51,362,000	$27,657,000
Monitoring and Adaptive Management[4]	$---	$29,632,000	$29,632,000	$19,261,000	$10,371,000
Total First Costs#	$824,000,000	$1,197,757,000	$2,021,757,000	$1,314,142,000	$707,615,000

1 – 6% of construction cost
2 – Federal Discount Rate of 3.375%
3 – 8% of construction cost
4 – 3% of construction cost
5 – Fed cost is administrative for non-Federal sponsor oversight.
6 – Contains a roll-up of PED and construction management costs.
* All table numbers have been rounded to the nearest thousand.

4.4.2 Items of Local Cooperation for the NER TSP:

a. Provide 35 percent of total project costs as further specified below:

1. Provide the non-Federal share of design costs allocated by the Government in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all

relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total project costs;

b. Not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the project;

c. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

d. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

g. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

h. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

i. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

j. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

l. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA.

m. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the ecosystem restoration features, hinder operation and maintenance of the project, or interfere with the project's proper function;

n. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project;

o. Not use project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project.

4.4.3 Items of Local Cooperation for the NED TSP:

a. Provide 35 percent of total project costs as further specified below:

1. Provide the non-Federal share of design costs allocated by the Government in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total project costs;

b. Not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the project;

c. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

d. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

e. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

f. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

g. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

h. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

i. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army" and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.);

j. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project.

However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

k. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

l. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA.

m. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

n. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

o. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

p. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal sponsor to prepare a floodplain management plan within one year after the date of signing a project partnership agreement, and to implement such plan not later than one year after completion of construction of the project;

q. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

r. Shall not use any project features or lands, easements, and rights-of-way required for such features as a wetlands bank or mitigation credit for any other project;

s. Pay all costs due to any project betterments or any additional work requested by the sponsor, subject to the sponsor's identification and request that the Government accomplish such betterments or additional work, and acknowledgement that if the Government in its sole discretion elects to accomplish the requires to so notify the non-Federal sponsor in writing that sets forth any applicable terms and conditions.

4.4.4 Non-Federal Sponsor Letter of Intent

CPRA
Coastal Protection and Restoration Authority of Louisiana

State of Louisiana

BOBBY JINDAL
GOVERNOR

March 13, 2015

Colonel Hansen
New Orleans District
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160-0267

Dear Colonel Hansen:

The State of Louisiana, acting through the Coastal Protection and Restoration Authority Board and the Coastal Protection and Restoration Authority, is pleased to offer its continuing support of the Southwest Coastal Louisiana Feasibility Study (SCLFS). This study is a critical component of the 2012 Comprehensive Master Plan for a Sustainable Coast and would provide coastal restoration measures including marsh creation, shoreline protection and hydrologic/salinity control as well as nonstructural hurricane and storm surge damage risk reduction measures for eligible properties within the 25-year floodplain across 4,700 square miles in Calcasieu, Cameron, and Vermilion Parishes.

This letter, while not legally binding on the State as an obligation of future funds as subject to appropriation by the State Legislature, generally declares the State's support for the SCLFS as described in the Revised Integrated Draft Feasibility Report and Programmatic Environmental Impact Statement dated March 2015.The State understands the nonstructural measures will consist of floodproofing, elevating structures, and in some cases, buying-out properties in the area. To the maximum extent practicable, implementation will target willing participants in the nonstructural program. Though never the preferred option, we understand eminent domain may be used if determined to be warranted by the USACE. Conditions that may warrant the use of eminent domain will include but are not limited to:

a. Severe Repetitive Loss properties (as established by the Federal Emergency Management Agency (FEMA)); and/or
b. Properties located in a regulatory floodway (as established by FEMA).

Unless determined to be warranted as described above, eminent domain will not be used to require an unwilling landowner to participate in floodproofing, elevating, or buy-out of a structure.

It should be noted that a National Nonstructural Flood Protection policy has not been developed and adopted by the USACE. Furthermore, the specifics of how the nonstructural measures for the SCLFS will be implemented have not yet been developed. Therefore, the State of Louisiana is being asked to support a plan for which many of the implementation details have not yet been determined.

To clarify, the State of Louisiana fully supports the SCLFS and support *in principle* its nonstructural component. In fact, our own Master Plan includes a nonstructural component and

we believe it is an essential part of an overall strategy to reduce risks associated with hurricanes and storm surge damages to our citizens.
The State of Louisiana looks forward to continuing to work with the USACE to develop the nonstructural measures that are part of the SCLFC and to ensure they are implemented in a fair and equitable way for affected individuals and communities.

Sincerely,

Kyle R. "Chip" Kline, Jr.
Chairman
Coastal Protection & Restoration Authority Board of Louisiana

CK/BH/jm

c: Kyle Graham, CPRA Executive Director
Bren Haase, CPRA Administrator
Jennifer Mouton, CPRA Study Manager
Troy Constance, USACE
Darrel Broussard, USACE
P.J. Varnado, USACE

5.0 ENVIRONMENTAL LAWS AND COMPLIANCE (*NEPA REQUIRED)

Civil works studies and projects should be in compliance with all applicable Federal environmental statutes and regulations and with applicable State laws and regulations where the Federal government has clearly waived sovereign immunity. The USACE will continue to coordinate with Federal and state resource agencies through release of the revised Draft Environmental Impact Statement (EIS). Status of compliance with the various laws and executive orders (EO) is presented in Table 5-1 below. See Appendix A, Annex J for a summary of applicable laws and regulations and for a more detailed discussion of agency coordination and project compliance.

Table 5-1: Status of environmental compliance.

Law, Regulation, or Policy	Status	Comments	Full Compliance Expected
Anadromous Fish Conservation Act of 1965	Coordination ongoing	Anadromous fish species would not be affected by the proposed action. Coordination with NMFS is ongoing.	Compliance achieved following coordination, disclosure and NMFS review of Final EIS.
Bald and Golden Eagle Protection Action of 1940	Coordination ongoing	Based on review of existing data and preliminary field surveys, the CEMVN finds the TSP would have no effect on bald or golden eagles, or their critical habitat. Subsequent NEPA analysis would be completed prior to implementing the NED Plan.	Compliance following coordination, disclosure and USFWS review of Final EIS.
Clean Air Act of 1970	Coordination ongoing	Sec. 309: EPA will rate the document during the public comment period. Sec. 176: Project area currently in attainment of NAAQS. No general conformity determination required	Compliance after disclosure and EPA, LDEQ review of Final EIS.
Clean Water Act of 1977	Coordination ongoing	Section 401: water quality certification from LDEQ not required for programmatic NED Plan. A water quality certification application for the constructible NER Plan is provided in this revised Draft EIS for LDEQ review. Section 404: A 404(b)(1) Evaluation not required for programmatic NED Plan. A 404(b)(1) evaluation is provided for constructible NER Plan.	NED Plan: Compliance for Section 401 and 404(b)(1) not applicable at programmatic level. NER Plan: Compliance with receipt of water quality certificate after disclosure and LDEQ review of Final EIS.
Coastal Zone Management Act of 1972	Coordination ongoing	A programmatic consistency determination has been prepared for the NED Plan. Consistency Determination for constructible NER Plan has been prepared and submitted to LDNR for consistency review with the Louisiana Coastal Resource Program.	Compliance with receipt of coastal zone consistency determination from LDNR, disclosure and review of Final EIS.
Coastal Barrier Resources Act of 1982 and Coastal Barrier Improvement Act of 1990	Coordination ongoing	The TSP would have temporary adverse effect but would provide long term permanent benefits to coastal barrier shoreline resources.	Compliance achieved upon disclosure and review of Final EIS.
Endangered Species Act of 1973	Coordination ongoing	A Biological Assessment (BA) has been prepared and ongoing consultation with NMFS/USFWS will be completed for Final EIS.	Compliance after NMFS and USFWS review the final BA, conclusion of Endangered Species formal consultation, disclosure and review of Final EIS.
Estuary Protection Act of 1968	Coordination ongoing	Estuaries would benefit from implementation of the TSP and there would be no significant adverse impacts to estuaries.	Compliance achieved following disclosure and review of Final EIS.
Farmland Protection Policy Act of 1981	Coordination ongoing	NRCS concurs that impacts to prime and unique farmlands from the TSP will not "irreversibly" impact prime farmland and is therefore exempt from the rules and regulations of Section 1539-1549 of Farmland Protection Policy Act .	Compliance achieved through coordination with NRCS, disclosure and review of Final EIS.




Law, Regulation, or Policy	Status	Comments	Full Compliance Expected
Federal Water Project Recreation Act of 1965	Coordination ongoing	Recreational opportunities have been analyzed and documented in revised draft EIS.	Compliance achieved upon disclosure and review of Final EIS.
Fish and Wildlife Coordination Act of 1958	Coordination ongoing	USFWS provided a draft Fish and Wildlife Coordination Act Report (CAR) dated Nov 5, 2013; a supplemental letter dated Dec 3, 2013; and revised CAR February 2015	Compliance achieved following receipt of final FWCAR and USFWS review of Final EIS.
Magnuson-Stevens Fishery Conservation and Management Act of 1976	Coordination ongoing	An EFH assessment of TSP has been conducted and documented in revised Draft EIS.	Compliance achieved following EFH consultation with NMFS and review of Final EIS.
Marine Mammal Protection Act of 1972	Coordination ongoing	With implementation of TSP & BMP the West Indian Manatee and dolphin is not likely to be adversely affected.	Compliance achieved upon conclusion of consultation with the USFWS/NMFS. Disclosure and review of Final EIS.
Marine Protection, Research, and Sanctuaries Act of 1972	Coordination ongoing	No adverse impacts of the TSP are anticipated to the resources under this Act.	Compliance upon disclosure and review of Final EIS.
Migratory Bird Treaty Act of 1918 and Migratory Bird Conservation Act of 1929	Coordination ongoing	Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the TSP would have no adverse effect on colonial nesting water birds or other migratory species.	Compliance after USFWS review of the Final EIS.
National Environmental Policy Act of 1969	Coordination ongoing	Revised Draft EIS is being coordinated with the public/agencies for a 45 day comment period. Subsequent NEPA analysis would also be completed for the programmatic NED Plan.	Compliance upon coordination of the Final EIS, remaining public involvement activities completed, and signing ROD.
National Historic Preservation Act of 1966	Consultation ongoing	Consultation with SHPO and Federally-recognized Tribes is ongoing. A programmatic Section 106 agreement will be executed prior to release of FEIS.	Compliance following conclusion of Section 106 consultation, disclosure and review of Final EIS.
Submerged Lands Act of 1953	Coordination ongoing	Coordination with LDNR and LDWF is ongoing.	Compliance achieved upon disclosure and LDNR, LDWF review of Final EIS.
Rivers and Harbors Act of 1899	Analysis On-going	The existing structure at Measure 74a may impede navigation. Proposed hydro and salinity control structure 74a may impede navigation.	Analysis On-going.
Resource Conservation and Recovery Act of 1976; Comprehensive Environmental Response, Compensation, and Liability Act of 1980; Toxic Substances Control Act of 1976	Analysis On-going	A standard Phase I Environmental Site Assessment for the NER Plan is currently ongoing and will be presented in the Final EIS. To date, preliminary review of the NER project area indicates the absence of any recognized environmental concerns. See Annex J for additional detail. A Phase I Environmental Site Assessment is not necessary at the programmatic level for the NED Plan This would be conducted in a subsequent NEPA document completed prior to implementing TSP.	Compliance achieved upon disclosure and review of PFEIS.
Wild and Scenic River Act of 1968	Coordination ongoing	The northern reach of the Calcasieu River that is designated as a Wild and Scenic river is in northeastern Calcasieu Parish and will not be affected by the proposed action.	Compliance achieved upon disclosure and review of Final EIS.
E.O. 11514 Protection and Enhancement of Environmental Quality,1970	Complete	The TSP complies with this EO.	Compliant.

Law, Regulation, or Policy	Status	Comments	Full Compliance Expected
E.O. 11988 Floodplain Management, 1977	Coordination ongoing	Portions of the proposed TSP would be located in the 25-year floodplain. However, subsequent NEPA analysis on the NED Plan would be completed prior to implementing TSP.	Compliance achieved after Calcasieu, Cameron, Vermilion Parish Floodplain Administrators review the Final EIS.
E.O. 11990 Protection of Wetlands, 1977	Coordination ongoing	Measures to avoid, minimize, and reduce impacts to wetlands will be maximized to the extent possible. NER Plan provides wetland restoration. No compensatory mitigation for unavoidable impacts is currently anticipated. However, subsequent NEPA analysis would be completed for NED Plan prior to implementing the TSP.	Compliance following programmatic design of the TSP; disclosure and review of Final EIS.
E.O. 12898 Environmental Justice for Low Income and Minority Populations, 1994	Coordination ongoing	Analysis of the NED and NER plan identified no disproportionate impacts to EJ communities. (see Appendix A, Annex O).Further evaluation will be performed prior to implementation of the NED Plan to ensure adequate consideration of the potential of EJ-related impacts across the study area.	Compliance achieved upon disclosure and review of Final EIS.
E.O. 13112 Invasive Species, 1999	Coordination ongoing	The project is not expected to lead to propagation of invasive species.	Compliance achieved upon disclosure and review of Final EIS.
E.O. 13175 Consultation and Coordination with Tribal Governments, 2000	Consultation ongoing	Consultation with Tribes is ongoing. Consultation would continue through preparation of subsequent NEPA documents prior to implementing the TSP.	Compliance achieved upon conclusion of Tribal consultation, disclosure, and review of Final EIS.
E.O. 13186 Responsibilities of Federal Agencies to Protect Migratory Birds, 2001	Coordination ongoing	No compensatory mitigation for unavoidable project-induced impacts to bird and wildlife habitat is anticipated.	Compliance achieved upon disclosure and review of Final EIS.

5.1 Fish and Wildlife Coordination

The Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) provides authority for the U.S. Fish and Wildlife Service (USFWS) involvement in evaluating impacts to fish and wildlife from proposed water resource development projects. It requires Federal agencies that construct, license or permit water resource development projects to first consult with the USFWS, National Marine Fisheries Service (NMFS) and state resource agencies regarding the impacts on fish and wildlife resources and measures to mitigate impacts. In accordance with Section 2(b) of the FWCA, the USFWS provided a Draft Coordination Act Report (Draft CAR) dated November 5, 2013. Due to earlier modifications to the proposed plan, USFWS provided a revised Draft CAR dated December 3, 2013. In connection with the recommended NED and NER TSPs detailed in this report, USFWS most recently provided a Revised Draft CAR dated February 2015. These documents can be found in Appendix A, Annex G. The USFWS' position and recommendations as provided in its February 2015 Revised Draft CAR along with MVN's responses are set forth below:

SERVICE POSITION AND RECOMMENDATIONS

Although the proposed ecosystem restoration measures will provide a substantial benefit to wetlands and associated fish and wildlife resources, aspects of those measures can nevertheless have some unintended adverse impacts to adjoining wetlands and/or fish and wildlife resources. The recommendations provided below address ways to avoid such unintended impacts and to improve fish and wildlife habitat quality in and adjacent to those restoration areas. Therefore, the Service supports implementation of the TSP provided the following recommendations are included as part of the plan.

Because submerged aquatic vegetation provides food for migratory waterfowl, and provides high quality nursery habitat for estuarine dependent fisheries (Castellanos and Rozas 2001, and Kanouse et al. 2006), the

open water areas targeted for marsh creation measures should avoid areas of dense submerged aquatic vegetation to the greatest degree possible.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

Marsh Creation south of Grand Chenier (measures 47a1, 47a2, and 47c1):
These proposed marsh creation measures would convert over 2,000 acres of existing shallow open water to solid marsh. Because those open water areas provide habitat for waterfowl and estuarine fisheries, we recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e.., ponds) used by fisheries and waterfowl.

Because the slurried fill material will come from the Gulf of Mexico, the salinity of the effluent may be very high. If that water is trapped within adjoining marshes or within the fill areas, evapotranspiration during summer and/or droughts could cause damage to adjoining marsh vegetation and/or reduce vegetative colonization of fill areas. To avoid such impacts, we recommend the engineers ensure that adequate channels exist to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, any ponds or enclosed non-fill areas should have drainage channels (existing or manmade) to carry away Gulf water effluent and avoid concentration of salts.

To the greatest degree possible, sediment pumping should be conducted during non-growing season periods to reduce possible salinity impacts on adjoining vegetation. If this would require mobilization and demobilization of the sediment pipeline at the beach crossing during months when piping plover area present, the Service does not believe that this would be a problem given limited extent of that activity, and the other proposed measures to reduce or avoid impacts to plovers.

The proposed pipeline route utilizes an existing north-south canal for much of its length. To pump into eastern and western extremes of the designed fill area, the pipeline route should depart from that designated route only within the proposed fill area, and should be routed through open water areas, to avoid impacting existing marshes.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

Marsh Creation along Freshwater Bayou Canal (measures 127c3 and 306a1):
The proposed fill areas are strategically located adjacent to Freshwater Bayou Canal to isolate the canal from interior marshes, to preclude canal related hydrology impacts form impacting interior marshes and waters. Currently the plans would have the fill areas drain into interior marshes away from Freshwater Bayou Canal. Because the slurried sediment will be obtained from the near shore Gulf of Mexico, the adjacent intermediate marshes and open water areas might be harmed by the saltwater effluent draining from the fill areas. To minimize that impact, the Service recommends that the effluent be drained into Freshwater Bayou Canal and not the interior marshes. After construction, dewatering, and saltwater drainage from the fill areas has been completed, those drainage routes should be p0lugged and drainage of the fill areas should be redirected into interior marshes.

If a containment dike is constructed adjacent to the Freshwater Bayou Canal, the Service would recommend that it not be degraded after construction so that it can help to maintain the desired hydrologic isolation of the canal form the interior marshes.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

Marsh Creation near Mud Lake (measures 124c and 124d):

Measure 124c would convert over 1,900 acres of existing shallow open water to solid marsh. Because those open water areas provide habitat for waterfowl and estuarine fisheries, we recommend that some of those open water areas should not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries, waterfowl, and other wildlife.

Because the slurried fill material will come from the Gulf of Mexico, the salinity of the effluent may be very high. If that water is trapped within adjoining marshes or within the fill areas, evapotranspiration during summer and/or drought could cause damage to adjoining marsh vegetation and/or reduce vegetative colonization of fill areas. To avoid such impacts, we recommend the engineers ensure that adequate channels exist to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, any ponds or enclosed non-fill areas should have drainage channels (existing or manmade) to carry away Gulf water effluent and avoid concentration of salts.

The proposed containment dikes along the western and southeastern fill area boundaries may block existing drainage routes for marshes adjacent to the fill area. Should construction of containment dikes create unintentional impoundments, evapotranspiration may increase the salinity of effluent water discharged into those drainage-impaired marshes during the summer and/or droughts. To avoid potential saltwater impacts and impaired drainage impacts, we recommend weir boxes along those section of dike be eliminated unless the presence of unimpeded drainage routes can be documented.

Measure 124d would create approximately 149 acres of marsh along the southern edge of West Cove. Because of oil field board roads located south of the proposed fill area, the fill, areas and marshes south of the fill areas must drain northward via several small canals, into West Cove. To prevent ponding impacts to marshes south of the fill area, we recommend the designs for the containment dikes should avoid closing both of those canals.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

Cameron-Creole Spillway (measure 74a):
The stated design of this structure differs substantially from that found in the 2012 Louisiana Comprehensive Master Plan for a Sustainable Coast (Master Plan). The Service would prefer a design that would allow for greater operational flexibility than the proposed spillway which would have an invert elevation of +2.0 ft NAVD1988. Although the Service supports the Master Plan concept for this measure, details regarding design and operation of this measure are not yet sufficient to authorize this measure under this study. According to staff working to determine benefits (Ken Duffy email correspondence Feb. 2015), the modeling methods used to assess this measure were not sufficient to capture anticipated flood reduction benefits. Consequently, the Service recommends that an independent feasibility assessment of this feature be conducted and that the design should include lower invert elevations and provide greater operational flexibility than that described under this study Such a design may also provide more benefits if it could be used to discharge excess water when stages are less than +2.0 feet NAVD1988.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED to achieve a design that minimizes adverse impacts.

The proposed ecosystem restoration measures will create and protect areas of strategically important marshes. However, implementation of some restoration measures could result in some minor adverse impacts. To avoid and/or reduce those project-related adverse impacts to fish and wildlife resources, and to enhance the desired ecosystem benefits, the Service provides the following general recommendations:

1. To the greatest degree practical, borrow pits for construction of marsh creation measures should be located to avoid and minimize direct and indirect impacts to vegetated wetlands. Borrow pit construction should also avoid the following:

a. avoid inducing wave refraction/diffraction erosion of existing shorelines
b. avoid inducing slope failure of existing shorelines
c. avoid submerged aquatic vegetation
d. avoid increased saltwater intrusion
e. avoid excessive disturbance to area water bottoms
f. avoid inducing hypoxia

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

2. Marsh creation measures should avoid, to the degree practical, areas of dense submerged aquatic vegetation.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

3. The Corps should monitor ecosystem restoration features to document the degree of success achieved. We recommend the Service and other interested natural resource agencies be included in developing those monitoring criteria and in the review of subsequent monitoring information and reports.

RESPONSE: An Adaptive Management and Monitoring Plan (AM&M Plan) has been developed for the ecosystem restoration measures and is included in Appendix A. A more detailed AM&M Plan or Plans will be developed during the feasibility level design phase of this study. It is not anticipated that mitigation would be required. The Tentatively Selected (TSP) Plan does not include any structural risk reduction measures; hence, there would be no potential for mitigation. Additionally, the nonstructural risk reduction features included in the TSP are not anticipated to require mitigation Hence, an AM&M Plan for mitigation is not anticipated. However, should any of the nonstructural features require mitigation following detailed analysis, appropriate mitigation will be developed along with appropriate monitoring and adaptive management plan(s).

4. The Corps should obtain a right-of-way from the Service prior to conducting any work on Sabine or Cameron Prairie National Wildlife Refuges, in conformance with Section 29.21-1, Title 50, Right-of-Way Regulations. Issuance of a right-of-way will be contingent on a determination that the proposed work will be compatible with the purposes for which the Refuge was established.

RESPONSE: Concur. The USACE will coordinate with the USFWS to obtain a right-of-way before implementing measure 74a (Cameron-Creole spillway outfall channel into Calcasieu Lake would be rock-lined for scour protection).

5. All construction or maintenance activities (e.g., surveys, land clearing, etc.) on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit for the Refuge Manager of the Southwest Louisiana Refuge Complex. We recommend that the Corps request issuance of a Special Use Permit well in advance of conducting any work on the refuge. Please contact the Refuge Manager (337/598-2216 or SWLRComplex@fws.gov) for further information on compatibility of proposed ecosystem restoration measures, and for assistance in obtaining a Special Use Permit. Close coordination by both the Corps and its contractor must be maintained with the Refuge Manager to ensure that construction and maintenance activities are carried out in accordance with provisions of any Special Use Permit issued by the NWR.

RESPONSE: Concur. The USACE will coordinate with the USFWS to obtain a Special Use Permit from the Refuge Manager of the Southwest Louisiana Refuge Complex. The USACE will also coordinate all restoration activities on the NWR with the Refuge Manager. The USACE will request issuance of a Special Use Permit well in advance of conducting any work on the refuge. The USACE will specifically contact the Refuge Manager at the following telephone number-- (337/598-2216) and/or the following email address-- SWLRComplex@fws.gov).

6. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

   RESPONSE: Concur. The USACE will contact the Louisiana Department of Wildlife and Fisheries at 337-491-2593, well in advance of conducting any work on the Rockefeller Refuge.

7. We recommend the Corps continue to coordinate with the Service throughout planning and construction to ensure that the proposed project does not impact waterbird nesting colonies, threatened or endangered species, or species that may be listed in the future.

   RESPONSE: Concur. The USACE will continue to coordinate with the USFWS throughout planning and construction to ensure that the proposed project features do not impact waterbird nesting colonies, or threatened or endangered species that may be listed in the future. The USACE will continue to closely coordinate with the USFWS to provide updated detailed design and analysis information from which the USFWS may fulfill its final Fish and Wildlife Coordination Act.

8. We recommend the Corps coordinate with the Service and other interested natural resource agencies when developing detailed plans regarding restoration measures, especially during the Preliminary Engineering and Design Phase (PED) and construction phase, for measures where specific recommendations have been provided below.

   RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts.

9. To the greatest degree possible, sediment pumping should be conducted during non-growing season periods to reduce possible salinity impacts on adjoining vegetation.

   RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts (response applies to recommendations 10 through 14)

Service recommendations regarding specific ecosystem restoration measures are provided below:

10. Marsh creation measures south of Grand Chenier (47a1, 47a2, and 47c1)
    a. Combined, these measures would convert over 2,000 acres of existing shallow open water to solid marsh. We recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries, waterfowl, and other wildlife.
    b. To avoid saltwater entrapment impacts, the engineers are encouraged to design channels to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, we recommend any ponds or enclosed non-fill areas have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of slats.
    c. To pump into eastern and western extremes of the designated fill area, the pipeline route should depart form that designated route only within the proposed fill area and should be routed through unvegetated open water areas, to avoid impacting existing marshes.

11. Marsh creation along Freshwater Bayou Canal (measures 127c3 and 306a1)
    a. To avoid saltwater effluent impacts, we recommend that the effluent be drained toward Freshwater Bayou Canal and not into the interior marshes. After construction, once saltwater drainage from the fill areas has been completed, those drainage routes should be plugged and drainage of the fill areas should be redirected into interior marshes.

If a containment dike is constructed adjacent to the Freshwater Bayou Canal, the Service recommends that it not be degraded after construction so that it can help to maintain the desired hydrologic isolation of the interior marshes from the canal.

12. Marsh creation near Mud Lake (measure 124c)
    a. This measure would convert over 1,900 acres of existing shallow open water to solid marsh. We recommend that some of those open water areas not be filled to maintain aquatic habitat (i.e., ponds) used by fisheries and waterfowl.
    b. To avoid saltwater entrapment impacts, the engineers are encouraged to design channels to provide drainage/water exchange, and avoid ponding of Gulf water effluent within or adjacent to the fill areas. Similarly, we recommend any ponds or enclosed non-fill areas have drainage channels (existing or man-made) to carry away Gulf water effluent and avoid concentration of salts.
    c. The proposed containment dikes along the western and southeastern fill area boundaries may block existing drainage routes for marshes adjacent to the fill area. To avoid potential saltwater entrapment impacts and impaired drainage impacts, we recommend weir boxes along those sections of dike be eliminated unless the presence of unimpeded drainage routes can be documented.

13. Marsh creation near West Cove (measure 124d)
    a. To prevent ponding impacts and saltwater entrapment impacts to marshes south of the fill area, we recommend the containment dike designs avoid closing both canals that provide drainage for the fill area and adjacent marshes.

14. Cameron-Creole Spillway (measure 74a)
    a. The Service recommends that an independent feasibility assessment of this feature be conducted and that the design include lower invert elevations and should provide greater operational flexibility than that described under this study. Such a design may also provide more benefits if it could be used to discharge excess water when stages are less than +2.0 feet NAVD1988.

RESPONSE: Acknowledged. USACE will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to achieve a design that minimizes adverse impacts (response applies to recommendations 10 through 14)

6.0 PUBLIC INVOLVEMENT (*NEPA REQUIRED)

The National Environmental Policy Act (NEPA) gives people, organizations, and governments' time to review and comment on proposed major Federal actions. This occurs throughout the planning process beginning with scoping meetings and continuing through comment periods on draft and final reports. Comments are accepted and considered throughout the planning process.

The original SWC draft report was previously released in December 2013 and the initial public review was completed in February 2014. However, as a result of the substantial public, technical, and policy comments received, USACE performed additional analyses in 2014 which resulted in significant revisions to the NED and NER Tentatively Selected Plans that warranted a second 45-day public review. Additional public meetings will be held and the study website will reflect changes made in this revised report.

Engaging the public and receiving input from the public, government agencies, and non-governmental organizations on the contents of the report is critical to achieve the USACE objective to "[e]nhance trust and understanding with customers, stakeholders, teammates, and the public through strategic engagement and communication." Public participation efforts began with the study scoping process and will continue through the conclusion of the formal comment period. In addition to traditional mailings, a web site, and other social media tools were used in an effort to broadly distribute study information.

6.1 Public Scoping Meetings

Scoping and the preparation of a scoping report is the initial step in the preparation of an EIS and is useful in identifying: (1) the project and procedural actions and changes to be made, (2) the alternatives to be evaluated and rigorously explored as well as those alternatives to be ultimately eliminated and, (3) the environmental resources to be considered in impact evaluations. A scoping report includes information about public meetings, meeting notices, and comments made by citizens, other interested parties, and stakeholders who attend the meetings.

Public Notification: The public was notified of three separate public scoping meetings held on March 24, 25, and 26, in 2009 in the three parishes covered by the Study Area. (see Table 6-1). The following communication mechanisms were used for notification: (1) a Notice of Intent to prepare a Draft EIS was published in the Federal Register (Volume 74, Number 38) on February 27, 2009; (2) a scoping meeting announcement requesting comments was mailed to Federal, state, and local agencies, and interested groups and individuals on March 13, 2009; and (3) a media advisory announcing the scoping meetings was provided to more than 200 media outlets on March 13, 2009.

Table 6-1: Public scoping meetings.

Date	Parish	Location	Attendees
March 24, 2009 6:00 – 9:00 p.m.	**Cameron Parish** Cameron Parish Courthouse	119 Smith Circle Cameron, LA	51
March 25, 2009 6:00 – 9:00 p.m.	**Calcasieu Parish** Central School Arts & Humanities Center	809 Kirby Street Lake Charles, LA	59
March 26, 2009 6:00 – 9:00 p.m.	**Vermilion Parish** Abbeville High School	1305 Wildcat Dr. Abbeville, LA	170

Scoping Comment Categorization by Theme. A total of 382 specific comments were received during the three scoping meetings and were categorized by subject and ranked. A subject raised more than three times was classified as a "theme" and a total of 13 themes was identified.

Table 6-2: Scoping comment themes.

Rank	Theme	# of Comments	% Occurrence
1	Storm risk reduction	57	14.9%
2	Importance of considering entire scope of study and cumulative	53	13.9%




Rank	Theme	# of Comments	% Occurrence
	effects of other projects		
3	Coastal protection	52	13.6%
4	Impact of changes to drainage patterns	38	9.9%
5	Importance of cooperation between Federal agencies, parishes, and stakeholders	34	8.9%
6	Timeframe and funding related to project implementation	27	7.1%
8	Salinity and saltwater intrusion	23	6.0%
9	Wetlands protection/restoration	22	5.8%
10	Protection of existing developed land	18	4.7%
11	Permitting issues	15	3.9%
12	Concern regarding loss of Highway 82	12	3.1%
13	Impacts to wildlife	4	1.0%
7	Other*	27	7.1%
	Total	382	100.0%

* Comments categorized as "other" occurred only once or were not directly related to the proposed action.

6.2 NEPA Cooperating Agencies

Cooperating agencies (as defined under 40 CFR 1501.6) for this study include the following:

- U.S. Department of the Interior–USFWS
- U.S. Department of Commerce–NOAA and NMFS
- U.S. Department of Agriculture–NRCS

6.3 Other Agencies Participating as a "Cooperating Agency"

The state of Louisiana Department of Environmental Quality (DEQ) and the state of Louisiana Department of Natural Resources (DNR) also participated but not as formal cooperating agencies.

6.4 Other Public Coordination Meetings

Other additional public meetings were held in the three parish area on:

- 2009 - July 21 thru July 23 - Various stakeholder meetings and presentations.
- 2010 - February 22 thru March 4 - Various stakeholder meetings and presentations.
- 2010 - July 12 thru July 15 - Various stakeholder meetings and presentations.
- 2011 - October 3 thru October 6 - Various stakeholder meetings and presentations.
- 2012 - April 3 thru April 6 - Various stakeholder meetings and presentations.
- 2013 - July 31 thru August 2 - Various stakeholder meetings and presentations.

The primary interest of meeting participants was the potential levee alignments and impacts to communities. Other comments were directed to the construction schedule, potential impacts to wetlands, the value of hurricane evacuation routes, and funding.

6.5 Draft Report Recipients

Federal, state, and local government agencies; elected officials; stakeholders; citizens; businesses; libraries, and universities, and other interested persons who requested copies were provided with the initial draft report. Notices of availability were mailed to the CEMVN District stakeholder/NEPA mailing lists. A full list of report recipients is available upon request. The following stakeholders received a copy of the 2013 draft report:

Table 6-3: List of 2013 initial draft report recipients.

Louisiana Congressional Delegation	Louisiana State Senators & Representatives	Levee Districts & Floodplain Management Agencies
Senator David Vitter	Senator Dan "Blade" Morrish	Chenier Plain Restoration & Protection Authority

Senator William Cassidy	Senator Jonathan Perry	Iberia Parish Levee District
Congressman Ralph Abraham	Representative Bob Hensgens	
Congressman Charles W. Boustany, Jr.	Representative Simone Champagne	
Congressman Garret Graves		
Congressman John Fleming		
Congressman Cedric Richmond		
Congressman Steve Scalise		
Cameron Parish Government	**Calcasieu Parish Government**	**Vermilion Parish Government**
Darryl Farque, **Police Jury President**	Police Jury	Nathan Granger, Police Jury President
Police Jury	Parish Administrator	Police Jury
Tina Horn, Parish Administrator		Tim Creswell, Assistant Emergency Manager
City of Abbeville	**City of Lake Charles**	**Town of Delcambre Government**
Mayor	Randy Roach, Mayor	Mayor
Council	City Administrator and City Council	Alderman
Federal Agencies		
Advisory Council on Historic Preservation	**Department of Energy:** Office of Environmental Compliance	**Department of Transportation:** Division Administrator, Federal Highway Administration; Southwest Region, Federal Aviation Administration
Department of Agriculture*:* Carl J. Breville. *Natural Resources Conservation Service:* Kevin Norton, State Conservationist; Michael Trusclair, District Conservationist	**Department of Homeland Security:** *Federal Emergency Management Agency:* Gary Zimmerer, Region VI	**Environmental Protection Agency:** Office of Federal Activities, EIS Filing Section: Region VI, Marine and Wetlands Section; Rhonda Smith, Region VI - Office of Planning and Coordination
Department of the Army: Rayford E. Wilbanks	**Department of the Interior:** *Office of Environmental Policy and Compliance. U.S. Fish and Wildlife Service:* Lacombe Office ; Lafayette Field Office, Jeff Weller, Field Supervisor	**Department of Commerce:** *National Oceanic and Atmospheric Administration:* David Bernhart, Protected Species Division; Richard Hartman, Habitat Conservation Division; NEPA Coordinator, Office of Program, Planning & Integration
Federal Emergency Management Agency: Gary Zimmerer, Region VI		
State of Louisiana Agencies and Offices		
Governor: Honorable Bobby Jindal **Lieutenant Governor:** Jay Dardenne	**Department of Agriculture & Forestry:** Office of Forestry; Mike Strain; Matthew Keppinger, Office of Agriculture & Environmental Science	**Department of Public Works**
Governor's Office for Coastal Activities	**Department of Environmental Quality:** Environmental Planning Division ; Office of the Secretary; Scott Guilliams	**Department of Transportation & Development**
Coastal Protection and Restoration Authority: Jerome Zeringue, Norwyn Johnson	**Department of Health & Hospitals:** Office of Public Health, Center for Environmental Health	**Department of Wildlife & Fisheries:** Secretary; Maurice Watson; Tim Morrison; Gary Lester, Natural Heritage Program
Lake Charles Harbor and Terminal District: Channing Hayden	**Department of Natural Resources:** Keith Lovell, Interagency Affairs; Charlie Mestayer, Lafayette Field Office; Division of State Lands; Office of Conservation, Surface Mining Division; Consistency Coordinator, Coastal Resources Program	**Division of Administration:** State Land Office; State Planning Office
Secretary of State	**Coastal Protection and Restoration Authority Board:** Chip Kline	**Office of Cultural Development:** Pam Breaux, State Historic Preservation Officer; Division of Outdoor Recreation
Office of the Attorney General	**Governor's Office of Indian Affairs**	**State Board of Commerce & Industry**
Federally Recognized Tribes		
Alabama-Coushatta Tribe of Texas	Coushatta Tribe of Louisiana	Seminole Tribe of Florida
Caddo Nation of Oklahoma	Jena Band of Choctaw Indians	Tunica-Biloxi Tribe of Louisiana
Chitimacha Tribe of Louisiana	Mississippi Band of Choctaw Indians	
Choctaw Nation of Oklahoma	Seminole Nation of Oklahoma	

6.6 Views of the public based upon public comments received on the 2013 draft report.

This revised draft report includes comments received on the initial 2013 draft report which was made available for public review and comment from December 13, 2013 until January 27, 2014. The 45-day public review period was extended until February 13, 2014, due to a technical error in receiving email comments. Two NEPA public meetings were conducted during public review of the 2013 draft report on:

- January 7, 2014 at the Lake Charles Civic Center - Contraband Room (2nd Floor), 900 Lakeshore Dr, Lake Charles, LA 70601.
- January 9, 2014 at the Vermilion Parish Library - Abbeville Branch Library, 405 E St Victor St, Abbeville, LA.

An open house for each public meeting was conducted from 6:00pm to 6:30pm with the main meeting commencing at 6:30pm and continuing until approximately 8:30pm. Comments made during the meetings were memorialized either by a court reporter or on hand-written comment cards provided at the meetings. A cumulative total of 121 people attended the 2 public hearings on January 7 and 9, 2014, with a total of 12 individuals offering oral comments. CEMVN received 11 written comments from Federal, state, parish and local governments, and 31 written comments from members of the public, all of which were postmarked within the comment period. Many of the written comments contained multiple comments and some contained attachments. A total of 578 individual comments were received during the public comment period between December 13, 2014 and February 13, 2014. The major themes of the comments included: the USACE SMART Planning procedures; levee and other forms of structural protection and/or risk reduction; consideration of impacts on agriculture, the Henry Hub, and other commercial industrial assets; the benefit/cost calculations for structural risk reduction; nonstructural risk reduction measures that were not wanted; levee "discrimination;" concerns that the project provides more protection for wetlands than for human life/people; ecosystem restoration; increasing salinities in freshwater areas; and impacts on the Calcasieu Ship Channel.

The Council on Environmental Quality regulations for Implementing the NEPA (40CFR§ 1503.4(a)), requires CEMVN to assess and consider all public comments both individually and collectively, and respond by one or more of the following means in the final EIS:

- Modify alternatives including the proposed action.
- Develop and evaluate alternatives not previously given serious consideration.
- Supplement, improve, or modify analyses performed.
- Make factual corrections.

In addition, CEMVN must explain why comments do not warrant further agency response, citing the sources, authorities, or reasons which support CEMVN's position and, if appropriate, indicate those circumstances which would trigger a reappraisal or further response. All substantive comments received on the 2013 initial draft report are included in Appendix J. The oral testimonies were reviewed and were considered in the preparation of this revised report. All oral and written salient comments, questions, and concerns were identified. Several comments received warranted revisions to the initial draft report including but not limited to, inclusion of the 0-25 year floodplain for the NED Plan, the development of additional and sufficient detail to make the NER Plan features constructible as opposed to programmatic, and also clarifications and updated and additional information. All registered commenting meeting participants, as well as those providing written comments, will be provided a copy of this Final Report. In addition, this revised draft Report will be posted at: http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx.