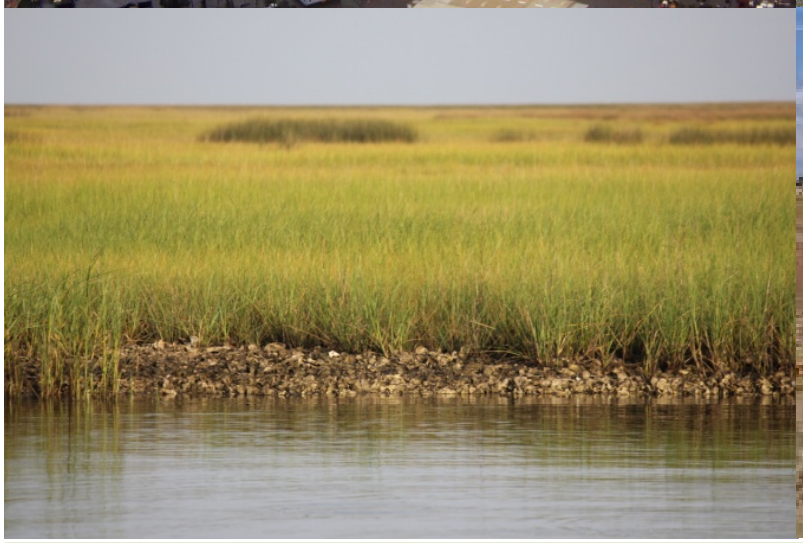
Southwest Coastal Louisiana



Integrated Final Feasibility Report
and
Environmental Impact Statement

US Army Corps of Engineers®

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

April 2016

Hurricane Ike flooding in Delcambre, Louisiana.

The Recommended Plan (RP) described in the Southwest Coastal Louisiana Integrated Final Feasibility Report and Environmental Impact Statement provides nonstructural hurricane and storm surge damage risk reduction and ecosystem restoration across 4,700 square miles in Calcasieu, Cameron, and Vermilion Parishes in southwest Louisiana.

The National Economic Development (NED) RP, *Modified Plan 8 – Nonstructural 0-25-Year Floodplain Plan*, would implement nonstructural measures to reduce coastal storm surge damages to 3,462 residential structures, 342 commercial structures and public buildings, and 157 warehouses. This would be achieved by elevating residential structures, dry flood proofing non-residential structures, and constructing localized storm surge risk reduction measures around warehouses. Residential structures would be elevated to the base flood elevation predicted to occur in the year 2075. Non-residential structures would have flood proofing measures applied generally up to 3 feet above ground level. Localized storm surge risk reduction measures would be less than 6 feet in height. Any structure that requires raising more than 13 feet above ground level would be ineligible to participate due to engineering and risk related factors. Implementation of the NED RP would directly, indirectly, and cumulatively benefit socioeconomic resources such as population and housing, tax revenue and property values, and community cohesion. Participation in the NED RP is entirely voluntary. The NED RP is fully compliant with Executive Order (EO) 12898 and no environmental justice issues are expected. The expected equivalent annual net benefits are $167.4 million dollars, with $906.1 million in project first costs, and a benefit-to-cost ratio of 5.65:1.

The Federal National Ecosystem Restoration (NER) RP, *Plan CM-4 – Small Integrated Restoration*, includes 49 ecosystem restoration measures that address land loss and ecosystem degradation and would stabilize the wetland perimeter geomorphology and is the least-cost, cost-effective, comprehensive ecosystem restoration plan. The Federal NER RP includes 9 marsh restoration measures restoring a net total of 7,900 acres of brackish and saline marsh with 2,700 Average Annual Habitat Units (AAHUs); 5 shoreline protection measures protecting a net total of 6,135 acres of marsh with 1,738 AAHUs; and 35 chenier reforestation measures that would plant cheniers with live oak and hackberry for a net total of 1,413 acres with 538 AAHUs. Overall, the Federal NER RP would reforest, protect, and restore a net total of 15,448 acres with a total of 4,976 AAHUs at a cost of $2.485 billion. This includes protecting 335 acres of designated critical wintering habitat for the threatened piping plover that is also utilized by the rufus subspecies of the threatened red knot; enhancing plant productivity; and reinforcing and protecting critical landscape features.

Two marsh restoration features (124d - *Marsh Restoration at Mud Lake* and 3c1 - *Beneficial Use of Dredged Material from the Calcasieu Ship Channel*) are partially located on United State Fish and Wildlife Service (USFWS) refuge lands. These two features provide 1,492 acres and 611 AAHUs at a cost of $297 million. The U.S. Army Corps of Engineers (USACE) recommends that USFWS seek authorization and appropriation to construct these projects as part of the overall Federal NER RP. The Corps NER RP presented for authorization is comprised of the remaining features which provide 13,950 acres and 4,365 AAHUs. The Calcasieu Ship Channel Salinity Control Structure and the Cameron-Creole Watershed Spillway are recommended as additional long-range studies at a cost of $6 million. The NER RP features comprise an integrated restoration plan that would have synergy with other ecosystem restoration projects and would facilitate hydrologic and geomorphic stability and resilience. Implementation of the NER RP would directly, indirectly, and cumulatively benefit chenier forests, brackish and saline marsh, essential fish habitat, wildlife, fisheries, the threatened piping plover and the rufus subspecies of the red knot, water quality, and recreation. The NER RP is fully compliant with EO 12898 and no environmental justice issues are expected. The Corps NER RP project first cost estimate is $2.188 billion.

The estimated total project cost for the Corps NED RP and NER RP (excluding projects that will be authorized, funded, and implemented as USFWS projects) is $3,094,276,000 at FY 2016 price levels.

Comments: Please send comments to the U.S. Army Corps of Engineers, New Orleans District, Attention: William P. Klein, Jr., 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) 862-2540. The comment period closing date will be 30 days from the date of publication of the Notice of Availability in the *Federal Register*.



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This Report Southwest Coastal Louisiana Final Integrated Feasibility Report and Environmental Impact Statement ("2016 Final Report") updates and finalizes the 2015 Revised Draft Report (which concluded its public review in May 2015). This report contains the Recommended Plan (RP) for the NED and the 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 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 authorizations, Congress authorized the investigation of alternatives to: (1) provide risk reduction from damages deriving from hurricane storm surge, and (2) significantly restore environmental conditions. Planning to address hurricane storm surge risk 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 Southwest Coastal Louisiana study area encompasses over 4,700 square miles of varying terrain in Calcasieu, Cameron, and Vermilion Parishes. The major physiographic divisions are the Gulf Coast Prairie 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, LA-27, and I-10. Population centers are mainly north of the GIWW, and the largest include the 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 hurricane 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 cultural and historic resources.

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




- *Objective 1.* Reduce the risk of damages and losses from hurricane 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 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, rufa subspecies of 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.* Prehistoric and historic archeological sites, buildings, structures, and properties that may be of religious and cultural significance to Indian tribes are located in the study area, including properties included in or eligible for inclusion in the National Register of Historic Places, although the majority of cultural and historic resources have not been assessed for eligibility.

National Economic Development (NED) Planning

Hurricane 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
- Delcambre/Erath
- Abbeville to Delcambre
- Abbeville
- Nonstructural Justified Reaches Plan
- 100-Year Floodplain [1% Annual Chance Exceedance (ACE)] Nonstructural 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 storm surge 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 "100-Year Floodplain Plan" were carried into the final array with Plan 7 being selected as the NED TSP in the 2013 Initial Draft Report.

After its release for public review and the receipt of comments on the 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 net NED benefits and a new benefit/cost ratio (BCR). That effort led to release of the 2015 Revised Draft Report which identified a new TSP based on these results. Further analysis after the release of the 2015 Revised Draft Report, resulted in refinements to the TSP, the results of which are presented here

as the NED RP in this 2016 Final Report. These revisions resulted from the evaluation of every structure in the updated inventory with a First Floor Elevation (FFE) below the 100-year stage for water surface elevations prevailing in the year 2025 rather than the year 2075. Now, the final NED RP would provide hurricane storm surge risk reduction for all structures in the study area with a FFE at or below the 25-year stage based on predicted year 2025 hydrologic conditions. The RP reduces the risk of hurricane storm surge damage for a total of 3,961 structures. The RP is 100% voluntary in nature and is comprised of 3,462 residential structures, 342 commercial structures and public buildings, and 157 warehouses. The equivalent annual net benefits are approximated at $167.5 million dollars, with ~$906 million in first costs, and a BCR of 5.65:1.

A brief summary of the components of the NED RP includes:

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 (structures requiring elevation greater than 13 feet above ground level would be ineligible to participate due to engineering and risk related factors).
2. Dry flood proofing of eligible non-residential structures (excluding large warehouses). Dry flood proofing consists of sealing all areas below the hurricane storm surge risk reduction level of a structure to make it watertight and to ensure that floodwaters cannot get inside by making walls, doors, windows, and other openings resistant to water penetration.
3. Construction of localized storm surge risk reduction measures less than 6 feet in height around non-residential warehouse structures. These measures are intended to reduce the frequency of flooding from hurricane storm surge, but not to eliminate floodplain management and flood insurance requirements.

NED Implementation Strategy

This Final Report recommends a strategy to implement the nonstructural project for eligible structures. Structures that have been identified as preliminarily eligible as part of the RP are located across the 4,700 mile, three-parish study area. In order to effectively implement the RP, clusters of eligible structures that represent the highest risk for hurricane storm surge damages (i.e. those with a FFE below the 10-year stage) would be identified and prioritized for construction. Individual structures would be addressed based on a ranking of risk from highest to lowest within the cluster. The ranking of individual structures would be revisited as elevation work is completed, as additional funding is distributed, and as new clusters are identified. Addressing multiple groups of structures within a small geographic area would be more cost-effective, efficient, and would also allow for a more strategic methodology for applying nonstructural measures to at-risk structures. More details on this process can be found in Appendix L.

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 features were estimated. Screening criteria included planning constraints; support for objectives; measure effectiveness; and 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 (covering both basins). Alternatives were evaluated for cost effectiveness and incremental costs.

The NER RP is "Small Integrated Restoration", also known as NER Plan CM-4, which consists of 49 ecosystem restoration features recommended for construction (9 marsh restoration features; 35 chenier reforestation features; and 5 shoreline protection features). The Federal NER RP is the least-cost, cost-effective, comprehensive ecosystem restoration plan that addresses land loss and ecosystem degradation. The Federal NER RP contains features to restore 15,448 acres of wetlands; restore and protect 335 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 and the Cameron-Creole Watershed Spillway are recommended as additional long-range studies. Two marsh restoration features, located partially on U.S. Fish and Wildlife Service (USFWS) refuge lands are included as part of the Federal NER RP [Feature 124d Marsh Restoration at Mud Lake (Sabine National Wildlife Refuge)] and Feature 3c1 Beneficial Use of Dredged Material from Calcasieu Ship Channel (Cameron Prairie National Wildlife Refuge). These two features make up an important and integral component of the overall restoration plan. Because USFWS is ultimately responsible for managing its refuge lands, USACE is not seeking authorization and funding for these two features. Rather, USACE supports USFWS in seeking its own authorization and appropriation to construct these features and offers USFWS the information that USACE developed under this study effort as a starting point for those efforts. The Federal NER RP project first cost estimate (which includes costs associated with these two features) is $2.49 billion. Of that cost, the USACE estimates approximately $297 million for the design, construction, and construction management costs of these two features. However, it is anticipated that USFWS would develop its own costs in connection with these features. The total ecosystem benefits associated with the two USFWS features are 1,492 acres and 611 average annual habitat units. The remainder of the NER RP benefits and costs, less those attributed to the USWFS features, represents the Corps NER RP.

NER Implementation Strategy

The Corps NER RP includes a three tiered implementation sequence. (1) Tier I features may be constructed simultaneously because they would not affect the construction of any nearby Tier I NER Recommended Plan feature. Shoreline protection features would be constructed prior to marsh restoration features in an effort to better protect the more storm-vulnerable marsh restoration features. This approach contributes to the sustainability of the marsh restoration features. The project first cost for Tier 1 is $850,998,000 producing 1,930 AAHU. (2) Tier II NER Recommended Plan features were so categorized because they utilize the same borrow or staging area, and/or construction of these features would potentially interfere with construction of a Tier I NER Recommended Plan feature. The project first cost for Tier II is $561,186,000 producing 1,117 AAHU. (3) Tier III NER Recommended Plan features were so categorized because they would utilize the same borrow or staging area, and/or interfered with construction of a Tier II feature, and/or interfered with an existing mitigation project. The project first cost for Tier III is $776,002,000 producing 1,318 AAHU.

Risk and Uncertainty

In accordance with USACE Sea Level Change Guidance, ER 1100-2-8162, the study evaluated potential impacts of sea level change in formulating and engineering the recommended plans. The risk reduction system and ecosystem restoration features being proposed are based on the intermediate relative sea level rise projection. However, the Corps will continue to monitor local conditions and determine if the

intermediate scenario of RSLR is occurring. If observed conditions deviate from intermediate to high sea level forecasts during design or construction, reevaluation of the NED and NER will be required.

The NED/NER RPs, and their integrated performance allow the direct management of the greatest identified risks and extend the performance and effectiveness of local hazard mitigation actions, as well as increase valuable ecosystem outputs. The NER RP tiered implementation assures that features will be implemented in a manner that will address the most potentially far reaching impacts. These impacts also represent the most likely threat to existing critical landscape features. The interface between the NER RP and these identified critical features produces additional resilience in the geomorphic structure and sustainability of the area and adds reliability in the ability of the landscape to support risk management. This in turn allows the NED RP features to perform in the most effective and efficient manner for the greatest possible duration.

Areas of Controversy Addressed During the Course of Study

The initial 2013 Southwest Coastal Louisiana Draft Integrated Feasibility Report and Programmatic Impact Statement ("2013 Initial Draft Report") identified a Tentatively Selected Plan (TSP) for the National Economic Development (NED) and the National Ecosystem Restoration (NER) aspects of the study. However public and internal policy comments on the 2013 Draft Report identified significant issues requiring resolution prior to completing a final report. As a result, in March 2015, a Revised Integrated Draft Feasibility Report and Environmental Impact Statement ("2015 Revised Draft Report") was released with updated NED and NER TSPs that differed from those identified in 2013. Additional public and policy comment on the 2015 Revised Draft Report resulted in final modification of the recommended plans and their implementation. This final report ("2016 Final Report") updates and finalizes the 2015 Revised Draft Report (which concluded its public review in May 2015). Listed below are significant areas of controversy identified over, and addressed during, the course of the study.

1. The 2013 Initial Draft Report primary area of controversy was public demand for design and implementation of structural risk reduction measures (e.g., levees), not non-structural measures.

2. Controversy over the perceived insufficient number of ecosystem restoration projects throughout the study area. The large study area has numerous areas in need of ecosystem restoration. However, the PDT took an approach to address those areas in greatest need of restoration. The public demands more acres of restoration to this area due to the rapid land loss being experienced.

3. Controversy over insufficient number of hydrologic/salinity control measures identified in the NER TSP, as well as controversy over recommending hydrologic/salinity control measures for future study instead of providing such measures for immediate construction.

4. The single-most important area of controversy focused on the 2015 Revised Draft Report TSP that included the mandatory removal of structures identified as being at high-risk of coastal flooding. This aspect of the NED TSP generated over 2,540 oral and written comments and signatures on a petition to "PLEASE TAKE IT OUT!"; and to completely remove any and all references or language to 'eminent domain' and 'mandatory/involuntary participation' from the study. The property owner's choice to remain at their 'own risk' or possibly without future assistance is considered the only appropriate course of action. Furthermore, the statement has been made that the goal of the plan was to restore and protect the coast and marshes, and assist in preserving the unique cultural heritage of Southwest Louisiana, not forcibly remove people from their homes and family lands.

5. Over 2,540 signatures on a petition and several oral and written comments requested that reforestation measures be replaced by shoreline protection measures. As stated in the petition: "Shoreline protection would be a better investment for our coast's future."

6. Over 2,540 signatures on a petition and several oral and written comments requested that a 'local sponsor' be chosen to have an immediate 'voice' in the remaining planning process of the study. The petition states that local sponsors can assist in making valid and important corrections and local concerns could be immediately addressed.

7. Over 2,540 signatures on a petition and several oral and written comments stating that "our parish deserves 'protection'." The report should include Parish Priority Restoration Projects and insert a list of all of the measures and projects proposed in the parishes' existing and proposed Coastal Restoration & Protection Plans. The stated purpose of this request is that the inclusion of all such measures and projects will eliminate the unintentional exclusion of projects that were not selected and will clearly indicate the worthiness for future consideration for funding.

8. Controversy over the lack of salinity and flood control measures to prevent the Calcasieu River from flooding areas upstream during storm surge events.

9. A primary issue for resolution in the Final Report was the development of a prioritization for implementation of the NED RP. This Final Report recommends a strategy to implement the nonstructural Project for eligible structures. Structures that have been identified as preliminarily eligible as part of the NED RP are located across the 4,700 mile, three-parish study area.

10. A second issue for resolution in the Final Report related to the costs of structure raising/flood proofing and the potential for significant inflation of these costs.

Information about the Areas of Controversy as well as their resolution can be found in Section 4.5 of Chapter 4, which describes the Final Recommended Plan.

Contents

Appendices

LIST OF ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AAA	Average Annual Acres
AAHUs	Average Annual Habitat Units
ACE	Annual Chance Exceedance Event
ACHP	Advisory Council on Historic Properties
ACS	American Community Survey
ADCIRC	Advanced Circulation Modeling
AEP	Annual exceedance probability
AM&M	Adaptive Management & Monitoring
APE	Area of Potential Effect
ASACW	Assistant Secretary of the Army for Civil Works
BCR	Benefit-to-Cost Ratio
BFE	Base Flood Elevation
BGEPA	Bald and Golden Eagle Protection Act
BLH	Bottomland hardwood
BMP	Best management practices
CAA	Clean Air Act
CAR	Coordination Act Report
CEMVN	U.S. Army Corps of Engineers, Mississippi Valley Division, New Orleans District
CEM	Conceptual Ecological Model
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfs	Cubic Feet Per Second
CIAP	Coastal Impact Assistance Program
CPRAB	Coastal Protection Restoration Authority of Louisiana Board
CSB	Calcasieu/Sabine Basin
CSC	Calcasieu Ship Channel
CWA	Clean Water Act
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act
cy	Cubic Yards
dBA	A-weighted Decibels
DIVR	Division Regulation
DO	Dissolved oxygen
EAD	Expected Annual Damage
EC	Engineering Circular
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPA	Environmental Protection Agency
EQ	Environmental Quality

ERDC	Engineering Research and Development Center
EQ	Environmental Quality
ER	Engineering Regulation
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Maps
FMA	Flood Mitigation Assistance
FPPA	Farmland Protection Policy Act
ft	Feet
FWCA	Fish and Wildlife Coordination Act
FWOP	Future Without Project
FWP	Future With Project
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway
HEC-FDA	Hydrologic Engineering Center Flood Damage Analysis
HEC-RAS	Hydrologic Engineering Center River Analysis System
HFIAA	Homeowner Flood Insurance Affordability Act
HHS	U.S. Department of Health and Human Services
HI	Hydrologic Indices
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HSI	Habitat Suitability Index
HSDRR	Hurricane and Storm Damage Risk Reduction
HTRW	Hazardous, Toxic, and Radioactive Waste
Hwy	Highway
I-10	Interstate 10
IBA	Important Bird Area
IPCC	International Panel on Climate Change
km	Kilometer
LA	Louisiana
LACPR	Louisiana Coastal Protection and Restoration
LADNR	Louisiana Department of Natural Resources
LADOT	Louisiana Department of Transportation and Development
LCA	Louisiana Coastal Area
LCWCRTF	Louisiana Coastal Wetlands Conservation and Restoration Task Force
LDEQ	Louisiana Department of Environmental Quality
LDHH	Louisiana Department of Health and Hospitals
LDWF	Louisiana Department of Wildlife and Fisheries
LERRD	Land, Easements, Rights-Of-Way, Relocations, and Disposal Areas
LF	Linear Foot
LIDAR	Light Detection and Ranging data
LNHP	Louisiana Natural Heritage Program
MB	Mermentau Basin
MBI	Mitigation Banking Instrument

MBTA	Migratory Bird Treaty Act
MII	Micro-Computer Aided Cost Estimating System
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MR&T	Mississippi River and Tributaries
NAAQS	National Ambient Air Quality Standards
NAVD	North American Vertical Datum
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NFIP	National Flood Insurance Program
NFS	Non-Federal Sponsor
NGO	Non-Governmental Organizations
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
O&G	Oil and Gas
O&M	Operations and Maintenance
OMRR&R	Operation, Maintenance, Repair, Rehabilitation and Replacement
OSE	Other Social Effects
PDT	Project Delivery Team
PDM	Pre-Disaster Mitigation
PED	Preconstruction Engineering and Design
PM	Particulate Matter
PMP	Project Management Plan
PPA	Project Partnership Agreement
ppt	Parts Per Thousand
Principles and Guidelines	1983 Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies
RED	Regional Economic Development
REP	Real Estate Plan
RESTORE Act	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies (Act)
Revised Draft Report	Revised Integrated Draft Feasibility Report and Environmental Impact Statement
ROD	Record of Decision
ROM	Rough Order of Magnitude
ROW	Right of Way
RP	Recommended Plan
RSLR	Relative Sea Level Rise
SAV	Submerged Aquatic Vegetation

SHPO	State Historic Preservation Office
SLR	Sea Level Rise
SMART	Specific, Measurable, Attainable, Risk Informed, Timely
SMP	State Master Plan
SoVI®	Social Vulnerability Index
SWPPP	Storm Water Pollution Prevention Plan
SWR	State Wildlife Refuge
T&E	Threatened and Endangered
TMDL	Total Maximum Daily Load
TSP	Tentatively Selected Plan
TY	Target Year
URA	Uniform Relocation Assistance
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
U.S.	United States
WIK	Work in Kind
WRDA	Water Resources Development Act
WRRDA	Water Resources Reform and Development Act
WCRA	Wetlands Conservation and Restoration Authority
WMA	Wildlife Management Area
WR	Wildlife Refuge
WSE	Water Surface Elevation
WVA	Wetland Value Assessment

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INTRODUCTION

This Integrated Final Feasibility Report and Environmental Impact Statement (Integrated Final Report & EIS) is the result of considering and incorporating responses to the public and policy comments on the Southwest Coastal Louisiana Integrated Draft Feasibility Report and Programmatic Environmental Impact Statement released on December 13, 2013 and the Revised Integrated Draft Feasibility Report and Environmental Impact Statement released on March 20, 2015. This Integrated Final Report & EIS documents revisions to the detailed feasibility design, analysis and impacts analyses of the Recommended Plan on significant resources. Revisions from the Revised Integrated Draft Feasibility Report and Environmental Impact Statement include changing the programmatic NED plan to a detailed and constructible nonstructural flood risk reduction plan and further 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 hurricane storm surge 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 into the future. Through separate authorizations, Congress authorized the investigation of alternatives to: (1) provide hurricane protection and storm damage risk reduction, and (2) significantly restore the natural ecosystem including the Chenier Plain in Calcasieu, Cameron, and Vermilion parishes in Louisiana. The intent is to develop potential solutions to address these water resource problems. Both the Nonstructural National Economic Development (NED) hurricane storm damage risk reduction measures and the National Ecosystem Restoration (NER) measures have been developed to a feasibility-level of design and are recommended for construction.

Federal Objectives

The Federal objective of water and related land resources planning is to provide the greatest net contribution to the 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 the 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 (FWOP) (No Action Alternative) which provide the basis for plan formulation. More detailed information concerning historic and existing conditions for a number of the important resources discussed in Chapter 1 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 city 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 supports the area's oil and shrimp industries and is the nearest access to Vermilion Bay and the Gulf of Mexico in this region.

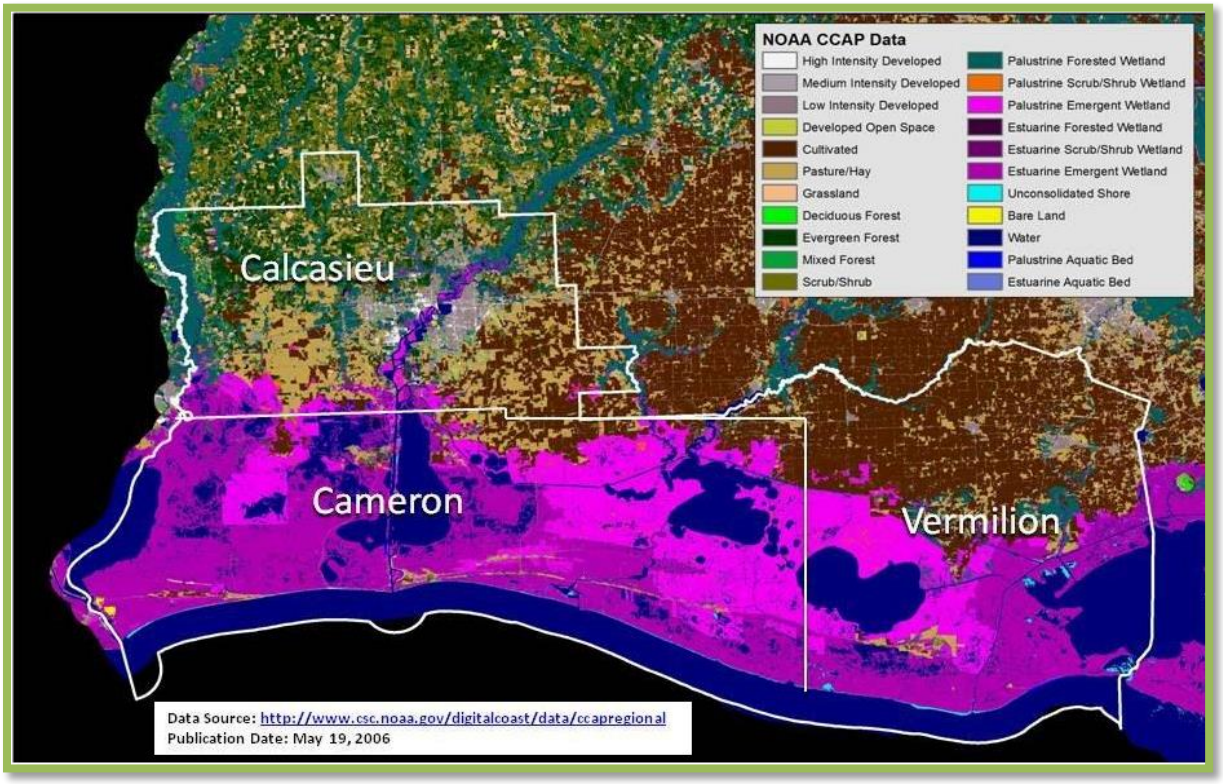

Figure 1-1: Study area map.

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 epoch 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. 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. Land cover classifications from the Louisiana Coastal Area (LCA) habitat dataset

for calendar year 2000, the most recent data set available from the U.S. Geological Survey (USGS), are presented in Table 1-1. The 2000 LCA habitat data composition does not cover the portion of the study area north of the coastal zone (USGS 2013). See Appendix A, for more detailed information concerning the study area.

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 December 14, 2015). 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 December 14, 2015).

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 storm surge 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). (NOTE: FEMA flood claims occur due to a property experiencing inundation regardless of the source of flooding; however, in the study area, the majority of the flooding experienced derives from a combination of storm surge and heavy rainfall associated with tropical events. The subject study is limited to addressing the risk of damages from flooding derived from hurricane storm surge and does not address flooding associated with rainfall events, even those associated with a hurricane or tropical storm event.)

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 on 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. See Appendix A for more detailed information concerning non-farm employment by industry for each parish.

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. LA 82 is an east-west state highway that serves as a vital route for the area's fishing, oil and gas, and seafood industries as well as hurricane evacuation. Like portions of LA 82, LA 27 is part of the Creole Nature Trail, also known as Louisiana's Outback, and the Gulf Beach Highway. Portions of LA 27 and LA 82 run east-west along the Gulf shoreline between Holly Beach and Cameron, LA. 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. See Appendix A for more detailed information concerning navigation projects including: the GIWW, the Sabine-Neches Waterway and Sabine Pass Ship Channel, the Calcasieu River and Pass, the Mermentau River, the Freshwater Bayou and Freshwater Bayou Lock, and the Bayou Teche and Vermillion River. See Appendix A for information concerning the operations and maintenance dredging of navigation channels.

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 risk of damages from hurricane storm surge has reduced property values since the cost of repairing those 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 captures an extensive array of factors such that the contribution of hurricane storm surge risk to changes in market value cannot be directly ascertained. As described in detail in the Economics Appendix, structure characteristics for 46,860 residential and 4,997 non-residential structures were collected to assist in evaluating the impacts of hurricane storm surge 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 hurricane storm surge 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)

In accordance with the USACE Institute for Water Resources (IWR) handbook in Applying Other Social Effects in Alternatives Analysis (USACE, 2013) seven social factors that describe the social fabric of a community were identified. The social factors identified and described in Table 1-7 are based on conventional psychological Human Needs Theory and Abraham Maslow's Hierarchy of Needs (USACE 2013). These social factors are also covered in the socioeconomic sections of the report. Additional detailed information is included in the Other Social Effects section of Appendix A.

Table 1-7: Social Factors

Social Factor	Description
Health and Safety	Refers to perceptions of personal and group safety and freedom from risks
Economic Vitality	Refers to the personal and group definitions of quality of life, which is influenced by the local economy's ability to provide a good standard of living
Social Connectedness	Refers to a community's social networks within which individuals interact; these networks provide significant meaning and structure to life
Identity	Refers to a community member's sense of self as a member of a group, in that they have a sense of definition and grounding
Social Vulnerability and Resiliency	Refers to the probability of a community being damaged or negatively affected by hazards, and its ability to recover from a traumatic event
Participation	Refers to the ability of community members to interact with others to influence social outcomes
Leisure and Recreation	Refers to the amount of personal leisure time available and whether community members are able to spend it in preferred recreational pursuits

Socioeconomic data for Calcasieu, Cameron, and Vermilion Parishes are presented in order to provide a context from which to evaluate the potential social impacts of the proposed project. A more detailed explanation of socioeconomic characteristics is available in Sections 1.2.1, 1.2.2, 1.2.5 and 1.2.9. The Social Profile of Communities provides a baseline profile of existing and future without project conditions for the social communities in the study area. Data for the social profile were obtained from a variety of sources including 2010 U.S. Census records, the 2007-2011 U.S. Census Bureau's American Community Survey (ACS) estimates, ESRI data, public meetings, interviews with local representatives, and aerial photography. The baseline characteristics are considered the existing and future-without project conditions.

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 more socially vulnerable than 33 percent of counties/parishes in the nation. Hence, Cameron Parish is by far the most socially vulnerable to hurricane storm surge 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 hurricane storm surge 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 1-8 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 1-8: Racial characteristics.

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

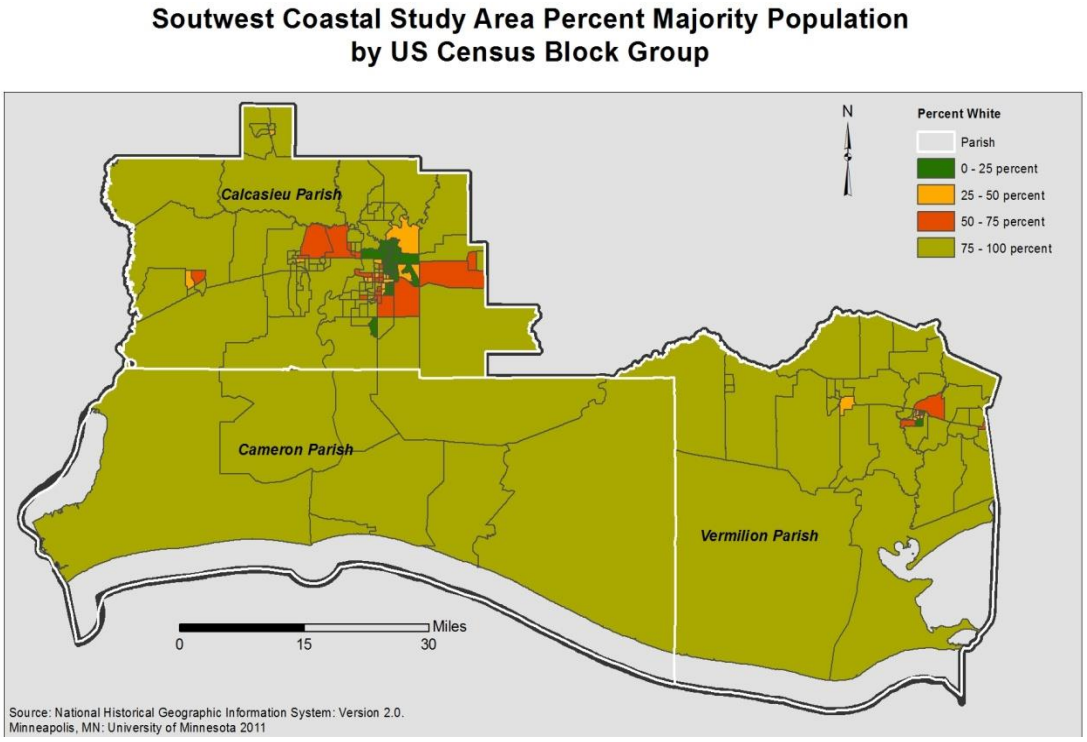

Figure 1-2: Racial majority by block group.

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 ACS 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

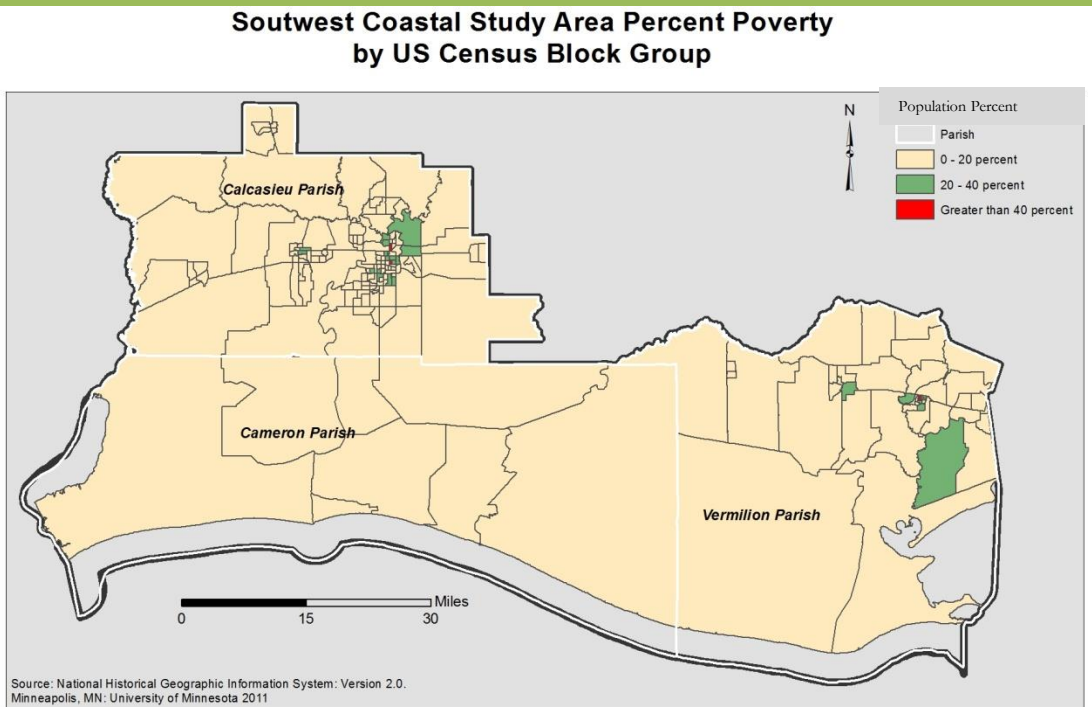

Figure 1-3: Percent population below poverty line by block group.

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 hydrologically 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.

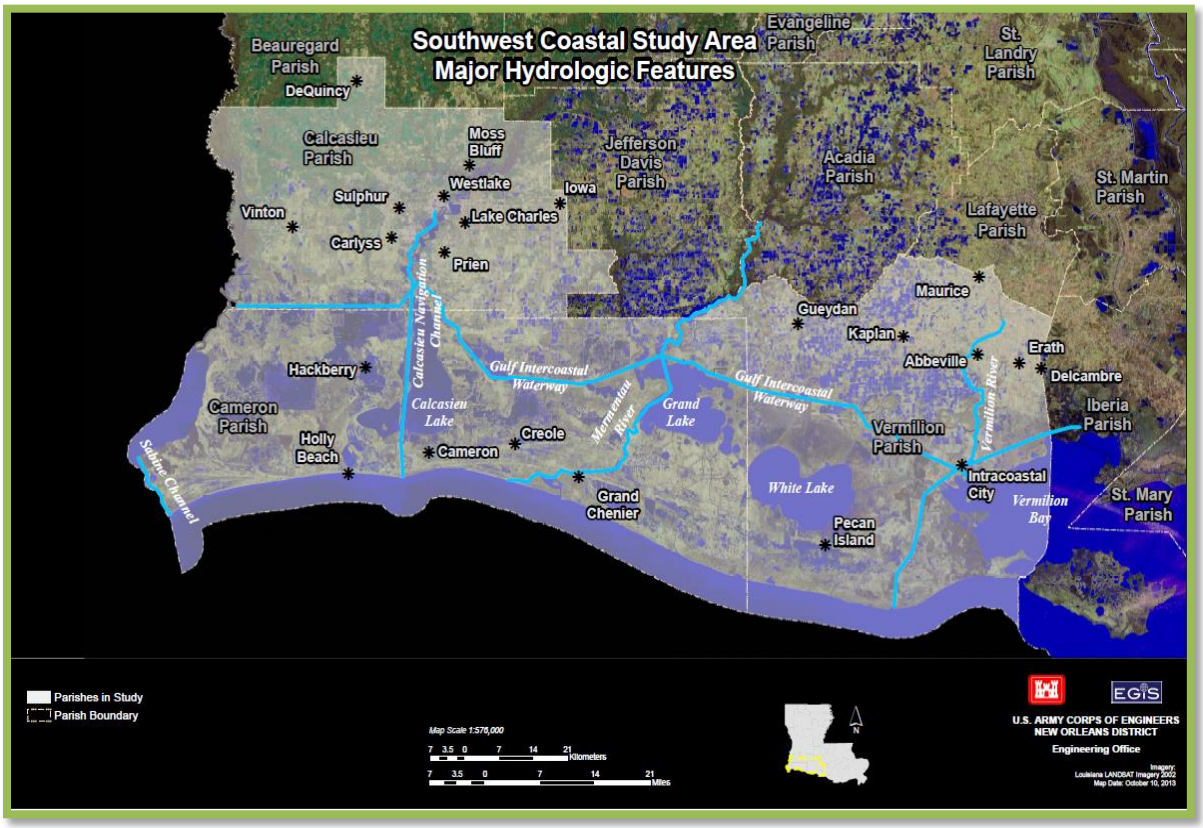

Figure 1-4: Major hydrologic features.

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.

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 this 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 four Category 2 or higher hurricanes (Lili, Rita, Gustav, and Ike), which inundated structures and resulted in billions of dollars in damages to southwest coastal Louisiana. Hurricane 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

Hurricane Audrey (June 25 - 29, 1957) ranks as the 7th deadliest hurricane to strike the United States and was the deadliest natural disaster in the history of southwest Louisiana in modern record-keeping with at least 500 deaths (source: http://www.srh.noaa.gov/lch/?n=audrey; accessed January 7, 2016).

Hurricane Lili (September 23 - October 3, 2002) was originally a Category 4 hurricane and first made landfall near Marsh Island in Iberia Parish with maximum sustained winds of 92 mph. Highest recorded rainfall amount was about 9 inches in some parts of Louisiana. The highest storm surge was over 11 feet in St. Mary Parish (source: https://coast.noaa.gov/hes/docs/postStorm/Lili_%20final.pdf; accessed December 15, 2015).

Hurricane Rita (September 24 - 26, 2005) Hurricane Rita, reaching its peak intensity southeast of the mouth of the Mississippi River as a Category 5, first made landfall just west of Johnson's Bayou and east of Sabine Pass at the Texas-Louisiana border as a Category 3 hurricane. Sensors recorded storm-surge water levels over 14 ft above NAVD 88 at Constance Beach (LC11), Creole (LA12), and Grand Chenier (LA11), La., about 20 miles, 48 miles, and 54 miles, respectively, east of Sabine Pass, Texas. In general, storm-surge water levels increased eastward from the Sabine River into southwest Louisiana. The magnitude of the storm surge was greatest near the coast and decreased inland through the approximate latitude of I-10, about 35 miles inland from the coast (source: http://pubs.usgs.gov/circ/1306/pdf/c1306_ch7_j.pdf; accessed December 15, 2015).

Hurricane Gustav (August 25 - September 4, 2008) Gustav made landfall near Cocodrie, Louisiana on September 1, 2008 as a strong category 2 (based on 110 mph sustained winds) and continued to move northwest, spreading hurricane force wind gusts across portions of Southeast and South Central Louisiana (http://www.srh.noaa.gov/lix/?n=gustavsummary; accessed January 26, 2016). Due to the storm making landfall east of the study area, storm surge values were only 4-5 feet across St. Mary, Iberia, and Vermilion parishes (http://www.srh.noaa.gov/images/lch/tropical/HPW1-SUN.pdf; accessed January 26, 2016).

Hurricane Ike (September 1-14, 2008) first made landfall near Galveston, Texas on September 13, 2008 as a Category 2 hurricane with maximum sustained winds of 110 mph (http://www.srh.noaa.gov/hgx/?n=projects_ike08; accessed December 15, 2015). Ike was a large hurricane with tropical-storm-force and hurricane-force winds associated at the time of its landfall extending approximately 275 miles and 120 miles from the storm center, respectively. In Louisiana, estimated wind speeds ranged from 80 mph near the Texas-Louisiana border to 50 mph in Vermilion Parish. Storm surge caused flooding in Cameron, Vermilion, and many parishes to the east, with over 9 foot stillwater levels estimated for Lake Charles (http://www.fema.gov/media-library-data/20130726-1648-20490-1790/757_ch1_final.pdf; accessed December 15, 2015).

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 (now Natural Resource Conservation Service [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

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 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).

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) provide detailed descriptions of water quality and salinity in the study area. In general, water quality concerns are related to urbanization in the parts of the area where hurricane storm surge risk reduction measures are proposed, oil and gas activities and saltwater intrusion in the Calcasieu River basin, and agriculture in the Mermentau River basin.

The Sabine River is the dominant influence across most of the basin in moderating gulf salinity and tidal fluctuations. Observations by USFWS personnel reveal that strong and prolonged south and southeast winds result in large volumes of Gulf of Mexico water being pushed into Calcasieu and Sabine lakes, which causes the water level in the marshes to rise (Paille 1996). A similar effect on marsh water level has been observed during periods of low barometric pressure in the region (LADNR 2002; Paille 1996).

The primary saltwater barrier in the Calcasieu Basin is the Calcasieu Lock, located approximately two miles east of the CSC. This sector-gated lock, which opened in 1950, was designed to prevent saltwater intrusion into the Mermentau Basin, and is operated primarily for navigation.

Louisiana Water Quality Inventory: Historical (1998-2012) Clean Water Act (CWA) 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-Vermilion 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 305(b) assessment for 2012, 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 (McBride et al. 2007). 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 with erosion rates generally highest where the shorelines protrude into the lakes, focusing wave and current action For example, White Lake average shoreline erosion rate of 15 feet per year (USACE 2006); southwest Grand Lake shoreline erosion rate of approximately 11 feet per year to 32 feet per year (source: https://lacoast.gov/reports/PPL/24/REGION4FSpwptsUPDATED.pdf; accessed January 6, 2016; and Sabine Lake about 10 feet per year (personal communication Darryl Clark, USFWS, January 6, 2016). 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 action. 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 area consists generally of forested terrace uplands and Gulf Coast Prairies in the northern portions and Gulf Coast Marsh habitats in the southernmost portions. Predominant 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.

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. For example, the average long-term erosion rate at Rockefeller Wildlife Refuge was estimated to be 30.9 ft/yr (Connor et al. 2004). Recent estimates of Gulf shoreline recession rates by Kindinger et al (2013) vary from -4.4 feet per year near Hackberry Beach, +8.7 feet per year at Ocean View Beach, -36.1 feet per year at Mermentau Beach and -52.4 feet per year at Rockefeller Wildlife Refuge. (Kindinger et al. 2013). The 9-mile stretch of the Gulf shoreline, starting on the western side of the Calcasieu Ship Channel's gulf outlet and proceeding to approximately two miles west of Holly Beach is presently eroding at a rate of 5 to 30 feet per year and is threatening coastal highways LA 82/27 (source: http://coastal.la.gov/project/cameron-parish-shoreline-protection/; accessed January 6, 2016).

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 1-9 compares habitat types pre- and post- Hurricane Rita.

Table 1-9: Habitat types by basin in acres.

Habitat Type	Calcasieu/Sabine Basin		Mermentau Basin		Teche/Vermilion Basin	
	2004	2005	2004	2005	2004	2005
Forested Wetlands	0.00	0.00	0.00	0.00	46,080	46,080
Other Land	46,080	45,4400	51,840	38,400	21,760	20,480
Freshwater Marsh	96,000	89,600	281,601	230,401	33,280	32,640
Intermediate Marsh	177,520	163,200	119,680	103,040	122,880	122,600
Brackish Marsh	81,280	78,720	60,800	55,680	82,560	80,640
Saline Marsh	8,960	8,960	26,240	25,600	5,120	5,120
Water	184,961	202,881	202,241	289,281	348,162	353,281
Totals	588,803	588,803	742,403	742,403	659,843	659,843

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 dropseed (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, and 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 December 14, 2015; 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.
- Submerged Aquatic Vegetation (SAV): wild celery, duckweed, pickerelweed, sago pondweed, southern naiad.

Invasive plants include water hyacinth, alligatorweed, hydrilla, common salvinia, giant salvinia, Chinese tallow, Chinese privet, Cogon grass, Johnsongrass, Japanese privet, Japanese honeysuckle, common ragweed, rescuegrass, sticky Chickweek, purple nutsedge, mimosa tree (personal communication Cindy Steyer, NRCS on September 20, 2013). These invasive species compete with native flora for resources such as nutrients and light, community structure and composition, and ecosystem processes. Water hyacinth, common salvinia, giant salvinia, and hydrilla all limit the amount of light penetrating the water column which effects plankton biomass production. Alligatorweed, Chinese tallow and Chinese privet are of minimal wildlife value and can proliferate until nearly monocultural stands exist, limiting food available for wildlife.

Land Loss – The processes of wetland loss can result from the gradual decline of marsh vegetation due to inundation and saltwater intrusion, as well as from storm surge events; both of which can eventually lead to complete loss of marsh vegetation. 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). Couvillion et al. (2011) analyses show coastal Louisiana has undergone a net change in land area of about -1,883 square miles from 1932 to 2010. Trend analyses from 1985 to 2010 show a wetland loss rate of about 16.57 square miles per year. Table 1-10 displays land area changes in chenier plain basins from 1932-2010 (Couvillion et al. 2011).

Table 1-10: Land area changes in chenier plain basins between 1932 – 2010 (Couvillion et al. 2011)

Date	Calcasieu/Sabine Basin (square miles)	Mermentau Basin (square miles)	Teche/Vermilion Basin (square miles)	Coastwide (square miles)
1932	824.99	958.27	548.94	7,545.92
2010	611.42	803.09	471.57	5,662.71
Change	-213.57	-155.18	-73.37	-1883.21

The effects of recent hurricanes have accelerated marsh loss. Table 1-11 includes estimates of wetland loss attributed to the major hurricanes of 2004 to 2008 in the Chenier Plain and throughout coastal Louisiana. More recently, Palaseanu-Lovejoy et al. (2013) estimated wetland loss in the Hackberry area located in the southwestern part of the chenier plain that was impacted by Hurricane Rita (2005) and Ike (2008). Persistent land loss in the Hackberry area due to Hurricane Rita was approximately 5.8% and increased by an additional 7.9% due to Hurricane Ike. It is expected that the chenier plain has sustained more persistent land loss with intermediate and brackish marshes experiencing the most land loss, while saline marshes were less impacted and fresh marshes showed evidence of vegetation seasonality change and regrowth, which concealed the hurricane impacts.

Table 1-11: Wetland loss estimates in acres (km^2) 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 (-431)	-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 1-12 displays information from the LNHP database identifying rare, unique or imperiled vegetative communities. See Appendix A for more detailed information concerning this important resource.

Table 1-12: 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
Batture	Vermilion-Teche
Live Oak Natural Levee Forest	Vermilion-Teche
Bayhead Swamp/Forested Seep	Calcasieu Parish

Table 1-12: LNHP rare, unique, or imperiled vegetative communities.

Vegetative Communities	Basins or 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, Calcasieu, 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; accessed December 14, 2015)	

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 the Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF) and the Wetlands Conservation and Restoration Authority (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 U.S. Forest Service (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed December 14, 2015) 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 [see 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 [see 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 December 14, 2015). Populations of

furbearers (nutria, muskrat, mink, otter, and raccoon) and game mammals (rabbits, squirrels, and white-tailed deer) have been stable or increasing [see 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. A substantial population increase of nutria is attributed to the decline in the price of pelts in 1989 (USGS 2000, Baroch et al. 2002). 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).

Common species of amphibians and reptiles include the Gulf coast salt marsh snake, Gulf coast toad, pig frog, American alligator, diamondback terrapin, Mediterranean gecko, and Texas horned lizard (source: http://www.fs.fed.us/land/pubs/ecoregions/ch21.html accessed December 15, 2015). The LADNR (2009) observed the following reptiles within the cheniers: the American alligator; turtles (e.g., musk turtle, pond slider, and red-eared slider); snakes (e.g., plain-bellied water snake, banded water snake). Various lizards, and skinks (LADNR 2009). Little is known about amphibian or reptile populations with the exception of the American alligator whose population continues to remain stable. (Source: http://www.wlf.louisiana.gov/general-alligator-information; accessed December 15, 2015). 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 (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 sheltering marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

Gulf of Mexico nearshore benthic habitats have been more thoroughly studied for longer periods of time, and hence our understanding of status and trends in these areas is greater. Within the Gulf of Mexico four benthic habitats have protracted temporal and synoptic data: oyster reefs, seagrasses, mangroves, and coastal wetlands (NOAA 2013). Mangroves are found only in southeastern Louisiana. Although wigeon grass is common along coastal Louisiana, true seagrass meadows, containing turtle grass, manatee grass, shoal grass and star grass currently occur only east of the Mississippi River near the Chandeleur Islands (source: http://pubs.usgs.gov/sir/2006/5287/pdf/StatewideSummaryforLouisiana.pdf; accessed January 6, 2016). Coastal wetland benthics in the area as referenced above are described in Gosselink et al. (1979), Mitsch and Gosselink (2000), and Day et al. (1989). The American oyster is discussed below.

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 (source: http://www.wlf.louisiana.gov/fishing/oyster-program; accessed December 14, 2015). The Louisiana portion of Sabine Lake has approximately 34,067 water bottom acres. This area was cleared by the Louisiana Department of Health and Hospitals (LDHH) in March of 2011 for harvesting, but LDWF has not opened a season on this area at this time.

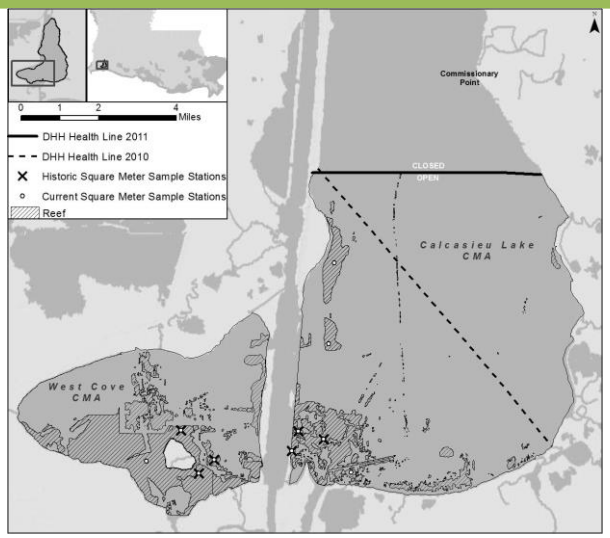

Figure 1-7: The 2011 oyster square meter sampling stations and results within the Calcasieu Lake Public Oyster Area (source: http://www.wlf.louisiana.gov/sites/default/files/pdf/document/37757-stock-assessments/2011_oyster_stock_assessment.pdf; accessed December 16, 2015)

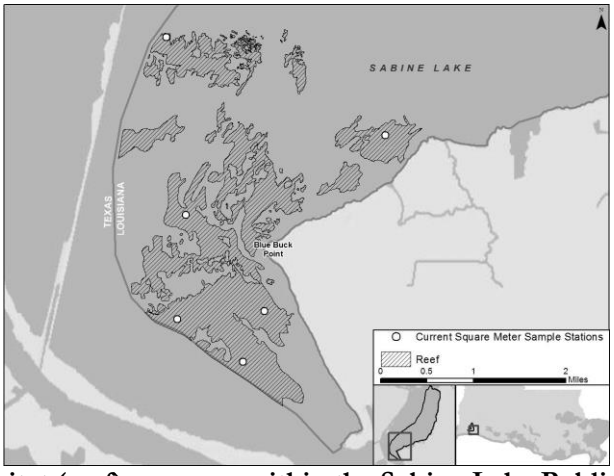

Figure 1-8. Oyster habitat (reef) coverage within the Sabine Lake Public Oyster Area (source: http://www.wlf.louisiana.gov/sites/default/files/pdf/document/37757-stock-assessments/2011_oyster_stock_assessment.pdf; accessed December 16, 2015).

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). See Appendix A for more detailed information concerning fisheries resources including a description of species typically found in freshwater areas.

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 are provided in Appendix A. Table 1-13 list the EFH for life stages of species.

Table 1-13: EFH life stages in the area (personal communication, NMFS August 29, 2015)

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[1]**	**EFH**
Brown shrimp	juvenile	E	<18m; SAV, sand/shell/soft bottom, emergent marsh, oyster reef
White shrimp	larvae/postlarvae	M/E	<82m; pelagi, soft bottom, emergent marsh
	juvenile	E	<30m; soft bottom, emergent marsh
Red drum	larvae/postlarvae	E	all estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	juvenile	M/E	GOM, <5m Vermilion Bay & E; all estuaries SAV, sand/shell/soft/hard bottom, emergent marsh
	adults	M/E	GOM 1-46 m Vermilion Bay & E; SAV, sand/shell/soft/hard bottom, emergent marsh
Lane snapper	larvae	E/M	4-132 m; reefs, SAV
	juvenile	E/M	<20; SAV, mangrove, reefs, sand/shell/soft bottom
	adults	E/M	4-132 m; shoal banks
King mackerel	juvenile	M	<9m; pelagic
Vermilion snapper	juvenile	M	1-25 m; hard bottom
Grey snapper	adult	E/M	0180 m; emergent marsh, soft bottom, hard bottom, sand shell, shoal banks
Cobia	adult/juvenile	M	1-300 m; pelagic
Greater amberjack	adult/juvenile	M	1-360 m; pelagic, drift algae
Atlantic sharpnose shark	neonate/juvenile/adult	M	All nearshore and offshore waters Freeport, TX, to mouth of the Mississippi River
Scalloped hammerhead	neonate	M	All nearshore waters to 30 fathoms; Galveston Bay, Vermilion Bay to West Bay, TX
Bull shark	neonate	M	Estuarine and nearshore waters Freeport to mouth of Sabine River; nearshore waters off west Cameron Parish.
[1]E=Estuarine, M=marine			

1.4.9 Threatened/Endangered Species and Other Protected Species of Concern

There are 10 threatened or endangered species (T&E), and one candidate species known or believed to occur in the area (see Table 1-14) 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 the supplemental information found in Appendix A and in Appendix A, Annex K.

Table 1-14: 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	NA	NA
Piping plover (*Charadrius melodus*)	NA	Threatened Critical habitat	Threatened Critical habitat
Red knot (*Calidris canutus*)	NA	Threatened	Threatened

Species	Calcasieu Parish	Cameron Parish	Vermilion Parish
**Whooping crane (*Grus americana*)	NA	NA	Threatened
West Indian manatee (*Trichechus manatus*)	NA	Endangered	Endangered
Gulf sturgeon (*Acipenser oxyrinchus desotoi*)	NA	Threatened	Threatened
Green sea turtle (*Chelonia mydas*)	NA	Threatened	Threatened
Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempi*)	NA	Endangered	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)	NA	Endangered	Endangered
Hawksbill sea turtle (*Eretmochelys imbricata*)	NA	Endangered	Endangered
Loggerhead sea turtle (*Caretta caretta*)	NA	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. See Appendix A and Annex K for a depiction of piping plover critical habitat in the Project area.

Loggerhead Critical Habitat (*Sargassum* habitat) exists in the southernmost (offshore) portion of the study area. This critical habitat expands the entire length of the project (west to east) with the closest points ranging from approximately four to nine miles offshore. See Appendix A and Annex K, Figure 4-3 for a depiction of Loggerhead sea turtle critical habitat in the Project area.

1.4.10 Cultural and Historic 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 study area is located within the Marginal Plain and the Pleistocene Prairie Terrace. Archaeological sites in the southernmost portion of the study area postdate the formation of the Marginal Plain (or Chenier Plain) at the end of the Pleistocene Epoch. Four NRHP listed historic districts, thirty-six NRHP listed standing structures, and seventeen NRHP eligible archeological sites are located within the study area.

An area of potential effects (APE) will be determined for each structure participating in the nonstructural flood risk reduction plan, after which cultural and historic resources, including the preliminarily eligible structures and any additional resources located within the APE, will be identified and assessed for significance and NRHP eligibility. Structures preliminarily eligible for the NED nonstructural flood risk reduction plan are located within the boundaries of two local historic districts as designated by the City of Lake Charles, the Downtown Development District of the Charlestown Cultural District and the Margaret Place Historic District.

An APE will be determined for each of the ecosystem restoration measures recommended for construction, the scope of which would include related project activities. Cultural and historic resources will be identified and assessed for significance and NRHP eligibility. A cultural resources assessment was completed for the

ecosystem restoration measures, and it is estimated that less than 15% of the proposed footprint for the measures has been investigated. Thirty-seven archaeological sites have been recorded in the vicinity of proposed measures. The previously recorded sites include: El Nuevo Constante Shipwreck, which has been determined to be eligible for listing in the NRHP; two prehistoric sites that are potentially eligible for listing in the NRHP; and eight sites, three of which date to the 20th century, that have been determined not eligible for listing in the NRHP. The remaining 26 have not been assessed for eligibility. Seven cemeteries have also been identified in the vicinity of proposed measures. Seventy-two standing structures inventoried in the Louisiana Historic Standing Structures Survey are located in the vicinity of the measures. One is potentially eligible for listing in the NRHP, sixty are not likely to be eligible for listing in the NRHP, and 11 are of undetermined eligibility.

The above information is detailed in the report titled Cultural Resources Assessment and Research Design for the Southwest Coastal Louisiana Project, Calcasieu, Cameron, and Vermilion Parishes, Louisiana on file with the Louisiana Division of Archaeology (Wells and Hill 2016). The USACE has elected to fulfill its obligations under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, through the execution and implementation of two Programmatic Agreements as provided for in 36 CFR Part 800.14(b) (see Appendix A, Annex F).

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). The Calcasieu River flows through a relatively uniform type of mixed pine-hardwood forest of uneven ages on low, rolling, well drained hills. Much of the timberland is grazed by cattle which tend to lower its value for wildlife. The best habitat can be found immediately adjacent to the stream where the area exhibits high habitat diversity.

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 Prairie 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. See Appendix A for additional detail concerning aesthetic and visual resources.

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

Wildlife Management Areas (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 national wildlife refuges (NWR), Louisiana state wildlife refuges (WR) and a state wetland conservation area, including: Cameron Prairie NWR, Lacassine NWR, and the 130,544-acre Sabine NWR; nearly 450,000 people visited the NWRs in 2012. The Louisiana 76,000-acre Rockefeller WR and the 71,544-acre White Lake Wetlands Conservation Area. Outside, but adjacent to the region, is Shell Keys NWR, and Louisiana Marsh Island WR, and Cypremort State Park.

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 December 14, 2015). 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 December 14, 2015). 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.

1.4.13 Noise

Noise, or unwanted sound, may be objectionable in terms of the nuisance, health, or well-being effects it may have upon humans and the human environment, as well as upon animals and ecological systems (Kryter 1994). Generally, noise is a localized phenomenon. There are many different noise sources throughout the area including commercial and recreational boats, and other recreational vehicles; automobiles and trucks, and all-terrain vehicles; aircraft; machinery and motors; and industry-related noise.

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. The loss of wetland and marsh habitat also exacerbates the potential for damages to property and infrastructure caused by hurricane storm surge. As hurricanes make landfall, surge from the Gulf of Mexico is pushed further inland since eroded marshes and wetlands that have converted to open water cannot as

effectively prevent the surge from encroaching. As surge comes ashore, the potential for damages and potential loss of life is increased. Without action, damages from storm surge are expected to increase. 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).

A wetland morphology model developed by Couvillion et al. (2013) and coupled with other predictive models suggests that under a "future-without-action" condition, coastal Louisiana is at risk of losing between 523,369 acres and 115,571 acres of land over the next 50 years. Soil organic carbon storage (to a depth of 1 m) could decrease by between 108 and 250 million metric tons, a loss of 12% to 30% of the total coastwide soil organic carbon. Couvillion et al. (2013) findings suggest that despite the efficacy of restoration projects in mitigating losses in certain areas, net loss of wetlands in coastal Louisiana is likely to continue. Model results also suggest certain areas may eventually be lost regardless of proposed restoration investment, and, as such, other techniques and strategies of adaptation may have to be utilized in these areas.

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:

- Residential and non-residential structures, warehouses, and industrial facilities
- Commercial harvest of fishery resources
- Critical infrastructure such as roads and utilities
- Rice, crawfish, and cattle farming
- Recreational saltwater and freshwater fisheries
- Ecotourism
- Oil and gas production
- Petrochemical industries
- Strategic petroleum reserve storage sites
- The buffering effect intact marshes and cheniers provide against storm surge
- 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 hurricane 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 hurricane 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 hurricane storm surge and associated inundation to more directly impact habitable areas. As a consequence, a smaller hurricane is able to inflict

significant surge-related flooding damages to residential and non-residential structures. As the coastal ecosystem continues to fragment, these losses are expected to increase, thus placing larger populations at risk.

Problems

The people, economy, unique environment, and cultural heritage of southwest Louisiana are at risk due to hurricane storm surge flooding and wave impacts. The area's low elevation, proximity to the Gulf of Mexico, land subsidence, and rising sea level, are expected to exacerbate flooding from hurricane events, 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 hurricanes.
- Increased submergence and inundation of wetlands, resulting in wetland loss.
- Erosion of channel banks and shorelines, resulting in wetland loss.
- Deforestation and mining of chenier ridges.

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

The first settlers were Native Americans who were present throughout the delta and chenier building processes. These human communities, both prehistoric and modern, have depended on the coastal environment in complex ways. This has always been a working coast. The way of life in coastal Louisiana has evolved over the past 300 years and forms an intricate and vital part of the world's social and natural ecosystems (Gramling and Hagleman 2005). 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 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 December 14, 2015).

- 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 and historic resources and have significant negative impacts on the navigation, oil and gas, and seafood industries, and the residents that service these industries.
- The implementation and OMRR&R of the NER RP should be designed so that the users of the resources of the "working coast", may continue use of the resources, including use of the surface, but only to the extent that such uses are practicable and economically justified without impinging upon the purpose, objectives, and sustainability of the features of the NER RP. Impacts of the NER RP on the "working coast" will be more fully addressed in Chapter 3. Chapter 4, and the Real Estate Plan (Appendix E) will address the manner and extent to which the present "working coast" usages of the resources in Southwest Louisiana will be able to continue when the NER features of the RP are implemented.

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 would 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 address, in part or entirely, the problems include:

- Incorporate structural and nonstructural hurricane and storm surge risk reduction measures 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 cultural and historic resources (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 feature was authorized for the Southwest Coastal Louisiana Feasibility Study by language from the River and Harbor Act of 1962 and from a 2005 House of Representatives Resolution adopted following the impact of Hurricane Rita respectively, as follows:

> *"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 (WRDA) 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 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 (No Action Alternative)

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. The No Action Alternative is the future condition without action and is considered the "future without project" (FWOP) conditions. However, under the future without project conditions that alternative of taking no action is not without impacts from preexisting on-going forces that affect the study area. Therefore, to be consistent with NEPA the following sections reflect the "impacts

of taking no action", which for purposes of alternative analysis are compared with the effects of implementing the proposed action alternatives. The difference between the impacts of taking an action and the no-action provides the basis from which alternative plans are evaluated. This analysis provides a benchmark, enabling decision makers to compare the magnitude of environmental effects of implementing an action alternative.

This section presents the future without project conditions for implementing the No Action Alternative. 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.

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 would 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 1-15). It is probable that refined building requirements and updated FEMA base flood delineation following the series of storms between 2000 and 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 1-15: 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 or multiple catastrophic hurricane storm surge event 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 NFIP should Flood Insurance Rate Maps (FIRMs) 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 would 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 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 Federal Emergency Management Agency (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.

FWOP 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 from sea level rise 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)

FWOP 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 hurricane storm surge 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 1-16). Cameron Parish, employment is expected to stabilize at 2012 levels (Moody's Analytics 2008).

Table 1-16: 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 hurricane 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 December 14, 2015). 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

FWOP conditions would include a greater potential for permanent displacement of public facilities and services due to hurricane 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 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 hurricane storm surge events due to expected RSLR. There would also be reduced access to infrastructure due to hurricane storm surge. For example, LA 82 in Cameron Parish is being eroded by Gulf waves (source: http://www.coast2050.gov/reports/Chap6.pdf; accessed January 7, 2016). A 5-mile-long segment of Louisiana Highway 27 almost totally blocks drainage from the western portion of the Lakes Subbasin of the Mermentau Basin into adjacent wetlands of the Calcasieu/Sabine Basin. Similarly, along the southern boundary of the Lakes Subbasin, LA 82 blocks drainage across 17 miles of marsh. The Freshwater Bayou navigation channel has altered the historic drainage pattern in the eastern portion of the Lakes Subbasin. These numerous blockages of drainage outlets significantly increase ponding in the subbasin (source: https://lacoast.gov/new/About/Basin_data/me/Default.aspx; accessed January 7, 2016).

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

FWOP conditions would include lower tax revenues as property values decline due to higher risk of damage from hurricane 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 risk of damage grows over time due to higher hurricane storm surge events as a feature of RSLR, the effects of the higher risk of damage from hurricane storm surge would continue to suppress real estate market values for residential and non-residential properties. As in other coastal regions, higher risk of damage from hurricane storm surge 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 fair market values, the tax base could be reduced and property tax revenues could decline.

Some property owners would choose to reduce higher expected future risk of damage from hurricane storm surge through activities to mitigate or reduce the potential for those damages to occur. 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 hurricane storm surge events that are projected to increase over the period of analysis. The increased risk of damage from hurricane storm surge 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 hurricane 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 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 damage from hurricane storm surge 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 hurricane storm surge events.

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 are shown in Figure 1-6 and listed in Table 1-17. Four gages were used for the entire RSLR analysis (Calcasieu Lock West, Catfish Point, Schooner Bayou, and Leland Bowman Lock East), however only the gage closest to the main area with potential benefits is shown here as an example.

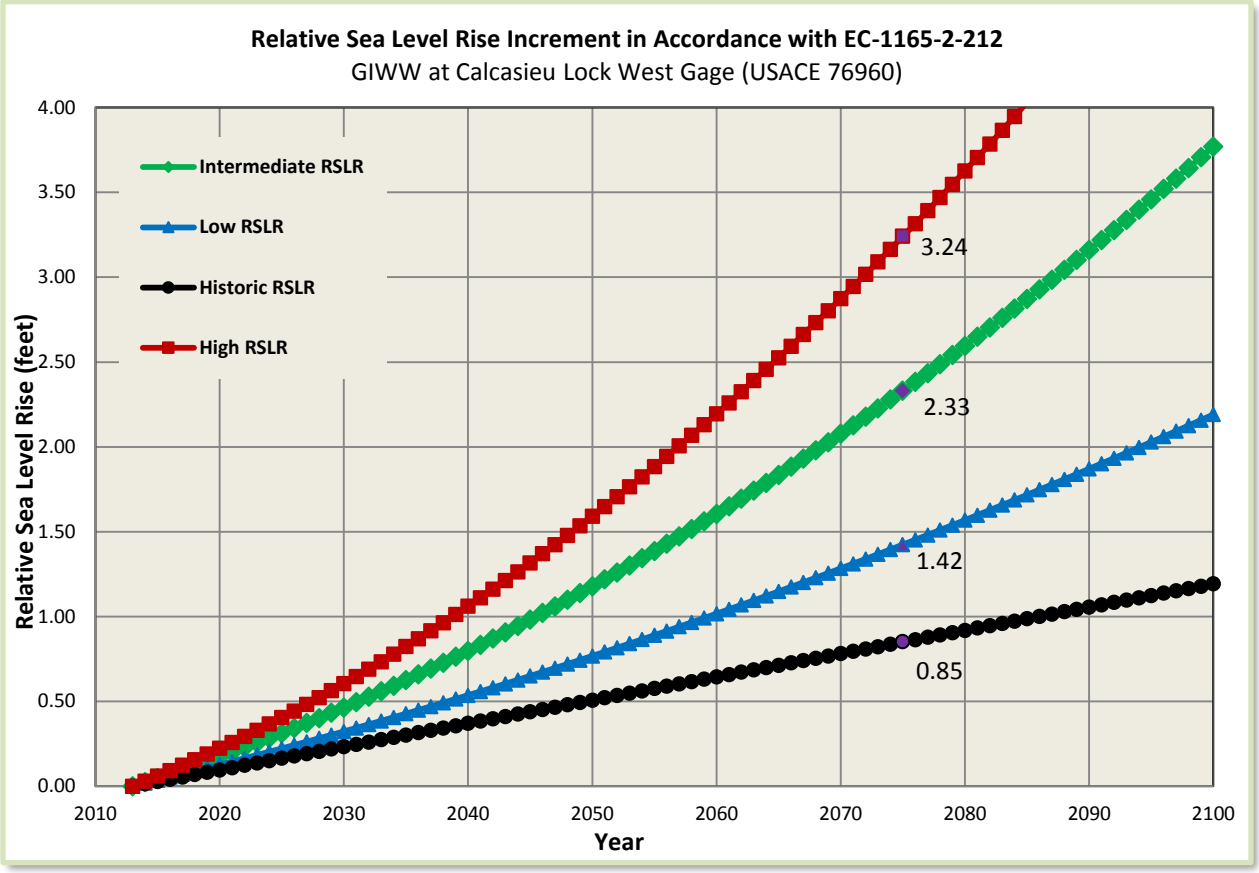

Figure 1-6: Relative sea level rise in the study area.
Historic RSLR rate is based hind cast of the local gauge data

Table 1-17: Predicted RSLR rise rates 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	0.125	0.222
2025 Intermediate SLR	0.216	0.313
2025 High SLR	0.307	0.405
2075 Low SLR	0.919	1.424
2075 Intermediate SLR	1.827	2.331
2075 High SLR	2.736	3.241

1.8.2.2 Hydrology and Hydraulics

Using the "intermediate" rate of RSLR as a plan formulation assumption is a technique to consider the impacts RSLR could have on the study area both in consideration of NED damages as well as NER ecosystem effects. The intermediate rate was chosen because it offers a balance between potentially unlikely scenarios (i.e. the current trend of RSLR continuing indefinitely and the high rate that could be disastrous for the study area). 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 (see data shown in tables in the Engineering Report - Southwest Coastal Louisiana Explanation of FWOP Results at Appendix B.) 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 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. More information about the potential effects of RSLR can be found in Appendix O.

1.8.2.3 Flow and Water Levels

Under the FWOP 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 as described in Section 1.3.6. Without implementing an action alternative there would be an increased risk of damages resulting from 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. Into the future the area would 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

FWOP conditions would include persistence of current sedimentation and erosion patterns. Existing hydrologic alterations would continue to affect water levels and salinities and continue influencing land loss at similar or increased rates. RSLR would expose additional shoreline areas to erosive forces into the foreseeable future. Couvillion et al. (2013) predict coastal Louisiana is potentially at risk of losing between 2,118 and 4,677 km^2 of land over the next 50 years. This would be a potential loss of between 14.6% and 32.3% of the remaining coastal wetlands in the state over the next 50 years (exclude Atchafalaya Basin). The uncertainty range for wetland change projections represents anywhere from a 32.2% reduction to a 49.6% increase in the average wetland loss rates experienced from 1932–2010 (Couvillion et al., 2011). These results suggest that a net wetland loss in coastal Louisiana over the next 50 years would likely occur regardless of uncertainties in parameters that influence coastal wetland loss.

Table 1-18: Net land area change (km^2) projections by basins in the study area (source: Couvillion et al. 2013)

Basin	Land Area 2010 (km^2)	Land Area 2060 (km^2)	Net change 2010-2060 (km^2)
Calcasieu/Sabine	1495.0	1348.5	-146.5
Mermentau	1914,1	1706.0	-208.5
Teche/Vermilion	1239.4	1172.4	-67.0
Total Louisiana Coast	16,793.8	14693.0	-2100.8

1.8.3.2 Soils, Water Bottoms, and Prime and Unique Farmlands

The FWOP conditions would be the continuation of existing conditions with coastal shoreline recession, subsidence and land loss continuing at similar or increasing rates of change with concomitant increase in shallow open waterbottoms. 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, the loss of cheniers 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 also be susceptible to flooding events and subsidence and could be lost as RSLR increases.

1.8.3.3 Gulf Coastal Shorelines

The FWOP conditions would be the continuation of existing conditions with coastal shoreline recession, subsidence and land loss continuing at similar or increasing rates of change. For example, from 1984 to 2010 the Rockefeller WR shoreline change rate was -43.4 acres per year or 0.056% per year; and Freshwater Bayou/North Pecan Island change rate was -111 acres per year or -0.308% (Appendix A, Annex W), Hypertemporal Subunit Change Rate and Map). The loss of these coastal shorelines would 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 hurricane 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

The FWOP 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 may continue to be restored through other restoration projects and programs such as those authorized for construction through the 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. (Note, however, that the CWPPRA project authority, absent Congressional amendment, will end in 2019. However, recent approval for the trust fund that funds projects has been approved for an additional five years (personal communication, Brad Inman USACE CWPPRA Lead Manager, January 28, 2016). Additionally, funding approved for construction of CWPPRA projects may be reduced in the intervening years before the expiration of the CWPPRA authorization as the Task Force addresses funding requirements to OMRR&R constructed CWPPRA projects for the remainder of their project life. Finally, some LCA projects, such as the LCA BUDMAT project authority is presently subject to a Federal cost cap; therefore, unless that project authority is amended, construction of future LCA BUDMAT projects will be limited by the existing cap on Federal expenditure.) 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. Table 1-19 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 1-19: Predicted acreage loss of different wetland types in study area (Coast 2050 Report 1999).

SOUTHWEST COASTAL LOUISIANA	Fresh Marsh lost by 2050 (acres)	Intermediate Marsh lost by 2050 (acres)	Brackish Marsh lost by 2050 (acres)	Saline Marsh lost by 2050 (acres)	Net Marsh loss by 2050 (acres)
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

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 to barrier shorelines.
- 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 Neotropical avian species would have less suitable stopover habitat 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. Subject to the above described limitations of the CWPPRA and LCA programs, wildlife would benefit from restoration activities implemented by other programs such as CIAP, CWPPRA, LCA 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, as described in Section 1.4.7, would 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. Subject to the above described limitations of the CWPPRA and LCA programs, 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, as described in Section 1.4.8 and Appendix A, Annex W 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 open water and marine EFH.

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

Land loss would directly reduce the availability of habitat for threatened and endangered species. Sprague's pipit populations could decline due to habitat conversion to seeded pasture, hayfield, and cropland, as well as overgrazing by livestock. Moreover, management favoring intensive cattle grazing and reduced fire frequency may lead to the degradation of remaining suitable grassland tracts over much of their range. Without proper fire intervals, shrubs and excessive vegetation litter may reduce habitat quality; in addition, grasslands may eventually succeed to shrubland or savannah (source: http://www.fws.gov/mountain-prairie/species/birds/spraguespipit/SpraguesJS2010r4.pdf; accessed December 17, 2015). Red-cockaded woodpeckers require open pinelands and savannahs with large old pines for nesting and roosting habitat. Foremost among the limiting factors for the red-cockaded woodpecker is suitable nesting habitat and lack of cavity trees, habitat fragmentation, and degradation of foraging habitat through fire suppression. Continued and extensive coastal land loss would continue to reduce the availability of transitional estuarine marsh and chenier forest habitats for use by threatened and endangered 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, red knots, green sea turtles, Kemp's Ridley sea turtles, loggerhead sea turtles, hawksbill sea turtles, leatherback sea turtles, 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 Cultural and Historic Resources

Impacts to cultural and historic resources in southwest Louisiana have resulted from both natural processes, such as erosion and reworking of archaeological deposits, and human activities, such as land development, dredging, agriculture, and vandalism. Coastal environments are dynamic, and impacts to cultural and historic resources in the area would continue as a result of both natural processes and anthropogenic modifications of the landscape.

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 hurricane 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, freshwater 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).

1.8.3.12 Noise

There would be no direct, indirect, or cumulative effects to noise.

1.9 Cumulative Impacts for Future Without Project Conditions (No Action Alternative)

Cumulative impacts would be the incremental direct and indirect effects of not taking action to address hurricane storm surge damage risk reduction or ecosystem restoration on the human, water and natural environment resources, in addition to the direct and indirect impacts of other past, present and reasonably foreseeable future actions (40 CFR § 1508.7) on these important resources. In the FWOP conditions, the following human, water and natural environmental important resources would continue to be at risk.

Human Environment

- An estimated population increase of 225,000 and 15,000 residential structures in the study area in the year 2075 would remain at risk of hurricane storm surge damage;
- 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 would remain at risk of hurricane storm surge damage;
- Transportation infrastructure would be more susceptible to damages resulting from hurricane storm surge events due to expected RSLR and loss of coastal wetlands;
- Infrastructure would remain at risk and continue to experience reduced access due to hurricane storm surge damage and loss of coastal wetlands;
- Community and regional growth would remain at risk of continued hurricane storm surge damage;
- Tax revenues and property values would remain at risk due to continued hurricane storm surge damage and continued erosion, fragmentation and eventual loss of coastal wetlands;
- Expected 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 from hurricane storm surge and may be forced to relocate to areas with risk reduction measures in place;

- Continued higher risks of damage from hurricane storm surge would manifest itself in higher premiums for flood insurance under the NFIP;
- Continued shoreline recession, subsidence, and land loss would result in the movement of unstable sediments and 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 storm surge events;
- Continued erosion by wave and current action resulting in continued shoreline erosion of most channels, lakes, and the Gulf.

Natural Environment

- Degradation, fragmentation and continued loss of soil resources, especially coastal wetlands would continue into the FWOP condition. 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. More recently, Couvillion et al (2013) estimated that between 2010-2060 coastal Louisiana would show a net change of -519,119 acres with the Calcasieu/Sabine basin showing a net change of -36,201 acres, Mermentau basin a net change of -51,521 acres and the Teche/Vermilion basin with a net change of -16,556 acres. However, wetland soil losses would be offset to some extent by restoration projects implemented through other programs;
- Continued increases in RSLR could increase saltwater intrusion and exacerbate ongoing conversion of existing estuarine wetlands to shallow open water;
- Impacts to cultural and historic resources in coastal Louisiana would continue as a result of both natural processes and cultural modifications of the landscape;
- Recreational infrastructure and consumptive recreational opportunities would remain vulnerable to damage from hurricane 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 with sloughing, fragmentation and continued degradation of shorelines;
- Continued encroachment of salinity into fresher areas of brackish and freshwaters;
- Continued habitat switching by organisms due to continued fragmentation, degradation and loss of transitional estuarine habitats due to increasing RSLR, subsidence, shoreline erosion, and other land loss drivers; and
- Loss of existing transitional estuarine and chenier habitats would further stress species that are dependent on these habitats for all or a part of their life cycle.

The future without project risks to the important resources in the human, water and natural environment could be offset, to some undetermined degree, by other hurricane storm damage risk reduction projects and ecosystem restoration efforts. The Future Without Conditions are the same as described in Chapter 3, Section 3.4, *Reasonably Foreseeable Actions* subsections.

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 describes the process to identify the TSP and shows work performed after public and agency comments on the revised draft report released in March 2015.

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.

Note: This chapter describes the alternative development, formulation, and evaluation process that led to the identification of the NED and NER TSPs. The information contained herein was presented in the 2015 Revised Draft Report that was released for public review in March 2015. Changes to the NED and NER TSPs have occurred since that public review which are briefly described at the end of the NED and NER sections in this chapter. The changes to the TSPs resulted in the Recommended Plan presented in this final report. Descriptions of these plans appear in Chapter 4.

Risk Reduction

The term "100-year level (1% ACE) of risk reduction," refers to a level of reduced risk of hurricane and storm surge 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 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 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, restore environmental conditions for the Chenier Plain ecosystem, 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 T&E species including, but not limited to 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.
- **Cultural and historic resources.** Prehistoric and historic archeological sites, buildings, structures, districts, and properties that may be of religious and cultural significance to Indian tribes are located in the study area, including properties included in or eligible for inclusion in the NRHP.

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 and storm damage risk 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.

The U.S. Army Corps of Engineers, Mississippi Valley Division, New Orleans District (CEMVN) initiated a Section 905(b) reconnaissance study in April 2006. NED alternatives to reduce 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 sufficiently economically justified with a benefit-to-cost ratio (BCR) greater than 1.0, which would warrant further Federal investigation:

- 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 LCA 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. 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	✓	✓	

Prior Studies, Reports, Programs, and Water Projects	Parish	Potential Data Source	Consistency	Source of Measures
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	✓	✓	
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 hurricane storm surge 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 surge-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 (e.g., pipelines, production facilities, etc.) or agriculture (e.g., livestock, field crops, etc.). However, because no assurance of reduction in damage or associated loss of productivity can be determined through a dedicated, site-specific application of the measures and features available, these damages could not be included.

The structure inventory was supplemented with additional residential and non-residential properties that are expected to be placed in service in FWOP conditions. These supplemental properties generically represent "future growth" with respect to economic assets. Flood plain regulations, mandated by the NFIP (managed by FEMA) and executed through local government 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 the risk of flooding from hurricane storm surge 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, including oil and gas facilities, was considered as an NED benefit for BCR computations. To achieve this, direct telephone contact was initiated to all 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 provided data that is required in the economic analysis. However, no information was provided by the remaining 27 owners/operators. Lacking these data, no speculative estimation of depth-damage relationships to these facilities was 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 for further Federal investigation 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 (Hwy) 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 Louisiana Coastal Protection and Restoration (LACPR) study.

- **Comprehensive Nonstructural Plan.** Nonstructural measures were considered as alternatives that could be implemented in the entire study area. 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 localized storm surge risk reduction measures. Property acquisition may also be considered if circumstances warrant.

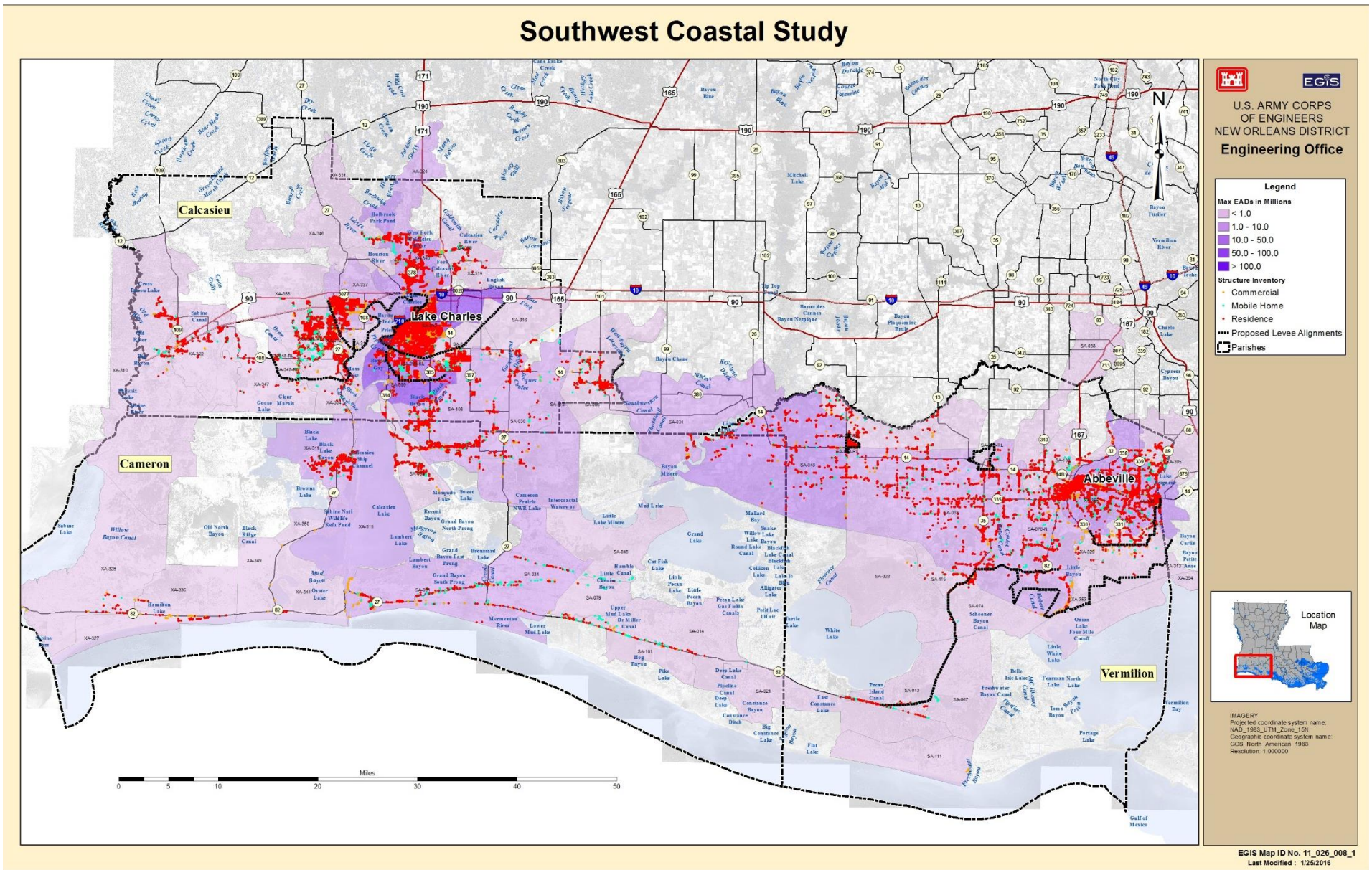

Figure 2-1: Structure inventory and density.

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.

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

Measures were evaluated to form comprehensive risk reduction alternatives for the entire study area. North of the GIWW, combinations of structural and nonstructural measures were based on existing Federal, State, and local 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 determined to be technically unfeasible because of broadly dispersed (rural) populations.

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

Fifteen HSDRR alternatives were identified for further analysis (Table 2-3):

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 Hwy 333/82 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 Hwy 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 following assumptions were used in 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 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 Hydrologic Engineering Center-River Analysis System (HEC-RAS) (for rainfall) and Advanced Circulation (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, operations and maintenance (O&M), engineering and design, and supervision and administration costs].
- The difference between the benefits and costs represents net benefits.
- Simplifying assumptions were made that allowed the PDT to more easily compare alternatives:
  - No induced damages from hurricane storm surge induced flooding outside of levees. No damages from hurricane storm surge induced waves.
  - Though this study was not authorized to address damages from rainfall events, an assumption was made that structural alternatives would reduce risk for all potential hurricane storm 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 hurricane storm surge 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 Alternative 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 Hwy 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 cost5
Abbeville Levee along Hwy 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 damage (EAD) from floods. 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 risk 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 initial 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 Hwy 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 (LADOTD), 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 and Refinement of Focused Array

The PDT assessed the focused array of alternatives and as a result, some levee alignments were incrementalized and formulated 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 outweigh costs for the east Lake Charles levees, but for the western Lake Charles levees, costs outweigh benefits. As a combined set of structural features, the east and west Lake Charles levees had marginal benefits to justify costs, however, reconfigured Lake Charles west levees were carried forward 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.

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 BCR 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 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), and 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 the 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 Hydrologic Engineering Center-Flood Damage Analysis (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 risk reduction measures cannot prevent at higher frequency events.

A percentage was applied to the overall benefits by reach for each of the remaining 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.

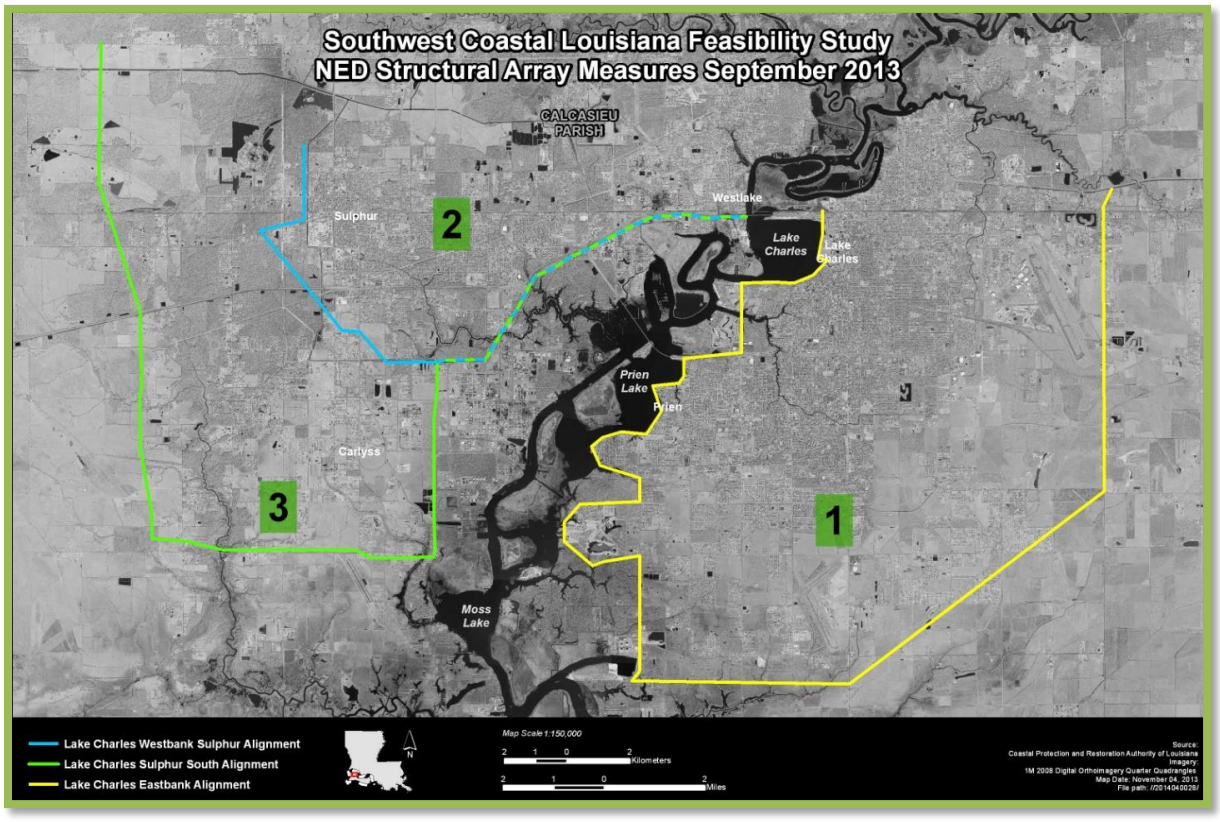

Figure 2-2: Lake Charles conceptual structural alignments.

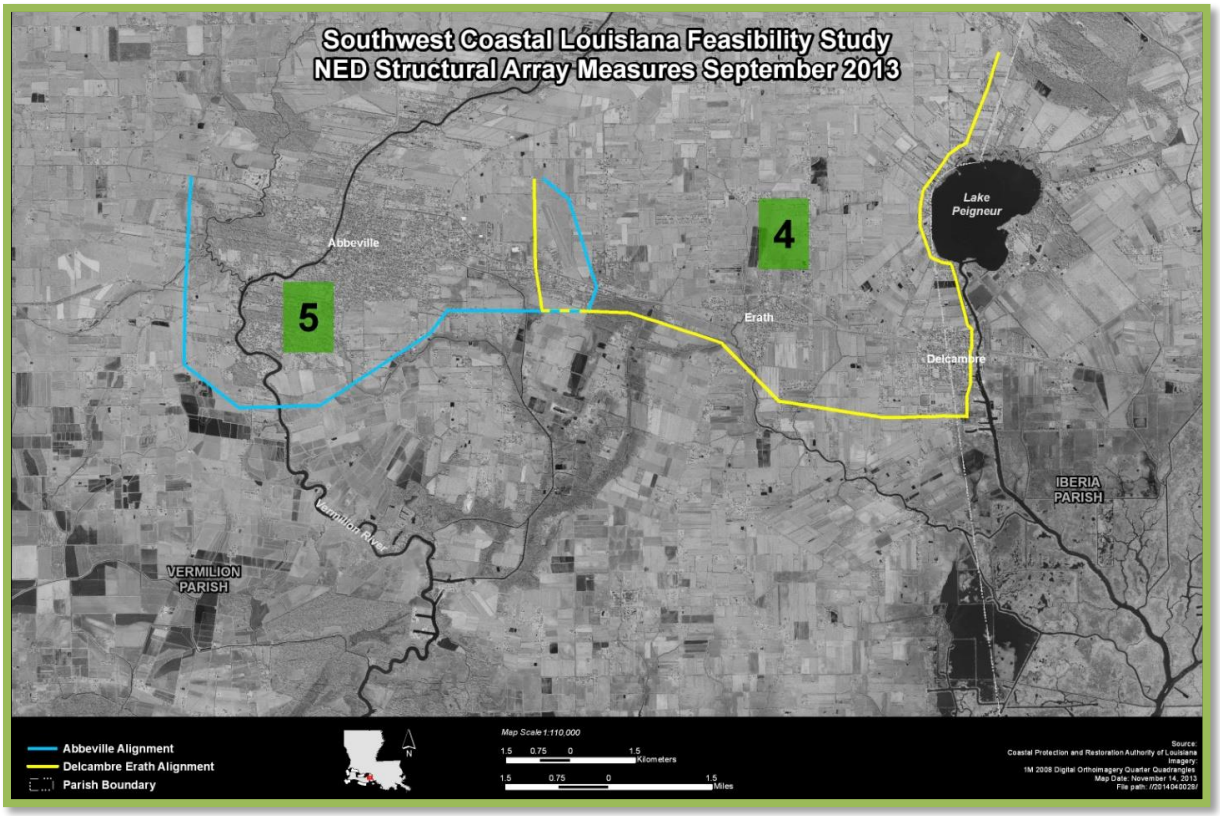

Figure 2-3: Abbeville, Delcambre, and Erath conceptual structural alignments.

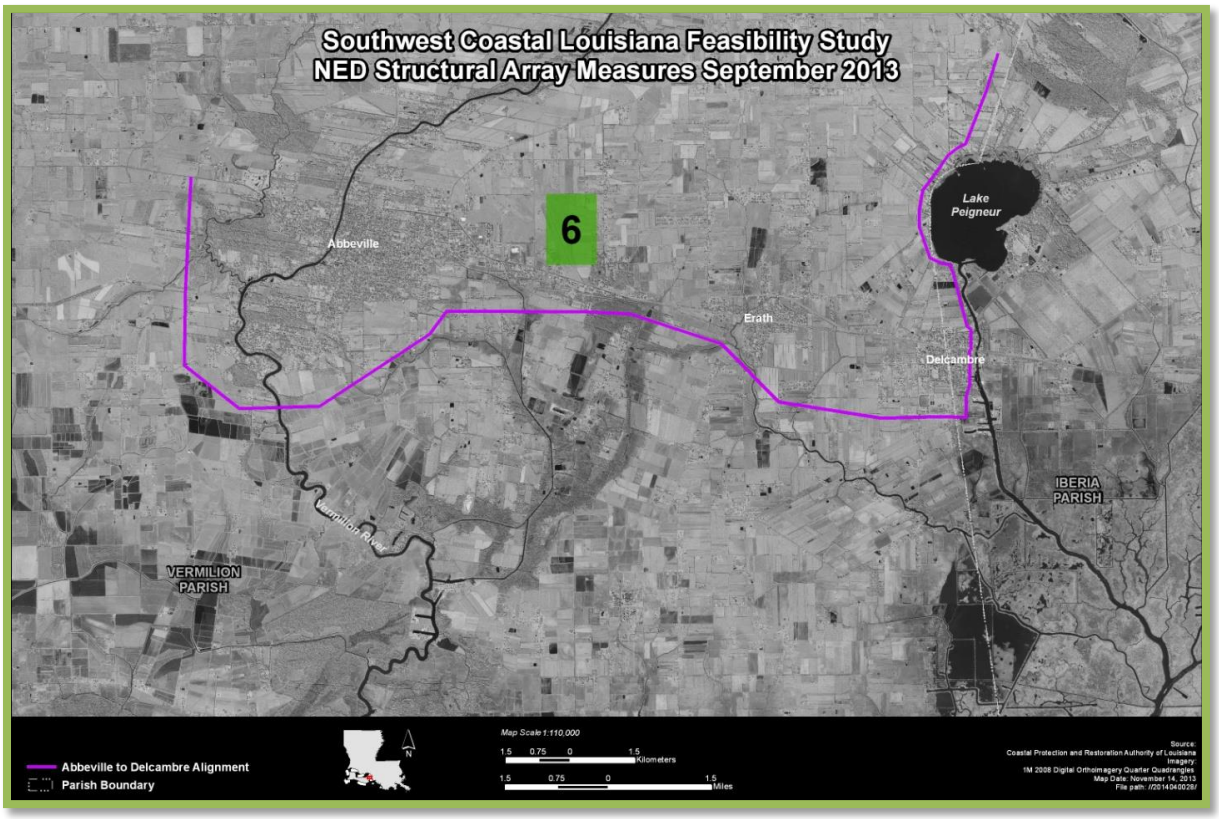

Figure 2-4: Abbeville to Delcambre combined conceptual structural alignment.

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 O&M 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 RSLR 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, BCR, 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 BCR (value >1.0). The Lake Charles Eastbank alternative was justified at each level of risk reduction. The highest net benefits were for the Lake Charles Eastbank alternative at the 100 year (1% ACE) level of risk reduction.

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 BCR for this alignment, further analysis revealed a negative BCR.

Refinement of the Levee Alternative

The assessment of economic feasibility for six independent structural measures was conducted in the focused array analysis. Initial results of the structural assessment showed that only one alternative was economically justified: the Lake Charles Eastbank Levee Alternative, Plan 1. However, additional economic assessments were conducted to refine costs for this alignment. Mitigation costs (costs any structural alternative must account for due to unavoidable habitat impacts) were calculated for the levee alternative. The USFWS and USACE determined programmatic costs for proposed structural alternatives based upon visual inspection of habitat types potentially impacted along proposed structural alternative routes, professional judgment, and experience with similar hurricane storm surge risk reduction structural systems, and based on engineering assumptions of right-of-way footprints. With mitigation costs of approximately $100,000,000 included for each risk reduction level, the 100-year (1% ACE) level of risk reduction yielded a revised BCR of 1.01 and the 200-year (0.5% ACE) level of risk reduction yielded a revised BCR of 1.04 (adding the mitigation costs made the 50-year (2% ACE) level of risk reduction not economically justified).

In addition, a review of the largest economic drivers of damages and benefits for the Lake Charles Eastbank Levee was conducted. The structure inventory used to calculate data for this alternative was modified to adjust the first-floor elevation (FFE) for a large commercial structure that was capturing a large share of benefits but was also not represented correctly within the 100-year (1% ACE) floodplain. This structure accounted for an unusually high percentage of damages and benefits in initial evaluations. Once this adjustment was completed, the BCR 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 of alternatives.

2.5.5 Nonstructural Plan Evaluation

The following nonstructural measures were evaluated:

- Elevation of residential structures to predicted 2075, 100-year base flood elevation (BFE) unless the required elevation is greater than a maximum of 13 ft above ground level*.
- Acquisition/relocation of residential structures that would require elevation over 13 ft above ground level. Property owners would receive fair market value for the property acquired and relocation benefits.
- Flood proofing of non-residential and public structures (excluding industrial buildings and warehouses) for flood depths not greater than 3 ft above the adjacent ground.

**- Raising structures greater than 13 ft above ground level introduces damage risk from winds during tropical events as a new condition. This height generally serves as a differentiator for insurance rates for wind/hail coverage as well and is therefore used as the upper limit for elevating structures.*

2.5.6 Economic Analysis of NED Nonstructural Alternative Plans

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, total approximately 16,000 residential, commercial, and public buildings (but excluding warehouses and industrial buildings).

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 BCR 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. 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 BCR 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 BCR of 1.25. As a result, benefits and costs were calculated on a reach-by-reach basis. The results of this 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. Continuing the economic analysis and improving upon the benefits of Plan 7 led the PDT to further refine the nonstructural project. 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 BCR for addressing all structures within the 2075 100-year floodplain was 0.54.

Two nonstructural plans, Plan 7 and Plan 8, were carried into the final array of alternatives for evaluation.

2.5.7 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.

2.5.8 Final Array of NED Plans

Plan 0: **No Action.** There would be no NED benefits 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 would also continue to affect residents and infrastructure through the encroachment of open water exacerbating potential storm damage risk and increasing life/safety risk (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.** This plan provides positive net NED benefits and has a BCR greater than or equal to 1.0. 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 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 surge 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 BCR less than 1.0. 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 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 surge related damages would continue unabated for structures that are not addressed under this alternative. This alternative does address the most populated communities.

2.6 2013 Draft Report TSP

The NED TSP identified in the 2013 Initial Draft Report was Plan 7 (See Appendix M). Technical and policy comments received during the concurrent review phase of the 2013 report suggested more economic work could be completed that would yield a more efficient plan than on a reach-by-reach basis. 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 preliminary estimated cost of Plan 7 as presented in the initial draft report was $388,000,000 for nonstructural measures benefiting a total of 3,915 structures.

2.7 Nonstructural Plan Optimization

The nonstructural evaluation indicated promising results that warranted further investigation. All structural alternatives were eliminated from further consideration, leaving only nonstructural alternatives as the preferred method for reducing hurricane storm surge risk across the study area. Plan 8 represents a different methodology

from Plan 7 for assessing how the study area, structure inventory, floodplain, and evaluation criteria could be partitioned to identify the most effective hurricane storm surge damage risk reduction solution. Plan 8 offered the greatest flexibility for further evaluation and hence was used as the starting point for optimization. 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 hurricane storm surge damage risk structures resulted in positive net NED benefits and a BCR greater than or equal to 1.0. This additional assessment consisted of evaluating every structure in the updated inventory with a FFE below the 100-year stage for WSEs prevailing in the year 2025 rather than the year 2075. Warehouses were also added to the structure inventory for benefit evaluation where localized storm surge risk reduction measures represented the most appropriate nonstructural measure to reduce the risk of damage from hurricane storm surge. While RSLR is expected to raise the 100-year stage throughout the 50-year period of analysis and bring the FFEs for other structures that are not in the 100-year floodplain in the 2025 base year into the 100-year floodplain by the year 2075, economic benefits for implementing such plans for these additional structures were found to be small and heavily discounted; relative costs were high given the significant fixed costs for structure elevation, and were therefore 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 risk from hurricane storm surge 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. These increments differentiated structures between the 0-25-year; 25-50-year; and 50-100-year floodplains.

Table 2-9 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.

The economic appendix (Appendix D) describes the specific methodology used to evaluate increments of the new nonstructural plan ("Modified Plan 8") within the separate 100-year floodplain increments so that net benefits could be optimized.

Table 2-9: Optimized Net NED benefits.

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

2.8 2015 Revised Draft Report TSP and EIS

The additional work completed since release of the 2013 Initial Draft Report and EIS led to the identification of a new TSP in the 2015 Revised Draft Report and EIS. The optimization of net benefits based on increments of the 100-year floodplain led to a **new TSP** (**Modified Plan 8**). In sum, the highest level of net benefits are associated with the 0-25-year floodplain increment of Modified Plan 8. This plan implements nonstructural measures to only those structures with FFEs between the 0-25-year flood stage predicted to occur in year 2025 and is the NED TSP. 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 BCRs. As described in the 2015 Revised Draft Report, Modified Plan 8 offers the greatest net benefits and best BCR of all nonstructural alternatives and increments evaluated in this study.

A brief summary of the components of the revised NED TSP includes:

1. Acquisition and demolition (involuntary component). Structures that meet certain criteria would be acquired and demolished. Owners of these structures would receive just compensation for the structure, would be provided with a similarly sized structure, and would be provided relocation benefits.
2. Elevation of remaining eligible residential structures (voluntary component). This measure would provide eligible owners with the opportunity to lift the entire structure or the habitable area to the predicted 2075, 100-year BFE unless the required elevation is greater than a maximum of 13 ft above ground level.
3. Dry flood proofing of eligible non-residential structures (excluding large warehouses and industrial complexes). Dry flood proofing consists of sealing all areas below the hurricane storm surge damage risk reduction level of a structure to make it watertight and ensure that hurricane storm surge cannot get inside by making walls, doors, windows, and other openings impermeable to water penetration as a result of hurricane storm surge.
4. Construction of localized storm surge risk reduction measures less than six feet in height around non-residential structures (primarily industrial complexes and warehouses). These measures are intended to reduce the frequency of flooding from hurricane storm surge but not eliminate floodplain management and flood insurance requirements.
5. Floodplain Management Plans. The Non-Federal Sponsor (NFS) would be required to prepare a Floodplain Management Plan in coordination with USACE to maintain the integrity of the project. The NFS will be obligated to ensure that governing bodies within the three parishes enact local development plans and building codes, land use and zoning regulations that are compliant with the requirements of the floodplain management plan and that they enforce those regulations and the prevent encroachment upon the requirements of the floodplain management plan and the project's goals and objectives.
6. Adoption and enforcement 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 hurricane storm surge 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.
7. Adoption of more restrictive parish and municipal building codes, land use and zoning regulations and other developmental controls. Local governments within the floodplain would 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 hurricane storm surge damage risk.

2.8.1 2015 Revised Draft Report TSP and EIS – Updated Analyses

Once again, concurrent review phase technical and policy comments led the PDT to refine the NED TSP. This time, two economic adjustments were made for each structure in the 25-year floodplain increment since that was the TSP. The structure inventory was adjusted to account for future severe damage mitigation under FWOP conditions and each structure was evaluated for individual economic justification. This analysis considered likely nonstructural measure costs as applied to a particular structure against the damages avoided over the 50-year period of analysis. If nonstructural measure costs were lower than predicted incurred damages, the structure was individually justified. Not all structures identified as eligible in the 2015 Revised Draft Report and EIS met this criteria and approximately 950 structures initially deemed eligible fell out of the updated TSP. However, even with this economic adjustment, the 0-25-year floodplain increment still represents the highest net benefits and best BCR for all increments evaluated.

The NED TSP would provide reduced hurricane storm surge damage risk for all eligible structures in the study area with a FFE at or below the 25-year stage based on predicted year 2025 hydrologic conditions. The TSP identifies a total of 3,961 impacted structures comprised of 3,462 residential structures, 342 commercial structures and public buildings, and 157 warehouses. Table 2-10 displays the costs and benefits of the TSP and maps of eligible structures can be found in Appendix N. Figure 2-5 displays the location and type of preliminarily eligible structures.

Table 2-10: Net NED benefits for the updated TSP

Optimized Net Benefit Analysis FY15 Price Level; 3.375% Discount Rate	
Floodplain Increment	0–25-Year
First Cost	$678,126,000
Equivalent Annual Project Benefits	$200,100,000
Average Annual Cost	$28,262,000
Annual Net Benefits	$171,838,000
B/C Ratio	7.1

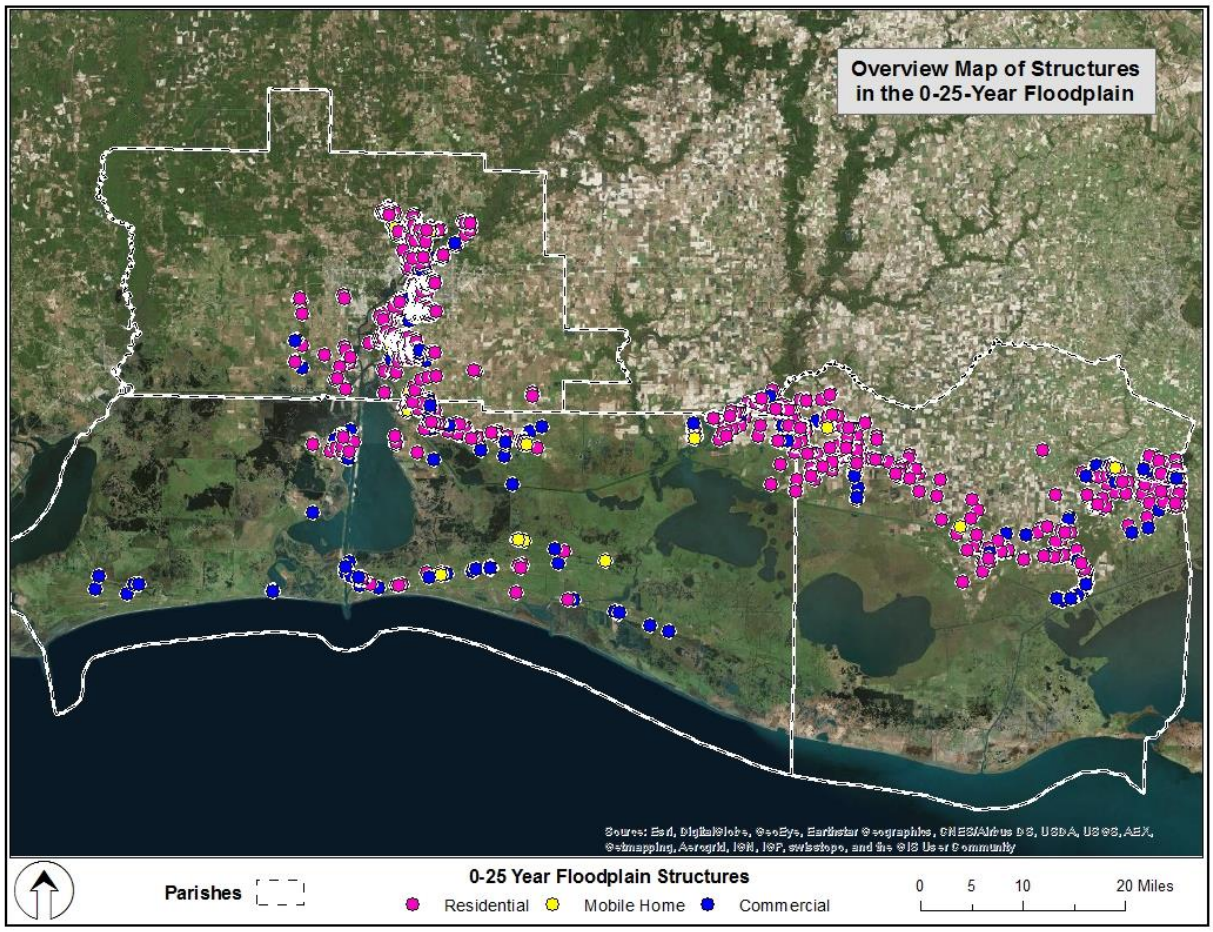

Figure 2-5: TSP Eligible structures in the 0-25-year floodplain.

Additional updates and changes to the TSP occurred after release of the 2015 Revised Draft Report for public review. The most noteworthy change consists of elimination of the involuntary component from the nonstructural plan and making any structure requiring elevation greater than 13 feet above ground level ineligible for participation in the NED RP due to engineering and risk related factors. The entire project is now 100% voluntary. Other changes to the plan consist of updating costs and benefits. These updates and a summary of comments received are described in Chapter 4 and in Appendix L.

2.9 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 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 2-6), this study does consider overlapping features in those areas.

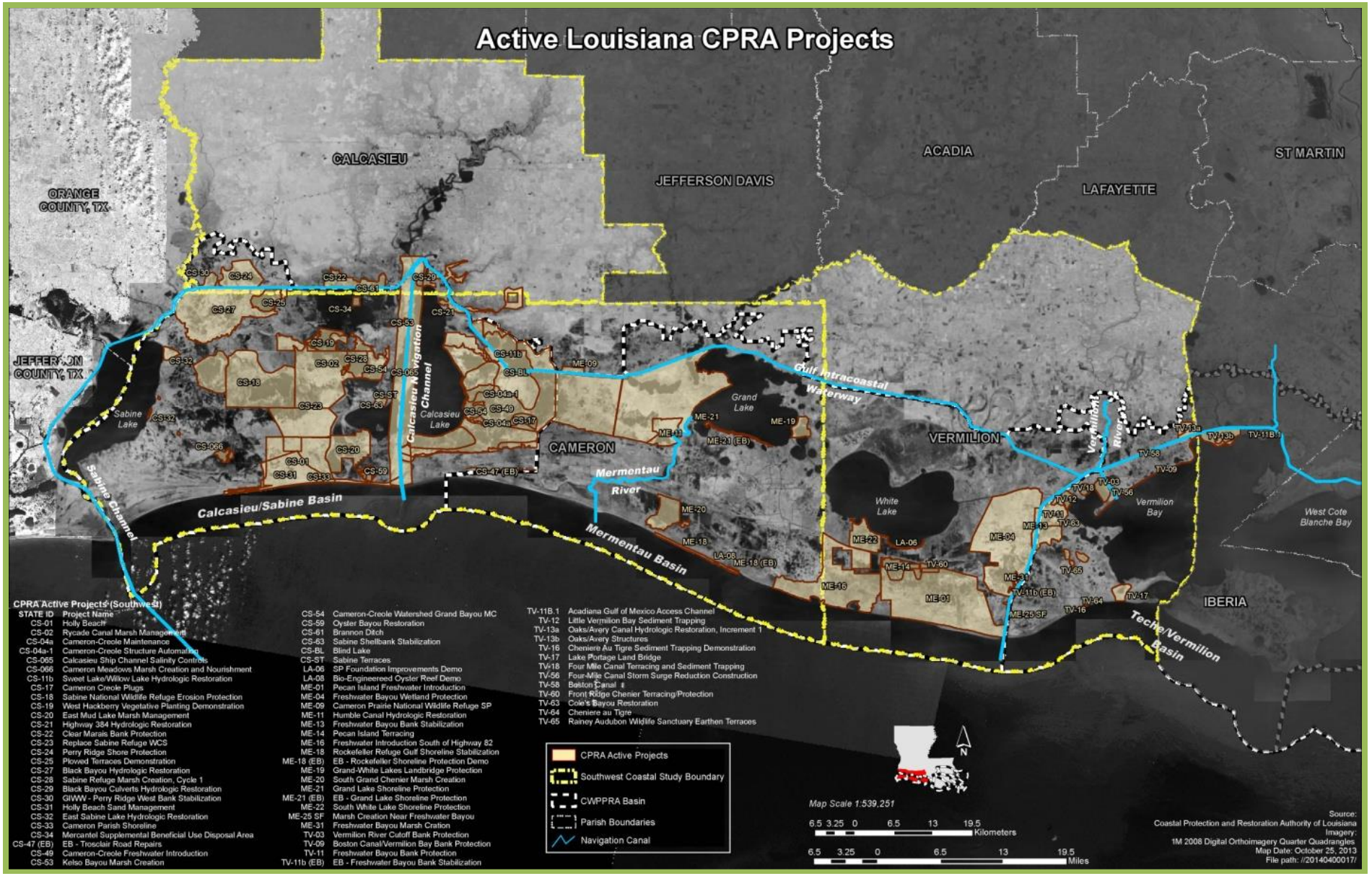

Figure 2-6: Restoration projects in the study area.

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) Aiding 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 2-7) 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.

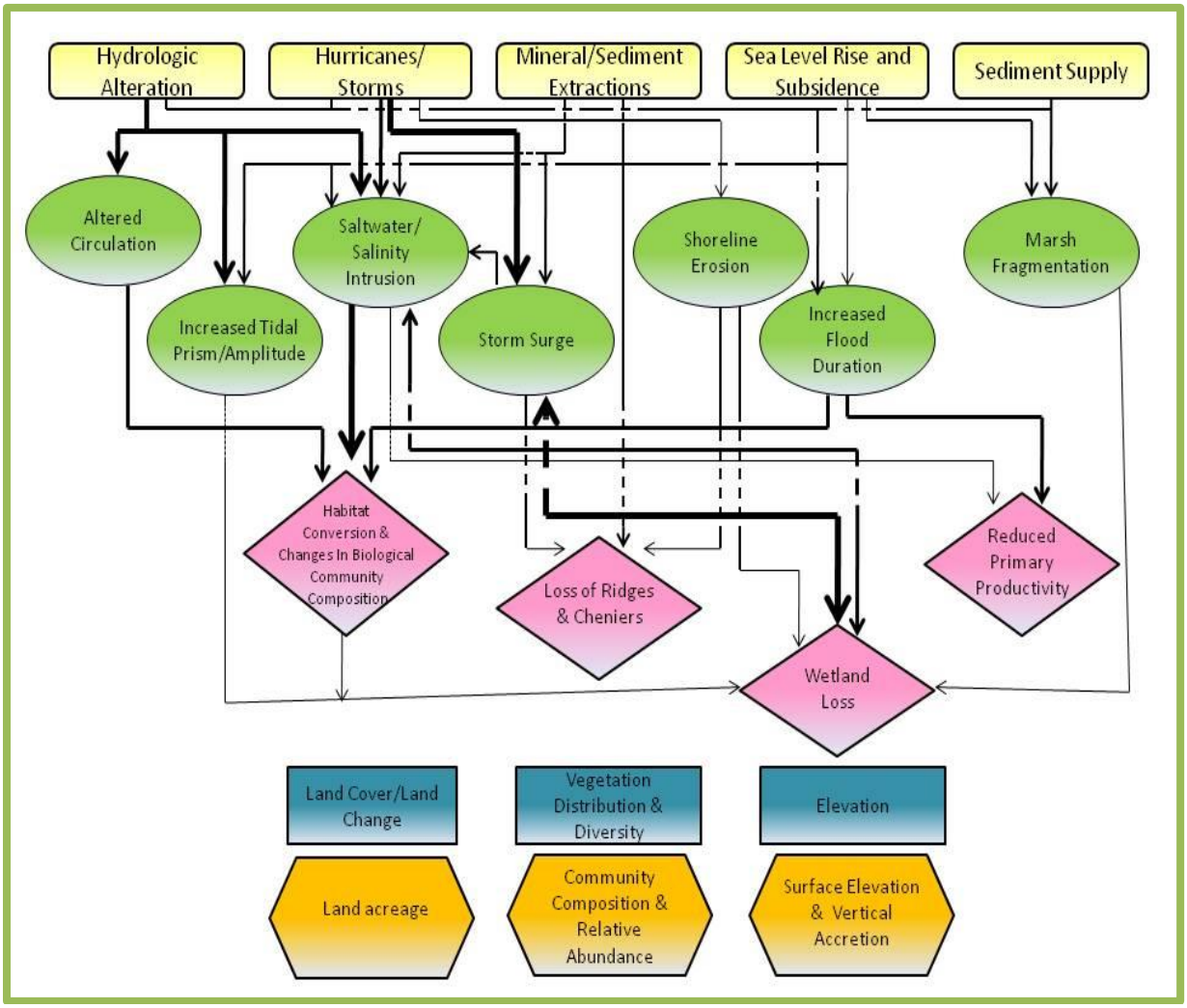

Figure 2-7: Conceptual ecological model.

2.9.1 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 (SMP), 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.

2.9.1.1 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 ft or in high subsidence areas along with chenier reforestation in locations with elevations less than 5 ft and areas with high shoreline erosion rates.

- **Objectives.** These criteria were used to ensure that the measures being considered for inclusion were applicable to at least one study objective. Each of the measures was found to support a particular objective. Although an evaluation of each measure against the objectives took place, no measures were eliminated due to their lack of meeting objectives.

- **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 2-11.

Table 2-11: 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 ft 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 NAVD88 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 (ways to classify and combine NER features according to a predefined strategy) to further screen features and develop an initial array of alternatives.

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

Individual features were developed for each of the five NER measures and formed into five separate plan development strategies. 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.

2.9.2.1 Screening of the Initial Array of NER Alternative Plans

Another screening (outlined below and more fully explained in Appendix C) was conducted and more features were removed from further consideration. Land loss analyses were conducted by the 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 LNHP).
- **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 SMP analyses) and assumptions based on professional experience and knowledge. The results of the WVAs (see Appendix A) 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 under initial screening because the WVA model cannot adequately describe the benefits of these features across such a large area using preliminary information. 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 SMP models. Eight features that met these criteria were carried forward into the final array.
- **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 SMP 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. See Appendix A for more information on the modeling for restoration alternatives.

2.9.3 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 2-13) 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 SMP are identified as such. 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". The 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 2-12. 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 2-12: 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.

2.9.4 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 SMP Models were used to compare benefits among alternatives in acres and AAHUs, and compared them to the FWOP conditions or "No Action" 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) condition or "Action" 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 SMP 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 SMP modeling system to predict wetland loss and other trends over time. The SMP 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 (see Appendix A).

Table 2-13: NER Focused array of Alternative Plans

AlternativePlan/ 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").

2.9.4.1 Cost Estimates

The construction cost and schedule estimates were developed from similar projects in the 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 SMP. The costs of alternative plans are the sums of the costs of the individual features (see Table 2-14). 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 2-14: NER Cost Estimates and Benefits

Plan #	Cost $ Low Nav	Cost $ High Nav	AAA
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

2.9.4.2 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 2-8, 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 blue are cost-effective (no other plan produces more benefits for the same or less cost as another plan) and plans in red are best-buys (subset of cost-effective plans that offer the lowest incremental cost per benefit).

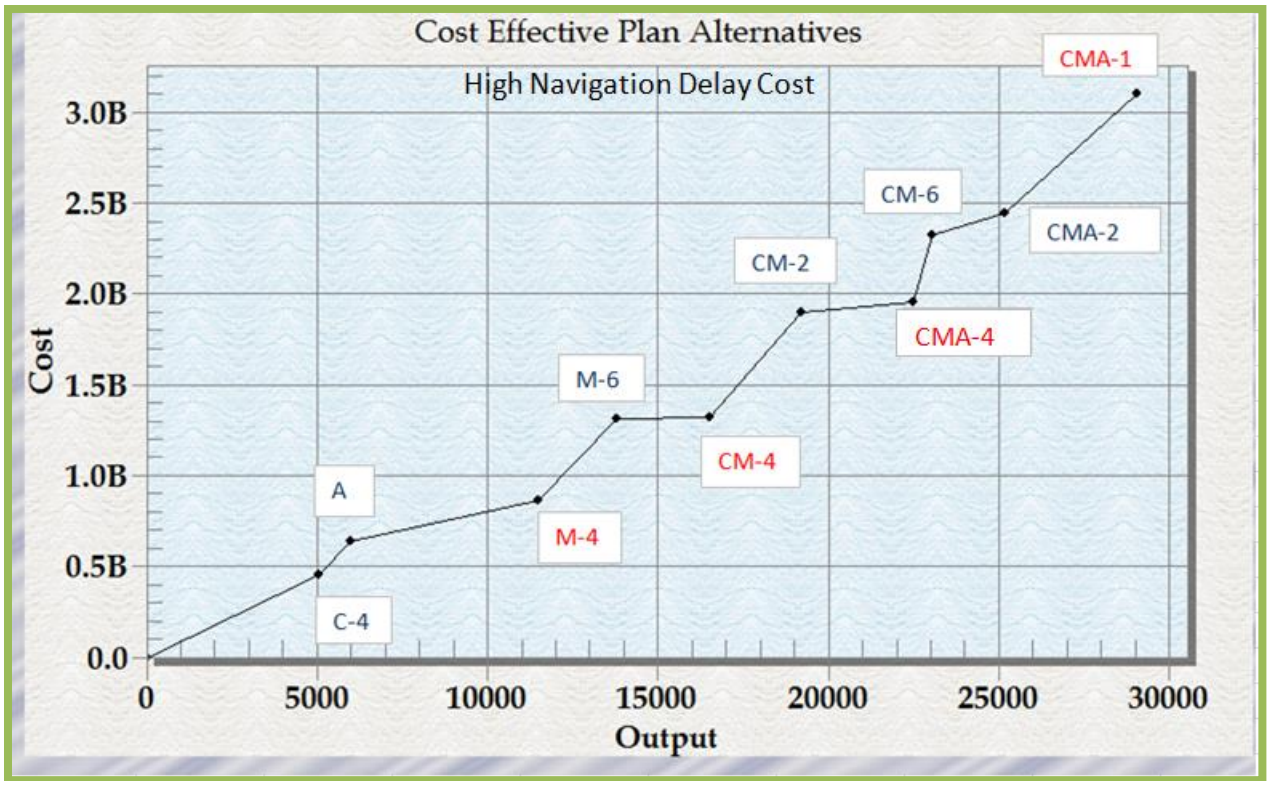

Figure 2-8: CE/ICA analysis using high navigation cost.

The second CE/ICA analysis is shown in Figure 2-9. 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 ft. 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.

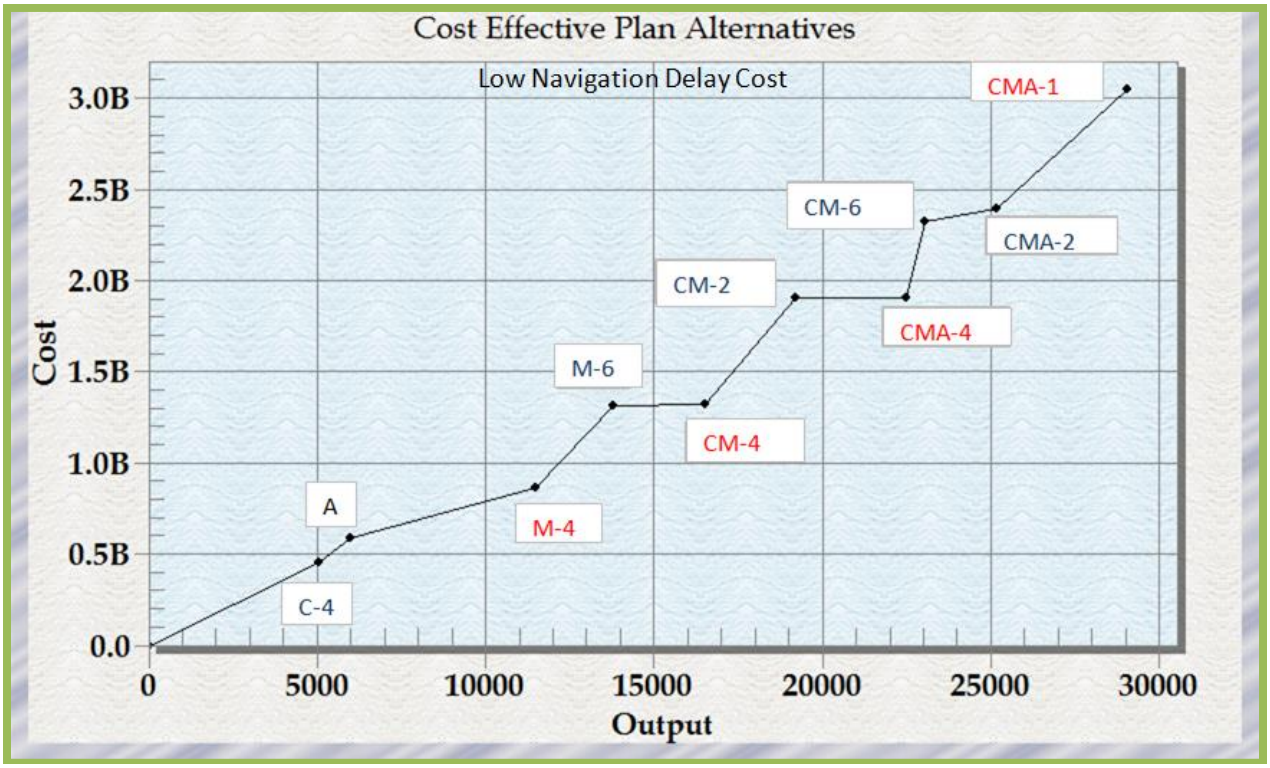

Figure 2-9: CE/ICA analysis using low navigation cost.

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 AAA, 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 AAA) 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 structure exist 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 part of a 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 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 produces greater benefits than comprehensive plans are those which include the CSC salinity control structure as a component.

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

The final array of alternatives 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 2-15.

Table 2-15: 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. 6.3 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 with 13.4 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 1,288 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 26 acres of beach and dune 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.

**- Renourishment and maintenance lifts are considered an Operations and Maintenance (O&M) cost and are a 100% NFS responsibility.*

2.10 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).

All NER alternative plans provide positive net EQ benefits that contribute to the regional ecosystem outputs and functions, and provide coastal sustainability. All plans considered provide synergy with NED objectives by providing resilience to key elements of regional geomorphic structure that facilitate storm risk management. The alternative plans also support RED benefits in maintaining the regional geomorphic structure that in turn maintains an existing hydrology which supports a regional agricultural economy. The plans also support RED objectives by providing resiliency to natural risk reduction features. Regarding OSE, all alternative plans address the southern-most portion of the study, which is comprised largely of coastal wetlands and ridges. The populations of this portion of the study area has a long and rich history of utilizing the natural landscape as the

source of their economy. All the plans considered facilitated that continued use and history and provide the possibility of social as well as physical resiliency for the area.

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 RSLR through the loss of a protective wetland buffer. Ecosystem restoration projects would take place under CWPPRA, SMP, RESTORE Act, and Parish plans but at a smaller scale.

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. These include benefits to the flora and fauna of the study area through the restoration and protection of important imperiled habitat. Aquatic, terrestrial, and bird species would benefit from the restored ecosystem. 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. Restoring the ecosystem also has positive benefits for surrounding communities through a preservation of cultural values, community cohesion, economic vitality, and leisure and recreation.

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 in the Calcasieu and Mermentau Basins. Effects of restoring the ecosystem would be similar to Plan M4, but would be on a much larger scale. 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. Additional benefits to OSE, such as those described for Plan M4, would occur but on a much larger scale. This alternative provides the most cost-effective and comprehensive benefit.

2.11 Additional Evaluation of the Final Array of Alternatives

Both the 2013 Initial Draft Report and the 2015 Revised Draft Report identified Plan CM-4 as the TSP. However, during technical reviews and based on new information from the feasibility level design phase of the study, additional work and other assessments were completed for several of the features in each alternative. These efforts required a reevaluation of each alternative against one another to confirm Plan CM-4 remained the TSP.

In order to use the best available data and models, alternative plan feature benefits (AAHUs) were updated with the certified version of the WVA model. Refined annualized costs were also developed and input into the IWR Planning Suite model with the new AAHU calculations. The PDT completed a new analysis of the NER focused array of alternatives 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 and was therefore removed as a component from all alternatives. Other features that comprised the alternative plans were also evaluated. The Sabine Lake Oyster Reef Preservation feature was removed from further consideration 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. The PDT also determined that the CSC Salinity Control Structure and

the Cameron-Creole Spillway (feature 74a) should be assessed through additional studies because there are too many uncertainties about potential effects on salinity, habitat, and navigation. These features also need complex and detailed hydrodynamic and navigation economics modeling that this study effort is not scoped to support at this time. Given these adjustments, the focused array of alternatives was re-run to calculate the CE/ICA without these features and based on the updated annualized benefits and costs. The outputs from these adjustments are presented below (see Table 2-16 and Figure 2-10).

Table 2-16: NER cost efficient alternative plan comparison.

Plan Name	Total Cost x 1,000	Annual Cost	AAHUs	Cost/AAHU	Annual Cost/AAHU	Cost Effective Status
CM-1	$2,159,512	$85,933,395	8,623	$250,430	$9,965	Best Buy
CM-6	$2,032,615	$80,883,760	8,285	$245,324	$9,762	Best Buy
CM-3	$1,874,080	$74,575,197	7,170	$261,388	$10,401	Yes
CM-2	$1,588,626	$63,216,127	6,990	$227,278	$9,044	Best Buy
CM-5	$1,460,681	$58,124,842	5,156	$283,297	$11,273	Yes
CM-4	$1,175,227	$46,765,771	4,976	$236,176	$9,398	Yes
C-1	$826,903	$32,904,915	4,129	$200,289	$7,970	Best Buy
C-2	$740,684	$29,474,025	3,688	$200,821	$7,991	Yes
C-5	$671,458	$26,719,300	1,980	$339,172	$13,497	Yes
C-4	$386,003	$15,360,229	1,800	$214,475	$8,535	Yes
No Action Plan	$0	$0	0	$0	$0	Best Buy

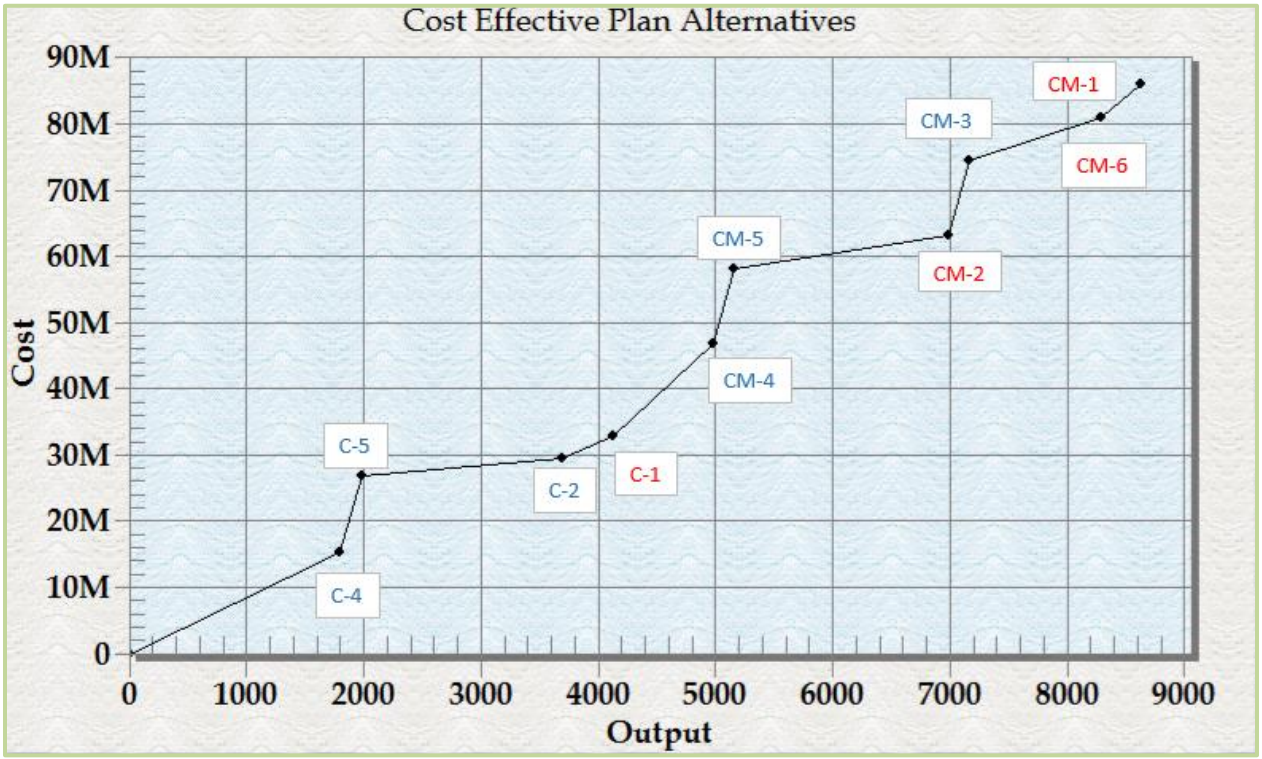

Figure 2-10: CE/ICA analysis using updated annualized costs and benefits.

2.12 Confirmation 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 CE/ICA despite continuing

to demonstrate the potential to deliver a relatively significant magnitude of benefits (975 AAHUs). Note that for CE/ICA runs after the initial alternative screening process AAHUs were used in lieu of AAAs in the benefits calculations.

Several features included in the TSP appear, on an individual basis, to lack adequate restoration performance to justify their inclusion. The basis/rationale for the inclusion of those features, specifically 124d, 5a, & 306a1, in various alternative plans including the TSP is important. These features, as well as all of the features in the TSP, titled Small Integrated Restoration, represent the minimum critical components necessary for providing restoration in a manner that protects the geomorphic integrity and resiliency of the larger Chenier Plain system. While the features of the TSP were assessed for their individual outputs and are not interdependent, they do support a holistic objective. That is to provide long-term resilience to the overall ecosystem structure of the Chenier Plain. Each feature, in addition to restoring valuable habitat, enhances the resilience to a structural element of the larger ecosystem.

In the case of features 124d and 5a, these features are anchor pieces that also work with feature 124c to prevent the long-term failure of a heavily deteriorated land bridge in the vicinity of Mud Lake, which lies between the Gulf of Mexico and the western extent of Calcasieu Lake. Feature 5a is particularly critical to this area since the beach and dune ridge represents the sole contiguous chenier crossing the area. The breakdown of this land bridge would ultimately result in the establishment of an open estuary reaching approximately 20 or more miles inland from the coast and elevating salinities and coastal storm effects throughout the area. Feature 306a1, in addition to creating valuable marsh, stabilizes the eastern ridge associated with the Freshwater Bayou channel. Feature 127c3 provides similar support for the western side of this ridge. Loss of one, or both sides of this ridge would result in a rapidly expanding embayment that could threaten the remainder of the Mermentau Basin.

Plan CM-4 is the plan that reasonably maximizes ecosystem restoration benefits compared to costs, and consistent with the Federal objective. CM-4 is the TSP because it is cost-effective, it contains restoration features in both hydrologic basins, and it is the least cost alternative that contains an integrated suite of restoration types including chenier reforestation, marsh restoration, and shoreline protection/stabilization. While there are larger-scale alternatives that would cost more and would contain more features, implementation of alternative CM-4 would achieve all study objectives with the exception of NER Objective 2 ("Manage tidal flows to improve drainage and prevent salinity from exceeding 2 ppt for fresh marsh and 6 ppt for intermediate marsh."). NER Objective 2 would be partially achieved because the CSC Salinity Control Structure and the Cameron-Creole Spillway, the only features that would manage tidal flows and prevent salinities from increasing, are recommended for additional study. CM-4 achieves most of the study objectives for the least cost. This makes it the NER plan.

Based on the data presented in Table 2-16, 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 71.2 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 ft 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 access corridors. Some restoration sites may require containment to hold sediments in place. 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 (to be constructed by the USFWS); (f) east of Mud Lake and north of Highway 82; (g) Mud Lake west of the CSC adjacent to southern rim of West Cove (to be constructed by the USFWS). Dredged material sources would be the CSC (both beneficial use and dedicated dredging) and the Gulf of Mexico.

A table summarizing details of these features is included at Table 2-17a. Construction of marsh restoration features 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 ft 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 renourishment cycle (as part of O&M and a 100% NFS responsibility). 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 a lightweight aggregate core that would be located approximately 150 ft offshore with geotextile fabric and stone built to an 18 foot crest width. In addition, approximately 13.4 miles of rock revetment built to +3 ft NAVD88 with a 4 foot crown would be placed at three locations to fortify spoil banks of the GIWW and Freshwater Bayou. Two future maintenance lifts would be required (as part of O&M and a 100% NFS responsibility). Rock and breakwaters would also be placed at Holly Beach as a continuation of existing breakwaters; two future maintenance lifts would be required (as part of O&M and a 100% NFS responsibility). Details of these features are included in Table 2-17b.
- **Chenier Reforestation.** Chenier restoration consists of replanting of 435 seedlings per acre at 10 foot x 10 foot 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 2-17c.
- **Hydrologic and Salinity Control.** The Cameron-Creole Spillway salinity control structure south of Lambert Bayou is recommended for additional study. It would serve as a drainage manifold and the outfall channel into Calcasieu Lake would be rock-lined for scour protection The SMP model used to evaluate this feature needs additional refinement to properly evaluate the benefits over the 6,600-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 AAHUs). Nevertheless, the modeling performed for this feature would not be able to adequately measure the potential benefits of this feature because it would only operate in extreme conditions (e.g., after a high storm surge). Therefore it would be prudent to examine this measure in more detail under a new study effort.
- The **CSC Salinity Control Structure** is recommended as an additional long-range study feature to adequately account for potential environmental benefits, navigation impacts, and engineering.
- O&M costs for all NER features (a NFS responsibility) are estimated at approximately $311,573,000.
- First construction costs only are estimated at $1,175,227,000.
- **Changes and updates to the NER TSP since release of the 2015 Revised Draft Report are minor and consist of providing more details about each feature in the fact sheets (Appendix K), and updating costs and benefits. These changes can be found in Chapter 4.**

2.13 NER TSP Feature Details

Table 2-17a. Details of the marsh restoration features of the TSP (See Appendix K for fact sheets and maps detailing each NER TSP marsh restoration feature).

Measure Number	Measure Name	Basin	Marsh Type	Acres Restored	Acres Nourished	Total Acres	Net Benefits (acres)	Average Annual Habitat Units (AAHU)	Borrow Volume (cy)	Borrow Area (acres)	Renourishment Volume (cy)	Initial Construction Costs (US $)	TY 30 Renourishment (US $)
3a1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	Calcasieu	Brackish	599	-	599	454	191	5,339,286	139	1,000,000	$66,593,748	$17,759,470
3c1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	Calcasieu	Brackish	1,347	734	2,081	1,324	607	9,458,313	314	3,651,841	$168,194,346	$70,984,253
47a1	Marsh Restoration Using Dredged Material South of Highway 82	Mermentau	Brackish	933	88	1,021	895	272	3,022,782	1,716[1]	1,500,000	$105,234,982	$21,239,680
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]	1,500,000	$97,348,440	$17,585,890
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]	1,800,000	$95,372,834	$14,981,607
124c	Marsh Restoration at Mud Lake	Calcasieu	Saline	1,077	708	1,785	1,228	500	10,369,956	531	2,001,611	$112,219,520	$24,680,885
124d	Marsh Restoration at Mud Lake	Calcasieu	Brackish	159	448	607	168	4	1,420,943	378	1,200,000	$28,882,160	$17,636,205
127c3	Marsh Restoration at Pecan Island	Mermentau	Brackish	832	62	894	735	241	7,301,057	3,950[2]	781,000	$61,662,041	$15,683,451
306a1	Rainey Marsh Restoration Southwest Portion (Christian Marsh)	Mermentau	Brackish	627	1,269	1,896	743	151	8,128,181	3,950[2]	3,500,000	$75,885,692	$37,551,555
	Totals			8,175	3,439	11,614	7,900	2,700	62,428,722	7,028	16,934,452	$811,393,763	$238,102,996

1- *This borrow source provides the sediment for all three restoration features but the full amount of available material will not be dredged each cycle. Therefore this total acreage is only counted once in the column total.*

2- *This borrow source provides the sediment for both restoration features but the full amount of available material will not be dredged each cycle. Therefore this total acreage is only counted once in the column total.*

(Table 2-17a continued)

Measure Number	Measure Name	Impact to State Water Bottoms permanent (acres)	Floatation Footprint (acres)	Disposal Footprint (acres)	Dike Footprint (feet)	Dike Footprint (acres)	Impact to State Water Bottoms (temporary)	Dredge Pipeline Route (feet)	Dredge Pipeline Route (acres)	Piping Plover Critical Habitat (temporary impact acres)	Construction Period
3a1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	139	132	-	44,700	30.8	-	43,942	30	-	16 months
3c1	Beneficial Use of Dredged Material from Calcasieu Ship Channel	314	182	-	97,250	51.4	-	61,497	42	-	33 months
47a1	Marsh Restoration Using Dredged Material South of Highway 82	1,716[1]	47	-	68,300	47.0	-	35,519	24	0.14	23 months
47a2	Marsh Restoration Using Dredged Material South of Highway 82	1,716[1]	47	-	41,000	28.2	-	30,898	21	0.14	24 months
47c1	Marsh Restoration Using Dredged Material South of Highway 82	1,716[1]	47	-	35,200	24.2	-	29,858	21	0.14	23 months
124c	Marsh Restoration at Mud Lake	531	28	-	78,100	31.5	-	9,485	7	1.8	27 months
124d	Marsh Restoration at Mud Lake	314	182	-	32,500	22.4	-	21,452	15	-	9 months
127c3	Marsh Restoration at Pecan Island	3,950[2]	110	-	46,000	31.7	-	37,074	26	-	12 months
306a1	Rainey Marsh Restoration Southwest Portion (Christian Marsh)	3,950[2]	178	-	108,000	74.4	-	59,731	41	-	17 months
	Totals	6,964	953		551,050	341.6		329,456	227	2.2	---

1- This borrow source provides the sediment for all three restoration features but the full amount of available material will not be dredged each cycle. Therefore this total acreage is only counted once in the column total.

2- This borrow source provides the sediment for both restoration features but the full amount of available material will not be dredged each cycle. Therefore this total acreage is only counted once in the column total.

Table 2-17b. 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)	Average annual habitat units (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)	Initial Construction Costs (US $)	TY15 Maintenance (US $)
5a	Holly Beach Shoreline Stabilization – Breakwaters	Calcasieu	Saline	26	56	46,014	860,540	250	386,460	0	129,081	86,054	$144,044,021	$16,786,222
6b1	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	Mermentau	Brackish	2,140	625	58,293	868,480	250	447,830	479,150	86,848	0	$198,480,921	NA
6b2	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	Mermentau	Brackish	1,583	466	42,883	687,140	250	363,270	357,010	68,714	0	$145,876,561	NA
6b3	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	Mermentau	Brackish	1,098	312	33,355	561,530	250	244,205	279,030	56,153	0	$115,270,890	NA
16b	Fortify Spoil Banks of the GIWW and Freshwater Bayou	Mermentau	Brackish	1,288	279	70,983	617,640	250	516,860	0	92,646	61,764	$36,018,600	$5,695,468
	Totals			6,135	1,738	251,528	3,595,330		1,958,625	1,115,190	433,442	147,818	$639,690,993	$22,481,690

(Table 2-17b continued)

Measure Number	Measure Name	TY 25 Maintenance (US $)	Impacts to State Water Bottoms (permanent)	Breakwater Footprint (feet)	Flotation Footprint* (acres)	Temporary Disposal Footprint* (acres)	Impact to State Water Bottoms (temporary acres)	Critical Habitat (acres)	Temporary Staging Area (acres)	Crown Elevation (feet NAVD88)	Crown Width (feet)	Slopes	Aprons (feet)	Construction Period
5a	Holly Beach Shoreline Stabilization – Breakwaters	$11,247,740	57.4	57.4	479	462	941	-	-	3.50	24	2:1	10-ft front & 6-ft back	19 months
6b1	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	$15,389,345	65.9	65.9	725	711	1436	-	21	3.25	18	2:1	10-ft front & 6-ft back	31 months
6b2	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	$11,343,672	40.2	40.2	507	497	1004	-	21	3.25	18	2:1	10-ft front & 6-ft back	23 months
6b3	Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou	$9,041,421	37.8	37.8	372	289	661	-	21	3.25	18	2:1	10-ft front & 6-ft back	18 months
16b	Fortify Spoil Banks of the GIWW and Freshwater Bayou	$3,966,404	77.1	77.1	358	-	-	-	-	3.00	4	4:1	none	13 months
	Totals	$50,988,582	278.4	278.4	2,441	1,959	4,042	-	63	-	-	-	-	---

**- Access for heavy equipment to construct shoreline stabilization features consists of dredging a channel in open water to allow construction equipment to reach shoreline areas and placing the dredged material alongside the channel so the necessary channel depth is maintained. This material stored adjacent to the channel will be returned to the access channel after construction. These impacts are temporary and will naturally revert to existing conditions over time.*

(Table 2-17b continued)

Linear Feet for Access and Temporary Disposal							
Measure	**5a**	**6b1**	**6b2**	**6b3**	**16b***	**Total Feet**	**Miles**
Disposal	159,741	239,001	168,533	98,683	0	665,958	126.1
Equipment Access	161,957	244,857	173,050	126,542	0	706,406	133.8

**- No dredging or temporary disposal is anticipated for Feature 16b since Freshwater Bayou has adequate water depths to allow the necessary construction equipment access.*

Table 2-17c. 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 Name	Net Benefits (acres)	Benefits (AAHU)	Species	Total Fence Length (feet)	Fence Height (feet)	Planting Density (#/acre)	Spacing (feet)	Min. Survival % at Year 4*	Equip-ment Access Corridor (feet)	Equip-ment Access Corridor (acres)	State Water Bottoms (permanent)	State Water Bottoms (tempor-ary)	Critical Habitat (acres)	Staging Area (acres)
Chenier Reforestation (CR)	1,413	538	Live Oak; Hackberry	150,000	7.5	435	10 x 10	57%	13,867	10	0	0	0	0

**- For a given planting, a minimum of 250 seedlings/saplings per acre must be present (with a 60 to 40 hard mast to soft mast ratio) at the end of the fourth year (i.e., Year 5) following successful attainment of the one-year survivorship criteria. Costs to ensure the minimum survival percent are considered 'construction' and will be cost-shared accordingly.*

2.14 Views of the Non-Federal Sponsor

CPRAB recognizes the importance of hurricane and storm surge risk reduction and ecosystem restoration 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. 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 implementing the alternatives for the nonstructural hurricane storm surge damage risk reduction (HSDRR) NED plans and the ecosystem restoration NER plans. The impacts of the NED and NER plan measures described herein and in Appendix A are assessed at a full feasibility level and are recommended for construction. Fact sheets describing the NER measures in more detail can be found in Appendix K. The Alternatives carried forward, as described in Chapter 2, for comparative analysis include the following:

NED Alternatives:

(A) Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain is the recommended plan consisting of approximately 3,961 structures that meet the eligibility criteria broken down as follows:
   a. 3,462 residential
   b. 342 non-residential
   c. 157 warehouses

(B) Plan 8 Alternative – Nonstructural 100-Year Floodplain includes 15,667 total eligible structures broken down as follows:
   a. 13,934 residential
   b. 1,003 non-residential
   c. 730 warehouses

NER Alternatives: Table 2-13 includes a listing of measures included in the final array of alternatives and tables at 2-17 includes a listing of measures that make up the NER RP alternative.

(A) Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan is the RP. It includes 22 features in the Mermentau Basin and 27 measures in the Calcasieu/Sabine Basin for a total of 49 features. The hydrologic/salinity control measures are recommended for further study, and the oyster reef preservation measure was removed from further consideration. The features comprising the recommended plan are broken out as follows:
   a. 9 marsh restoration measures restoring/nourishing 11,614 acres of wetlands.
   b. 35 Chenier reforestation locations.
   c. 5 shoreline protection measures totaling approximately 47.6 miles.

(B) Plan M4 Alternative - This alternative totals 22 measures in the Mermentau Basin only. The measures comprising the alternatives include:
   a. 5 marsh restoration features restoring/nourishing 6,542 acres of wetlands.
   b. 13 Chenier reforestation locations
   c. 4 shoreline protection measures totaling approximately 38.9 miles.

The CM-4 Alternative would restore approximately 50% more marsh or 6,063 more acres; reforest approximately 60% more (22 more) Chenier reforestation locations; and protect approximately 22% or 8.7 miles more of shoreline through shoreline protection measures.

Two marsh restoration features (124d - Marsh Restoration at Mud Lake and 3c1 - Beneficial Use of Dredged Material from the Calcasieu Ship Channel) are partially located on USFWS refuge lands. The USACE recommends that USFWS independently seek authorization and appropriation to construct these projects.

3.1 The Human Environment (Socioeconomics)

Consideration of public and policy comments on the Southwest Coastal Louisiana, Integrated Draft Feasibility Report and Programmatic Environmental Impact Statement released on December 13, 2013 and the Revised Integrated Draft Feasibility Report and Environmental Impact Statement released on March 20, 2015 regarding the NED TSP resulted in removal of the mandatory component of the plan which called for the acquisition and demolition of structures located within the FEMA Regulatory Floodway. Consequently, implementation

of the nonstructural NED Alternative would be performed on an entirely voluntary basis, which lessens the potential adverse impacts on the human environment.

3.1.1 Population and Housing

HSDRR (NED) Plan

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

Direct impacts include the potential for damage to structures, landscaping and driveways while the structure is being elevated. There could 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. Additionally, access to the residence would be impeded 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.

Indirect impacts would include reduced risk of damages from hurricane storm surge events for population and housing located in the 25-year floodplain. This risk reduction 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 an elevator and other special access improvements. 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 potential drainage issues, especially related to construction of localized storm surge risk reduction measures. However, any such Project-induced impacts would be avoided or corrected to pre-construction conditions. There is a potential that existing landscaping around residential structures could be damaged and require restoration.

Direct and indirect impacts associated with residential and commercial properties that are located in the 25-year floodplain but that do not undergo nonstructural risk reduction measures (either by choice or due to ineligibility) or that are located in the study area but do not fall within the 25-year floodplain are similar to those impacts described in Chapter 1 under the FWOP condition. This is generally true for each of the below resources and as such, will not be repeated throughout this analysis.

Plan 8 Alternative – Nonstructural 100-Year Floodplain

The impacts from this alternative are similar to the impacts identified in connection with the Modified Plan 8 Nonstructural 0-25-Year Floodplain Plan (RP) alternative but greater in scale because of the larger numbers of structures that would be included in the Project under this alternative as compared to the RP, as described in paragraph 3.0 above This will be generally true for all resources below. Hence a discussion of impacts associated with the Plan 8 alternative will not be detailed for each of the following resources unless there is a significant reason for it to be addressed in connection with a specific resource. The scale of the differences would vary by resource but the general rule remains: impacts would be similar in nature but greater in scale for the Plan 8 alternative as compared to the RP.

Ecosystem Restoration (NER) Plans

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

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

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

The impacts of Plan M-4 are the same as the impacts identified for the Mermentau Basin component of Plan CM-4 alternative (NER RP) but overall lesser in scale due to the size of the RP by comparison, as described in paragraph 3.0 above (i.e., 49 measures in the RP as compared to 22 measures for the Plan M-4 alternative). This will be generally true for all resources below. Hence a discussion of impacts associated with the Plan M-4

alternative will not be detailed for each of the following resources unless there is a significant reason for it to be addressed in connection with a specific resource. The scale of the differences in impacts between Plan M-4 compared to the Plan CM-4 would be approximately 50% less for marsh restoration measures as there would be approximately 6,063 less acres restored; there would be 22 less chenier reforestation locations and therefore approximately 60% less impacts; miles of shoreline protected would be 8.7 miles less resulting in approximately 22% less impacts.

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

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

There would be direct impacts associated with the flood proofing of businesses and the construction of localized storm surge risk reduction measures 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. The construction of localized storm surge risk reduction measures 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. 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.

Indirect impacts would include reduced risk of hurricane storm surge- related damage for employment, business, and industrial activity in the 25-year floodplain of the study area which translates into greater stability of productivity in the region.

Ecosystem Restoration (NER) Plans

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

Restoration measures would have no direct impacts on employment, business, and industrial activity. Indirect effects would include the prevention of further land loss, which could result in localized positive effects of maintaining employment and businesses (e.g., recreational and commercial fishing), and industrial activity. Cumulative impacts would be beneficial and would result from improved sustainability of southwest Louisiana with similar restoration efforts, making a more stable environment for employment, business, and industrial activity.

Plan M-4 Alternative - Mermentau Small Integrated Restoration Plan

The impacts for this alternative are similar to the impacts identified for the CM-4 Alternative RP but lesser in scale. For example there are 6,063 less acres of marsh restoration, 22 less Chenier reforestation locations and 8.7 miles less shoreline protection. Impacts are the same as the Mermentau Basin component of the RP.

3.1.3 Public Facilities and Services

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

Direct impacts associated with flood proofing to public facilities in the area would be the interruption and temporary unavailability of public services if these facilities are forced to close or are relocated to temporary locations during implementation of the nonstructural risk reduction measures.

Indirect impacts include reduced risk of hurricane storm surge-related damages for public facilities and services in the area thereby reducing the number of days a structure is unavailable for use and minimizing the inconvenience to the general public. Indirect impacts to public facilities and services not included in the plan would be the same as identified under the no-action alternative. Other direct and indirect impacts would be similar to those described in sections 3.1.1 and 3.1.2.

Ecosystem Restoration (NER) Plans

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

Restoration measures would have no direct, indirect, or cumulative impacts on public facilities or services.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

Impacts are the same as MB component of the RP.

3.1.4 Transportation

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

Direct impacts associated with the NED RP for transportation would include temporary and intermittent delays, disruption of traffic movement, congestion of roads, and re-routing of vehicles and pedestrians during the construction of the various risk reduction measures. Local parking access to businesses could also be affected by construction vehicles and crews and construction of the localized storm surge risk reduction measures around the warehouses.

Indirect impacts would include the additional wear and tear on roads, especially local roads, caused by large trucks transporting construction materials including borrow material transported for construction of local risk reduction measures at warehouses, 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 limit dust emissions and to ensure the safety of construction workers, residents, and employees during construction of the nonstructural measures. There could be minor indirect short term impact to transportation due to construction related activities related to both structural elevations and commercial /warehouse flood proofing measures. These impacts will vary depending on the number and location of structures undergoing improvements at a given time and the timing and duration of the construction-related activities. There would be no long term impact.

Ecosystem Restoration (NER) Plans

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

No direct impacts on transportation. Dredging for borrow material from the Calcasieu Ship Channel would be conducted in a manner to avoid impacting navigation. Indirect impacts would include the additional wear and tear on roads, especially local roads, caused by large trucks transporting construction materials. Additional indirect impacts to transportation includes reducing the intensity of damages to the following transportation structures:

- Marsh restoration measures 124c and 47a1 would reduce the intensity of almost daily wind-generated wave action which erodes areas adjacent to Highway 82;
- Marsh restoration measure 3c1 would reduce the wave action which erodes the southern spoil bank along the GIWW from the south (This impact would only apply if USFWS obtains authorization and funding and independently implements measure 3c1.);
- Shoreline protection measure 16b would protect the shoreline of Freshwater Bayou through the placement of foreshore rock dikes;

Plan M-4 Alternative - Mermentau Small Integrated Restoration Plan

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

3.1.5 Community and Regional Growth

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

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 an increase the region's income for as long as the

spending continued. For the study area as a whole, temporary relocations would likely take place within the overall study area during implementation of the nonstructural measures, resulting in little if any change.

Indirect impacts would include reduced risk of hurricane storm surge-related damages for those low-lying structures located in the 25 year floodplain thus reducing overall social vulnerability and preserving growth opportunities for communities in the region and enhancing the potential for long-term growth and sustainability.

Ecosystem Restoration (NER) Plans

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

Restoration measures 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 above in connection with the NED RP.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

Impacts are the same as MB component of the RP.

3.1.6 Tax Revenues and Property Values

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

For the nonstructural plan, Parish sales tax revenue would likely increase during the implementation of nonstructural measures as a result of an expected influx of workers and construction expenditures from outside of the area. Construction activities associated with the NED RP would provide jobs and could increase the level of spending, labor, and capital expenditures in the area.

Ecosystem Restoration (NER) Plans

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

No direct effects to tax revenues and property values. Indirect effects could include following:

- fee lands acquired by the State would be removed from the ad valorem tax base of local government and no property taxes could be collected on those lands.
- the prevention of land loss could result in localized positive effects of maintaining tax revenues and property values.

Plan M-4 Alternative - Mermentau Small Integrated Restoration Plan

Impacts are the same as the MB component of the RP. Two marsh restoration features (124d - Marsh Restoration at Mud Lake and 3c1 - Beneficial Use of Dredged Material from the Calcasieu Ship Channel) are partially located on USFWS refuge lands. The USACE recommends that USFWS independently seek authorization and appropriation to construct these projects.

3.1.7 Other Social Effects (OSE)

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

A summary of OSEs is presented in the Table 3-1. These include reduction in risks associated with damages from hurricane storm surge events to housing units, public facilities, and commercial structures located within areas where the RP 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 could be at a reduced risk of incurring costs associated with clean-up, debris removal, and building and infrastructure repair associated with damage from a hurricane storm surge event.

Table 3-1: Summary of other social effects.

OSE Alternative Evaluation				
Social Factors and Metrics	**Nonstructural Measures**	**CM-4**	**M-4**	**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)				

Under the NED RP, tenants would be eligible for certain relocation assistance benefits. While structure owners would not be responsible for eligible costs associated with the nonstructural measures, (see Appendix L for a description of eligible costs), they would be responsible for ineligible costs associated with the structure elevation, including temporary relocation costs and any costs for moving out of the eligible structure during construction of the nonstructural measure. (See Chapter 4 and Appendix L for more information about the benefits of and the eligible and ineligible costs associated with the nonstructural plan.) The ability of lower income groups to participate in the Project could be impacted by these out of pocket expenses including the costs associated with temporary relocation during structure elevation, and any additional costs that would be required in order to meet the Project eligibility criteria, (i.e., costs associated with any necessary structural repair or asbestos abatement). This could potentially offset, to some degree, the reduction in overall social vulnerability at least in lower income communities.

Ecosystem Restoration (NER) Plans

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

This alternative would reduce the adverse impacts to OSE associated with continued land loss, habitat fragmentation and degradation, especially with regard to the vulnerability of existing transportation (navigation and roads), oil and gas infrastructure, and recreational and commercial fishing opportunities. In the short-term the area's social vulnerability would be reduced, to some extent, by increasing wetland EFH habitat for aquatic species associated with recreational and commercial fishing. In addition, the proposed action would increase marsh-related leisure and recreational and commercial fishing opportunities thereby having a positive localized economic impact. The long-term benefits of marsh restoration, shoreline protection, bank stabilization, and chenier reforestation would improve wetland and chenier habitats which would subsequently improve or slow the loss of leisure and recreation opportunities and contribute to regional economic growth and sustainability.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

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

3.1.8 Community Cohesion

HSDRR (NED) Plan

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

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 Project implementation.

Indirect impacts for the nonstructural plan would include reduced risk of hurricane storm surge-related damages for lower-lying structures within communities, thus preserving community cohesion in the region. Other indirect impacts include improvements to pedestrian and handicap access not only to homes, but also to community facilities benefiting from nonstructural measures.

Ecosystem Restoration (NER) Plans

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

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.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

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

3.1.9 Environmental Justice

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

An 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 nonstructural risk-reduction measures. EJ 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 ACS estimates. Based on the analysis described in Appendix A, Annex O, the NED RP would not cause any disproportionate adverse impacts to minority or low-income residents within the Project or study area.

Ecosystem Restoration (NER) Plans

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

Many of the areas in which these activities will occur are sparsely populated or devoid of permanent structures and/or population. 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. 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. The long-term benefits of marsh restoration, shoreline protection, bank stabilization, and chenier reforestation would improve wetland habitat which would subsequently improve leisure and recreation opportunities to all residents of the area. The proposed action would have no disproportionate adverse impacts on minority and low-income populations.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

The proposed action would have no disproportionate adverse impacts on minority and low-income populations.

3.2 Water Environment (Hydrology and Hydraulics)

3.2.1 Flow and Water Levels

HSDRR (NED) Plan

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

The total level of impact would be relatively minor and would be dependent on the combination of nonstructural methods used and the participation rate in the Project. Potential direct and indirect impacts to flow and water depend on the method used. For example:

- Raising structures with pilings could increase storage capacity and lower surge elevations for those structures not elevated.
- Localized storm surge risk reduction measures could decrease storage capacity and raise the surge elevations for those nearby structures that are not elevated.
- 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.

Ecosystem Restoration (NER) Plans

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

Marsh Restoration: Existing fragmented marsh and shallow open water areas would be restored to marsh habitat. Temporary containment/exclusion dikes would temporarily prevent local flows from coming into and over marsh restoration site during construction activities. However, temporary containment/exclusion dikes would naturally degrade or would be degraded to provide hydrologic exchange following dewatering and consolidation of dredge sediment slurry. Consequently, these changes would not cause water levels in adjacent lakes to permanently alter flows or water levels.

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.

Chenier Reforestation: No direct or indirect impacts.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

Impacts are the same as MB component of RP.

3.2.2 Water Quality and Salinity

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

No direct impacts to water quality or salinity by implementing any of the nonstructural risk reduction measures. Construction would use the best practical techniques and BMPs to avoid potential adverse impacts. Construction impacts to runoff would be minimized through implementation of a Stormwater Pollution Prevention Plan (SWPPP) (USEPA 2012).

Indirect Impacts: Elevating and flood proofing structures, as well as protecting warehouses with localized storm surge risk reduction measures, would prevent them from being flooded, which would reduce water quality impacts associated with flooding from storm surge events that exists under the FWOP conditions.

Ecosystem Restoration (NER) Plans

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

Marsh Restoration and Shoreline Protection: Direct impacts of marsh restoration and shoreline protection measures would include protection and restoration of existing open water, fragmented and degrading wetlands to transitional estuarine marsh and shoreline protection. Construction activities, hydraulic dredging and placement of dredged sediments and other fill materials could result in the following localized and temporary impacts to water quality including: reduction of water clarity; change in color; reduction in the pH of receiving area waters toward more acidic conditions; emission of reduced sulfur compounds including hydrogen sulfide often characterized as an objectionable rotten-egg smell; release of organic material with varying quantities of ammonia, nitrogen, and phosphorus compounds which could stimulate growth of algae and other aquatic plants. The factors responsible include increased turbidity, increased suspended sediments, and organic enrichment, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels, among others. Tidal currents present in the Project measure areas would serve to disperse and thereby dilute localized changes. Following construction, pH levels, water clarity, color, emissions of sulfur compounds, and release of organic material, ammonia, nitrogen, phosphorus compounds, turbidity, organic enrichment, dissolved oxygen, and

carbon dioxide levels in the area would return to those observed prior to measure construction. Any such impacts would be minimized and controlled by the use of the best available practical techniques and BMPs. The proposed action would have no significant long-term adverse impacts to water chemistry. Because rock, fill, and construction materials for proposed shoreline protection measures are anticipated to be free of contaminants, discharge of these materials into existing adjacent waters is not expected to result in adverse effects to aquatic organisms. During marsh restoration, effluent from the dredge discharge pipe would be directed to adjacent fragmented marsh for nourishment. Material proposed for construction of marsh restoration and shoreline protection has been evaluated to determine suitability for placement in the aquatic environment in accordance with Clean Water Act Section 404(b)(1). Dredging borrow from the CSC would occur during regularly scheduled maintenance events. Hence, water quality and salinity impacts at the CSC borrow sites would be the same as those described under future without Project conditions. The depths of borrow pits in the Gulf would be limited to the area of wave penetration. There is no expectation of low dissolved oxygen in the borrow pits due to designs that will control depth, shape and location in the existing wave/wind climate. The NER RP would utilize the best available practical techniques and BMPs during construction to avoid, minimize and reduce potential adverse impacts.

Indirect impacts of marsh restoration and shoreline protection include water quality improvements as restored and nourished marsh would trap sediments and nutrients helping to maintain or improve local water quality. Sediments and dredge effluent taken from off-shore borrow areas (see Appendix K Fact Sheets) and placed at interior marsh restoration (disposal) areas may have higher salinities compared to the saline marsh restoration sites. However, any differences would likely be minimal and the dredged effluent and higher saline borrow sediments would rapidly desalinate to those ambient salinity conditions following dewatering and consolidation of sediments. Borrow areas would be configured so that stratification would be minimized by orienting the long axis of each borrow area parallel to the Gulf shoreline and with side slopes no steeper than 4(H):1(V). Borrow material has been evaluated to determine suitability for placement in the aquatic environment in accordance with Clean Water Act Sections 401 and 404(b)(1) and are anticipated to be free of contaminants. Discharge of these materials into waters would not be expected to result in adverse contamination effects to aquatic organisms. Indirect impacts regarding ecosystem restoration measures could lead to water quality improvements through the restoration and protection of wetland and chenier habitats.

Chenier Reforestation: Water quality impacts of these measures would be minimal, if at all, as these features are located on chenier ridges and removed from nearby waters.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the NER RP.

3.3 Natural Environment

3.3.1 Sedimentation and Erosion

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
There would be no direct or indirect impacts.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (RP)
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. Previous STWAVE modeling performed in 2012 for the Louisiana Coastal Area – Stabilize Shoreline at Point Au Fer Island Project indicated that offshore borrow areas and access channels would not be expected to significantly increase wave energy or erosion processes. Detailed modeling of specific borrow areas proposed for this study would be conducted during the PED phase.

Shoreline Protection: Sedimentation patterns in the vicinity of the measures 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 measures could cause erosion and/or sediment accretion. Shoreline erosion adjacent to the measures would likely be reduced. Longshore sediment transport in the vicinity of the shoreline protection measures in the Gulf of Mexico may result in the accumulation of sediment behind breakwater measures, creating salients or tombolos. No detrimental changes in longshore sediment transport processes are anticipated to occur from the construction of the four offshore breakwater measures (5a, 6b1, 6b2, and 6b3). Edwards (2006) examined breakwaters at Holly Beach that have caused sediment deposition, specifically low tide tombolos. Analysis of survey data and tracer data indicated that the beach/breakwater system is in a state of dynamic equilibrium at high tide, and static equilibrium at low tide. Measure 5a would extend from the western CSC jetty to the existing breakwaters of the Holly Beach Sand Management (CS-31) project. The introduction of sands for the Cameron Parish Shoreline Restoration (CS-33) project increased the sediment budget for this area, so that downstream (longshore) sediment starvation is not expected to be a problem. Additionally, the existing jetty and shipping channel already disrupt the littoral sediment transport in this area from the east. The area immediately west of the CSC jetty has been used as a single point discharge for maintenance dredging sediment from the jetty channel. Its probable continued use as such in the future should also help to further offset down current sediment starvation caused by the jetty. Measures 6b1, 6b2, and 6b3 would be constructed offshore from the Gulf of Mexico shoreline of Rockefeller Refuge, which is fine-grained marsh sediment, with a veneer of shell hash. The fine-grained sediment does not contribute to the littoral sediment transport. All offshore breakwater measures are expected to reduce shoreline erosion rates by approximately 50% based on previous experiences with this type of structure at Holly Beach and other nearby areas.

Chenier Reforestation: Tree roots bind sediments together and would likely reduce erosion of cheniers if the Cheniers are overtopped during storm events or by rising sea levels. Trees would likely reduce storm surge and subsequent erosion of adjacent marshes.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the RP.

3.3.2 Soils, Water Bottoms, and Prime and Unique Farmlands

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
Although there could be some minor direct and or indirect impacts on soils due to nonstructural elevation, flood proofing and construction of small localized storm surge risk reduction measures, nonstructural measures would be implemented in residential and non-residential commercial areas where soils have been previously disturbed and the best available practical techniques and BMPs would be used during construction to avoid, minimize and reduce potential direct and indirect impacts to soils, water bottoms and prime and unique farmlands. There would be no direct or indirect impacts associated with nonstructural measures on prime and unique farmlands or water bottoms.

The PDT anticipates that only a small amount of borrow would be needed for construction of the localized storm surge risk reduction measures for each warehouse being accomplished by separate task order. Based on this conclusion, it is foreseeable that commercial borrow sites would be used. As of the date of this Report, there are several commercial borrow sites within the project area that are readily available. Real Estate regulations (ER. 405-1-12, paragraph 12-9d(3)) allow for small quantities of borrow material to be supplied by the construction contractor through the use of readily available commercial sites, if supported by an analysis conducted by the Government and the NFS, and if no other constraints exist. Since it has been determined that each IDIQ task order will address a single warehouse, for purposes of this Final Report, it has been assumed that the analysis performed pursuant to the above cited ER 405-1-12 will determine that the required borrow quantities constitute a small quantity that can be obtained through a commercial site that meets the Project requirements. Prior to issuing a construction task order, the Government will conduct the necessary analysis in accordance with ER 405-1-12. Contractors would be required to demonstrate that any proposed commercial borrow site is environmentally cleared and contains geotechnically suitable borrow material. In evaluating the suitability of the proposed commercial borrow site, impacts to wetlands or bottomland

hardwoods would be prohibited. Costs of utilizing a commercial borrow site would be considered an item of construction cost, and not an item of LERRD cost.

Ecosystem Restoration (NER) Plans

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

Marsh Restoration: Marsh restoration measures would include the 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. Direct impacts to water bottoms in the marsh restoration footprints in Calcasieu and Mermentau Basins would result in the restoration of existing water bottom habitat to marsh habitat. The containment dikes would naturally degrade over time, resulting in the restoration of water bottom habitat to marsh habitat. Borrow areas to provide sediment for the restoration and nourishment of the marsh areas would result in direct impacts to water bottom habitat topography. 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 could 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. See Table 2-17 (Chapter 2) for a listing of each marsh restoration measure with total acres of temporary and permanent impacts to water bottom habitat.

Shoreline Protection: The Holly Beach Shoreline Stabilization - Breakwaters measure (5a) would include placement of rock breakwaters, resulting in direct impacts to 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 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 water bottoms in Freshwater Bayou. The potential for unintended adverse consequences, such as alteration of sedimentation patterns, associated with shoreline protection measures has been determined not to be significant. In addition, all shoreline protection measures would include construction of "fish dips" to allow for ingress and egress of aquatic organisms. In all shoreline protection measures, soft surface water bottoms would be replaced with rock resulting in indirect impacts to aquatic habitat along the shorelines. Additionally, the dredging of floatation canals and associated disposal areas would result in temporary direct impacts to 4,042 acres of water bottom habitat. 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. See Table 2-17 (Chapter 2) for a listing of each shoreline protection measure with total acres of temporary and permanent impacts to water bottom habitat.

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 measures. 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 measure. 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 measure of the RP. Indirect impacts to this area of prime farmland soil 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. Edwards (2006) examined breakwaters at Holly Beach that have caused sediment deposition, specifically low tide tombolos. Analysis of survey data and tracer data indicated that the beach/breakwater system is in a state of dynamic equilibrium at high tide, and static equilibrium at low tide.

Chenier Reforestation: 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 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). (See Appendix A, Annex E).

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the RP.

3.3.3 Coastal Shorelines

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
No impacts as the NED areas are far removed from the Gulf coastal shoreline.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (RP)
Marsh Restoration: Only measure 124c (Marsh Restoration at Mud Lake) would occur in proximity to the Gulf shoreline. Construction of this measure would require temporary placement of dredge pipeline so that dredged material may be pumped from the Gulf borrow site to the marsh restoration sites. This would result in temporary and minor disturbance to the shoreline resources such as the nearshore, beach and dune as a designated pathway for placement of the dredge pipeline resulting in the temporary unavailability of this small area until this construction activity is completed. Following construction, the best available practical techniques and best management practices (BMPs) would be used to restore the shoreline to pre-construction conditions.

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. The potential for unintended adverse consequences, such as alteration of sedimentation patterns, associated with shoreline protection measures has been assessed and determined not to be significant. In addition, all shoreline protection measures would include construction of "fish dips" to allow for ingress and egress of aquatic organisms. Edwards (2006) examined breakwaters at Holly Beach that have caused sediment deposition, specifically low tide tombolos. Analysis of survey data and tracer data indicated that the beach/breakwater system is in a state of dynamic equilibrium at high tide, and

static equilibrium at low tide. Indirectly, the breakwaters would help to 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 inland of the Gulf shoreline. The Gulf shoreline restoration measures Calcasieu River to Freshwater Bayou Measures (6b1, 6b2, and 6b3) would prevent new openings from forming between the Gulf and these inland water bodies.

Chenier Reforestation: 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. Following reforestation efforts, the best available practical techniques and best management practices (BMPs) would be used to restore the shoreline to pre-construction conditions.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Direct and indirect impacts are the same as MB impacts of RP.

3.3.4 Vegetation Resources

HSDRR (NED) Plans

Modified Plan 8 Alternative – Nonstructural 0-25-Year Floodplain Plan (RP)
Implementation of the NED RP takes place at residential and commercial sites that have been previously disturbed. There could be some direct or indirect impacts to existing vegetation resources, such as landscaping vegetation, during construction of nonstructural measures. Best available practical techniques and BMPs would be used to avoid impacts vegetation resources.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative – Comprehensive Small Integrated Restoration Plan (RP)
The RP would restore/nourish/protect acreage in the CSB and the MB.

Marsh Restoration: These measures would restore and/or nourish saline marsh and brackish marsh in both the CSB and the MB. Of these totals, saline marsh and brackish marsh would be temporarily impacted in the CSB and the MB from access required for borrow deposition. See Table 2-17 (chapter 2) for linear feet and acres of dredge pipeline access and flotation channels. These areas would be restored to pre-construction conditions following completion of the restoration activities. 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 (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 when tallow trees could invade). See table 2-17 (Chapter 2) for quantities of acres of marsh restored and nourished.

Coastal Restoration Projects Impacted by NER RP Measures: The NER RP measures would be constructed in the immediate vicinity of existing coastal restoration projects See Figure 3-1 for a depiction of existing coastal restoration projects listed in Table 3-4. Specific NER RP marsh restoration measures that could impact existing restoration projects include:

- Marsh Restoration Measure 3c1 (Figure 3-2) is immediately adjacent to Project CS-54 (Cameron-Creole Watershed Grand Bayou Marsh Creation).
- Marsh Restoration Measure 124c (Figure 3-3) would is immediately adjacent to Project CS-59 (Oyster Bayou Marsh Creation and Terracing).

Due to the close proximity of construction, the proposed NER RP measures would be constructed to avoid existing coastal restoration projects by construction of temporary containment/exclusion dikes that would

contain dredged borrow sediments used for construction of the NER RP measure and also prevent dredged effluents from entering the existing coastal restoration project sites. Temporary containment/exclusion dikes would be allowed to degrade naturally to restore connectivity with surrounding areas or they would be degraded by this Project's non-Federal Sponsor in the third year following completion of construction, whichever first occurs. Following completion of marsh restoration, the NER RP measures and existing restoration projects would synergistically interact to provide higher quality transitional marsh habitats in the area

Mitigation Projects Impacted by the NER RP Measures: Mitigation projects (e.g., the creation of marsh and marsh terraces) are designed and constructed to offset anticipated losses from permitted activities. In some instances, NER RP measures would overlap and impact existing mitigation projects. When overlap occurs, NER measures would not be constructed until the mitigation projects satisfy their permitted obligations (see Chapter 4 for NER measure implementation details). Mitigation Manger Kelley Templet with the LADNR, Office of Coastal Management, identified for the PDT existing mitigation projects in the study area constructed by various companies (e.g., oil and gas, Union Pacific, and others) and are designed and constructed to offset unavoidable anticipated losses to wetlands from permitted activities. Figure 3-4 depicts the location of mitigation projects in the area. In most instances, these mitigation projects were developed to provide a sustainable buffer from wave action and storm surge generated by tropical storm and hurricane events. Where overlap occurs, proposed NER RP measures would not be constructed until the mitigation projects satisfy their permit obligations. The permitted mitigation projects, the anticipated expiration date of the mitigation permit, and the specific NER RP measure that would overlap some portion of the permitted mitigation project is provided in Table 3-5. Impacts to the mitigation projects would be avoided by tiering construction of NER RP features until after the mitigation permit obligations have been satisfied.

Shoreline Protection: These measures would protect barrier island habitat in the CSB and saline and 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. See table 2-17 (Chapter 2) for quantities of length and project details associated with each shoreline protection measure. The NER RP shoreline protection measure 5a (Holly Beach Shoreline Stabilization-Breakwaters) would be located immediately offshore of the projects CS-31 (Holly Beach Sand Management) and CS 33 (Cameron Parish Shoreline). Construction of Measure 5a would work synergistically with these existing restoration projects by providing additional protection to inland marsh resources.

Chenier Reforestation: Measures would reforest chenier forests in the CSB and MB. Measure CR is a series of chenier ridge reforestation features located along existing chenier ridges situated within Cameron and Vermilion Parishes (see NER Fact Sheets Appendix K). Reforestation would help ensure the viability of the cheniers into the future thereby offering continued natural protection to sensitive chenier areas. The measure would consist of invasive species control and planting native species seedlings to achieve a 50 percent canopy cover. Prior to planting, an application of 64 ounces of Clearcast® would be sprayed over the top of hardwoods to control invasive species, primarily Chinese tallow (*Triadica sebifera*), if needed. 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. It is not anticipated that the use of the herbicide would result in any adverse impacts to water quality resources.

Up to 50 percent of the measure acreage would be planted with live oak (*Quercus virginiana*) and hackberry (*Celtis occidentalis*). Bare-root seedlings would be planted on 10x10-foot spacing (435 trees per acre), which assumes 57% survival. For a given planting, a minimum of 250 seedlings/saplings per acre must be present (with a 60 to 40 hard mast to soft mast ratio) at the end of the fourth year (i.e., Year 5) following successful attainment of the one year survivorship criteria. Trees established through natural recruitment may be included in this tally; however, no less that 125 hard mast-producing seedlings per acre must be present. Surviving hard mast seedlings must be representative of the species composition and percentage identified in this Plan. Exotic/invasive species may not be included in this tally. By Year 5 (four years following successful attainment

of the one-year survivorship criteria) the perimeter would be virtually free (approximately 5% or less on an acre-by-acre basis) of exotic/invasive vegetative species.

Fencing would be installed to exclude cattle and reduce deer herbivory. Fencing would be 7.5 feet tall, and fence posts would be installed in concrete with a small tractor using an auger bit and portable cement mixer. Approximately 150,000 linear feet of fencing would be required, however fencing would not be required for the CR-509c and CR-509d measures, since they are located in a remote area along the coast where there is currently no cattle grazing.

The developing plant community must exhibit characteristics and diversity indicative of a viable native forested chenier. The proposed reforestation would provide critical stopover habitat for migratory neotropical birds. See table 2-17 (Chapter 2) for planting details associated with the chenier reforestation feature. The proposed reforestation would provide critical stopover habitat for migratory neotropic 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.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the RP.

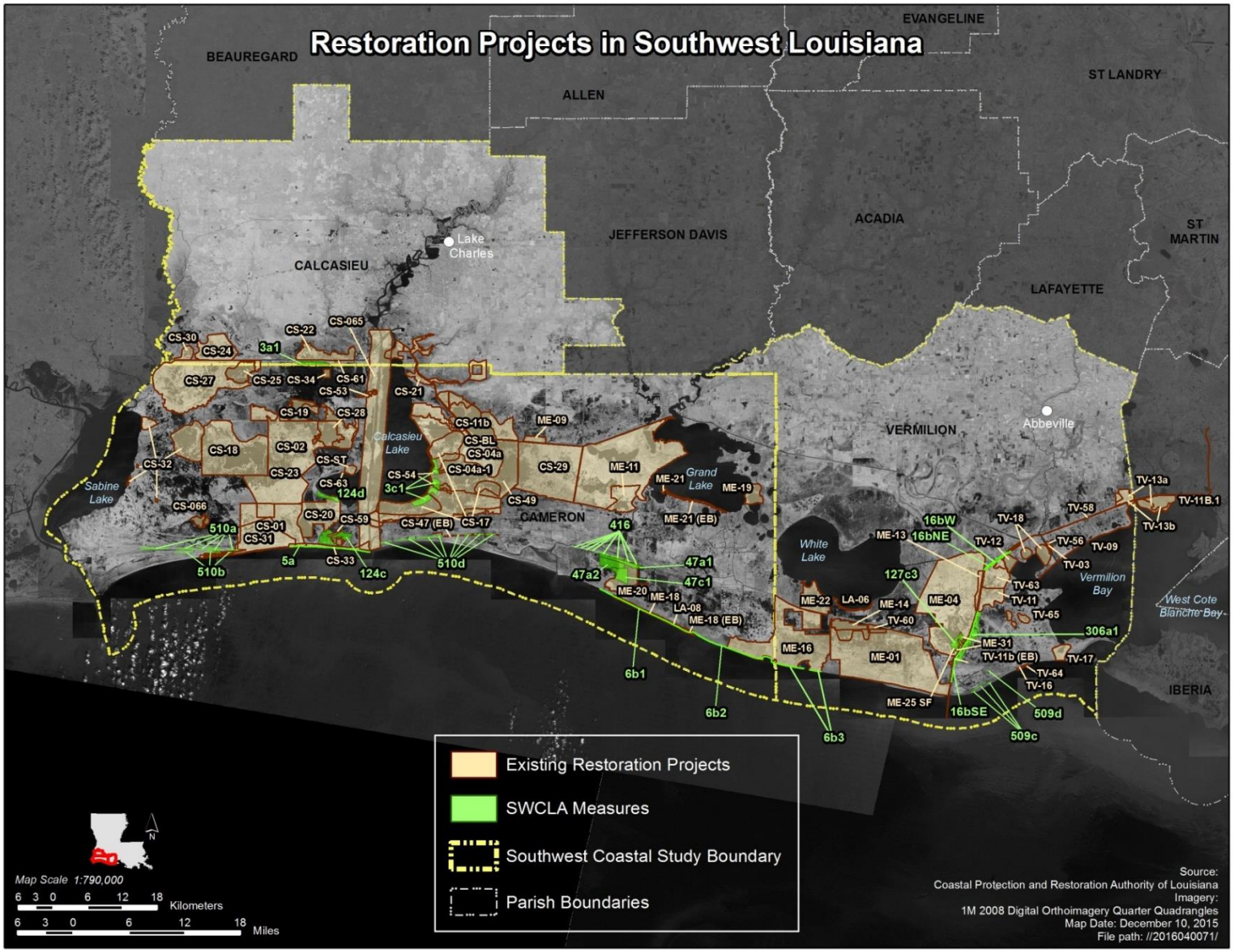

Figure 3-1. Ecosystem Restoration Activities and proposed NER RP Projects in Southwest Coastal Louisiana Project Area.

Table 3-4. List of Ecosystem Projects Displayed in Figure 3-1. (*projects would be impacted/benefitted by the NER RP measures)

CS-01 Holly Beach Breakwaters Project
CS-02 Rycade Canal Marsh Management
CS-04a Cameron-Creole Maintenance
CS-04a-1 Cameron-Creole Structure Automation
CS-11b Sweet Lake/Willow Lake Hydrologic Restoration
CS-17 Cameron Creole Plugs
CS-18 Sabine National Wildlife Refuge Erosion Protection
CS-19 West Hackberry Vegetative Planting Demo
CS-20 East Mud Lake Marsh Management
CS-21 Highway 384 Hydrologic Restoration
CS-22 Clear Marais Bank Protection
CS-23 Replace Sabine Refuge Water Control Structures
CS-24 Perry Ridge Shore Protection
CS-25 Plowed Terraces Demonstration
CS-27 Black Bayou Hydrologic Restoration
CS-28-1 Sabine Refuge Marsh Creation, Cycle 1
CS-28-2 Sabine Refuge Marsh Creation, Cycle 2
CS-28-3 Sabine Refuge Marsh Creation, Cycle 3
CS-28-4-5 Sabine Refuge Marsh Creation, Cycles 4-5
CS-29 Black Bayou Culverts Hydrologic Restoration
CS-30 GIWW - Perry Ridge West Bank Stabilization
*CS-31 Holly Beach Sand Management (impacted by NER RP Measure 5a)
CS-32 East Sabine Lake Hydrologic Restoration
*CS-33 Cameron Parish Shoreline Restoration (impacted by NER RP Measure 5a)
CS-34 Marcantel Supplemental Beneficial Use Disposal Area
CS-47 Trosclair Road Repairs
CS-49 Cameron-Creole Freshwater Introduction
CS-53 Kelso Bayou Marsh Creation

CS-53 Kelso Bayou Marsh Creation
*CS-54 Cameron-Creole Watershed Grand Bayou Marsh Creation (impacted by NER RP Measure 3c1)
*CS-59 Oyster Bayou Marsh Creation and Terracing (impacted by NER RP Measure 124c)
CS-61 Brannon Ditch
CS-63 Sabine Shellbank Stabilization
CS-65 Calcasieu Ship Channel Salinity Controls
CS-66 Cameron Meadows Marsh Creation and Nourishment
CS-BL Blind Lake
CS-ST Sabine Terraces

LA-06 SP Foundation Improvements Demo
LA-08 Bio-Engineered Oyster Reef Demo

ME-01 Pecan Island Freshwater Introduction
ME-04 Freshwater Bayou Wetland Protection
ME-09 Cameron Prairie National Wildlife Refuge Shoreline Protection
ME-11 Humble Canal Hydrologic Restoration
ME-13 Freshwater Bayou Bank Stabilization
ME-14 Pecan Island Terracing
ME-16 Freshwater Introduction South of Highway 82
ME-18 Rockefeller Refuge Gulf Shoreline Stabilization
ME-19 Grand-White Lakes Landbridge Protection
ME-20 South Grand Chenier Marsh Creation
ME-21 Grand Lake Shoreline Protection
ME-22 South White Lake Shoreline Protection
ME-25 Marsh Creation Near Freshwater Bayou
ME-31 Freshwater Bayou Marsh Creation

TV-03 Vermilion River Cutoff Bank Protection
TV-09 Boston Canal/Vermilion Bay Bank Protection
TV-11 Freshwater Bayou Bank Protection
TV-11b Freshwater Bayou Bank Stabilization
TV-11b.1 Acadiana Gulf of Mexico Access Channel
TV-12 Little Vermilion Bay Sediment Trapping
TV-13a Oaks/Avery Canal Hydrologic Restoration, Increment 1
TV-13b Oaks/Avery Structures
TV-16 Cheniere Au Tigre Sediment Trapping Demonstration
TV-17 Lake Portage Land Bridge
TV-18 Four Mile Canal Terracing and Sediment Trapping
TV-56 Four-Mile Canal Storm Surge Reduction Construction
TV-58 Boston Canal
TV-60 Front Ridge Chenier Terracing/Protection
TV-63 Cole's Bayou Restoration
TV-64 Cheniere au Tigre
TV-65 Rainey Audubon Wildlife Sanctuary Earthen Terraces

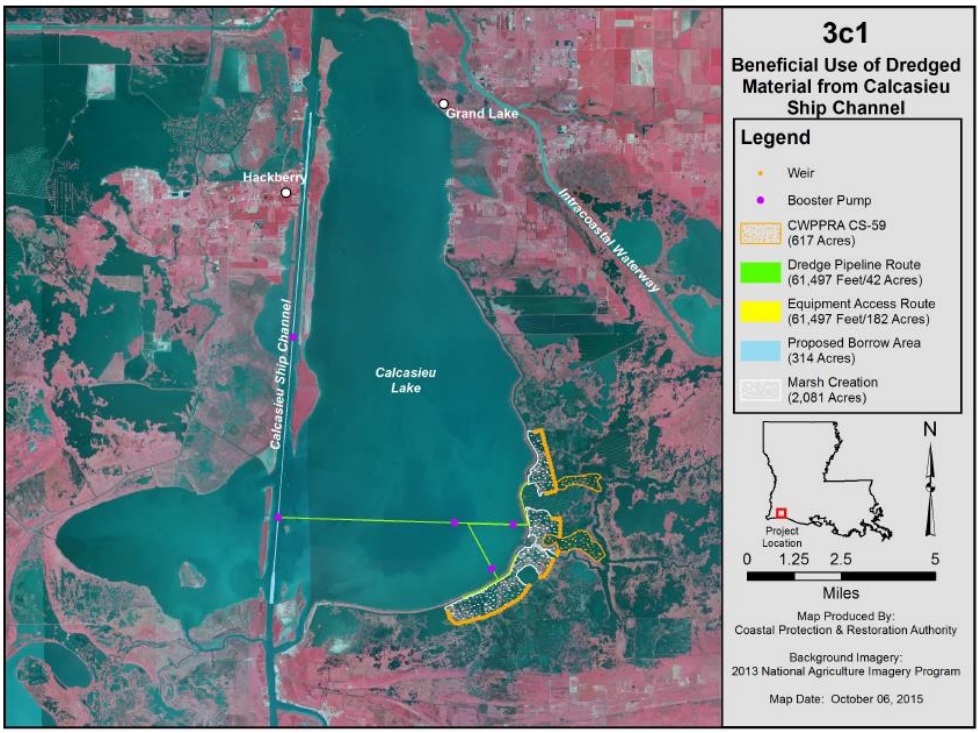

Figure 3-2. NER RP Measure 3c1 Adjacent to CWPPRA Project CS-54 Cameron Creole Watershed

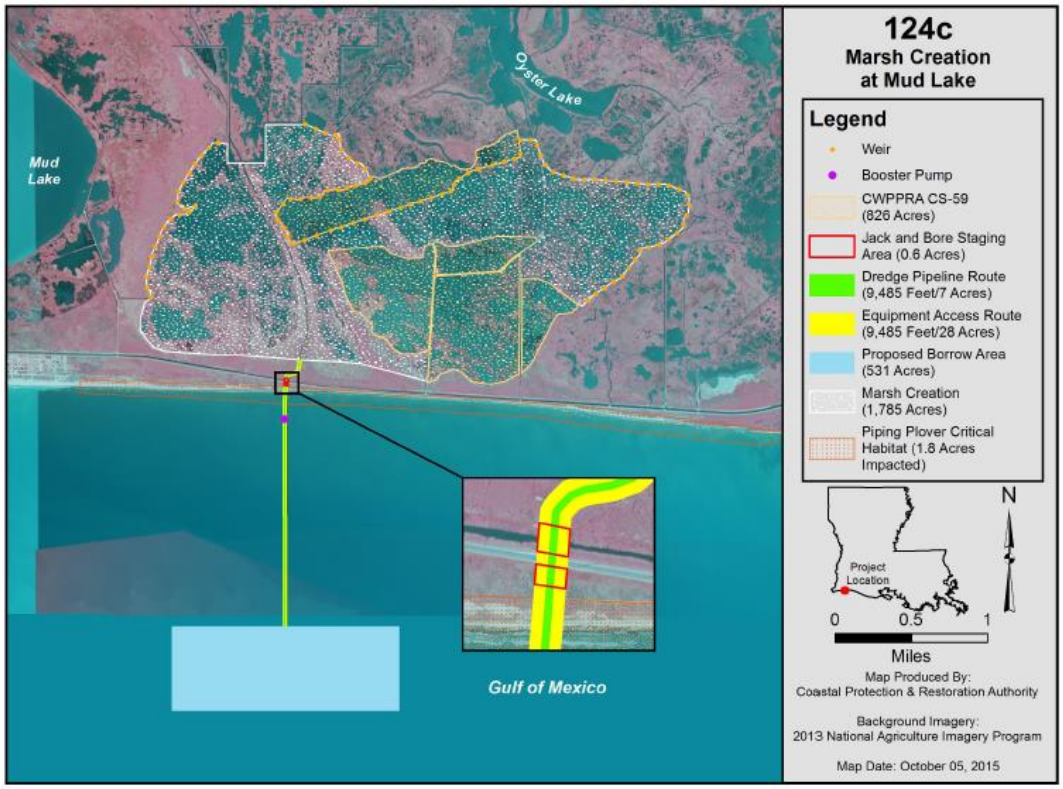

Figure 3-3. NER RP Measure 124c Adjacent to CWPPRA CS-59 Oyster Bayou Restoration

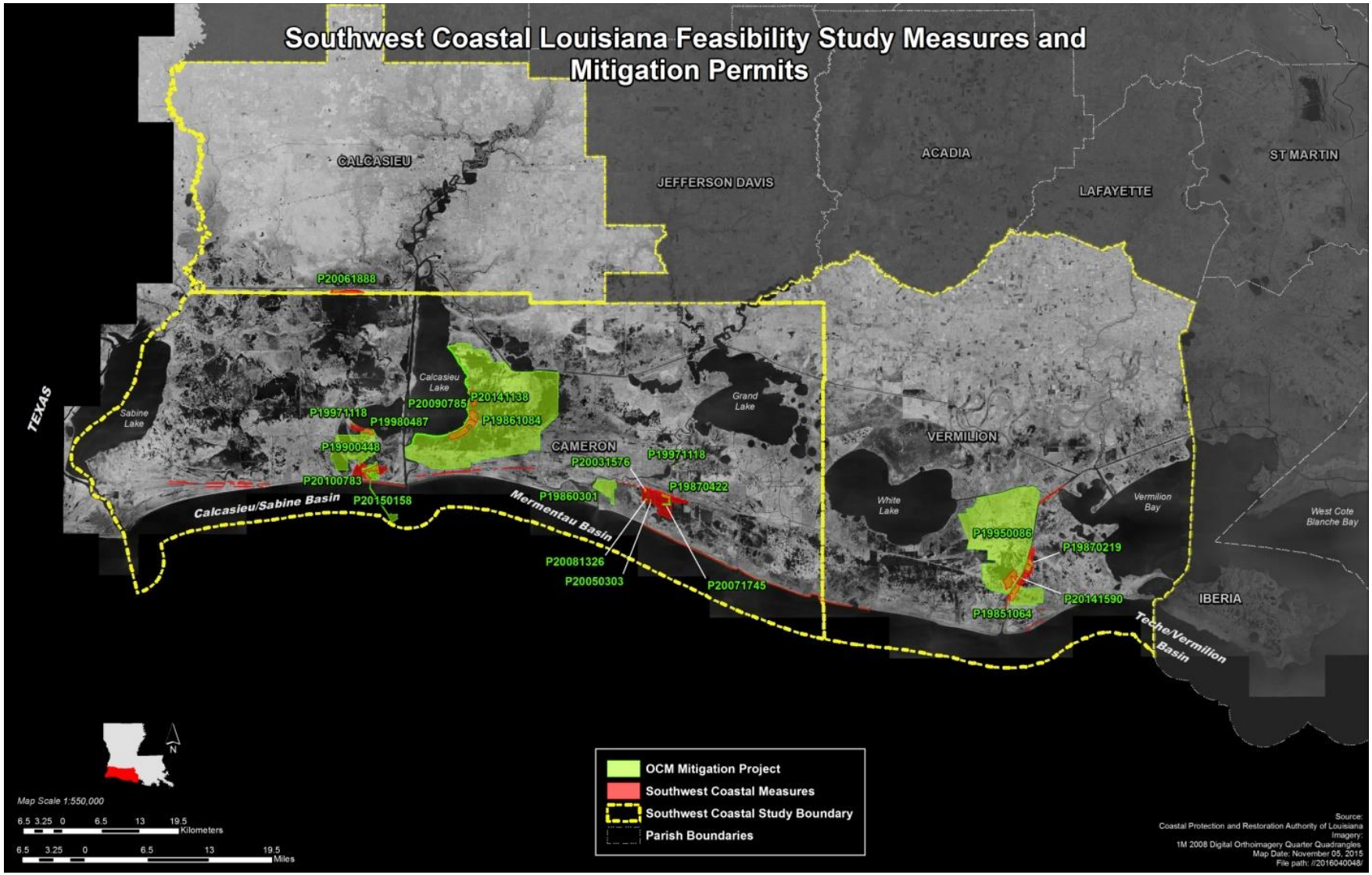

Figure 3-4. Permitted Mitigation Projects and Southwest Coastal Louisiana Study Measures

Table 3-5. Existing Mitigation Projects Impacted by NER RP Measures

Permit #	Description	NER RP Feature	Permittee or Owner	Expiration Date (permit completion date + 20 years)*	Mitigation Project Description
Tier I Features					
P20061888	Terraces at GIWW N of Black Lake	3a1	Gulfport Energy Corporation	11/30/2032	Proposed construction of 5,358 linear ft of terraces south of the GIWW and north of Black Lake.
P19900448	Marsh Management Plan area	124d	Apache Louisiana Minerals	11/13/2016	Install and maintain water control structures for CTU 1 and 2. In CTU 1, 64,000 linear ft of smooth cordgrass plantings. In CTU 2, 32,470 linear ft of boundary levee are to be repaired. Various water control structures are to be repaired or replaced.
P19971118	West Cove Planting Project	124d	Union Pacific Resources	7/28/2022	West Cove Planting Project; 5,000 ft of plantings of *Spartina alterniflora*.
P19950086	Marsh Management Plan area	127c3	Vermilion Corporation	4/1/2021	Eight water control structures will be installed; a riprap levee will be constructed; five double flapgated culverts and one earthen plug will be installed; two earthen plugs will be constructed.
Tier II Features					
P20141590	Spoil Placement	306a1	Hilcorp Energy Company	4/8/2040	Dredging of 15,430 cubic yards of native material to construct slip for the purpose of installing a drill rig, well protector and pilings. The dredged material will be pumped into a shallow pond adjacent to the proposed drill site using a temporary discharge pipe. An additional 301 cubic yards of material will be displaced to construct containment berms.
Tier III Features					
P20141138	Rip-rap Grand Bayou	3c1	CPRA	1/29/2040	Installation of 21,000 tons of riprap along the Calcasieu Lake Shoreline near the Peconi, Mangrove and Grand Bayou water control structures.
P19870422	Marsh Management Plan area	47a2	T. Bonsall	2/3/2023	Construction of a levee and multiple water control structures (South of Upper Mud Lake).
P20031576	Mitigation for P20031304	47a2	Kash Oil & Gas, Inc.	3/31/2029	Constructed 4,803 linear feet of terraces and planted with *Spartina alterniflora*.
P20081326	Mitigation for P20080132	47a2	PetroQuest Energy, L.L.C.	11/25/2033	Construct and plant 2,897 linear ft of wave dampening terraces that will capture re-suspended sediments and protect fragile shorelines by planting plugs of smooth cordgrass on both sides of constructed terraces.
P20071745	Mitigation for 20070883	47c1	Manti Operating Company	3/5/2025	Construction of ten 500-foot terraces, eight 300-foot terraces, two 200-foot terraces and eight 400-foot terraces (6.1 acres). Plantings of *Spartina alterniflora* rows on each side of the terraces.
*Expiration Date: if permit completion date is greater than 20 years, then implementation of measure would be similarly delayed.					

3.3.5 Wildlife Resources

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)

No significant impacts to most wildlife resources except commensal vermin (e.g., rats, mice, pigeons, etc.) that thrive in association with human habitations and, which, typically disrupt the natural habitats

Ecosystem Restoration (NER) Plans

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

Marsh Restoration: Shallow open water would be restored to brackish marsh and saline marsh in the CSB, and open water would be restored to brackish marsh in the MB. Additional nourishment could occur adjacent to the marsh restoration sites. The CEMVN has determined that the proposed action "may affect but will not likely adversely affect" the Sprague's pipit and would have no effect on the red-cockaded woodpecker or critical habitats and would not adversely impact other species of concern that could potentially be found in the Project area. See table 2-17b (Chapter 2) for feature details associated with each marsh restoration measure.

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 measures 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.

Shoreline Protection: The installation of segmented offshore breakwaters and shoreline 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. The potential for unintended adverse consequences, such as alteration of sedimentation patterns, associated with shoreline protection measures has been assessed and determined not significant. Some existing habitat would be converted to rock revetment thereby reducing the available wetland habitat for wildlife species and 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. See table 2-17b (Chapter 2) for specific feature details associated with each shoreline protection measure.

Chenier Reforestation: Existing chenier habitat in the CSB and the MB would undergo invasive species control and reforestation with construction of the proposed action. See table 2-17b (Chapter 2) for specific feature details associated with chenier reforestation features. 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 measures during construction, but would quickly return once construction is complete.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts to wildlife resources would be similar to those discussed for the NER RP except to a lesser extent.

3.3.6 Fisheries and Aquatic Resources

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan)
The nonstructural measures should have no direct, indirect, or cumulative impacts to these resources.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (RP)
Marsh Restoration: Impacts in the construction footprint, and construction activities using earthen materials to restore and nourish marsh would directly impact fisheries and aquatic resources by the elimination of benthic, oyster, and fishery habitat or the conversion of shallow open water habitats to less valuable deep water borrow areas. Additionally, direct mortality or injury of fisheries and benthic species could occur due to burial or increased turbidity. Borrow areas are identified from Calcasieu Ship Channel, and the Gulf of Mexico. See table 2-17b (Chapter 2) for borrow quantities associated with each marsh restoration measure. 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 two main limiting factors in SAV colonization are depth and turbidity, not seed source. When marshes are restored the shallow open water that is left is more conducive for SAV colonization due to the shallower depth. Also due to the marsh the fetch is reduced so turbidity is reduced thus improving the likelihood of SAV colonization. The conversion of open water to marsh is generally considered a benefit to aquatic species.

During marsh restoration, effluent from the dredge discharge pipe would be directed to adjacent fragmented marsh for nourishment. Dredging and construction activities would smother sessile and slow-moving benthic and suspension/filter feeders and force more mobile fish and aquatic organisms to move from the dredging, disposal and construction areas. It is expected that benthic and suspension/filter feeders would re-colonize the newly deposited dredged material at marsh restoration sites within 1-3 years due to its similarity with the existing substrate in the disposal areas. The conversion of shallow open-water to marsh habitat would prevent some larger fishery and aquatic organisms from immediately re-entering the disposal area (marsh restoration/nourishment sites). Following dredging and construction activities, larger fishery and aquatic organisms would gain access to the newly restored marsh and tidal pools during normal water flows and tides. Marsh is considered to have a higher ecological value than shallow open-water in this coastal ecosystem that is presently experiencing widespread coastal land loss.

Benthic, plankton, suspension/filter-feeding species, visual predators and other fishery and aquatic organisms could have short-term and localized adverse indirect effects caused by increased turbidity, total suspended sediments, and water temperatures and lower dissolved oxygen levels from dredging and construction. Benthic organisms could be smothered. Suspension/filter feeding organisms could be impacted due to clogging of the gills and feeding mechanisms which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate at catching prey due to lower visibility levels. Mobile species would be forced to relocate away from the dredging and construction area. Following dredging and construction activities, turbidity and suspended sediment levels, water temperature, and dissolved oxygen levels would return to pre-construction conditions. These temporary and localized impacts would be minimized and controlled by utilizing the best available practical techniques and BMPs during construction.

Waterbottoms used for borrow could cause the conversion of shallow open water habitats to less valuable deeper water borrow areas. Depending on the depth of the borrow area, this deeper water habitat could over the long term provide a refuge during extreme water temperature spikes. It is not anticipated that dredged borrow sites would cause hypoxic conditions. In addition there would be a short term direct adverse impact to

benthic species as well as the habitat of other aquatic species as 953 acres of water bottom is deepened and then refilled for the temporary floatation access 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. Restored transitional estuarine marsh habitats and increased SAV could have positive indirect impacts on juvenile fishes, shrimp, crabs, and other species by increasing EFH which provides food and cover to the area. The conversion of open water to marsh is generally considered a benefit to aquatic species. See table 2-17b (Chapter 2) for specific feature details associated with each marsh restoration measure. The best available practical techniques and BMPs would be utilized during construction to avoid, minimize and reduce potential adverse impacts to fishery and aquatic organisms.

Shoreline Protection: Impacts in the construction footprint would include the elimination of benthic and fishery habitat and the conversion of existing sandy shallow open water habitats to rock habitat which will only partially be submerged. Additionally, shallow mud bottoms would be converted to rock with the MB components in Fortify Spoil Banks of the GIWW and Freshwater Bayou measure. There would be a short-term direct adverse impact to benthic species as well as the habitat of other aquatic species as water bottoms are deepened and then refilled for the temporary floatation access 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 temporary flotation access area during the construction. There could also be short-term indirect adverse impacts to plankton, benthic populations, suspension/filter-feeders and other fisheries caused by increased turbidity, total suspended sediments, and water temperatures and lower dissolved oxygen levels from construction activities. Benthic organisms could be smothered. Suspension/filter feeding organisms could be impacted due to clogging of the gills and feeding mechanisms which could either cause death or reduce growth and reproduction. Visual predators would have a reduced success rate due to lower visibility levels. Mobile species would be forced to relocate away from the dredging and construction area. Following construction, turbidity and suspended sediment levels, water temperature, and dissolved oxygen levels would return to pre-construction conditions. These temporary and localized impacts would be minimized and controlled by utilizing the best available practical techniques and BMPs during construction. 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. See table 2-17b (Chapter 2) for specific feature details associated with each shoreline protection measure.

Chenier Reforestation: There would be no direct, indirect, or cumulative impacts on these resources.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts are the same as the MB component of the RP.

3.3.7 Essential Fish Habitat (EFH)

HSDRR (NED) Plans

Modified Plan 8 - Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
No direct, indirect, or cumulative impacts are expected to this resource from implementation of this action.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (RP)
Marsh Restoration: Both the CSB and MB components would convert open water and degraded marsh (combination of estuarine marsh and estuarine mud bottoms EFHs) to transitional, intertidal, estuarine marsh (marsh edge, SAV, marsh ponds, and inner marsh EFHs). See table 2-17b (Chapter 2) for specific feature details associated with each marsh restoration measure. 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. However, increases in SAV colonization would be limited by depth and turbidity, not seed source. When marshes are restored the shallow open water that is left is more conducive for SAV colonization due to the shallower depth. Also due to the marsh the fetch is reduced so turbidity is reduced thus the likelihood of SAV colonization. In addition, there would be a short term direct adverse impact to estuarine mud bottoms

as water bottoms are deepened and then refilled for the temporary floatation access channels. The floatation access for measure 3c1 would temporarily traverse the Calcasieu Lake Public Oyster Area with the dredge pipeline floated over the public oyster area, but no oyster reef EFH would be impacted by the measure. Any identified oyster reefs would be avoided. Dredging and construction activities to restore and nourish marsh would bury existing EFH substrates and temporarily change environmental conditions, including: short-term and localized increased turbidity, total suspended sediments, and water temperatures and lower dissolved oxygen levels in the water column. However, these effects would be short-term and localized and the area would return to pre-construction conditions following completion of dredging and construction activities. The proposed action would provide indirect positive effects by increasing SAV and estuarine marsh EFH. The CSB components and MB components would also nourish existing marsh and terraces in areas adjacent to the marsh restoration sites. There would be long term indirect positive impacts to marsh (marsh edge, SAV, marsh ponds, and inner marsh EFH). Waterbottoms identified for borrow include areas within the CSC and the Gulf of Mexico for the CSB. If the dredged material from the CSC 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. High-energy offshore Gulf borrow areas could naturally refill with material over time.

Shoreline Protection: Both the CSB 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 water bottoms are deepened and then refilled for the floatation channels. See table 2-17b (Chapter 2) for specific feature details associated with each shoreline protection measure.
Chenier Reforestations: Reforesting chenier ridges would have no direct, indirect, or cumulative impacts on EFH as these areas are far removed from waters with EFH. In addition, reforestation would use the best practical techniques and BMPs to avoid potential adverse impacts associated with non-point source storm water runoff associated with construction into adjacent marsh and water areas.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts would be same as the MB component of RP.

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

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
The CEMVN has determined that the proposed action "may affect but will not likely adversely affect" the Sprague's pipit and would have no effect on the red-cockaded woodpecker or critical habitats and would not adversely impact other species of concern that could potentially be found in the Project area. However, the presence, as define by the guidelines provided by USFWS, of threatened or endangered species would render that structure ineligible to participate in the project. Furthermore, direct impacts to species of concern would be avoided in accordance with the Bald and Golden Eagle Protection Act (BGEPA), MBTA, and the Marine Mammal Protection Act (MMPA) by implementing recommendations from USFWS and the National Marine Fisheries Service (NMFS) and utilizing the best available practical techniques and BMPs during construction to avoid, minimize and reduce potential adverse impacts to threatened and endangered species. Further consultation would occur as measures are implemented if construction has not been conducted within one year of signing the Record of Decision (ROD). Adverse direct and indirect impacts would be avoided in accordance with the Endangered Species Act (ESA), Bald and Golden Eagle Protection Act, the BGEPA, the MBT and MBTA and the use of best management practices (BMPs) (see also Appendix A) and recommendations from USFWS (see Appendix A, Annex G for final USFWS CAR). Potential minimal indirect impacts could occur to the candidate species, Sprague's pipit, including the temporary displacement of any birds that may be present during construction activity and noise. However, the best practical techniques and BMPs would be utilized during construction to avoid, minimize and reduce potential adverse impacts to this species. However, the presence of candidate species would render that structure ineligible to participate in the project.

Species of Concern: Depending on the final designs of the NED RP, 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 measures. 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

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

The CEMVN has determined that the proposed action "may affect but will not likely adversely affect" the piping plover or it's critical habitat, red knot, Sprague's pipit, West Indian manatee, Gulf sturgeon, loggerhead and Kemps Ridley sea turtles; would have no effect on the red-cockaded woodpecker, green, leatherback, and hawksbill sea turtles or loggerhead critical habitat and would not adversely impact other species of concern that could potentially be found in the Project area. Furthermore, direct impacts to species of concern would be avoided in accordance with the BGEPA, MBTA, and the MMPA by utilizing the best available practical techniques and BMPs during construction to avoid, minimize and reduce potential adverse impacts to threatened and endangered species (see Appendix A, Annex K for information on T&E species in the Project area and Annex G for recommendations from USFWS and the National Marine Fisheries Service (NMFS). Further consultation would occur as measures are implemented if construction has not been conducted within one year of signing the ROD.

Marsh Restoration: Potential temporary and minimal indirect impacts to the West Indian manatee, Gulf sturgeon and all sea turtles identified in Appendix A, Annex K. Temporary dredging and construction-related impacts would result, primarily from noise, water turbulence, increased turbidity, suspended total sediments, and water and the presence of workers in the marsh restoration sites, access routes and borrow sites. However, these typically mobile species would temporarily avoid the area where construction-related activity is taking place. Critical habitat for piping plover will be temporarily impacted by placement of the dredge pipeline coming from the Gulf borrow sites and crossing the beach as it is moved to more interior marsh restoration sites (measures 47a1, 47a2, 47c1 and 124c. See table 2-17b (Chapter 2) for impacts to critical habitat in acres associated with each marsh restoration measure. Timing of dredge pipeline placement and removal will be coordinated with USFWS. Loggerhead critical habitat would not be impacted as the borrow sites are within approximately three miles offshore. Beneficial impacts would be the increase in wetland habitat which is utilized by the whooping crane.

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 measures 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. See table 2-17b (Chapter 2) for flotation footprint of associated with each shoreline protection measure.

Chenier Reforestation: There could be potential minimal indirect impacts to Sprague's pipit if reforestation of grasslands occurred. It is assumed that the birds would relocate to adjacent or nearby suitable foraging/roosting area.

Species of Concern: There is the 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, Annexes K & Q). 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 measures. 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 shoreline protection measures, but with the utilization of the best management practices for reducing entrapment of this species (see Appendix A, Annex K), no indirect impacts are anticipated.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts to T&E resources would be similar to those discussed for the NER RP except to a lesser extent.

3.3.9 Cultural and Historic Resources

The following alternatives have the potential to impact cultural and historic resources, and the CEMVN has elected to fulfill its obligations under Section 106 of the NHPA of 1966, as amended, through the execution and implementation of two Programmatic Agreements as provided for in 36 CFR Part 800.14(b). (See Appendix A, Annex F). Cultural resources investigations and consultation would be required prior to implementing the recommended plans in order to identify cultural and historic resources, including historic properties, and assess potential impacts and/or adverse effects to historic properties. The CEMVN will seek ways to avoid, minimize, or mitigate any adverse effects on historic properties. The information provided below is detailed in the report titled *Cultural Resources Assessment and Research Design for the Southwest Coastal Louisiana Project, Calcasieu, Cameron, and Vermilion Parishes, Louisiana* (Wells and Hill 2016) on file with the Louisiana Division of Archaeology.

HSDRR (NED) Plan

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
There is the potential for direct and indirect impacts to previously recorded archaeological sites, buildings, structures, districts, and properties that may be of religious and cultural significance to Indian tribes, as well as any unrecorded cultural and historic resources that may be identified during subsequent cultural resource investigations.

The designated eligible NED RP structures have not been assessed for significance and NRHP eligibility. These structures and any additional resources located within an Area of Potential Effect (APE) will be identified and assessed following the determination of the APE for each participating NED RP structure. It is possible that some of the structures and other resources identified within an APE shall be considered eligible for listing in the NRHP. Four historic districts within the study area are listed in the NRHP, although none of the preliminarily eligible NED RP structures are located within the boundaries of an NRHP historic district. Thirty-six NRHP listed standing structures are located within the study area, most of which are located within a mile of one or more preliminarily eligible NED RP structures. Sixteen of the preliminarily eligible NED RP structures are located within the boundaries of a local historic district, 14 within the Downtown Development District of the Charlestown Cultural District and two within the Margaret Place Historic District, as designated by the City of Lake Charles.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (RP)
CSB - There is the potential for direct and indirect impacts to previously recorded archaeological sites, buildings, structures, and properties that may be of religious and cultural significance to Indian tribes, including 15 previously recorded archaeological sites and 39 previously inventoried standing structures, as well as any unrecorded cultural and historic resources that may be identified during the cultural resources investigations. Five historic cemeteries have also been documented in the vicinity of the proposed features. The previously recorded sites include one potentially eligible for listing in the NRHP, four not eligible for listing in the NRHP, and ten of undetermined eligibility. Of the 15 previously recorded sites, eight have prehistoric components, and seven have historic components.

Marsh Restoration: Eight sites have been recorded and 27 structures inventoried within a mile of the proposed features 3a1, 3c1, 124c, and 124d. Three prehistoric sites (two undetermined and one ineligible) are located within a mile of 3c1, and one ineligible prehistoric and four historic sites (three undetermined and one ineligible) are located within a mile of 124d. No resources have been recorded within the proposed borrow areas. High probability areas have been identified located within the boundaries of the marsh restoration features, and there is the potential that archaeological sites could be altered or destroyed by Project activities. If the USFWS obtains authorization and funding, then impacts of these measures to cultural resources would be the responsibility of the USFWS.

Shoreline Protection: One ineligible historic site has been recorded within a mile of the proposed feature 5a. There is the potential that archaeological sites could be altered or destroyed by Project activities.

Chenier Reforestation: Nine sites have been recorded and 11 structures inventoried within a mile of the proposed features 510a, 510b, and 510d. Two of the sites, one structure, and one cemetery are within or immediately adjacent to 510a, and three of the sites are within or immediately adjacent to 510d. Two prehistoric sites (one potentially eligible and one undetermined) and two historic sites (one undetermined and one ineligible) are located within a mile of 510a. Two prehistoric sites (one potentially eligible and one undetermined) and one ineligible historic site are located within a mile of 510b. Two prehistoric sites and three historic site of undetermined eligibility are located within a mile of 510d. Cheniers are high probability areas, and there is the potential that archaeological sites could be altered or destroyed by Project activities.

MB - There is the potential for direct and indirect impacts to previously recorded archaeological sites, buildings, structures, and properties that may be of religious and cultural significance to Indian tribes, including 22 previously recorded archaeological sites and 33 previously inventoried standing structures, as well as any unrecorded cultural and historic resources that may be identified during the cultural resources investigations. Two historic cemeteries have also been documented in the vicinity of the proposed features. The previously recorded sites include one eligible for listing in the NRHP, one potentially eligible for listing in the NRHP, four not eligible for listing in the NRHP, and 16 of undetermined eligibility. Of the 22 previously recorded sites, 20 have prehistoric components, and three have historic components.

Marsh Restoration: Nine prehistoric sites have been recorded and 17 structures inventoried within a mile of the proposed features 47a1, 47a2, 47c1, 127c3, and 306a1. Two of the sites are within or immediately adjacent to 306a1. Six prehistoric sites (one potentially eligible and five undetermined) are located within a mile of 47a1, and three prehistoric sites (one potentially eligible and two undetermined) are located within a mile of 47a2. Three prehistoric sites of undetermined eligibility are located within a mile of 306a1. No resources have been recorded within the proposed borrow areas. High probability areas have been identified within the boundaries of the marsh restoration features, and there is the potential that archaeological sites could be altered or destroyed by Project activities.

Shoreline Protection: Nine sites have been recorded within a mile of the proposed features 16b, 6b1, 6b2, and 6b3. Five of the sites are within or immediately adjacent to 6b2, including an NRHP listed site, and one site is within or immediately adjacent to 6b3. Three prehistoric sites of undetermined eligibility are located within a mile of 16b. Four prehistoric sites (one undetermined and three ineligible) and one NRHP listed historic site are located within a mile of 6b2. One prehistoric site of undetermined eligibility is located within a mile of 6b3. There is the potential that archaeological sites could be altered or destroyed by Project activities.

Chenier Reforestation: Eleven sites have been recorded and 39 structures inventoried within a mile of the proposed features 416, 509c, and 509d. Three of the sites, ten structures, one of which is potentially eligible for listing in the NRHP, and one cemetery are within or immediately adjacent to 416, and two sites are within or immediately adjacent to 509d. Eight prehistoric sites, one with a historic component (one potentially eligible and seven undetermined) and one ineligible historic site are located within a mile of 416. Two prehistoric sites of undetermined eligibility are located within a mile of 509d. Cheniers are high probability areas, and there is the potential that archaeological sites could be altered or destroyed by Project activities.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts would be the same as those described for the MB component of the RP.

3.3.10 Aesthetics (Visual Resources)

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
There would be minimal impacts on visual resources due to elevating residential structures. Most viewsheds would not significantly change when individual or small groups of residential structures are elevated. However, in those viewsheds with relatively homogenous low-elevated residential structures, elevating residential structures up to 13 feet may disrupt the symmetry of the existing viewshed. Under Louisiana Civil Code Art 701, the Servitude of View, the owner of the dominate estate has the right to prevent the raising of constructions on the servient estate that would obstruct the existing view.

Ecosystem Restoration (NER) Plans

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (RP)
Marsh Restoration: Construction of the marsh restoration measures would not adversely impact the Visual Resources. The primary difference is in how the marsh is restored. With the use of dredge material from the CSC, where impacts would be minimal, visual resources would be greatly and positively impacted. Those areas along the Creole Nature Trail would positively impact the byway creating enhanced view sheds for travelers. Other areas, such as those located along the Intracoastal Waterway and Freshwater Bayou Canal 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 would temporarily alter open water to bare mud flats, which may be considered aesthetically unpleasant. With dewatering and natural colonization of marsh plants, based on previous experience with beneficial use of dredged material and marsh restoration, it will take approximately one to three years before the marsh becomes fully established with vegetation.

Shoreline Protection: These elements do have public visual significance and their protection and restoration would add an element of form, line and color to the shoreline of Louisiana. 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.

Chenier Reforestation: Visually, these measures 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 viewshed 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 measures are located directly adjacent to the Creole Nature Trail and would considerably and positively add to existing design elements already described under marsh restoration.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan
Impacts would be the same as those described for the MB component of the RP.

3.3.11 Recreation

HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (RP)
There are no direct impacts from structure elevation on recreational resources. A direct impact from flood proofing park buildings is the recreational use would be temporarily unavailable during flood proofing 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

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

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.

Chenier Reforestation: 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.

Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan

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

3.4 Cumulative Impacts

The historic and existing conditions for the significant resources involving both the NED and NER plans are presented in Chapter 1. The direct and indirect impacts of the No Action Alternative (Future Without Project Conditions) on significant resources is also presented in Chapter 1. The direct and indirect impacts for each of the NED and NER Plans, as compared to the No Action Alternative, is presented in Chapter 3 (sections 3-1 to 3-3). Cumulative impacts are the effects on the environment that result from the incremental direct and indirect impacts of the proposed action 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 the proposed NER RP measures when added to other past, present and reasonably foreseeable future wetland restoration projects throughout the study area could significantly modify an entire basin's habitat diversity. The Council on Environmental Quality's (CEQ) "Considering Cumulative Effects Under the National Environmental Policy Act" (CEQ 1997) provides an 11-step framework for cumulative effects analysis (CEA) that was utilized to conduct the cumulative impact assessment for this study.

The following describes the cumulative effects or impacts for each alternative NED and NER plan by describing both the spatial (United States, Louisiana, and Study Area) and the temporal (past, present and reasonably foreseeable future (50-year period of analysis) actions of other nonstructural flood risk reduction and ecosystem restoration projects as compared to the impacts of the proposed actions presented in Chapter 3 (sections 3-1 to 3-3). The action detailed in this section are limited to those of the Federal, State and Local governments as there are no relevant private or pulic actions related to either the NED or NER actions.

3.4.1 HSDRR (NED) Plans

Modified Plan 8 Alternative - Nonstructural 0-25-Year Floodplain Plan (NED RP)

As described in detail in Chapter 4, the NED RP proposes implementing nonstructural measures across the 4,700 square mile study area to reduce coastal storm surge damages to 3,462 residential structures, 342 commercial structures and public buildings, and 157 warehouses through the combined voluntary elevation of residential structures, dry flood proofing of non-residential structures, and construction of localized storm surge risk reduction measures around warehouses. To assess the cumulative impacts for the NED RP, the incremental direct and indirect impacts of implementing the NED RP, as detailed in Chapter 3 above, are considered

together with other past, present and reasonably foreseeable future nonstructural risk reduction projects which are identified and described below. The cumulative impacts are summarized in Table 3-6.[1]

Nonstructural Risk Reduction Measures throughout the United States:

Contributions to national economic development (NED outputs) 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. Contributions to NED include increases in the net value of those goods and services that are marketed and also of those that may not be marketed. For any storm surge risk reduction plan, the NED outputs can be used to measure the cumulative effect to the Nation's economy. To that end, the cumulative effects can be seen in the thousands of miles of levees, nonstructural measures and hazard mitigation programs in place throughout the nation and the region. The measure of NED outputs within the study area would also contribute to the measure at the National level. Therefore there is no reason to perform computations of outputs beyond the study area.

Evaluations of the study alternatives eliminated all structural alternatives which could have had local, regional, or National environmental impacts. The remaining nonstructural alternatives developed eligibility criteria which eliminated any structure for which implementation of the nonstructural measure would have resulted in an impact to wetlands, threatened and endangered species, or the deposition of fill materials into the waters of the United States. For these reasons the evaluations of cumulative impacts is confined to the study area.

Reasonably foreseeable ongoing programs:

It is reasonably foreseeable that the FEMA Hazard Mitigation Assistance (HMA) (http://www.fema.gov/hazard-mitigation-assistance) grants programs would continue to 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 NFIP.

Nonstructural Risk Reduction Measures throughout Louisiana:

The conceptual 2012 State Master Plan recommends a comprehensive nonstructural program as part of its strategy to reduce the flood risk for Louisiana citizens. The 2012 State Master Plan's appendix F2 Nonstructural Implementation Strategy includes the following nonstructural strategies: 1) flood proofing of residential and commercial properties, 2) elevation of residential properties, and 3) voluntary Acquisitions of residential properties. In addition, programmatic measures such as land use planning, building codes, and education that can reduce risk to future buildings within communities will be integral to the nonstructural program (source: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwi_msiI0ovLAhVCWT4KHcrSD-sQFggqMAE&url=http%3A%2F%2Fcoastal.la.gov%2Fwp-

[1] The cumulative impacts of the Plan 8 Alternative – Nonstructural 100-Year Floodplain are similar to, but greater in scale, to the cumulative impacts identified in connection with the NED RP alternative because of the larger numbers of structures that would be included in the Plan 8 Alternative. Hence a discussion of the cumulative impacts associated with the Plan 8 alternative will not be further detailed.

content%2Fuploads%2F2014%2F03%2FAppendix_F2_NonstructuralStrategyFINAL.pdf&usg=AFQjCNE3WYY2tiNH924gwCffvwwbH8uLNA; accessed February 22, 2016).

Past and Present Actions:

Following Hurricanes Katrina, Lili, Rita, Gustav, Ike, and Issac many residents were required to meet certain building requirements to meet floodplain management ordinances. Some individuals met these building requirements at personal expense. Many others utilized the FEMA Hazard Mitigation Assistance (HMA) (http://www.fema.gov/hazard-mitigation-assistance) grants programs (including: HMGP, PDM and FMA programs) to provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from past, present and future disaster damages in Louisiana.

Nonstructural Risk Reduction Measures throughout the Study Area:

Past and Present Actions:

Within the study area the only known Federal program addressing reduction in damages from hurricane storm surge events is FEMA's Hazard Mitigation Assistance (HMA), as expressed in the FEMA Federal Insurance and Mitigation Administration (FIMA) policy guidance. The key purpose of Hazard Mitigation Grant Program (HMGP) is to ensure that the opportunity to take critical mitigation measures to reduce the risk of loss of life and property from future disasters is not lost during the reconstruction process following a disaster. HMGP funding is available, when authorized under a Presidential major disaster declaration, in the areas of the State requested by the Governor. Federally-recognized tribes may also submit a request for a Presidential major disaster declaration within their impacted areas (see http://www.fema.gov/media-library/assets/documents/85146). The amount of HMGP funding available to the Applicant is based on the estimated total Federal assistance, subject to the sliding scale formula outlined in Title 44 of the Code of Federal Regulations (CFR) Section 206.432(b) that FEMA provides for disaster recovery under Presidential major disaster declarations. As described in greater detail at the above referenced website, the following project types are eligible under the HMA programs:

- Property Acquisition and Structure Demolition;
- Property Acquisition and Structure Relocation;
- Structure Elevation;
- Mitigation Reconstruction; and
- Dry Flood proofing.

Table 40 in the Economic Appendix D indicates a total of 51,857 structures in the study area. Of these, 46,860 residential structures, 3,432 non-residential structures, and 1,565 warehouses are within the 100-year floodplain. Above the 100-year floodplain are 36,190 residential structures, 2,429 non-residential structures, and 835 warehouses that are above the 100-year floodplain. Many of these structures are located on naturally higher elevations. However, based on personal communications, some of the structures in the study area that are above the 100-year floodplain have already been elevated or subjected to other nonstructural risk reduction via FEMA grants or at personal expense. Personal communications with many different residents in the study area's Parishes of Calcasieu, Cameron and Vermilion during public meetings and hearings for the Draft and Revised Draft Integrated Feasibility Report and EIS revealed many of residents (total numbers unknown) have previously or are in the process of elevating their structures at personal expense or through grant assistance programs such as FEMA's Hazard Mitigation Assistance following Hurricanes Katrina, Rita, Gustave, and Ike. It is reasonably foreseeable that many of these self-proclaimed self-reliant residents would continue to stay in the area and raise their structures or take other measures to reduce hurricane storm surge damages. For example, in Calcasieu Parish 61 structures received residential mitigation grants in various forms, including: 24 structures were acquired; 22 structures were elevated; 5 structures were pilot reconstruction; 5 structures were wind retrofitted; 3 structures were provided shutters; 1 structure was provided drainage, and 1 structure was

provided roof repair (personal communication Laurie T. Cormier, Calcasieu Parish Police Jury, February 23, 2016).

Reasonably foreseeable ongoing programs:

There are ongoing programs within the region that may be implemented during the period of analysis, however, at the time of this report construction specific information is not available. A brief discussion of these programs follows.

As referenced above as an ongoing program throughout Louisiana, the conceptual 2012 State Master Plan recommends a comprehensive nonstructural program as part of its strategy to reduce the flood risk for Louisiana citizens. The 2012 State Master Plan's appendix F2 Nonstructural Implementation Strategy includes the following nonstructural strategies: 1) flood proofing of residential and commercial properties, 2) elevation of residential properties, and 3) voluntary Acquisitions of residential properties. In addition, programmatic measures such as land use planning, building codes, and education that can reduce risk to future buildings within communities will be integral to the nonstructural program (source: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwi_msiI0ovLAhVCWT4KHcrSD-sQFggqMAE&url=http%3A%2F%2Fcoastal.la.gov%2Fwp-content%2Fuploads%2F2014%2F03%2FAppendix_F2_NonstructuralStrategyFINAL.pdf&usg=AFQjCNE3WYY2tiNH924gwCffvwwbH8uLNA; accessed February 22, 2016).

Reasonably Foreseeable Actions:

There are no reasonably foreseeable nonstrucutral risk reduction projects/actions identified within the study area.

CEQ's recommends 11 Steps for Cumulative Effects Analysis. These steps are the end of this section. Some considerations specific to NED analysis are as follows:

- Regulatory thresholds have been identified (e.g., air quality and water quality standards) including the factors for managing and identifying cultural resources and the requirements (including age of the structure (50 years) that could trigger eligibility for listing on the national register of historic structures. This latter example is of particular importance considering the 50-year period of analysis due to the numerous structures in the area that could potentially qualify as a historic or national register structure over the course of the period of analysis.
- Generally, current trends in the human environment such as employment, business and industrial activity, and community and regional growth tend to mirror the increases demonstrated in populations and housing. Only Cameron Parish has had a population decline.
- During plan formulation the alternatives were modified, removed and new alternatives added to avoid, minimize and reduce potential significant Project-induced effects. For example several structural levees were considered but were later screened out due to a failure of benefits to exceed costs.
- For the NED RP, a notice of construction completion (NCC) for a participating structure would be provided to the non-Federal sponsor upon completion of the flood proofing measure for that structure. Although the non-Federal sponsor will have certain OMRR&R obligations, among other things, to inspect and to ensure no encroachment upon the Project purpose or functionality, there is no post construction monitoring or adaptive management for the NED RP. It is the responsibility of the owner to OMRR&R the flood proofing improvements to his/her property.

3.4.2 Ecosystem Restoration (NER) Plans

Coastal Ecosystem Restoration in Study Area:

The processes of coastal wetland loss in the Study Area can result from the gradual decline of marsh vegetation due to inundation and saltwater intrusion, as well as from storm surge events; both of which can eventually

lead to complete loss of marsh vegetation. 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. Table 1-10 displays land area changes in chenier plain basins from 1932-2010 (Couvillion et al. 2011). The effects of recent hurricanes have accelerated marsh loss. Table 1-11 includes estimates of wetland loss attributed to the major hurricanes of 2004 to 2008 in the Chenier Plain and throughout coastal Louisiana. More recently, Palaseanu-Lovejoy et al. (2013) estimated wetland loss in the Hackberry area located in the southwestern part of the chenier plain that was impacted by Hurricane Rita (2005) and Ike (2008). Persistent land loss in the Hackberry area due to Hurricane Rita was approximately 5.8% and increased by an additional 7.9% due to Hurricane Ike. It is expected that the chenier plain has sustained more persistent land loss with intermediate and brackish marshes experiencing the most land loss, while saline marshes were less impacted and fresh marshes showed evidence of vegetation seasonality change and regrowth, which concealed the hurricane impacts.

According to the Louisiana Recovery Authority's 2006 "The Rita Report", the devastation Hurricane Rita left behind made it the third most expensive natural disaster in US history (source: http://lra.louisiana.gov/assets/docs/searchable/reports/RitaReportFinal091806.pdf). The Rita Report estimated almost $600 million dollars of damage to agriculture, forestry and fishing. More than 200,000 acres of fresh water and intermediate marshland was inundated with saltwater threatening native species on already-threatened environmentally sensitive wetlands. Hence, the southwest coastal Louisiana area, like the remainder of coastal Louisiana has been and will continue to be subjected to stresses which will continue the decline of environmental resources.

It is anticipated that future conditions in the Study Area would include persistence of current sedimentation and erosion patterns. Existing hydrologic alterations would continue to affect water levels and salinities and continue influencing land loss at similar or increased rates. RSLR would expose additional shoreline areas to erosive forces into the foreseeable future. Table 1-18 displays net land area change projections by basins in the study area (Couvillion et al. 2013). The Study Area basins would experience the following net changes between 2010-2060: -146.5 km2 for Calcasieu/Sabine Basin, -146.5 km^2 for Mermentau Basin, and -67.0 km^2 for Teche/Vermilion Basin. These results suggest that a net wetland loss in coastal Louisiana as well as the Study Area over the next 50 years would likely occur regardless of uncertainties in parameters that influence coastal wetland loss.

Plan CM-4 Alternative - Comprehensive Small Integrated Restoration Plan (NER RP)

Cumulative impacts for the NER RP would be the incremental direct and indirect impacts of implementing the NER RP marsh restoration, shoreline protection and chenier reforestation measures (summarized below) in addition to other past, present and reasonably foreseeable future coastal and other ecosystem restoration projects described below. Alternative Plan: M-4– Mermentau Small Integrated Restoration Plan is a separable increment of the NER RP so impacts would be the same as described for the Mermentau Basin component of the NER RP. Therefore Plan M-4 is no longer discussed. Following presentation of other present and reasonably foreseeable ecosystem restoration programs and projects, the cumulative impacts are summarized in Table 3-6.

Over the 50-year period of analysis, the NER RP would protect, restore, and nourish a net total of 14,035 net acres of emergent marsh (including 7,900 net acres from the nine marsh restoration measures and 6,135 net acres from the five shoreline protection measures). At the end of the 50 year period of analysis, the marsh restoration and shoreline protection measures together would achieve a total net ecological benefit of 4,430 AAHUs; with 2,700 AAHUs from the nine marsh restoration measures, and 1,738 AAHUs from the five shoreline protection measures. Whereas the chenier restoration measures would restore a total of 1,413 net acres with 538 AAHUs. The positive cumulative impacts of implementing the NER RP would be the additive and, in some instances. the synergistic effects of restoring and nourishing sites over the 50-year period of analysis, an estimated 7,900 net acres and 2,700 AAHUs. The five shoreline protection measures would span approximately 251,528 linear feet, and are anticipated to protect/stabilize approximately 6,135 net acres and

1,738 AAHUs. Although not impacting waters of the United States, the approximately 1,413 net acres from 35 reforestation sites in Cameron and Vermilion Parishes would be reforested over the 50 year period of analysis, resulting in 538 AAHUs. The only significant long-term adverse cumulative impact of implementing the NER RP measures is the conversion of existing degraded marsh and shallow open water to transitional estuarine marsh habitat, breakwaters, and rocked shoreline protection habitats.

Coastal Ecosystem Restoration in the United States:

Dahl and Stedman (2013) reporting on the status and trends of wetlands in conterminous United States coastal watersheds from 2004 to 2009 indicate that in 2009, there were an estimated 41.1 million acres of wetlands in the coastal watersheds of the United States. This area represented 37.3 percent of total wetland area in the conterminous United States. Between 2004 and 2009, wetland area in the coastal watersheds of the United States declined by an estimated 360,720 acres. The average annual rate of change was an estimated loss of 80,160 acres, a 25 percent increase in the rate of wetland loss from the previous reporting period. The increase in the rate of coastal wetland loss was statistically significant ($p = 0.007$) when results from this study were compared to the coastal wetland loss estimates from the 1998 to 2004. Erosion and/or inundation are the primary causes of saltwater wetland losses in the Gulf of Mexico. In addition, saltwater impacts have been adversely affected by the cumulative effects of oil and gas development, hurricanes and other coastal storm events.

While the Coastal wetlands loss is occurring across the nation, and is significant as a national resource, the connections between other national coastal restoration projects and those occurring within the region is limited or nonexistent. For this reason, the resources of concern and the remainder of this analysis will focus on those resources within the study area and those that are transient to or affected by this study area.

Past and Present Actions: Regional, Louisiana, and Study Area

The below list is not exhaustive, but provides a representative sample of coastal ecosystem restoration efforts that cumulatively effect coastal wetland loss within the region. 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; which contributes to the success of neo-tropical migratory species (sources: http://www.nwd-mr.usace.army.mil/rcc/MRFTF/docs/USACE-NFPC%20Nonstructural%20Measures%20Definitions.pdf; and http://water.epa.gov/type/wetlands/restore/principles.cfm; accessed January 22, 2016).

- Coastal Impact Assistance Program (CIAP) is authorized by the Outer Continental Shelf (OCS) Lands Act, as amended; 31 U.S.C. 6301-6305. The intent of the program is to disburse funding to eligible producing states and coastal political subdivisions for the purpose of conservation, protection, or restoration of coastal areas including wetlands; mitigation of damage to fish, wildlife, or natural resources; planning assistance and the administrative costs of complying with these objectives; implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; and mitigation of the impact of outer Continental Shelf activities through funding of onshore infrastructure projects and public service needs. Louisiana's CIAP Program, administered by the Department of Interior, provides approximately $500 million dollars to Louisiana and includes a total of 103 projects state-wide, with 11 state projects, 17 state/parish projects and 75 parish projects. Examples of CIAP projects recently completed or under construction are presented below.
    - East Grand Terre Island Barrier Island Restoration
    - Barataria Land Bridge Dedicated Dredging created more than 2,000 acres of marsh
    - Marcantel Beneficial Use created 440 acres of marsh
- CWPPRA Program – There are currently 149 active CWPPRA projects throughout coastal Louisiana. In September 2015, 101 projects had been completed, benefiting over 97,401 acres. 21 projects are currently

under active construction with 22 additional projects approved and in the engineering and design phase of development (source: https://lacoast.gov/new/About/FAQs.aspx; accessed November 23, 2015).

- CS-04a Cameron-Creole Maintenance
- CS-11b Sweet Lake/Willow Lake Hydrologic Restoration
- CS-17 Cameron Creole Plugs
- CS-18 Sabine National Wildlife Refuge Erosion Protection
- CS-19 West Hackberry Vegetative Planting Demonstration
- CS-20 East Mud Lake Marsh Management
- CS-21 Highway 384 Hydrologic Restoration
- CS-22 Clear Marais Bank Protection
- CS-23 Replace Sabine Refuge Water Control Structures at Headquarters Canal, West Cove Canal, and Hog Island Gully
- CS-24 Perry Ridge Shore Protection
- CS-25 Plowed Terraces Demonstration
- CS-27 Black Bayou Hydrologic Restoration
- CS-28-1 Sabine Refuge Marsh Creation, Cycle 1
- CS-28-2 Sabine Refuge Marsh Creation, Cycle 2
- CS-28-3 Sabine Refuge Marsh Creation, Cycle 3
- CS-28-4-5 Sabine Refuge Marsh Creation, Cycles 4 and 5
- CS-29 Black Bayou Culverts Hydrologic Restoration
- CS-30 GIWW - Perry Ridge West Bank Stabilization
- CS-31 Holly Beach Sand Management
- CS-32 East Sabine Lake Hydrologic Restoration
- CS-054 Cameron-Creole Watershed Grand Bayou Marsh Creation
- CS-59 Oyster Bayou Marsh Creation and Terracing
- ME-04 Freshwater Bayou Wetland Protection
- ME-09 Cameron Prairie National Wildlife Refuge Shoreline Protection
- ME-11 Humble Canal Hydrologic Restoration
- ME-13 Freshwater Bayou Bank Stabilization
- ME-14 Pecan Island Terracing NMFS Sediment and Nutrient Trapping
- ME-16 Freshwater Introduction South of Highway 82
- ME-18 Rockefeller Refuge Gulf Shoreline Stabilization
- ME-19 Grand-White Lakes Landbridge Protection
- ME-20 South Grand Chenier Marsh Creation
- ME-21 Grand Lake Shoreline Protection
- ME-22 South White Lake Shoreline Protection
- TV-03 Vermilion River Cutoff Bank Protection COE Shoreline Protection
- TV-04 Cote Blanche Hydrologic Restoration
- TV-09 Boston Canal/Vermilion Bay Bank Protection
- TV-12 Little Vermilion Bay Sediment Trapping
- TV-13a Oaks/Avery Canal Hydrologic Restoration, Increment 1
- TV-14 Marsh Island Hydrologic Restoration
- TV-15 Sediment Trapping at "The Jaws
- TV-16 Cheniere Au Tigre Sediment Trapping Demonstration
- TV-17 Lake Portage Land Bridge
- TV-18 Four Mile Canal Terracing and Sediment Trapping
- TV-21 East Marsh Island Marsh Creation

- Louisiana Coastal Area (LCA), Ecosystem Restoration Study (USACE 2004) recommends 15 near-term measures aimed at addressing the critical restoration needs. The components recommended for authorization include five critical near-term ecosystem restoration measures, a demonstration program consisting of a series of demonstration projects, a beneficial use of dredged material (BUDMAT) program,

and a science and technology program. The five critical near-term ecosystem restoration measures, demonstration projects, and BUDMAT projects are all subject to the approval of feasibility level of detail decision documents by the Secretary of the Army. The January 31, 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. Some of the LCA projects have not yet been authorized for construction, and some of those that have been authorized for construction but no longer have a local non-federal sponsor. LCA projects that are completed or are currently under construction include:

- LCA West Bay Marsh Creation Tier 1 project, which is part of the LCA's Beneficial Use of Dredged Material (BUDMAT) Program
- LCA Baratarria Basin Barrier Shoreline Caminada
- LCA Baratarria Basin Barrier Shoreline Shell Island
- LCA Terrebonne Basin Barrier Shoreline Whisky Island
- LCA Amite Diversion Canal modification

- The 2012 Louisiana's Comprehensive Master Plan for a Sustainable Coast, (source: http://issuu.com/coastalmasterplan/docs/coastal_master_plan-v2?e=3722998/2447530; accessed November 23, 2015) indicates that the CPRAB has, since 2007:
  - Benefited 19,405 acres of coastal habitat
  - Moved over 150 projects into design and construction
  - Constructed projects in 20 parishes
  - Constructed 32 miles of barrier islands/berms
- USACE Navigation projects, Beneficial Use of Dredged Material Program

  The CEMVN removes, on average, about 75 million cubic yards (CY) of shoal material from Federal navigation channels every year. Of this annual total, about 19 million CY is removed from projects located too far from potential beneficial use disposal sites to be economically feasible. The Mississippi River Deep Draft Crossings account for about 18 million CY of this total of this annual total, about 16 million CY consists of "fluff" material that is not usable/suitable for marsh restoration the Atchafalaya River and Calcasieu River bar channels account for this "fluff" material. Thus, of the 75 million CY that the CEMVN dredges every year, only about 40 million CY are actually available for beneficial use placement.

  On average, about 16.0 million CY of dredged material is beneficially used on an annual basis. This equals about 40 percent of all dredged material removed annually in CEMVN that is actually available and suitable for beneficial use placement. The majority of this beneficial use is funded by the O&M budget. The remainder is paid for by CWPPRA, LCA BUDMAT, Continuing Authorities Program - Section 204, or by Contributed Funds depending on availability. To date (1976-2015), the CEMVN has used dredged material to create/restore:

  a. Approximately 61 square miles of coastal habitat in Louisiana.
  b. Approximately 32,623 acres of wetland habitat.
  c. Approximately 3,495 acres of bird nesting islands, beach/shoreline, and barrier island habitat.
  d. Approximately 3,000 acres of scrub/shrub, maritime forest ridge, grassland habitat (Southwest Pass).

  Channel-by-channel breakdown of beneficial acres created/restored by Federal navigation projects:

  a. Calcasieu River = 3,320 acres
  b. Mermentau River = 242 acres
  c. Freshwater Bayou = 344 acres
  d. Atchafalaya River = 8,996
  e. Houma Navigation Canal = 143 acres
  f. Port Fourchon = 309 acres
  g. Barataria Bay Waterway = 1,079 acres
  h. Tiger Pass = 624 acres
  i. Baptiste Collette = 1,828 acres

j. South Pass = 1,971 acres
k. Southwest Pass = 17,591 acres
l. MRGO = 2,591 acres
m. Berwick Bay Harbor = 59 acres
n. Tangipahoa River = 21 acres

- The State of Louisiana, Division of Administration, Office of Community Development, CDBG Program helps communities provide a suitable living environment and expand economic opportunities for their residents, particularly in low to moderate income areas. There are presently 10 different CDBG projects in coastal Louisiana, including levee repairs, water assimilation, bulkhead, flood control, and terracing projects. The scale of this program past and present is such that the cumulative impact in the region is not significant.
- The Mississippi Coastal Improvements Program (MsCIP) consists of structural, nonstructural and environmental project elements, including restoration of 1,280 square miles of Mississippi sound aquatic restoration 30,000 acres coastal habitat restoration. Some of the completed projects include (source: http://www.sam.usace.army.mil/Portals/46/docs/program_management/mscip/images/PlaceMap07Dec2015.jpg; accessed February 22, 2016):
  - Hancock County Beaches
  - Harris County Beaches
  - Hancock County Streams
  - Jackson Marsh
  - Gautier Coastal Streams
  - Franklin Creek Floodway
  - West Ship Island

  Projects with construction underway include:
  - Camille Cut
  - East Ship Island, South
  - Cat Island Restoration
- Houston-Galveston Navigation Channels, Texas (HGNC) project is a collection of beneficial uses sites under one project scope in Galveston Bay, Texas. The Port of Houston Authority and the US Army Corps of Engineers, Galveston District along with 6 local state and federal agencies developed a plan to contain the material dredged from the channel constructing 1,720 hectares (4,250 acres) of intertidal marsh and islands that supported vegetation and bird habitats.

Reasonably foreseeable ongoing programs: Regional, Louisiana, and Study Area

There are ongoing programs within the region that may be implemented during a period of analysis, however, at the time of this report construction specific information is not available. A brief discussion of these programs follows.

- Restoration of injuries to natural resources damaged by the 2010 Deepwater Horizon oil spill is presently under the Natural Resource Damage Assessment (NRDA), a legal process under the Oil Pollution Act of 1990 (OPA) and the Louisiana Oil Spill Prevention and Response Act of 1991 (LOSPRA) whereby designated trustees represent the public to ensure that natural resources injured in an oil spill are restored (source: http://la-dwh.com/AboutNRDA.aspx; accessed November 25, 2015). Both federal and state NRDA regulations provide a step-by-step process for trustees to determine injuries, to assess damages, and to develop and implement restoration projects that compensate the public for injuries to natural resources impacted by an incident. In general, the NRDA process involves three steps: (1) pre-assessment; (2) restoration planning; and (3) restoration implementation. On July 11, 2011, Governor Bobby Jindal unveiled the "Louisiana Plan" which outlines 13 initial proposed early restoration projects (source: http://la-dwh.com/LouisianaPlanProjects.aspx; accessed November 25, 2015). The projects are consistent with Louisiana's Coastal Master Plan and they support the goal of compensating the public for natural resource injuries resulting from the Deepwater Horizon Oil Spill.
  - On October 5, 2015, the Deepwater Horizon Natural Resource Damage Assessment Trustees released the Deepwater Horizon Oil Spill Draft Programmatic Damage Assessment and Restoration Plan and

Programmatic Environmental Impact Statement (PDARP/PEIS) for public review and comment (source: http://la-dwh.com/PDARP_PEIS/Draft_PDARP_PEIS.aspx; accessed November 25, 2015). The Trustees identified Alternative A as their preferred alternative. Alternative A is an integrated restoration portfolio that emphasizes the broad ecosystem benefits that can be realized through coastal habitat restoration in combination with resource-specific restoration in the ecologically interconnected northern Gulf of Mexico ecosystem. The restoration dollars could be used for a variety of restoration approaches. For illustration purposes only, the approximately $4 billion allocated to Louisiana could be sufficient to create 20,000 to 40,000 acres of coastal marsh in Louisiana along hundreds of miles of shoreline, supporting the diversity of fish, birds, and animals that depend on coastal marsh. Although no NRDA sponsored projects have yet been constructed, it is reasonably foreseeable that the nearly Gulf-coast wide damages would be mitigated.

- The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act) represents a portion of the Congressional response to the Deepwater Horizon oil spill. The Act dedicates 80 percent of all Clean Water Act administrative and civil penalties related to the Deepwater Horizon oil spill to the Gulf Coast Restoration Trust Fund (Trust Fund). RESTORE Act funds are allocated between five buckets: the Direct Component (35%), the Council-Selected Restoration Component (30%), the Spill Impact Component (30%), the Gulf Coast Ecosystem Restoration Science Program (2.5%); and Centers of Excellence Research Grants Program (2.5%). In early 2013, Transocean entered into a plea agreement to pay $1 billion to resolve federal Clean Water Act civil penalty claims, of which $800 million will be made available under the RESTORE Act to fund Gulf Coast recovery projects. The process of selecting projects for implementation under the RESTORE Act is anticipated to continue through the period of analysis, until the allocated funds are exhausted. Some projects have been selected and funded for implementation and will be discussed as a part of the reasonably foreseeable actions section below.

Reasonably Foreseeable Actions: Regional, Louisiana, and Study Area

The causes of coastal wetland degradation and loss have been researched extensively and are well documented. Nationwide coastal wetland degradation and loss is expected to continue due to many different, and often interacting factors, including: agriculture, nutrient enrichment, drainage, climate change, human development, silviculture, pollution, invasive species, world-wide eustatic sea level rise, subsidence, navigation channels, oil and gas activities, saltwater intrusion, hurricane and storms, and others. The EPA, reporting on the Nation, states the number of restoration projects grows yearly. Therefore, it is reasonably foreseeable, for this region, that future Federal, state and local initiatives will continue to call for a wide range of restoration actions, including coastal ecosystem restoration.

Couvillion et al. (2013) models for a 2010–2060 simulation period under a "future-without-action" condition, determined that coastal Louisiana is at risk of losing between 2,118 and 4,677 km^2 of land over the next 50 years. With the extensive coastal ecosystem degradation and coastwide land loss, it is anticipated future focus will be on the desire to implement coastal restoration projects designed to help offset these expected future coastal land losses. These projects could potentially be pursued under the CWPPRA Program, CIAP projects within Louisiana, Louisiana's Community Development Block Grant Projects (CDBG), Louisiana Coastal Area (LCA) Program, 2012 State Master Plan, State-sponsored projects, and WRDA. Reasonably foreseeable coastal ecosystem restoration projects in Louisiana include:

- The CIAP authorization is subject to a Federal fiscal cap. Within the limitations of its authorization, CIAP will continue to be implemented under the Outer Continental Shelf (OCS) Lands Act. The purpose of the program is to disburse funding to eligible producing states and coastal political subdivisions for conservation, protection, or restoration of coastal areas including wetlands; mitigation of damage to fish, wildlife, or natural resources; planning assistance and the administrative costs of complying with these objectives; implementation of a federally-approved marine, coastal, or comprehensive conservation management plan; and mitigation of the impact of outer Continental Shelf activities through funding of

onshore infrastructure projects and public service needs (source: http://www.saj.usace.army.mil/Missions/Environmental/EcosystemRestoration.aspx; accessed February 22, 2016).
  - PO-73-2 - Central Wetlands – EBSTP to A2
  - PO-148 - Living Shoreline
  - TE-63 - Falgout Canal Freshwater Enhancement
  - BA-0161 - Mississippi River Water Reintroduction into Bayou Lafourche
- The MsCIP will continue with structural, nonstructural and environmental project elements to restore coastal Mississippi. Future study elements that are as yet unfunded but included in Public Law 113-121 and may be reasonably foreseeable include the following (source: http://www.sam.usace.army.mil/Portals/46/docs/program_management/mscip/images/PlaceMap07Dec2015.jpg; accessed February 22, 2016):
  - Coast-wide Beach and Dune Restoration
  - Waveland Residential Flood proofing
  - Turkey Creek Ecosystem Restoration
  - Deer Island Restoration
  - Admiral Island Ecosystem Restoration
- The CWPPRA Program authorization has been extended to 2019. There are 22 projects in the engineering and design phase of development. It is therefore reasonably foreseeable that some CWPPRA projects that are presently in design will be authorized and constructed in the near future (such as).
  - PO-104 - Bayou Bonfouca Marsh Creation
  - ME-20 - South Grand Chenier Marsh Creation Project
  - CS-54 - Cameron-Creole Watershed Grand Bayou Marsh Creation
  - TE-72 - Lost Lake Marsh Creation and Hydrologic Restoration
  - CS-59 - Oyster Bayou Marsh Creation and Terracing
  - ME-21 - Grand Lake Shoreline Protection- Tebo Point
- The State of Louisiana, Division of Administration, Office of Community Development, CDBG Program helps communities provide a suitable living environment and expand economic opportunities for their residents, particularly in low to moderate income areas. There are presently 10 different CDBG projects in coastal Louisiana, including levee repairs, water assimilation, bulkhead, flood control, and terracing projects. The scale of this program past and present is such that the cumulative impact in the region is not significant.
  - TE-78 - Cut-Off/Pointe Aux Chene Levee
  - TV-60 - Front Ridge Chenier Terracing/Protection
  - TV-0067 - Bayou Tigre Flood Control Project
- Louisiana Coastal Area (LCA), Ecosystem Restoration Study (USACE 2004) recommends 15 near-term measures aimed at addressing the critical restoration needs. LCA Program — the USACE and the State will continue to partner to construct the Caminada Headland and Shell Island component of the Barataria Basin Barrier Shoreline project.
  - LCA BUDMAT Tiger Pass
- The Restore Act Council voted on Dec. 9, 2015, to approve the first round of Funded Priorities Lists of projects that it intends to fund with the Council-Selected Restoration Component of funds received from the Transocean settlement. Of the $241.4 million available for the current Council-Selected Restoration Component, the Council is approving approximately $156.6 million for funding this FPL, with approximately $26.6 million reserved for future activities.
  - Jean Lafitte Canal Backfilling
  - West Grand Terre Beach Nourishment and Stabilization
  - Golden Triangle Marsh Creation
  - Biloxi Marsh Living Shoreline
  - Mississippi River Reintroduction into Maurepas Swamp
  - Bayou Dularge Ridge, Marsh & Hydrologic Restoration

- NRDA: The Trustees identified Alternative A as their preferred alternative. Although no NRDA sponsored projects have yet been constructed, it is reasonably foreseeable that the nearly Gulf-coast wide damages would be mitigated. The following project has been selected for construction.
    - TE-100 - NRDA Caillou Lake Headlands

Impacts of the NER RP:

The primary impacts of the NER RP would be related to dredging and construction of the nine marsh restoration measures and the five shoreline protection measures and the reforestation of the 35 chenier reforestation measures. Dredging and construction related impacts are generally temporary and localized and include: increased turbidity and total suspended sediments, organic enrichment, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels. Following construction, these temporary and localized effects would return to pre-construction levels. The only significant long term adverse cumulative effects expected from implementing the NER RP measures would be associated with the conversion of existing fragmented marsh and shallow water bottom habitats to transitional estuarine marsh habitat and rocked shoreline protection habitats. However, conversion of fragmented marsh and shallow water bottoms to these transitional estuarine marsh habitat and shoreline protection habitat would provide greater long-term positive benefits when considered within the context of the ongoing extensive land loss throughout coastal Louisiana and the project area which is converting extensive areas of marsh to shallow open water.

a. Additional long term positive cumulative impacts would be related to restoring and protecting important, essential and in some instances critical habitats (e.g., piping plover) used by various terrestrial and aquatic organisms for shelter, nesting, feeding, roosting, cover, nursery, EFH and other life requirements; as well as local increases in productivity. The NER RP breakwater measures would provide protection to designated critical wintering habitat for piping plover which would work synergistically with other barrier shoreline restoration and protection features (e.g., State of Louisiana Caminada Headland Beach and Dune Restoration, Shell Island restoration; CWPPRA projects TE-27 and TE-50 Whiskey Island restoration and other barrier restoration projects). Increased recreational and commercial fishing opportunities provided by marsh restoration measures that would provide important, critical and essential habitats (e.g., piping plover) as well as protection of recreational marsh lands from wave erosion effects by the shoreline protection measures. The cumulative impacts of the proposed action would be a positive increase in visual resources, especially the viewscape, in the form of providing additional acres of marsh wetlands (and chenier ridge) in an area that is otherwise being degraded, fragmented and lost throughout the southwest coastal basin, coastal Louisiana, and the Nation. Restoration of marsh would convert existing view sheds of open water into marsh wetlands interspersed with large bodies of open water and use the basic design elements of form, line, texture, color, and repetition to create an aesthetically pleasing viewshed.

b. Recreation: Temporary negative impacts of marsh restoration activities due to 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 restoration measures help protect recreational resource lands from effects of coastal storm surge while improving recreational opportunities by enhancing the sustainability of valuable nursery habitats.

c. Visual resources: The continued relative sea level rise could potentially impact the entire area resulting in vast areas of shallow open water as vertical accretion rates fail to keep pace with rising sea levels. Impacts to visual resources would continue throughout not only the project area but coastal Louisiana and the Nation due to the loss of wetlands and conversion of existing habitats to open water habitats. However, wetland restoration efforts such as the CWPPRA, CIAP, and LCA Programs could restore partially the land, would convert existing viewsheds of open water into marsh, wetland, swamp 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 viewshed.

d. The historic modifications of coastal marshes for agricultural purposes (e.g., draining and filling) and their reclamation for domestic and industrial development have substantially reduced viable wetlands habitat area during the past century (Adam, 1990; Anderson et al., 1992). Longer term, indirect impacts are also

associated with some of these habitat disturbances. For example, the construction of impoundment dikes, water-control embankments, levees, dams for flood control, as well as canals and their associated spoil banks invariably alters the hydrology of these wetland systems, often interfering with normal tidal flooding and drainage, modifying overland water flow, decreasing sediment supply to the marsh surface, and arresting vertical accretion.

e. According to Orson et al. (1985) coastal wetlands can respond to increasing sea level rise in three ways: (1) coastline retreat if the rates of coastal submergence exceed the vertical accretion of the wetland surface; (2) remain stable if sediment input from interior regions equals the rate of coastal submergence so that surface elevations are maintained; or (3) they can expand both vertically and laterally if the rate of coastal submergence is less than the sediment accretion rate. The failure of coastal wetlands to keep pace with sea level rise is generally ascribed to insufficient sediment deposition on the wetland surface leading to accretion deficits (i.e., vertical accretion is less than relative sea level rise). Delaune et al. (1983) and others have documented that, throughout coastal Louisiana wetlands are being replaced at an alarming rate by shallow open water.

CEQ's recommends 11 Steps for Cumulative Effects Analysis. The following describes how the study is consistent with the CEQ's 11-step cumulative effects analysis for both the NED and NER Plans. Some considerations specific to NER analysis are as follows:

- Step 1: This document has identified in previous sections the significant effects and issues associated with implementing the proposed action by documenting the direct and indirect effects of the proposed action on significant environmental resources.
- Step 2: This document has identified the geographic scope of the analysis as the area consisting of Calcasieu, Cameron and Vermilion Parishes including the migratory species frequenting the geographic area.
- Step 3: The time frame of the analysis consisted of the historic, existing, future without project and future with project conditions for the identified significant natural and human environmental resources.
- Step 4: Other actions affecting the significant natural and human resources (the significant resources have been previously described).
- Steps 5 and 6: The responses of each identified significant resource to change has been documented for each identified significant human and natural resource, as have the factors or stressors potentially affecting significant human and natural resources, and if appropriate, their relationship to regulatory thresholds (e.g., air quality standards; threatened and endangered species and their designated critical habitat).
- Step 7: The baseline condition has been documented for each significant human and natural resources including the historic, existing, and future without project conditions (Chapter 1).
- Step 8: The incremental project-induced impacts would be in addition to impacts from other actions such as continued oil and gas exploration/extraction/production/refining, navigation, commercial and recreational fisheries, inhabitation and employment, other coastal protection and restoration activities, and other human activities in the project area.
- Step 9: The magnitude and significance of cumulative effects on identified significant resources are identified for:
  a. Study area influences,
  b. Region-wide influences on significant resources.
- Step 10: Theplan has been evaluated to ensure steps were taken to avoid and minimize impacts to significant resources. During plan formulation steps were taken to remove, modify or add alternatives to avoid, minimize, reduce, or mitigate potential significant effects.
- Step 11: Monitoring effects of the proposed action and adaptation of management are identified and described in the Adaptive Management and Monitoring (AM&M) Plan (see Appendix A Annex L).

This analysis considers known past, present, and reasonably foreseeable future nonstructural hurricane storm damage risk reduction projects and ecosystem restoration projects over a 50-year period of analysis from 2025 to 2075. Table 3-6 provides a summary of this cumulative impacts analysis.

Table 3-6 Summary of Cumulative Impacts

(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)

(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Population and Housing Levels	Risks of hurricane storm surge impacts continue to those not provided risk reduction by structural or nonstructural risk reduction measures. United States (US): Population and households increasing. Louisiana (LA): population in 1970 estimated at 3.645 million. Risks of hurricane storm surge impacts to those not provided risk reduction by structural or nonstructural risk reduction measures. Study Area (SA): 1970 populations and number of households in Calcasieu, Cameron and Vermilion Parishes is 196,680 with 57.2 thousand households	Risks of hurricane storm surge impacts continue to those not provided risk reduction by structural or nonstructural risk reduction measures. US: Population and households increasing. LA: 2015 populations increasing to 4,605 million. Continued coastal land loss and conversion to open water and loss of forested cheniers. SA: 2012 population 259,918 with 96.2 thousand households. Continued coastal land loss and conversion to open water and loss of forested cheniers.	Risks of hurricane storm surge impacts continue to those not provided risk reduction by structural or nonstructural risk reduction measures. US: Population and households increasing. LA: Increasing population and households in Louisiana. Continued coastal land loss and conversion to open water and loss of forested cheniers. SA: Increases population and households in Calcasieu, Cameron and Vermilion Parishes. Households likely continue. Risk of hurricane storm surge damages continue. Continued loss of brackish and saline marsh and forested chenier habitats.	US: Population and households increasing. LA: Increasing populations and households. Risks of hurricane storm surge impacts continue to those not provided risk reduction by structural or nonstructural risk reduction measures. SA: Hurricane storm surge related risks reduced for individual households and people located in the 25-year floodplain and in structures that volunteer to participate in nonstructural risk reduction measures. People and households associated with those structures not included in the proposed voluntary nonstructural risk reduction measures would continue to be at risk from hurricane storm surge risk reduction.	US: Population and households increasing. Continued coastal land loss and conversion to open water especially for coastal states. Offset by nationwide coastal restoration efforts. LA: Continued Louisiana coastal wetland loss and loss of forested cheniers offset by coastal restoration efforts such as CWPPRA, LCA, and others described in Sections 1.9 and 3.4. SA: Cumulative impacts would include incremental impacts of proposed action in the SA in addition to other ecosystem restoration throughout the basin, Louisiana, and the Nation being converted or restored from open water back to land mass. Similar projects include diversion projects, marsh, and swamp restoration and nourishment by CWPPRA, LCA and others described in Sections 1.9 and 3.4.
Employment, Business, and Industrial Activity (Including Agriculture)	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 for the region as a whole grew from 1970 through 2000.	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.	Employment is expected to continue to follow the same trend in the study area. However, businesses would face a higher risk of closing periodically due to damages sustained from hurricane storm-surge.	Would lower the risk that hurricane storm-surge damage would cause the businesses included in the recommended plan. This lower risk could shorten the amount of time businesses would need to close following a hurricane.	Land loss would be stabilized, which could result in localized positive effects of maintaining employment and businesses (e.g., recreational and commercial fishing), and industrial activity.
Public Facilities and Services	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.	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.	FWOP conditions would include a greater potential for permanent displacement of public facilities and services due to hurricane 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	Would reduce risk of hurricane storm surge-related damages for public facilities and services in the area thereby reducing the number of days a structure is unavailable for use and minimizing the inconvenience to the general public.	Plan CM-4 would have no cumulative impacts on public facilities or services.

Table 3-6 Summary of Cumulative Impacts
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Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-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.	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.	Portions of Interstate 10 and other highways and local roads will continue to be periodically damaged by hurricane storm surge.	Portions of Interstate 10 and other highways and local roads will continue to be periodically damaged by hurricane storm surge.	Would reduce the intensity of almost daily wind-generated wave action which erodes areas adjacent to Highway 82; would reduce the wave action which erodes the southern spoil bank along the GIWW from the south; would protect the shoreline of Freshwater Bayou through the placement of foreshore rock dikes;
Community and Regional Growth	Growth in the study area has been largely steady and follows population trends	Residents currently living in low-lying areas face the prospect of relocating due to the high risk of hurricane storm surge damage.	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.	Would include reduced risk of hurricane storm surge-related damages for those low-lying structures located in the 25 year floodplain thus reducing overall social vulnerability and preserving growth opportunities for communities in the region and enhancing the potential for long-term growth and sustainability.	Plan CM-4 would have no cumulative impacts on Community and Regional Growth.
Tax Revenues and Property Values	Tax revenues from property taxes tend to rise over time with the increase in property values.	Property values in the low-lying areas are likely not rising in value at the same rate as comparable properties facing a lower risk of sustaining hurricane storm-surge damage.	FWOP conditions would include lower tax revenues as property values decline due to higher risk of damage from hurricane storm surge events over time. Higher risk of damage from hurricane storm surge 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	For the properties included in the recommended plan, property values would stabilize as the higher risk of damage from hurricane storm surge is arrested and reduced.	Would facilitate the prevention of land loss, which could result in localized positive effects of maintaining tax revenues and property values

Table 3-6 Summary of Cumulative Impacts
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(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Other Social Effects	US: Severe storm surge events threaten the health and safety of residents living in coastal areas. Loss of life, injury, and post flood health hazards may occur in the event of catastrophic flooding. LA and SA: The study area was severely impacted by Hurricane Rita in 2006 and Hurricane Ike in 2008. When facilities that provide critical care or emergency services are impacted by storm surge events, residents are at an even greater risk for experiencing negative health outcomes. Hurricanes Rita and Ike reduced the accessibility and availability of health facilities and services and required additional first-responder (fire and police) protection.	US, LA and SA: Other Social Effects that storm surge has on communities include impacts to health and safety, economic vitality, social connectedness, vulnerability and resiliency and leisure and recreation. Many communities along the eastern seaboard and the gulf coast remain vulnerable to these social effects.	US, LA and SA: Social vulnerability is expected to increase over time if subsidence and sea level rise continue to occur, and the population of coastal communities 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 storm surge 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. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane and storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA and SA: Cumulative impacts include reducing the risks associated with damages to housing units, public facilities, and commercial structures during storm events as well as improving the health and safety of residents living within the study area. The study area's social vulnerability would be reduced under this alternative with the possible exception of populations unwilling to participate or unable to participate in the Project due to ineligible Project costs. Reduced social vulnerability leads to the potential for enhanced long-term growth and sustainability. Also, the area would be at a reduced risk of incurring the costs associated with clean-up, debris removal, and building and infrastructure repair as a result of storm surge events. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane and storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA and SA: Restoration projects 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, economic vitality, and reduced stress. Thus, the potential for long-term growth and sustainability would be enhanced. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane and storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts
(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)
(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Community Cohesion	US, LA and SA: 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. Many areas across the country, state and in the study area are 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 and social institutions were impacted which affected community cohesion.	US, LA and SA: Due to the absence of hurricane storm surge risk reduction measures, and the resulting direct impacts to existing structures, local populations are often forced to evacuate and/or relocate for significant time periods, thereby significantly disrupting temporarily, and in some instances, permanently, community cohesion.	US, LA and SA: Due to the absence of hurricane storm surge risk reduction measures, and the resulting direct impacts to existing structures, local coastal populations, which are projected to increase in the future, are often forced to evacuate and/or relocate for significant time periods, thereby significantly disrupting temporarily, and in some instances, permanently, community cohesion. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane and storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA and SA: Storm surge risk reduction measures could temporarily affect community cohesion due to 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 Project implementation. The nonstructural plan would provide positive benefits to the community and it's cohesiveness by reducing the risk of storm surge damage resulting in fewer evacuations or permanent displacement. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane and storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA and SA: Restoration impacts would include maintaining the integrity of the coastal landscape that supports ecosystem services that in turn supports human population and activities. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane and storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.
Environmental Justice	US, LA & SA: Institutional recognition of Environmental Justice because of Executive Order 12898 of 1994 (E.O. 12898) and the Department of Defense's Strategy on Environmental Justice of 1995, which direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations.	US, LA: 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.	US, LA & SA: Institutional recognition of Environmental Justice because of Executive Order 12898 of 1994 (E.O. 12898) and the Department of Defense's Strategy on Environmental Justice of 1995, which direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations.	US, LA: 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.	US, LA & SA: Institutional recognition of Environmental Justice because of Executive Order 12898 of 1994 (E.O. 12898) and the Department of Defense's Strategy on Environmental Justice of 1995, which direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations.

Table 3-6 Summary of Cumulative Impacts
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(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Flow and Water Levels	US & LA & SA: Flows and water levels respond to and are impacted by natural conditions such as hurricane storm surge and man-made conditions. Subsidence and eustatic sea level rise cause landward movement of marine conditions into estuaries, wetlands and fringing uplands.	US & LA: Increased flows and water levels associated with increased runoff due to increasing urbanization and wetland loss. Rate of RSLR increasing over historic conditions. SA: Water control structures 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. 1990 inventory identified 174 individual water control structures in the interior and along the perimeter of the Calcasieu-Sabine basin.	US & LA & SA: Increased hurricane storm surges; increased flows and water levels associated with increase urbanization and associated runoff and increased wetland loss. Rate of RSLR increasing over historic conditions. Existing and authorized structural and nonstructural hurricane storm surge damage risk reduction projects provide risk reduction. SA: Continued disjointed and uncoordinated operation of water control structures. There are no identified existing or authorized for construction risk structural or nonstructural risk reduction measures in SA.	US & LA: Increased hurricane storm surges; increased flows and water levels associated with increased urbanization and associated runoff and increased wetland loss. Rate of RSLR increasing over historic conditions. Existing and authorized structural and nonstructural hurricane storm surge damage risk reduction projects provide risk reduction. SA: Total level of project-induced impact would be relatively minor and in addition to other existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US: increased flows and water levels associated with increased urbanization and associated runoff and increased wetland loss, and increased hurricane storm surges. Continued coastal land loss and conversion to open water especially for coastal states. Offset by nationwide coastal restoration efforts. LA: Similar to US and including increasing rate of RSLR over present conditions. Continued Louisiana coastal wetland loss and loss of forested cheniers offset by coastal restoration efforts such as CWPPRA, LCA, and others described in Sections 1.9 and 3.4. SA: Cumulative impacts include incremental impacts of proposed action on flow and water levels in the SA in addition to impacts to flow and water levels by other ecosystem restoration throughout the basin, Louisiana, and the Nation. Similar projects include diversion projects, marsh, and swamp restoration and nourishment by CWPPRA, LCA and others described in Sections 1.9 and 3.4.
Water Quality and Salinity	LA & SA: Clean Water Act of 1977, NEPA of 1969, Coastal Zone Management Act, and Estuary Protection Act and institutional recognition to restore and protect water bodies, especially with respect to point sources. Non-point sources still unregulated. LA & SA: Increasing human development adversely impacts water quality. Salinity levels increase inland due to salt water intrusion, due in part to wetland loss, channelization, and oil and gas exploration canals.	US & LA & SA: Continued institutional recognition. Increasing human development, agriculture and oil & gas exploration and industrialization result in increased potential for water quality problems and saltwater intrusion. SA: coastal wetland loss results in loss of water purification by wetlands. Channels and oil & gas exploration canal continue to provide conduit for saltwater intrusion and coastal land loss.	US & LA & SA: Continued institutional recognition. Increasing human development, agriculture and oil & gas exploration and industrialization result in increased potential for water quality problems and saltwater intrusion. These water quality impacts offset by existing and authorized for construction ecosystem restoration projects. SA: coastal wetland loss results in loss of water purification by wetlands. Channels and oil & gas exploration canal continue to provide conduit for saltwater intrusion and coastal land loss.	US & LA: Continued institutional recognition. Increasing human development, agriculture, channelization and oil & gas exploration and industrialization continue to result in increased potential for water quality problems and saltwater intrusion. These water quality impacts offset by existing and authorized for construction ecosystem restoration projects. SA: The NED RP would reduce water quality impacts associated with flooding from storm surge events. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US & LA: Continued institutional recognition. Increasing coastal land loss, human development, agriculture, channelization and oil & gas exploration and industrialization continue to result in increased potential for water quality problems and saltwater intrusion. These water quality impacts offset by existing and authorized for construction ecosystem restoration projects throughout the US and LA. SA: NER would have short term, localized and generally minor adverse water quality impacts during construction. There would be long term positive water quality improvements as restored, nourished and protected marsh improves local water quality by sequestering and filtering degraded waters. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts
(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)
(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Sedimentation and Erosion	US & LA & SA: Flood Control Act of 1928 helps reduce sedimentation of rivers and other water bodies caused by erosion associated with agriculture, human development, industrialization and storms. SA: Sediment delivery by Atchafalaya River and other rivers throughout SA.	US & LA: continued sedimentation and erosion associated with agriculture, human development, industrialization, storms, navigation channels and oil and gas canals. LA: 350 miles of sandy barrier shoreline and gulf beaches lost. SA: White Lake average shoreline erosion rate of 15 feet per year; Grand Lake shoreline erosion rate of 11 feet per year to 32 feet per year; and Sabine Lake about 10 feet per year.	US & LA: continued sedimentation and erosion associated with agriculture, human development, industrialization, storms, navigation channels and oil and gas canals. These impacts would be offset by existing and authorized for construction ecosystem restoration projects. SA: continued shoreline erosion and sedimentation.	US & LA: continued sedimentation and erosion associated with agriculture, human development, industrialization, storms, navigation channels and oil and gas canals. These impacts would be offset by existing and authorized for construction ecosystem restoration projects SA: No project-induced impacts of NED RP.	US & LA: continued sedimentation and erosion associated with agriculture, human development, industrialization, storms, navigation channels and oil and gas canals. These impacts would be offset by existing and authorized for construction ecosystem restoration projects SA: 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. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.
Soils, Water Bottoms, Prime & Unique Farmlands	US: Institutional recognition of soil and water resources conservation. Prime agricultural land decreases from 1997 to 2012 LA: land area decreases from 1932 to 2010; SA: land area decreases from 1932 to 2010 with concomitant increase in shallow open water area.	US: Institutional recognition of soil and water resources conservation. Prime agricultural land decreases from 1997 to 2012 LA: land area decreases from 1932 to 2010 SA consists primarily of wetland type soils and shorelines prone to frequent flooding and not suitable for agricultural use. Prime farmland consist of 941,196 acres, or 34.3 percent of the soils in SA	US: Institutional recognition of soil and water resources conservation. Prime agricultural land decreases from 1997 to 2012 LA: land area continues to decrease with concomitant increase in shallow open water resulting in greater potential for hurricane storm surge damages to human habitations and loss of estuarine marsh habitats. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: land area continues to decrease with concomitant increase in shallow open water resulting in greater potential for hurricane storm surge damages and loss of estuarine marsh habitats	US: Institutional recognition of soil and water resources conservation. Prime agricultural land decreases from 1997 to 2012 LA: land area continues to decrease with concomitant increase in shallow open water resulting in greater potential for hurricane storm surge damages to human habitations and loss of estuarine marsh habitats. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: no significant impacts of the NED RP on soils, water bottoms or prime and unique wetlands.	US: Institutional recognition of soil and water resources conservation. Prime agricultural land decreases from 1997 to 2012 LA: land area continues to decrease with concomitant increase in shallow open water resulting in greater potential for hurricane storm surge damages to human habitations and loss of estuarine marsh habitats. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: total 15,448 net acres with 4973 AAHUs of brackish and saline marsh and cheniers restored, protected, and reforested. Total 14,635 acres of water bottoms impacted by borrowing sediments for marsh restoration, placement of shoreline protection rock, and restoring water bottoms to marsh. Marsh restoration and shoreline protection would increase and help stabilize hydric soils. Direct impacts to water bottoms in the marsh restoration footprints in Calcasieu and Mermentau Basins would result in the restoration of existing water bottom habitat to marsh habitat. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts
(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)
(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Coastal Shorelines	US: Institutional recognition of coastal barrier resources. Beach shorelines continue to erode as sea level rises and in many instances subsidence continues. Losses offset by federal, state, and local beach nourishment and restoration projects. LA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. Losses offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: Gulf coastal shorelines and interior waterbody shorelines continue to erode due to natural and man-induced causes.	US: Institutional recognition of coastal barrier resources continues. Beach shorelines continue to erode as sea level rises and subsidence continues. Losses offset by federal, state, and local beach nourishment and restoration projects. LA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and their state and local efforts LA: beach shorelines continue to erode as sea level rises and subsidence continues. Losses offset by federal, state, and local beach nourishment and restoration projects. LA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. Losses offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA the average long-term erosion rate at Rockefeller Wildlife Refuge estimated to be 30.9 ft/yr; Gulf shoreline recession rates vary from -4.4 feet per year near Hackberry Beach, 8.7 feet per year at Ocean View Beach, 36.1 feet per year at Mermentau Beach and 52.4 ft/yr at Rockefeller Wildlife Refuge.	US: Institutional recognition of coastal barrier resources continues. Losses offset by federal, state, and local beach nourishment and restoration projects. LA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. Losses offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts	US: Institutional recognition of coastal barrier resources continues. Beach shorelines continue to erode as sea level rises in many instances subsidence continues. These impacts offset by federal, state and local beach nourishment and restoration projects. LA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. Losses offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: NED RP has no significant direct, indirect or cumulative impacts on coastal shorelines.	US: Institutional recognition of coastal barrier resources continues. Beach shorelines continue to erode as sea level rises in many instances subsidence continues. These impacts offset by federal, state and local beach nourishment and restoration projects. LA: Gulf shoreline and interior waterbody shoreline losses continue as sea level rises and subsidence continues. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: 251,528 linear feet of shoreline protection would benefit 6,135 net acres marsh with 1,738 AAHUs. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts

(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)

(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Vegetation Resources	US: Institutional recognition of Natural Resources. Vegetation resources continue to be lost to human encroachment and development LA: from 1985 to 2010 increasing coastal land loss of -16.57 mile^2 per year SA: from 1985 to 2010 increasing coastal land loss of – 0.97 square miles per year Calcasieu Basin; -1.30 mile^2 in Mermentau Basin; -0.45 mile^2 in Teche-Vermilion Basin	US: Institutional recognition of Natural Resources continues. Vegetation resources continue to be lost to human encroachment and development LA: from 1985 to 2010 increasing coastal land loss of -16.57 square miles per year SA: from 1985 to 2010 increasing coastal land loss of – 0.97 mile^2 per year Calcasieu Basin; -1.30 mile^2 in Mermentau Basin; -0.45 mile^2 per year in Teche-Vermilion Basin	US: Institutional recognition of Natural Resources continues. Vegetation resources continue to be lost to human encroachment and development. These impacts would be offset by existing and authorized for construction ecosystem restoration projects. LA: estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: estimated net change between 2010-2060 under moderate sea level rise scenario in Calcasieu/Sabine basin is -146.5 km^2; in Mermentau Basin -208 km^2; and in Teche-Vermilion Basin -67 km^2	US: Institutional recognition of Natural Resources continues. Vegetation resources continue to be lost to human encroachment and development. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts. SA: NED RP has no significant direct, indirect or cumulative impacts on vegetation resources.	US: Institutional recognition of Natural Resources continues. Vegetation resources continue to be lost to human encroachment and development. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries, and other state and local efforts. SA: total 15,448 net acres with 4973 AAHUs of brackish and saline marsh and cheniers restored, protected, and reforested. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.
Wildlife Resources	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats. Wetland dependent wildlife populations respond primarily to natural population-regulating mechanisms. Institutional recognition of wildlife and its habitats. Wildlife resources continue to be adversely impacted and lost due to human encroachment and development of wildlife habitats LA: wildlife habitats lost from 1985 to 2010 due to increasing coastal land loss of -16.57 mile^2 per year SA: wildlife habitat losses from 1985 to 2010 increasing coastal land loss of – 0.97 square miles per year Calcasieu Basin; -1.30 mile^2 in Mermentau Basin; -0.45 mile^2 in Teche-Vermilion Basin	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats continues. Continued institutional recognition of wildlife and its habitats. Wildlife resources continue to be adversely impacted and lost due to human encroachment and development of wildlife habitats. LA: wildlife habitats lost from 1985 to 2010 due to increasing coastal land loss of -16.57 square miles per year SA: from 1985 to 2010 increasing coastal land loss of – 0.97 mile^2 per year Calcasieu Basin; -1.30 mile^2 in Mermentau Basin; -0.45 mile^2 per year in Teche-Vermilion Basin	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats continues. Wildlife resources continue to be adversely impacted and lost due to human encroachment and development of wildlife habitats. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: continued wildlife habitats lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: estimated net change between 2010-2060 under moderate sea level rise scenario in Calcasieu/Sabine basin is -146.5 km^2; in Mermentau Basin -208 km^2; and in Teche-Vermilion Basin -67 km^2	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats continues. Wildlife resources continue to be adversely impacted and lost due to human encroachment and development of wildlife habitats. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: continued wildlife habitats lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: NED RP has no significant direct, indirect or cumulative impacts on wildlife resources.	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats continues. Wildlife resources continue to be adversely impacted and lost due to human encroachment and development of wildlife habitats. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: continued wildlife habitats lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: total 15,448 net acres with 4973 AAHUs of brackish and saline marsh and cheniers restored, protected, and reforested and used by various wildlife species. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts
(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)
(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Fisheries and Aquatic Resources	US & LA & SA: Institutional recognition of natural resources and fish and aquatic resources and its habitats. Reduction in fisheries habitat, increased catches, gear improvement, catch regulations, Magnuson-Stevens Fishery Conservation and Management Act and amendments, formation of NMFS and LDWF. About 90% of the world's seafood resources have been depleted in the past century; 38% of the depleted species have declined by more than 90%; 7% of the species of fish studied by researchers have become extinct.	US & LA & SA: Institutional recognition of natural resources and fish and aquatic resources and its habitats. LA: from 1985 to 2010 increasing coastal land loss of -16.57 square miles per year results in loss of coastal estuaries used as fish and aquatic organisms nursery and foraging habitat. SA: from 1985 to 2010 increasing coastal land loss of – 0.97 mile^2 per year Calcasieu Basin; -1.30 mile^2 in Mermentau Basin; -0.45 mile^2 per year in Teche-Vermilion Basin	US: Institutional recognition of natural resources and fish and aquatic resources and its habitats continues. Fisheries and aquatic resources continue to be adversely impacted due to reduction in fisheries habitat, increased catches, gear improvement, catch regulations. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: continued fish and aquatic organisms estuarine habitats lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: estimated net change between 2010-2060 under moderate sea level rise scenario in Calcasieu/Sabine basin is -146.5 km^2; in Mermentau Basin -208 km^2; and in Teche-Vermilion Basin -67 km^2	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats continues. Fisheries and aquatic resources continue to be adversely impacted due to reduction in fisheries habitat, increased catches, gear improvement, catch regulations. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: continued fish and aquatic organisms estuarine habitats lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: NED RP has no significant direct, indirect or cumulative impacts on fisheries or aquatic resources.	US: Institutional recognition of natural resources and fish and wildlife resources and its habitats continues. Fisheries and aquatic resources continue to be adversely impacted due to reduction in fisheries habitat, increased catches, gear improvement, catch regulations. These impacts would be offset by existing and authorized for construction ecosystem restoration projects LA: continued wildlife habitats lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by beach nourishment and restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: total 9,313 net acres with 3,239 AAHUs of brackish and saline marsh restored, nourished and protected and available for use by fish and aquatic organisms. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.
Essential Fish Habitat	US & LA & SA: Institutional recognition of decline in EFH quality; passage of Magnuson-Stevens Fishery Conservation and Management Act, as amended, formation of NMFS and LDWF.	US & LA & SA: Institutional recognition of EFH continues. LA: from 1985 to 2010 increasing coastal land loss of -16.57 square miles per year results in loss of coastal estuaries used as transitional estuarine EFH nursery and foraging habitats. SA: from 1985 to 2010 increasing coastal land loss of – 0.97 mile^2 per year Calcasieu Basin; -1.30 mile^2 in Mermentau Basin; -0.45 mile^2 per year in Teche-Vermilion Basin results in loss of coastal estuaries used as EFH nursery and foraging habitats.	US: Institutional recognition of EFH continues. LA: continued transitional estuarine EFH lost with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: continued transitional estuarine EFH lost with estimated net change estimated net change between 2010-2060 under moderate sea level rise scenario in Calcasieu/Sabine basin is -146.5 km^2; in Mermentau Basin -208 km^2; and in Teche-Vermilion Basin -67 km^2	US: Institutional recognition of EFH continues. LA: continued transitional estuarine EFH lost with estimated net change with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: NED RP has no significant direct, indirect or cumulative impacts on fisheries or aquatic resources. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US: Institutional recognition of EFH continues. LA: continued transitional estuarine EFH lost with estimated net change with estimated net change between 2010-2060 under moderate sea level rise scenario is -2100 km^2. These impacts offset by restoration projects such as CWPPRA, LCA, NOAA Fisheries and other state and local efforts SA: total 9,313 net acres with 3,239 AAHUs of brackish and saline marsh restored, nourished and protected and available for use by fish and aquatic organisms. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts
(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)
(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Threatened & Endangered Species & Other Protected or Species of Concern	US, LA & SA: The Endangered Species Act of 1973 (ESA), Migratory Bird Treaty Act of 1918 as amended (MBTA), Bald and Golden Eagle Protection Act (BGEPA) and Marine Mammal Protection Act of 1972 (MMPA) help protect the existence of certain species listed under each Act. Listed and protected species habitat is impacted by natural conditions such as hurricane storm surge, saltwater intrusion and subsidence, and man-made conditions such as agriculture, human development and industrialization.	US, LA & SA: continued impacts to listed and protected species habitat by natural conditions such as hurricane storm surge, saltwater intrusion and subsidence, and man-made conditions such as agriculture, human development and industrialization.	US, LA & SA: continued impacts to listed and protected species habitat impacts by natural conditions such as hurricane storm surge, saltwater intrusion and subsidence, and man-made conditions such as agriculture, human development and industrialization.	US & LA: continued impacts to listed and protected species habitat impacts associated with agriculture, human development and industrialization. SA: minimum and temporary project-induced impacts such as temporary avoidance of nearby habitat due to noise and construction activity. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US & LA: continued impacts to listed and protected species habitat by natural conditions such as hurricane storm surge, saltwater intrusion and subsidence, and man-made conditions such as agriculture, human development and industrialization. SA: beneficial impacts to listed and protected species habitat associate with shoreline protection and the creation of marsh & chenier habitats. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects.
Cultural and Historic Resources	US, LA, & SA: Institutional recognition via the National Historic Preservation Act (and others). Historic and cultural resources subjected to natural processes and man-made actions.	US, LA, & SA: Continued institutional recognition. Human activities as well as natural processes can potentially destroy historic and natural resources. The loss of land threatens the existence and integrity of these resources.	US, LA, & SA: Continued institutional recognition via the National Historic Preservation Act (and others). Potential loss of historic and cultural resources due to natural and human causes. SA: The continued adverse impacts associated with hurricane storm surge and land loss within the SA threatens the existence and integrity of historic and cultural resources that may exist within the SA.	US & LA: Continued institutional recognition via the National Historic Preservation Act (and others). Potential loss of historic and cultural resources due to natural and human causes. SA: Implementing the NED RP could directly and indirectly affect any recorded or unrecorded cultural resource that may exist within the footprint of the project, the project's borrow source, or within any area identified as an area of potential effects (APE). A programmatic agreement (PA) is in place to govern future investigations and activities. In accordance with the PA, to the extent any adverse effect to identified cultural resources cannot be avoided, such impacts will be mitigated. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US & LA: Institutional recognition via the National Historic Preservation Act (and others). Potential loss of historic and cultural resources due to natural and human causes. SA: Implementing the NER RP has a chance to directly and indirectly affect any recorded or unrecorded cultural resource that may exist within the footprint of the project, the project's borrow source, or within any area identified as an area of potential effects (APE). A programmatic agreement (PA) is in place to govern future investigations and activities. In accordance with the PA, to the extent any adverse effect to identified cultural resources cannot be avoided, such impacts will be mitigated. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

Table 3-6 Summary of Cumulative Impacts

(*NED Plan 8 Alternative – Nonstructural 100-Year Floodplain cumulative impacts would be similar in nature but greater in scale compared to NED RP)

(**Plan M-4 Alternative – Mermentau Small Integrated Restoration Plan cumulative effects are same as impacts identified for the Mermentau Basin component of NER RP)

Significant Resource	Past Actions (Historic Conditions)	Present Actions (Existing Conditions)	The No-Action Alternative (Future Without Project condition)	Cumulative Impacts NED RP: Modified Plan 8 Nonstructural 0-25 year Floodplain Plan*	Cumulative Impacts NER RP: Plan CM-4**
Aesthetics (Visual Resources)	US, LA, & SA: Technical recognition via 1988 USACE Visual Resources Assessment Procedure. Institutional recognition via Wild and Scenic Rivers Act, Louisiana Scenic Rivers Act, Scenic Byways and others. LA & SA: Aesthetic resources negatively impacted by hurricanes Katrina, Rita, Gustav, and Ike	US, LA, & SA: Continued institutional recognition. Visual resources have been destroyed, enhanced, or preserved by human activities and natural processes. LA & SA: Continued wetland loss may have an adverse effect on the visual complexity of the bayous and swamps.	US, LA, & SA: Continued institutional recognition. Continued human population growth and development and other human activities have the potential to destroy, enhance or preserve visual resources. SA: Erosion and land loss could result in the loss of vegetation that may provide a visually complex environment and desirable views and reduce opportunities for viewing wildlife.	US, LA, & SA: Generally, there would be no significant effects on the natural environment. Most effects would be on the human environment. This includes incremental risk reduction achieved by elevating 3,665 residential structures, flood proofing 247 non-residential structures and acquiring 3 residential structures. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA, & SA: 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. Temporary impacts due to construction activities. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.
Recreation	US, LA and SA: 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.	US, LA and SA: Federal and State agencies are major providers of recreational opportunities throughout the country and State of Louisiana. There are eight Wildlife Refuges and Conservation Areas in the Study Area, and two State parks. In addition to the high quality recreational fishing and hunting in the parks in the region, several lakes and inland marshes offer opportunities for birding, hunting and catching both freshwater and saltwater species.	US, LA and SA: The continued loss of wetlands/marshes and habitat diversity affects recreational opportunities. Storm surge and saltwater could have a negative impact on freshwater forests and habitats and could reduce recreational resources (e.g., fishing, hunting, bird watching, and other). In general, further degradation of area marshes will continue and its associated negative impacts on recreation activities will increase. Additionally, recreational infrastructure would remain vulnerable to surges. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA and SA: By elevating residential recreational structures, such as camps, damage from storm surge is less likely to occur. Additionally, elevated structures should create less debris that must be removed following a storm surge event. These impacts would be in addition to other national, state and local existing and authorized for construction structural and nonstructural hurricane storm surge damage risk reduction projects as described in more detail in Sections 1.9 and 3.4.	US, LA and SA: The cumulative impacts of other ongoing and planned ecosystem restoration measures are expected to be generally beneficial to recreation as the risk of destruction of recreation resources by storm surge is reduced and habitat areas supporting fish and wildlife resources are enhanced. 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 restoration enhances the sustainability of valuable nursery habitats. These impacts would be in addition to other national, state and local existing and authorized for construction ecosystem restoration projects as described in more detail in Sections 1.9 and 3.4.

3.5 Irreversible and Irretrievable Commitments of Resources Involved in the Implementation of the Recommended Plan

NEPA 40 CFR 1502.16 requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the tentatively selected plan should it be implemented." Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g., energy and minerals) that cannot be replaced within a reasonable time frame. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., extinction of a T&E species or the disturbance of a cultural site).

The NER RP would result in the direct and indirect commitments of resources. These would be related mainly to construction components. Energy typically associated with construction activities would be expended and irretrievably lost under all of the alternatives excluding the no action alternative. Fuels used during the construction and operation of dredging equipment and barges would constitute an irretrievable commitment of fuel resources.

For the NER RP, most resource commitments are neither irreversible nor irretrievable. The dredging of borrow material is considered reversible although it is anticipated that the natural infilling of the borrow pits may take several years. Benthic communities would be removed and lost along with the sediment during dredging operations. Benthic communities would also take several years to recover. Fish and plankton would be entrained in the dredge during the dredging of the borrow areas. These losses would be irretrievable. However, most impacts to fish and plankton are short term and temporary and would only occur during dredging and construction activities. For example, access channels that would be dredged and retention dikes that are constructed would be restored to natural conditions after construction.

Other impacts, including disruption of community cohesion, may have longer effects that can be reduced through appropriate enhancement measures and best management practices. There are no irreversible or irretrievable commitments of resources which would preclude formulation or implementation of reasonable alternatives for this Project.

3.6 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 environmental impact statement 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 RP would affect the short-term use and the long-term productivity of the environment. For the RP, "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.

Construction of the NER RP 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 DO, 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 RP would assist in 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 emergent transitional marsh and the invertebrates, fish, and wildlife that use these habitats. The NER RP would enhance the long-term productivity of natural communities throughout the region. These long-term beneficial effects would outweigh the impacts to the environment resulting primarily from Project construction. With an increase in the wetland habitat quality, fish populations would experience beneficial impacts. These improvements in productivity would beneficially impact long-term commercial and recreational fishing in the study region.

3.7 Mitigation

Mitigation per 40 CFR §1508.20 includes measures to avoid the impact by not taking an action or parts of an action; minimize impacts by limiting the degree or magnitude of the action and its implementation; rectifying the impact by repairing, rehabilitating, or restoring the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and compensating for the impact by replacing or providing substitute resources or environments. 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. No impacts from the NED RP or NER RP have been identified that would require compensatory mitigation. In addition, the CEMVN has determined that the proposed action "may affect but will not likely adversely affect" the piping plover or it's critical habitat, Red knot, Sprague's pipit, West Indian manatee, Gulf sturgeon, loggerhead and Kemps Ridley sea turtles; would have no effect on the Red-cockaded woodpecker, green, leatherback, and hawksbill sea turtles or loggerhead critical habitat and would not adversely impact other species of concern that could potentially be found in the Project area. No unique or valuable habitats would be adversely affected. However, the presence of threatened or endangered species would render that structure ineligible to participate in the Project.

To reduce potential fisheries impacts, any clearing and snagging would adhere to the Stream Obstruction and Removal Guidelines (1983); however, no such actions are anticipated.

The Lake Charles Metropolitan Statistical Area is vulnerable to being designated as non-attainment for ozone and particulate matter (PM) in the next few years (personal communication, EPA April 30, 2015). The Imperial Calcasieu Regional Planning & Development Commission, representing Calcasieu Parish, Cameron Parish, the Cities of Lake Charles, Westlake, Sulphur, Vinton, DeQuincy, the Town of Iowa, the Lake Charles Harbor and Terminal District, the Chennault International Airport, the Lake Area Industrial Alliance, the Southwest Louisiana Economic Development Alliance, and the Chamber SWLA has applied for and been accepted by EPA into the EPA Ozone Advance and PM Advance programs. The Advance programs are collaborative efforts between EPA, states, and local governments to enact expeditious emission reductions to help near non-attainment areas remain in attainment of the National Ambient Air Quality Standards. This reflects the sensitivity of ozone and PM levels in the area, and the need for federally-funded projects in the study area to consider air emissions. In addition to all applicable local, state, or Federal requirements, the mitigation measures for potential air quality impacts for reducing impacts associated with emissions of NOx, CO, PM, $S0_2$, and other pollutants from construction-related activities would include consideration of the following, as appropriate.

Noise vibration and emissions:

- The use of heavy machinery fitted with approved muffling devices that reduce noise, vibration, and emissions.

Fugitive Dust Source Controls:

- Stabilize open storage piles and disturbed areas by covering and/or applying water or chemical/organic dust palliative where appropriate at active and inactive sites during workdays, weekends, holidays, and windy conditions;
- Install wind fencing and phase grading operations where appropriate, and operate water trucks for stabilization of surfaces under windy conditions; and
- Prevent spillage when hauling material and operating non-earthmoving equipment and limit speeds to 15 miles per hour. Limit speed of earth-moving equipment to 10 mph.

Mobile and Stationary Source Controls:

- Plan construction scheduling to minimize vehicle trips;
- Limit idling of heavy equipment to less than five minutes and verify through unscheduled inspections;
- Maintain and tune engines per manufacturer's specifications to perform at EPA certification levels, prevent tampering, and conduct unscheduled inspections to ensure these measures are followed;

- If practicable, utilize new, clean equipment meeting the most stringent of applicable Federal or State Standards. In general, commit to the best available emissions control technology. Tier 4 engines should be used for Project construction equipment to the maximum extent feasible;
- Lacking availability of non-road construction equipment that meets Tier 4 engine standards, the responsible agency should commit to using EPA-verified particulate traps, oxidation catalysts, and other appropriate controls where suitable to reduce emissions of diesel particulate matter and other pollutants at the construction site; and
- Consider alternative fuels and energy sources (e.g., natural gas, electricity and plug-in or battery).

4.0 RECOMMENDED PLAN
(PREVIOUSLY TENTATIVELY SELECTED PLAN) (*NEPA REQUIRED)

The NED RP is the Nonstructural 0-25-Year Floodplain Plan (Modified Plan 8).

The NER RP is Alternative Plan CM-4.

4.1 The National Economic Development (NED) Plan
4.1.1 Description of the NED RP

The NED RP applies nonstructural measures to eligible structures and is a 100% voluntary project. Eligible structures are located in the 0-25-year floodplain and are individually economically justified (i.e. the costs to apply a particular nonstructural measure are less than the hurricane storm surge damages predicted to occur to that structure over the 50-year period of analysis). Eligible structures are those whereby the structure owner would be offered the opportunity to apply nonstructural measures (elevating, dry flood proofing, or localized storm surge risk reduction measures) to the structure if certain eligibility criteria are met. If the structure owner does not want to participate in the Project, USACE and the NFS would defer any further action on that structure until such time as the structure owner elects to participate or until the period of construction ends. However, the Government reserves, at its sole discretion, the right to determine whether or not a structure may participate in the NED RP after a structure owner has declined participation, and if allowed to participate, the timing and scheduling of such participation in the Project. There are 3,961 residential and non-residential structures that meet the initial eligibility criteria (i.e., they are located in the 0-25-year floodplain and are individually economically justified).

The NED RP consists of the following measures (see Appendix L 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 NFIP as the "flood having a 1% chance of being exceeded in any given year and is also called the 100-year flood." For purposes of this study, the BFE has been forecast into the future based on anticipated hydrologic conditions predicted to occur over the 50-year period of analysis (2025-2075). This measure entails lifting the entire structure or the habitable area to the predicted 2075, 100-year BFE unless the required elevation is greater than a maximum of 13 ft above ground level. Any structure that requires elevating greater than 13 ft above ground level would be ineligible to participate due to engineering and risk related factors. At the time of this Final Report, a structure inventory has been compiled which identifies 3,462 residential structures in the Study Area that have been deemed to be preliminarily eligible to participate in the Project (See Appendix N). The following process to determine final eligibility, which is more fully described in Appendix L, would apply to property owners willing to participate in the elevation Project whose structures meet the initial eligibility criteria (i.e. structure is located in the 0-25-year floodplain and is individually economically justified):
    - Residential property owners would be asked to grant a temporary right-of-entry to USACE and the NFS to enter upon the property to conduct such property and structural investigations deemed necessary to determine final eligibility for participation in the Project.
    - The property owner would submit satisfactory documentation as deemed necessary by USACE to establish proper proof of structure ownership.
    - The NFS would conduct title research to confirm the property has clear title; and any appraisals that may be necessary (i.e., if a structure requires elevation of greater than 13 ft).
    - An ASTM Phase I Environmental Site Assessment (ESA) and asbestos investigation would be conducted to confirm the absence of HTRW and damaged or friable asbestos or asbestos-containing materials. If warranted, additional HTRW investigations may be required.
    - The structure would be evaluated by USACE to ensure that certain eligibility criteria are satisfied including but not limited to: elevation of the structure would not exceed 13 ft above ground level, the structure is in suitable condition for elevation, threatened or endangered species would not be




impacted, no fill would be placed in waters of United States, wetlands would not be impacted, and the property has not previously receive any disaster assistance for structure elevation.

2. Dry flood proofing of eligible non-residential structures (excluding large warehouses). Dry flood proofing consists of sealing all areas below the hurricane storm surge damage risk reduction flood protection level of a non-residential structure to make it resistant to water intrusion from hurricane storm surge and to reduce the risk that hurricane storm surge can get inside by making walls, doors, windows, and other openings resistant to water penetration. Walls are coated with sealants or waterproofing compounds, or plastic sheeting is placed around the walls and covered. Back-flow prevention mechanisms for water and sewer lines 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 hurricane storm surge depths are generally less than 3ft. 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 resistant to the passage of waters from hurricane storm surge.

   While each individual eligible non-residential structures will be evaluated for the most cost effective nonstructural measure, the government reserves the right to determine which measure shall be implemented at each structure location.

   The process of determining eligibility would be substantially similar to the process followed above in connection with the elevation of residential structures. Identification of eligibility criteria and details concerning the process will be developed during PED and provided prior to Project implementation. At the time of this Final Report, a structure inventory has been compiled which identifies 342 preliminarily eligible non-residential structures and public buildings in the Study Area. Eligible property owners who request application of the dry flood proofing measures to their commercial structures or public buildings, must provide temporary right-of-entry, undergo site and structural assessments, present the requisite documentation, and undergo a structure-specific analysis performed during the design phase that is substantially similar to that which is described above in connection with the elevation of residential structures but is designed to ensure that the structure is suitable for this method of flood proofing and that this method of flood proofing is the most cost-effective measure for the structure under consideration.

3. Construction of localized storm surge risk reduction measures less than six feet in height around warehouses. These measures are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements. Localized storm surge risk reduction measures 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 create the potential for drainage problems by displacing flood storage, elevating buildings on fill, requiring significant tree removal, etc.

   While each individual eligible warehouse will be evaluated for the most cost effective nonstructural measure, the government reserves the right to determine which measure shall be implemented at each warehouse location.

   At the time of this Final Report, a structure inventory has been compiled which identifies 157 preliminarily eligible warehouses in the Study Area. Eligible property owners, who request implementation of the localized storm surge risk reduction measures around their warehouses must provide temporary right-of-entry, undergo site and structural assessments, present the requisite documentation, and undergo a site-specific analysis performed during the design phase that is substantially similar to that which is described above in connection with the elevation of residential structures but is designed to ensure that the structure is suitable for this method of flood proofing and that this method of flood-proofing is the most cost-

effective measure for the structure under consideration. Identification of eligibility criteria and details concerning the process will be developed during PED and provided prior to Project implementation.

4.1.2 Implementing Nonstructural Measures for Eligible Structures

During the Preconstruction Engineering and Design (PED) phase of the Project, the Government, in consultation with the NFS, will develop the Agreement which must be executed by the Owners of each eligible property in advance of the implementation of the non-structural measure determined by the Government to be appropriate for that structure. Appendix L provides an exemplary listing of some of the provisions anticipated to be included within that Agreement and describes the process and requirements for securing that agreement and proceeding with the eligibility determination and non-structural implementation for each structure measure. The agreement will contain restrictive covenants that run with the land in perpetuity. Among other rights, the agreement will include the right for the NFS and the Government to inspect the property during structure elevation. The agreement, as well as any required curative documents, subordination or release agreement(s), shall be recorded by the NFS in the public records of the Parish in which the property is located prior to commencement of the nonstructural improvements on the property. While each individual eligible structure would be evaluated for the most cost effective nonstructural measure, the government reserves the right to determine which measure would be implemented at each structure location. Once the eligibility determination investigations are complete (as described in Appendix L), Appendix L describes the steps that would be completed to initiate the appropriate nonstructural measure at each eligible structure location.

4.1.2.1 Implementation of Nonstructural Improvements

Following eligibility determination, execution of an Agreement between the non-Federal sponsor and the Owner(s), and receipt of proof of recordation of the required documentation, construction of the nonstructural measure would begin. Detailed information regarding the anticipated non-structural measures that would be utilized for each type of structure, eligibility requirements, the process for implementation of the non-structural measures and the eligible and ineligible costs of non-structural measures is contained in Appendix L of this Report.

4.1.2.2 Notice of Construction Completion

Upon completion of the nonstructural improvement of each structure, an inspection would be performed by USACE and upon final approval by the District Engineer, or his designee, a Notice of Construction Completion (NCC) would be issued to the NFS and the individual nonstructural project would be closed out as complete.

4.1.3 NED Implementation Plan

This Final Report recommends a strategy to implement the nonstructural Project for eligible structures. Structures that have been identified as preliminarily eligible as part of the RP are located across the 4,700 mile, three-parish study area. In order to effectively implement the NED RP, clusters of eligible structures that represent the highest risk for hurricane storm surge damages (i.e. those with a FFE below the 10-year stage) would be identified and prioritized for construction. Individual structures would be addressed based on a ranking of risk from highest to lowest within the cluster. The ranking of individual structures would be revisited as elevation work is completed, as additional funding is distributed, and as new clusters are identified. Addressing groups of structures within a small geographic area would be more cost-effective, efficient, and would also allow for a more strategic methodology for applying nonstructural measures to at-risk structures. Additional work on this process would occur during the design phase of the Project. More details on this process can be found in Appendix L.

4.1.4 Hydrologic and Economic Evaluation of the RP

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 FFEs was compiled for all structures in the 90 reaches (approximately 52,000 structures). Approximately 16,000 structures are located within the 100-year (1% ACE) floodplain. Based on 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.

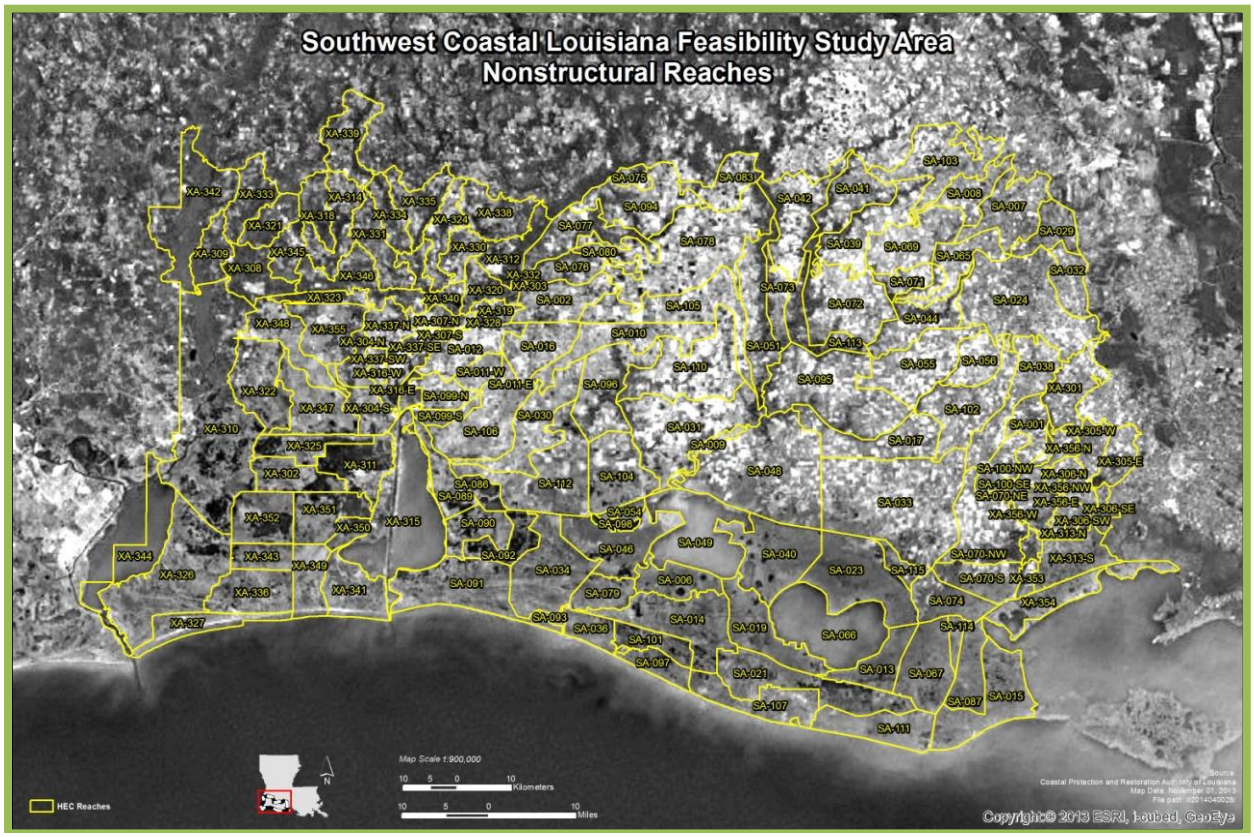

Figure 4-1: Hydrologic reaches in the study area.

The NED RP (Modified Plan 8) assessed benefits using 2025 conditions as the base flood criteria and identified properties in the 0-25-year (0-4% ACE) floodplain as the highest increment of net benefits. The economic evaluation employed several assumptions regarding the nonstructural action to be taken for any given structure. Residential structures with FFEs below the 2025 25-year (4% ACE) WSE 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 BCR 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. The NED RP addresses study area structures in most immediate need of hurricane storm surge damage risk reduction. Figure 4-2 depicts the eligible structures in the NED RP across the study area. High resolution maps depicting individual eligible structures can be found in Appendix N.

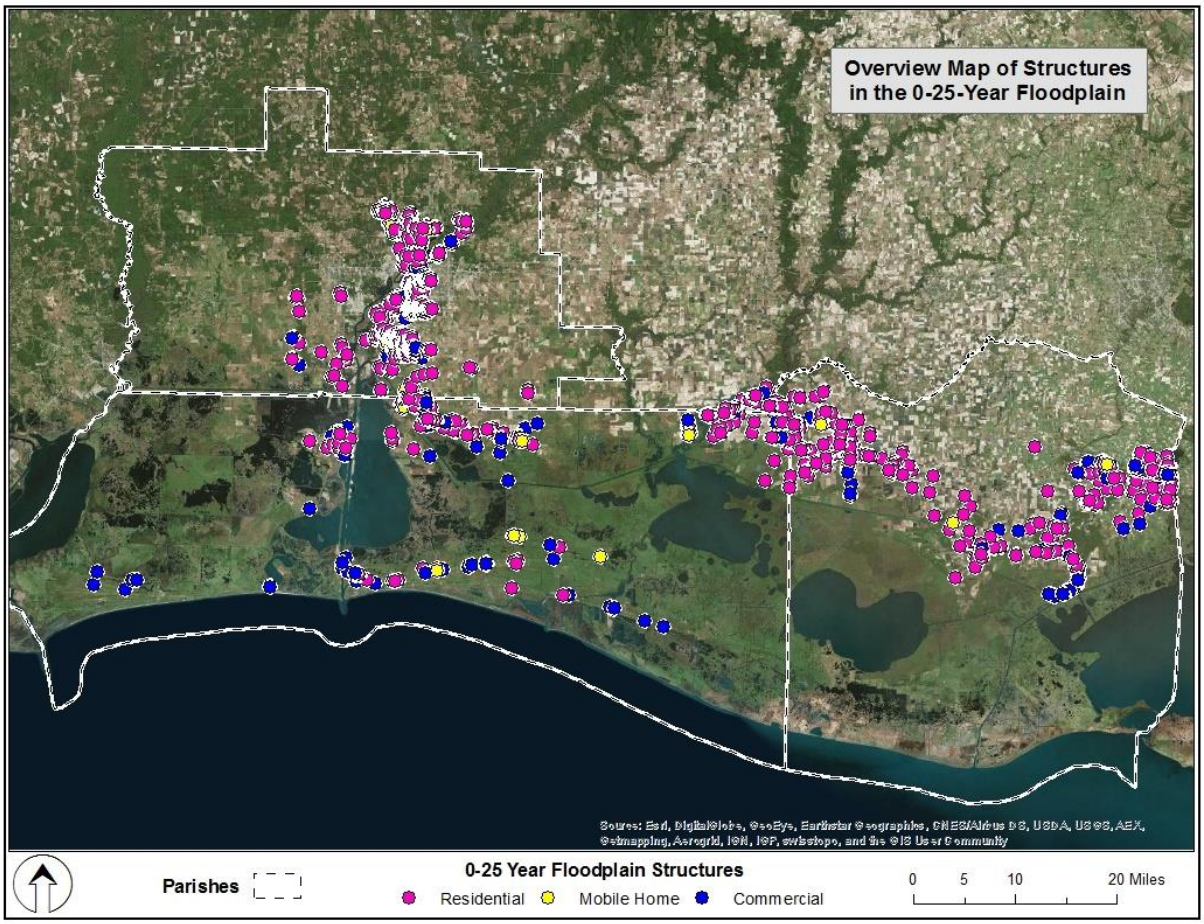

Figure 4-2: Eligible structures in the 0-25-year floodplain.

The expected annual benefits for addressing all the structures within the 0-25 year (0-4% ACE) floodplain are approximately $204 million. The project first cost for implementing the nonstructural Project is $906 million and the corresponding average annual cost is approximately $36 million. The NED RP would have no disproportionate adverse impacts on minority and low-income populations.

4.1.5 Compliance with Executive Order 11988

In implementing Executive Order (EO) 11988, the procedures identified below were followed in the formulation of the NED RP consistent with the 8-step process outlined in ER 1165-2-26, Paragraph 8.

1. While the proposed action is located within the limits of the base floodplain, the recommendation of the NED plan is designed to elevate residential properties that are the most prone to hurricane storm surge damage beyond the limits of the base flood and floodplain values would remain unaffected.

2. Since the study objective is to reduce the risk of damage from hurricane storm surge for the properties at the highest risk of damage specifically within the base floodplain, there are no practicable alternatives to the action that would result in an equivalent level of hurricane storm surge damage risk reduction.

3. The revised draft report was released to the public in February 2015 and a series of public meetings held in April 2015 in the communities of Abbeville, Lake Charles, and Cameron where the public was given the opportunity to express their views on the proposed plan and invited to submit written and electronic comments directly to the Corps during the official public comment period. CEMVN responded to all comments submitted by the public and a number of state and Federal agencies.

4. The proposed action is expected to exclusively have beneficial impacts to natural floodplain values. No losses of natural and beneficial floodplain values are foreseen. The nonstructural nature of the NED RP is designed to avoid adverse impacts to ecosystem or natural resources that are normally associated with structural hurricane storm surge damage risk management alternatives. The nature and extent of flooding within the base floodplain is unaffected by the measures designed to adapt structures to hurricane storm surge damage and/or make them resilient to damages during hurricane storm surge events.

5. The risk of inducement of development within the floodplain is normally associated with structural projects such as levees and floodwalls where vacant parcels are no longer subject to frequent flooding, lowering the cost of potential development and providing economic incentives for the addition of inventory to the floodplain. Even if induced inventory complies with floodplain management regulations such that the primary structure is technically higher than the base flood elevation, the addition of structures to the floodplain still incurs residual risk for hurricane storm surge events that are beyond the design performance of levees and floodwalls. In this case, the NED RP does not induce development since the actions to be taken address structures that are currently within the floodplain. The implementation of the NED RP may make the community more resilient and sustainable in the future, but it does not otherwise lower the cost of developing in the floodplain as a prerequisite to providing economic incentives that may induce development.

The NED RP is not expected to induce development in the base floodplain. Future development is defined as development that is expected, in equal amount, under both without-project and with-project conditions. In contrast, induced development is that which takes place only due to the fact the Federal government has taken action (with-project condition) to reduce hurricane storm surge damage risk in the floodplain. This generally occurs since the cost of development in the floodplain is lowered owing to the lowering or avoidance of future costs associated with hurricane storm surge damage. The NED RP does not reduce hurricane storm surge damage risk for any other structures in the floodplain other than those specifically identified under existing conditions. Therefore, the plan creates no further incentives created to develop in the floodplain. The spatial distribution of target properties in the NED RP is large and diverse. In instances where the application of nonstructural measures are in concentrated areas (neighborhoods or clusters), preservation and an enhanced sustainability of the area may result as a positive project effect. However, given the voluntary nature of plan participation it is too speculative to draw a conclusion of this nature.

Within the study area as a whole, approximately 75% of all hurricane storm surge damage risk, estimated as future without-project expected annual damages, is associated with hurricane storm surge events occurring in the 25-year floodplain. The NED RP effectively reduces risk of damage from the surge event for a majority (80%) of all structures in the 25-year floodplain. Therefore, project performance is exceptionally high and residual risk is correspondingly minimized to a significant degree. The Residual Risk section of the Economic Appendix (Appendix D) details the calculation of residual risk and documents this conclusion.

6. Structure elevation is the primary nonstructural measure comprising the NED RP. Implementation of this measure is not anticipated to extend beyond the footprint of the property boundaries and right-of-way associated with the structure being elevated. There are no identified adverse impacts to ecosystem resources associated with this action, with the possible exception of HTRW-related issues that can only be identified on a structure-by-structure basis through specific site inspection conducted prior to Project implementation. In cases where adverse impacts may occur due to the presence of HTRW, the Government reserves the right to revert to the no-action plan as it relates to that structure, thus avoiding the potential for adverse environmental impacts. This approach applies equally to the other two primary techniques: dry flood proofing and localized storm surge risk reduction measures. Therefore, methods to minimize adverse impacts of the action are not necessary for this NED RP.

7. The public has been notified through the dissemination of the revised draft report and public meetings that there is no practicable alternative to locating the action in the floodplain, particularly since the Project targets properties that are located in the areas within the base floodplain that are most prone to flooding from hurricane storm surge. Moreover, it has been observed that the public is accepting of the action located within the

floodplain since project performance is designed to lower the risk of damage from hurricane storm surge to the community without the adverse impacts normally associated with structural measures.

8. Of all alternatives considered, including those that have been found not to be economically justified and thus not in the Federal interest, the NED RP is the most responsive to the planning objectives established by the study and consistent with EO 11988.

The NED RP consists of applying nonstructural measures to residential and non-residential properties and commercial warehouses. Included among the estimated 342 non-residential structures are public and semi-public buildings, none of which are owned by the Federal government. No critical facilities are included in the plan that would necessitate action to relocate the structure outside of the 0.2% floodplain. Although EO 13690 is under current pubic review, the NED RP does comply with the current tenets of the EO by incorporating sea level rise in project planning. The target level of risk reduction for the elevation of residential structures is the 100-year BFE predicted under 2075 hydrologic conditions, which incorporates the effects of anticipated sea level rise. This approach utilizes data informed by the best available climate science. Moreover, since sea level rise in most reaches in the study area will increase the stage of the 100-year event from 2025 to 2075 by two ft or greater, then elevation to the 100-year stage under 2075 conditions will effectively elevate the structures by two or more ft above the 100-year stage under both 2025 and current (2012) conditions.

There are no practicable alternatives to implementing the Project in the floodplain. This is made evident by the fact that the avoidance of hurricane storm surge damage risk in the floodplain itself is the objective of the study and is positive in its effect on floodplain values.

Floodplain values in population centers primarily relate to conveyance of floodwaters from riverine systems and storage for storm-surge induced and rainfall flooding (tropical and extra-tropical in nature). Flood risk in the study area is dominated by storm-surge and rainfall effects, whereas riverine systems contribute relatively little. In much of the study area, drainage from flood events is characterized by slow gravity drainage past coastal cheniers toward the Gulf of Mexico. Flood durations involving saltwater standing in excess of 1-2 days is typical and accounts for higher than expected economic damage to structures. The NED RP would neither exacerbate nor alleviate this attribute of the floodplain, as nonstructural measures attempt to adapt to floodplain characteristics rather than alter them, as would be expected with structural measures such as levees, floodwalls, and channelization. For the same reason, any other attribute associated with floodplain values, such as water quality, carbon sequestration, fish and wildlife habitat, would be equally unaffected under the RP.

4.1.6 NED Mitigation

Since the application of all nonstructural measures would occur on existing developed properties there are no expected impacts to wetland habitats as a result of implementation of the NED RP and every attempt would be made to avoid impacting wetland habitats. For an eligible structure, if elevating, dry flood proofing, or construction of localized storm surge risk reduction measures results in impacts to wetlands or threatened/endangered species, or if the measure requires the placement of fill in waters of the United States the structure would no longer be eligible as part of the NED RP. Therefore, mitigation for unavoidable impacts from NED plan implementation is not anticipated to be necessary.

4.1.7 NED Adaptive Management and Monitoring

Mitigation is not anticipated to be necessary for the NED RP and as a result adaptive management would not be required.

4.1.8 NED Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R)

For all structure types (residential, non-residential, and warehouses) OMRR&R costs are expected to be 'de minimus' (works) and will be confined to regular, periodic surveys and site visits of structures where NED measures have been applied in order to determine that the requirements of the OMRR&R Manual are being

met (estimated to be $5,000 annually though this estimate will be revised during the PED phase). Once the NED measures have been implemented and NCC'd, the owner of the property will be responsible for all cost and risk of maintaining, repairing, rehabilitating and replacement the flood proofing measures that were utilized for the subject property. A draft OMRR&R Manual shall be provided to the NFS as early as possible in the period of implementation because USACE will issue a NCC for each flood proofed structure once the flood proofing is complete. At the time of the issuance of an NCC, the NFS's obligations for operation and maintenance for the subject structure or lands commences. Flood proofed structures and acquired tracts shall be considered a separable element and functional portion of the Project. The NFS is responsible for the enforcement of the provisions of the agreement executed by the owners of property benefiting from the NED measures and for enforcement of the requirements of the OMRR&R Manual, including by not limited to, compliance with the requirements of Section 402 of the Water Resources Development Act of 1986, as amended. Upon NCC for NED implementation for a given structure or contract, the USACE will furnish to the NFS a final OMRR&R manual addressing, among other things, the NFS responsibility for enforcement of terms of the flood proofing agreement, as well as other OMRR&R requirements.. The NFS shall conduct periodic inspections at the intervals specified in the OMRR&R Manual to ensure that the owners, their heirs, and assigns, are in compliance with the terms and conditions of the executed agreements and shall provide written certifications to USACE that the structures and lands have been inspected and that no violations have been found. Regarding the elevated residential structures, the inspections will determine among other things, that no part of the structure located below the level of the lowest habitable finished floor has been converted to living area for human habitation, or otherwise altered in any manner which would impede the movement of waters beneath the structure; that the area below the predicted 2075 100-year BFE is being used solely for the parking of vehicles, limited storage, or access to the structure and not for human habitation; that mechanical, electrical or plumbing devices have not been installed below the BFE; that the property is in compliance with all applicable floodplain ordinances and regulations. USACE shall have the right, but not the obligation, to perform its own inspections of the flood proofed structures and lands acquired pursuant to the Project.

Further details regarding the obligations of the NFS for the NED RP are set forth in Chapter 7 of this report.

4.1.9 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.

Environmental Factors

Relative Sea Level Rise: 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. (Appendix B). Calculations based on Engineering Regulation 1100-2-8162 determined that the low, intermediate, and high rates of RSLR at 2075 would be 1.4 ft, 2.3 ft, and 3.2 ft higher than current levels respectively (Table 4-1). The intermediate rate was used for models and screening alternatives, with the low and high rates then used in a sensitivity analysis on the RP to ensure that no superior alternatives had been accidentally eliminated due to the reliance on a single scenario. This analysis is detailed in Appendix O, the Climate Performance and Resilience Register.

RSLR could impact the benefits achieved by the RP. Because the NED RP was developed using the intermediate RSLR rate, the NED RP 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. This could ultimately lead to a shift in project strategy from elevations to relocations if future sea level is higher than anticipated. Such a shift would occur only after careful consideration of not only sea level, but also community cohesion and the viability of supporting infrastructure such as transportation, water supply, and wastewater. For those structures already raised in a previous round of elevation, actual economic benefits could be lower than anticipated if community cohesion and supporting infrastructure are not maintained. These factors would be considered during the implementation phase of the

Project. The Corps will continue to monitor local conditions and determine if the intermediate scenario of RSLR is occurring. If observed conditions deviate from intermediate to high sea level forecasts during design or construction, reevaluation of the NED and NER will be required.

Table 4-1: Predicted RSLR rise rates 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	0.125	0.222
2025 Intermediate SLR	0.216	0.313
2025 High SLR	0.307	0.405
2075 Low SLR	0.919	1.424
2075 Intermediate SLR	1.827	2.331
2075 High SLR	2.736	3.241

Storms: Uncertainty with regard to the size and frequency of hurricanes that could result from global 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 Appendix B, Engineering Report).

If indicated by monitoring of RLSR and/or climate non-stationarity, the nonstructural Project can be adaptive and make adjustments to design criteria and structures preliminarily recommended for inclusion in the Project. This is achievable because the implementation of a broad regional nonstructural project, as well as evidence of a greater-than-predicted rate of RSLR and/or coastal storm damages, would be distributed over time. As sea level changes and is updated over time, the floodplain definitions would change, design criteria can be adapted, and the predicted 2075 100-year BFE could be adjusted upward. This could require raising structures deemed eligible in the NED RP to a higher elevation than identified at this time. 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 a potential reduction of forecast benefits.

Modeling Factors

ADCIRC and HEC-RAS models appear to provide a specific response on the NED RP 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 such as boundary conditions, which are limited by the data available, especially during storm events and the time period selected for analysis. Another model parameter assumption is model geometry. Survey data/LiDAR has good coverage in some areas; other areas require assumptions, interpolations, extrapolations, or known elevation points to get coverage. Another uncertainty is that a limited number of storm scenarios are modeled. It is assumed that various storm scenarios over a number of years would represent a much higher indicator of the ability for nonstructural measures 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 FWOP damages. For structural features, this could potentially result in the feature not being economically justified or preliminary estimates of the BCRs being overstated. However, no structural features are part of the NED RP so this risk is minimized.

The HEC-FDA model (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 1% 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 RP, 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 project 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 NED plan should highlight the benefits of participation such as long-term hurricane storm surge damage risk reduction, and beneficial impacts to insurability. If the NED RP 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 in recommendation. For this analysis, 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 RP remain positive and the BCR unchanged.

The uncertainty surrounding each of the economic and engineering variables and a probability distribution were 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 plan costs were estimated based on the number of structures within the 25-year (4% ACE) floodplain in the 2025 base year. RSLR prior to the base year significantly affects 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 NED RP.

The NED RP offers hurricane storm surge damage risk reduction only for those eligible, economically justified structures in the 0-25-year floodplain, which equals 3,961 of a total of 4,952 structures. An additional 10,715 structures are present in the 25-100 year (4% - 1% ACE) floodplain. However, complete implementation of the NED RP has the potential to reduce damages from the design hurricane storm surge within the study area as a whole floodplain by 58%, 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 project benefits. From the standpoint of public safety, the NED RP 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.

The localized risk reduction measures as applied to single warehouse structures were formulated as a small-scale approach, similar in scale to individual structure elevations and dry floodproofing of commercial structures, but intended to reduce flooding associated with the highest frequency events for a unique type of structure for which this measure is both technically feasible and economically effective. The level of risk reduction for localized risk reduction measures is contingent upon the fixed maximum height of the barrier, which is constrained by the footprint of parcel ownership, and does not necessarily correlate with the 100-year level of risk reduction that is represented by the performance of the structure elevation measure applied to the overwhelming majority of structures comprising the recommended plan. Although, economically justified on an individual basis, localized risk reduction measures still carry potential large residual flood risk. The level of residual risk will vary by location, and not all warehouse operators are guaranteed to voluntarily participate in the recommended plan. Yet, because of the commercial/industrial nature of the occupational use of the structure, life-safety considerations are not as significant as they would be as for plans that address residential structures which may have equivalent high residual risk.

4.1.10 NED Real Estate Requirements

Costs for the nonstructural elevations were included as construction costs and not as separable real estate acquisition costs. In addition, a Chart of Accounts which captures the real estate costs associated with the plan implementation (administrative costs for elevations) is included in the Real Estate Plan (Appendix E). A maximum of 3,961 structures are eligible for inclusion in the NED Project. Additional discussion of the real estate requirements for NED RP features can be found in the Real Estate Plan (Appendix E). The NFS would be responsible for acquiring all necessary real estate interests under established criteria.

4.1.11 Summary of Environmental Consequences of NED Plan

Each non-residential structure will be evaluated to determine the most cost effective method of flood proofing. At the time of this Report, it is anticipated that implementation of localized storm surge risk reduction measures will be through the Federal procurement of Indefinite Deliverable, Indefinite Quantity (IDIQ) contracts that will be implemented by the issuance of individual task orders for the implementation of flood proofing measures at each warehouse. The basis for this assumption is that the PDT has completed an inspection of the warehouse inventory. That inspection indicates that the geographic distribution of these warehouses and the inability to determine the schedule for voluntary participation do not comport with the clustering strategy whereby the rest of the NED RP will be implemented. For these reasons it is anticipated that an individual task order will be limited to a single warehouse to be flood proofed. The PDT anticipates that only a small amount of borrow would be needed for construction of the localized storm surge risk reduction measures for each warehouse being accomplished by separate task order. Based on this conclusion, it is foreseeable that commercial borrow sites would be used. As of the date of this Report, there are several commercial borrow sites within the project area that are readily available.

Real Estate regulations (ER. 405-1-12, paragraph 12-9d(3)) allow for small quantities of borrow material to be supplied by the construction contractor through the use of readily available commercial sites, if supported by an analysis conducted by the Government and the NFS, and if no other constraints exist. Since it has been determined that each IDIQ task order will address a single warehouse, for purposes of this Final Report, it has been assumed that the analysis performed pursuant to the above cited ER 405-1-12 will determine that the required borrow quantities constitute a small quantity that can be obtained through a commercial site that meets the Project requirements. Prior to issuing a construction task order, the Government will conduct the necessary analysis in accordance with ER 405-1-12. Contractors would be required to demonstrate that any proposed commercial borrow site is environmentally cleared and contains geotechnically suitable borrow material. In evaluating the suitability of the proposed commercial borrow site, impacts to wetlands or bottomland hardwoods would be prohibited. Costs of utilizing a commercial borrow site would be considered an item of construction cost, and not an item of LERRD cost.

The NED RP avoids and minimizes negative environmental impacts to the maximum extent. The eligibility criteria for implementation of a plan measure stipulates that implementation cannot impact threatened or

endangered species, that implementation will not require fill in the waters of the United States and would not result in any impact to wetlands. The current impact analysis indicates that no mitigation for the NED RP would be required. This determination would be refined as each eligible structure is evaluated for a particular measure. The more significant changes between the initial TSPs and the NED RP are highlighted in Table 4-2 below.

Table 4-2: NED Plan Changes.

Plan	Recommendation	2013 Draft Report (TSP)	2015 Revised Draft Report (TSP)	Final Report (NED RP)
NED	Eligibility	11 Justified Reaches	Justified Floodplains	Justified Floodplains
	Eligible Floodplain	2075 100-Year	2025 0-25-Year	2025 0-25-Year
	Eligible Structures	3,915	4,952	3,961[1]
	Benefit/Cost Ratio	1.25:1	7.74:1	5.65:1[2]
	Eligibility	Voluntary	Voluntary & Involuntary	Voluntary
	Project First Cost	$388,000,000	$824,000,000	$906,091,000

1- Only economically justified structures are included in the NED RP
2- BCR was updated with certified cost numbers

4.2 National Ecosystem Restoration Recommended Plan (NER RP)

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

The NER RP (Alternative CM-4) consists of a broad range of ecosystem restoration measures including marsh restoration features (which involves hydraulic dredging and placing of sediments), shoreline protection/stabilization features, and chenier reforestation. The CSC Salinity Control Structure and the Cameron-Creole Spillway Structure are recommended as additional long-range studies to adequately account for potential environmental benefits, economic costs, and engineering. The NER RP 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 is detailed in a fact sheet which can be found in Appendix K.

The NER RP restoration features (together with their benefits and impacts) are constructible and would move into the preconstruction engineering and design (PED) phase next. The construction acres and habitat benefits for all NER RP features are depicted in Tables 4-3 and 4-4.

Table 4-3: NER RP Feature Construction Benefits.

	Category	ID	Description	Net Acres	Net AAHUs
Mermantau/Teche-Vermilion (Plan M-4)	Marsh Restoration[1]	47a1	Marsh restoration using dredged material south of LA-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 renourishment cycle.	895	272
		47a2	Marsh restoration using dredged material south of LA-82, approximately 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 renourishment cycle.	1,218	381
		47c1	Marsh restoration using dredged material south of LA-82, approximately 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 renourishment cycle.	1,135	353
		127c3	Marsh restoration at Pecan Island, west of the Freshwater Bayou Canal and approximately 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 renourishment cycle.	735	241
		306a1	Rainey marsh restoration at Christian Marsh, east of the Freshwater Bayou Canal and approximately 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 renourishment cycle.	743	151
	Shoreline Protection/ Stabilization[1]	6b1	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 11.0 miles of Gulf shore protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore consisting of geotextile fabric and stone built to an 18 ft crest width.	2,140	625
		6b2	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 8.1 miles of Gulf shoreline protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore using geotextile fabric and stone built to an 18 ft crest width.	1,583	466
		6b3	Gulf shore protection/stabilization from Calcasieu River to Freshwater Bayou. 6.3 miles of Gulf shoreline protection consisting of a reef breakwater with a lightweight aggregate core. Located ~150 ft offshore using geotextile fabric and stone built to an 18 ft crest width.	1,098	312
		16b	Fortify spoil banks of Freshwater Bayou. Approximately 13.4 miles of rock revetment at three critical locations to prevent shoreline breaching. Rock revetment would be built to +3 ft with a 4 ft crown. Two maintenance lifts would be required.	1,288	279
	Chenier Re-forestation	CR	13 separate chenier locations would be replanted. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated[3].	281	96
Calcasieu/ Sabine (CM-3)	Marsh Restoration[1]	3a1	Beneficial use of dredged material from the Calcasieu Ship Channel. Located adjacent to the south shore of the GIWW west of the Calcasieu Ship Channel near Black Lake. Restore 599 marsh acres with 5.3M cubic yards of dredged material with one renourishment cycle.	454	191

		3c1[2]	Beneficial use of dredged material from the Calcasieu Ship Channel. Located adjacent to the eastern rim of Calcasieu Lake and situated within the Cameron-Creole Watershed area. 1,347 marsh acres would be restored and 734 acres would be nourished from 9.4M cubic yards of dredged material with one renourishment cycle.	1,324	607
		124c	Marsh restoration at Mud Lake. Located adjacent and north of Highway 82 and east of Mud Lake. 1,077 marsh acres would be restored and 708 acres would be nourished from 10.4M cubic yards of dredged material with one renourishment cycle.	1,228	500
		124d[2]	Marsh restoration at Mud Lake. Located west of the Calcasieu Ship Channel and adjacent to the south 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 renourishment cycle.	168	4
	Shoreline Protection/ Stabilization[1]	5a	Holly Beach Shoreline Stabilization Breakwaters. Construction of 8.7 miles of rock and low action breakwaters and is a continuation of existing breakwaters. Crown elevation of +3.5 ft with a crown width of 24 ft. Two maintenance lifts would be required.	26	56
	Chenier Re-forestation	CR	22 separate chenier locations would be replanted. Approximately 435 seedlings per acre, at 10 ft x 10 ft spacing, with invasive species control incorporated[3].	1,132	442
	TOTALS			15,448	4,976

1-Renourishment and maintenance lifts are considered an OMRR&R cost and are a 100% NFS responsibility. Renourishment material would come from the site of the initial dredging effort.

2- Features 3c1 and 124d are partially located on USFWS property. While USACE believes that these features are worthy of recommendation, USACE has determined that these features would more properly be implemented by USFWS. Therefore, USACE will not seek authorization and funding of these features. Rather USACE will recommend to USFWS that it consider seeking independent Congressional authorization and funding for implementation of these features by USFWS.

3- Costs to ensure the minimum survival percent are considered 'construction' and will be cost-shared accordingly. Following NCC of these features, control of invasive species are considered an OMRR&R cost and are a 100% NFS responsibility.

The full benefits for all feature types in the NER RP are presented below.

Table 4-4: NER Plan Benefits by Measure Type.

Restoration Measure	# of Features	Net Acres	AAHUs	Parishes
Marsh Restoration	9	7,900	2,700	Calcasieu, Cameron, Vermilion
Shoreline Protection/Stabilization	5	6,135	1,738	Cameron, Vermilion
Chenier Reforestation	35	1,413	538	Cameron, Vermilion
Total	**49***	**15,448**	**4,976**	**---**

**- The Calcasieu Ship Channel Salinity Control Structure and the Cameron-Creole Spillway Structure are recommended for additional feasibility 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 ft 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 the CSC adjacent to the southern rim of West Cove. Dredged material sources would be the CSC (through beneficial use of dredged material) and the Gulf of Mexico (through dedicated dredging). 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 NFS (currently estimated at $311,573,000 for all restoration features). 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 five shoreline protection/stabilization features, which span approximately 252,000 linear ft, 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 planting of 435 seedlings per acre at 10 foot x 10 foot spacing, in 35 chenier locations on over 1,400 acres in Cameron and Vermilion parishes. Cheniers selected for restoration would be greater than five ft 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 RP features. Figure 4-4 depicts active restoration activities in the study area under various programs.

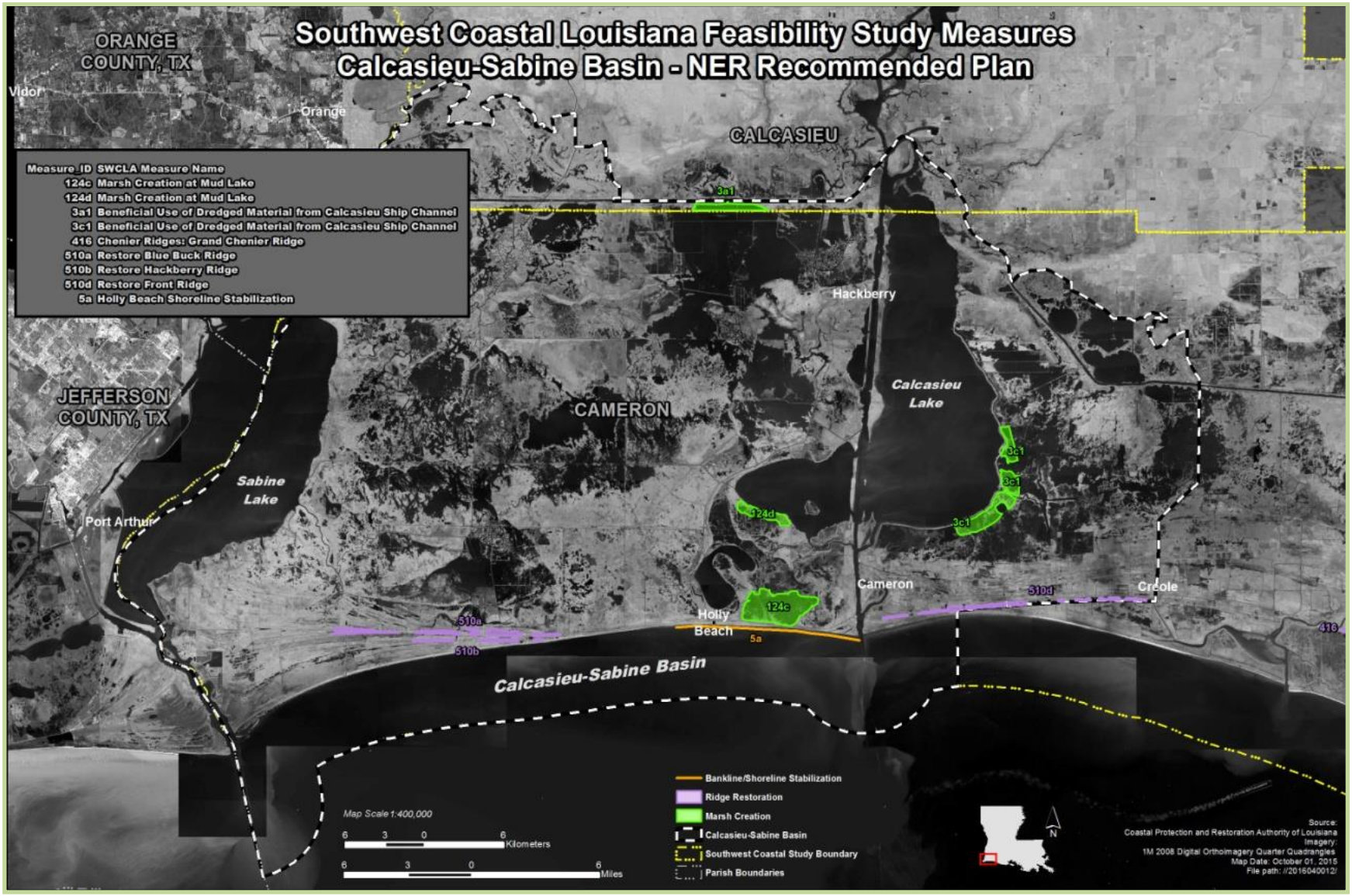

Figure 4-3a: NER RP features (Calcasieu-Sabine Basin).

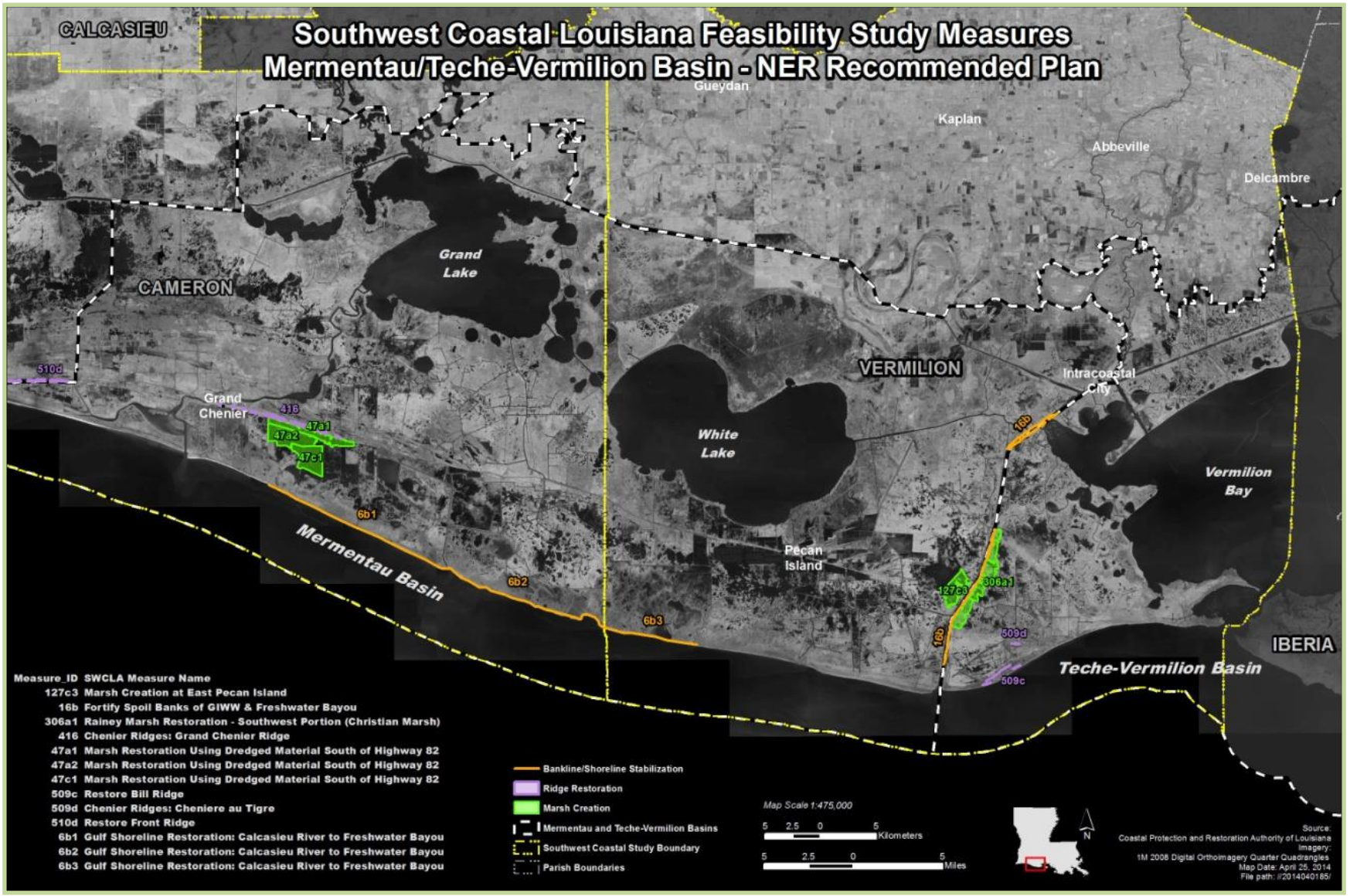

Figure 4-3b: NER RP features (Mermentau/Teche-Vermilion Basin).

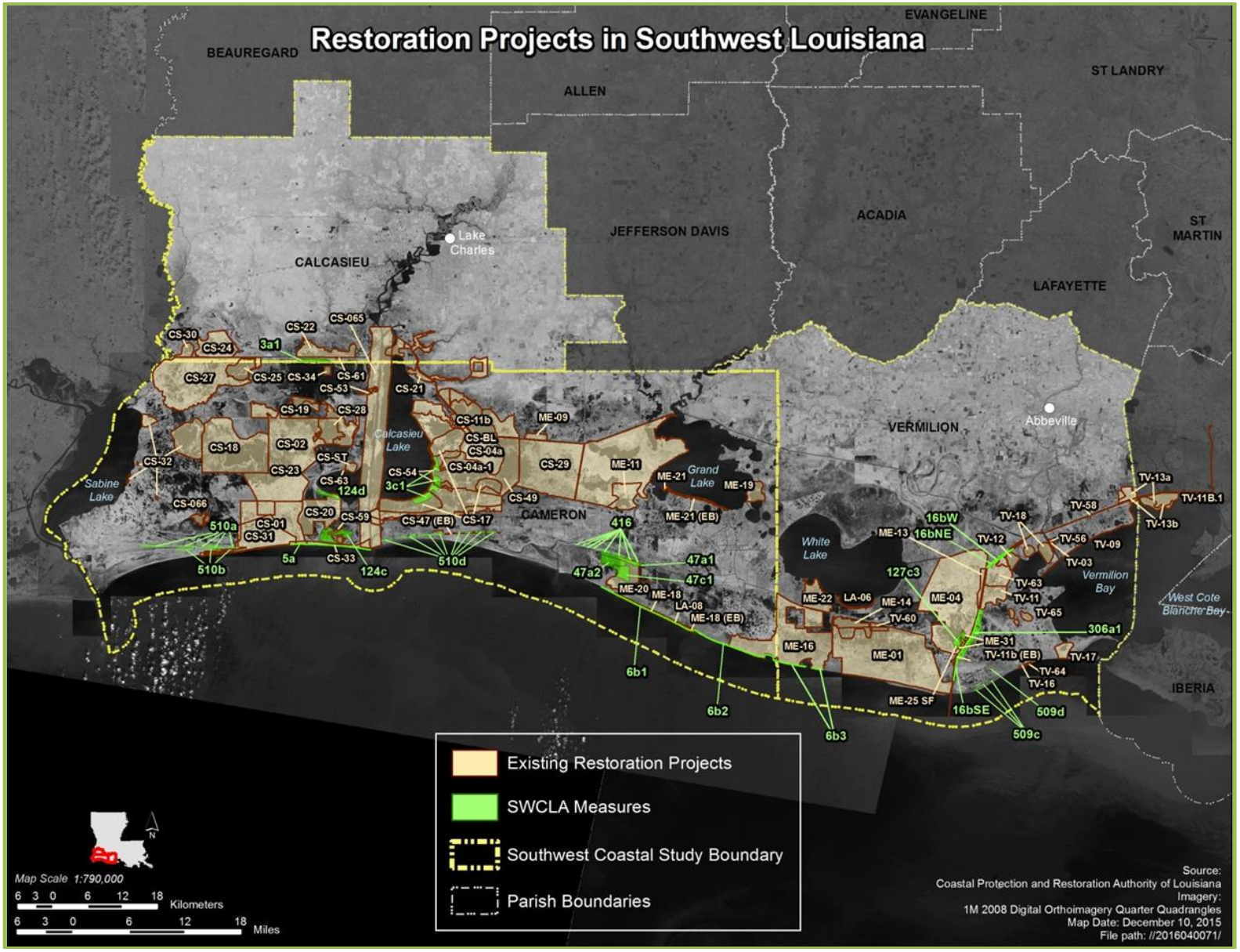

Figure 4-4: Ecosystem restoration activities in the study area

4.2.2 NER RP Implementation

This section describes the sequence in which NER RP features would be constructed. NER RP features were categorized into three tiers whereby Tier I features would be constructed before Tier II, and Tier II features constructed before Tier III. Tier I features may be constructed simultaneously because they would not affect the construction of any nearby Tier I NER RP feature. Shoreline protection features would be constructed prior to marsh restoration features in an effort to better protect the more storm-vulnerable marsh restoration features. This approach contributes to the sustainability of the marsh restoration features. Tier II NER RP features were so categorized because they utilize the same borrow or staging area, and/or construction of these features would potentially interfere with construction of a Tier I NER RP feature. Tier II NER RP features would be constructed contemporaneously as the construction of any one of these features would not affect any other feature within this grouping. Tier III NER RP features were so categorized because they would utilize the same borrow or staging area, and/or interfered with construction of a Tier II feature, and/or interfered with an existing mitigation project. Tier III features would be constructed contemporaneously if they would not affect construction of the other features within this grouping.

In categorizing features, it was assumed that all construction funds would be available, multiple construction contracts could be let at one time, and there is an adequate supply of all materials to facilitate construction. More detailed design and analysis would be undertaken during the PED phase. The initiation of construction for features within each tier was scheduled over ten year intervals. For planning purposes the first construction interval beginning at the base year of 2025 through 2034, the second 2035-2044, and the third 2045 to completion. Actual initiation of construction would be contingent on the date of authorization, and subsequent provision of appropriations, for this recommendation. The individual features are organized, and would be staged, within the tiers based on their systemic criticality and for sequential staging. The tiering and staging of the individual features has been developed to assure several implementation requirements. First, that the features are implemented in the most effective order for long-term ecosystem performance. Second, that no conflicts will occur with common resources required for construction, and finally, that the completion of any existing obligations for mitigation projects that interface with some plan features will be met prior to implementation. General prioritization for staging within the tiers would apply the criteria of addressing shorelines and channel banks, and working from the coastline landward. Features that interface with projects having outstanding mitigation obligations would also be staged later in each tier.

Tier I Projects (projected implementation 2025-2034):

- Holly Beach Shoreline Stabilization – Breakwaters (5a)
- Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b1)
- Fortify Spoil Banks of the GIWW and Freshwater Bayou (16bSE)
- Fortify Spoil Banks of the GIWW and Freshwater Bayou (16bNE)
- Fortify Spoil Banks of the GIWW and Freshwater Bayou (16bW)
- Beneficial Use of Dredged Material from the Calcasieu Ship Channel (3a1)
- Marsh Restoration at Mud Lake (124d)[1]
- Marsh Restoration at Pecan Island (127c3)
- Chenier Ridges: Grand Chenier Ridge (416)[2]
- Restore Bill Ridge (509c)[2]
- Chenier Ridges: Cheniere au Tigre (509d)[2]
- Restore Blue Buck Ridge (510a)[2]
- Restore Hackberry Ridge (510b)[2]
- Restore Front Ridge (510d)[2]

Tier II Projects (projected implementation 2035-2044):

- Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b2)
- Marsh Restoration at Mud Lake (124c)
- Rainey Marsh Restoration Southwest Portion (Christian Marsh) (306a1)

Tier III Projects (projected implementation 2045-completion):

- Beneficial Use of Dredged Material from the Calcasieu Ship Channel (3c1)[1]
- Gulf Shoreline Restoration: Calcasieu River to Freshwater Bayou (6b3)
- Marsh Restoration Using Dredged Material South of Highway 82 (47a1)
- Marsh Restoration Using Dredged Material South of Highway 82 (47a2)
- Marsh Restoration Using Dredged Material South of Highway 82 (47c1)

Recommended for Further Study:

- Calcasieu Ship Channel Salinity Control Structure
- Cameron-Creole Spillway Structure

[1]- *Recommended for independent Congressional authorization and appropriation for construction by USFWS*

[2]- *Individual features that comprise the chenier reforestation measure*

Two marsh restoration measures, (Features 124d and 3c1) are partially located on USFWS property (Sabine National Wildlife Refuge and Cameron Prairie National Wildlife Refuge, respectively) and are included in the NER RP. These features are vitally important to help preserve the Calcasieu Lake rim and prevent vast new expanses of open water from forming should the lake rim be breached by erosional forces. All NED and NER RP features (including those recommended for appropriation and construction by USFWS) represent the "Federal Plan". Because USFWS is ultimately responsible for managing its refuge lands, USACE is not seeking authorization and funding for the USFWS Features 124d and 3c1. The NED RP and the subset of NER features that are recommended for authorization and appropriation by USACE [all features minus 124d and 3c1) represent the "Corps Plan"]. Rather, USACE supports USFWS in seeking its own authorization and appropriation to construct the two features and offers USFWS the information that USACE developed under this study effort as a starting point for USFWS efforts to obtain independent authorization and funding for the USFWS features of the Federal Plan. The NER project first cost estimate for the Federal Plan (which includes costs associated with these two features) is $2.485 billion. The total benefits for the Federal NER RP are 15,448 acres and 4,976 AAHUs. Of the total cost, the USACE estimates approximately $297 million for the design, construction, and construction management costs of these two USFWS features. However, it is anticipated that USFWS would develop its own costs in connection with these features. The total NER benefits for the two USFWS suggested features are 1,492 acres and 611 AAHUs. The NER RP was evaluated and justified through the incremental analysis. Therefore, each individual restoration feature is justified as a stand-alone project. These features are particularly desirable because they provide additional benefit not quantified in the evaluation and selection process (i.e. preserving critical geomorphic structure of the lake rim). These features are in the Federal interest and USFWS is encouraged to seek independent authorization and appropriation for construction.

The NER recommended Corps Plan includes a three tiered implementation sequence. (1) Tier I features may be constructed simultaneously because they would not affect the construction of any nearby Tier I NER Recommended Plan feature. Shoreline protection features would be constructed prior to marsh restoration features in an effort to better protect the more storm-vulnerable marsh restoration features. This approach contributes to the sustainability of the marsh restoration features. The project first cost for Tier 1 is $850,998,000 producing 1,930 AAHUs. (2) Tier II NER Recommended Plan features were so categorized because they utilize the same borrow or staging area, and/or construction of these features would potentially interfere with construction of a Tier I NER Recommended Plan feature. The project first cost for Tier II is $561,186,000 producing 1,117 AAHUs. (3) Tier III NER Recommended Plan features were so categorized because they would utilize the same borrow or staging area, and/or interfered with construction of a Tier II feature, and/or interfered with an existing mitigation project. The project first cost for Tier III is $776,002,000 producing 1,318 AAHUs.

Construction of NER RP features would overlap ten permitted mitigation projects. Completion of the permit obligation requirements range between 2016 and 2040. Project-induced impacts to the mitigation projects would be avoided by tiering construction of NER RP features until after mitigation permit obligations have been satisfied. As contemplated in the current recommended tiered construction schedule, the expiration date for each mitigation project identifies the earliest construction start date for the corresponding NER RP feature. Prior to initiating construction of the NER RP measures, the Government and the NFS shall first obtain written confirmation from the permitting authority that the mitigation obligations and all other permit obligations have been satisfied by the permittee. Commencement of implementing the NER RP measure that overlaps a permitted mitigation project would be delayed until such time as written confirmation is obtained. Given that some mitigation features will not be completed for 20+ years, there is a risk that NER feature construction costs, schedules, and implementability could change from current estimates. Table 4-5 identifies mitigation projects and the tiers into which they are assigned based upon the estimated date of satisfying permit obligations. Following confirmation that all permit requirements have been met for a mitigation project, the Government would re-assess the site to assure that the proposed NER RP feature for the site remains justified.

Table 4-5: Mitigation Projects that Interface with NER RP Features.

Permit #	Description	NER RP Feature	Permittee or Owner	Expiration Date (permit completion date + 20 years)	Mitigation Project Description
Tier I Features					
P20061888	Terraces at GIWW N of Black Lake	3a1	Gulfport Energy Corporation	11/30/2032	Proposed construction of 5,358 linear ft of terraces south of the GIWW and north of Black Lake.
P19900448	Marsh Management Plan area	124d	Apache Louisiana Minerals	11/13/2016	Install and maintain water control structures for CTU 1 and 2. In CTU 1, 64,000 linear ft of smooth cordgrass plantings. In CTU 2, 32,470 linear ft of boundary levee are to be repaired. Various water control structures are to be repaired or replaced.
P19971118	West Cove Planting Project	124d	Union Pacific Resources	7/28/2022	West Cove Planting Project; 5,000 ft of plantings of *Spartina alterniflora*.
P19950086	Marsh Management Plan area	127c3	Vermilion Corporation	4/1/2021	Eight water control structures will be installed; a riprap levee will be constructed; five double flapgated culverts and one earthen plug will be installed; two earthen plugs will be constructed.
Tier II Features					
P20141590	Spoil Placement	306a1	Hilcorp Energy Company	4/8/2040	Dredging of 15,430 cubic yards of native material to construct slip for the purpose of installing a drill rig, well protector and pilings. The dredged material will be pumped into a shallow pond adjacent to the proposed drill site using a temporary discharge pipe. An additional 301 cubic yards of material will be displaced to construct containment berms.

Tier III Features					
P20141138	Rip-rap Grand Bayou	3c1	CPRA	1/29/2040	Installation of 21,000 tons of riprap along the Calcasieu Lake Shoreline near the Peconi, Mangrove and Grand Bayou water control structures.
P19870422	Marsh Management Plan area	47a2	T.Bonsall	2/3/2023	Construction of a levee and multiple water control structures (South of Upper Mud Lake).
P20031576	Mitigation for P20031304	47a2	Kash Oil & Gas, Inc.	3/31/2029	Constructed 4,803 linear feet of terraces and planted with *Spartina alterniflora.*
P20081326	Mitigation for P20080132	47a2	PetroQuest Energy, L.L.C.	11/25/2033	Construct and plant 2,897 linear ft of wave dampening terraces that will capture re-suspended sediments and protect fragile shorelines by planting plugs of smooth cordgrass on both sides of constructed terraces.
P20071745	Mitigation for 20070883	47c1	Manti Operating Company	3/5/2025*	Construction of ten 500-foot terraces, eight 300-foot terraces, two 200-foot terraces and eight 400-foot terraces (6.1 acres). Plantings of *Spartina alterniflora* rows on each side of the terraces.

*11 years, not 20 years

4.2.3 Adaptive Management and Monitoring (AM&M)

The AM&M plan describes the adaptive management and monitoring to be used to evaluate the progress made towards meeting project goals and objectives, and is contained in Appendix A. The primary reason for implementing AM&M is to increase the likelihood of achieving desired project outcomes given the uncertainties with ecosystem restoration. Adaptive management works best when it is tailored to the specific problem(s), designed to ensure accountability and enforceability, used to promote useful learning, and supported by sufficient funding. AM&M is warranted when there are consequential decisions to be made, when there is an opportunity to apply learning, when the objectives of management are clear, when the value of reducing uncertainty is high, and when a monitoring system can be put in place to reduce uncertainty. 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 would be refined further in subsequent design phases. AM&M costs are based on the monitoring needed to measure ecological success and the identified risks and uncertainties. Section 2039 of the WRDA 2007 allows ecological success monitoring to be cost-shared for up to ten years post-construction. Once ecological success has been achieved, which may occur in less than ten years post-construction, no further monitoring would be performed. If ecological success cannot be determined within the ten-year post construction period of monitoring, any additional required monitoring will be a non-Federal responsibility.

4.2.4 NER RP Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R)

The NFS is responsible for all of the OMRR&R of the NER RP. At the time of this Report, it is anticipated that the OMRR&R of the marsh restoration elements primarily consists of marsh renourishment through the periodic addition of dredged sediment to maintain wetland elevations. OMRR&R of the shoreline protection/stabilization features is currently anticipated to consist of periodic maintenance lifts and the addition of material for rock and/or rip-rap features. Construction and OMRR&R of the chenier reforestation features will not be required following the achievement of the minimum survival threshold criteria, which is anticipated to occur for each chenier feature by Target Year 5 (following initial planting). For purposes of this report, it has been assumed that the minimum survival threshold will be obtained on or before 10 years post construction; therefore, this report does not capture any OMRR&R beyond the 10 years post-construction date. At such time as the minimum survival threshold is obtained for a given element of the chenier feature, or 10 years from the

date of the construction of the element of the chenier feature, whichever comes first, the Government shall NCC the individual chenier element to the NFS. OMRR&R costs are the responsibility of the NFS (currently estimated at $311,573,000 for all NER RP features).The estimated average annual OMRR&R cost for the NER features is $5,958,000, which would be refined during the PED phase. The NFS shall commence OMRR&R once each project undergoes a final inspection by both USACE and the NFS and the USACE issues a NCC together with the OMRR&R Manual to the NFS.

4.2.5 Risk and Uncertainty Analysis

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

Environmental Factors

Relative Sea Level Rise: An assessment of RSLR (see Appendix O) 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. 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 Chapter 1.RSLR could impact the benefits of the NER RP. Because the features were developed using the intermediate RSLR rate, the NER RP 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. This is a risk to the effectiveness of the NER RP 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 NER RP 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 hurricane storm surge and associated flooding, salinity spikes, and tidal scour, though some hurricane storm surge damages may be unavoidable.

4.2.6 Real Estate Requirements

The Real Estate Plan (Appendix E) provides a description of the lands, easements, rights-of-way, including those needed for relocations and the borrowing of material, ensuring the performance of relocations and the disposal of dredged or excavated materials (LERRDs) as deemed by the Government to be required for the construction and OMRR&R of the NER RP features. Appendix E, Table 1 describes the estates to be acquired for each NER RP feature, and indicates whether the lands are owned by private landowners or by the state of Louisiana. An estimated 158 private landowners will be affected by the NER RP. A cost estimate was prepared in April, 2014, and is included within Appendix E. Fact sheet maps for NER RP 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 RP 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 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. A Real Estate Plan providing detailed information regarding real estate acquisition for the NER RP is found in Appendix E.

4.2.7 Summary of Environmental Consequences of NER Plan

Restoration, protection/stabilization, and chenier features for the NER RP are designed to be self-mitigating and would not require compensation. Table 4-6 depicts the changes between the NER TSP contained in the December 2013 Draft Report, the 2015 Revised Draft Report, and the final NER RP contained herein.

Table 4-6: NER Plan Changes.

Plan	Recommendation	2013 Draft Report	2015 Revised Draft Report	Final Report
NER	Marsh Features (Acres/AAHUs)	9 (8,714/N/A)	9 (8,714/3,481)	9 (7,900/2,700)
	Hydrology/Salinity Control Features (Acres/AAHUs)*	2 (6,092/N/A)	1 (-56/267)	Recommended for Study[1]
	Shoreline Protection/Stabilization Features (Acres/AAHUs)	5 (5,509/N/A)	5 (5,509/1,615)	5 (6,135/1,738)
	Oyster Reef Preservation Features (Acres/AAHUs)	1 (N/A/N/A)	Removed	Removed
	Chenier Features (Acres/AAHUs)	22 (1,413/N/A)	35 (1,414/538)	35 (1,413/538)
	Project First Cost (Oct 2015 Price Level)/Total Project Cost	$992,000,000[2]	$987,738,000[2]	$2,485,025,000/ $2,491,025,000[1]

[1] *The Calcasieu Ship Channel Salinity Control Structure and the Cameron-Creole Spillway Structure are recommended for additional study ($3M for each study has been added to the Total Project Cost).*

[2] *Based on uncertified costs, no adaptive management, and without a tiered construction schedule.*

4.2.8 Significance of Benefits for the Recommended Plans

The Southwest Coastal study area is significant for multiple reasons as described below. Aside from the institutional, public, and technical considerations, the area is extremely important locally, regionally, and nationally, and the NED and NER RPs would help to preserve and sustain this importance in a number of ways.

NED Significance

Implementing the NED RP measures to reduce damages from hurricane storm surge to structures in the study area serves multiple purposes. First, it would help to lessen the financial and social impacts that tropical storms and hurricanes can cause by reducing the risk of property damage that displaces residents, shuts down commercial and industrial services, and disrupts livelihoods. If structures avoid or have reduced damages because of nonstructural measures, families and businesses can rebound much more quickly after a tropical event. This is exemplified by increasing the opportunity to return children to school where their residences and schools were not damaged from the design hurricane storm surge event; by reducing lost work days of workers who support the local or regional economy by decreasing the number of hurricane storm events that require repairs to hurricane storm surge damaged houses, businesses and other non-residential structures, by minimizing the debris from hurricane storm damaged structures that can affect other properties; and by generally improving the opportunity and time necessary for residents, businesses and government to return to normal function after the design hurricane storm event. Eligible structures that are at-risk from storm surge from the NED RP design hurricane would be subject to nonstructural measures that would reduce the risk of the anticipated storm surge Second, time, money, and energy would not be lost to repairing structures damaged by storm surge from the NED RP design hurricane, relocating to other areas due to displacement from a home or business, or disruptions in community cohesiveness. This would help to ensure that the economy would continue to operate after the NED RP design hurricane and that the stress and hardship associated with hurricane storm surge would be lessened. Implementing the NED RP would also help to preserve a sense of place and community identity by reducing the potential for this unique culture in the United States to be displaced, perhaps permanently, to other areas in the region. Finally, the study area supports national needs, logistics, and persona. For example, the nation enjoys Louisiana seafood, relies on the uninterrupted supply of energy and material goods, and benefits from having a culture that exemplifies the passionate and hard-working

spirit that defines the study area. Pronounced impacts from repetitive hurricane storm surge events, such as the NED RP design hurricane, threatens the productivity and sustainability of these important national interests by reducing the continuity, functionality, and export of supplies, commerce, and culture.

NER Significance

Restoring fresh, intermediate, brackish, and saline marshes within a framework of marsh restoration, shoreline protection/stabilization, and chenier features would interact to provide benefits greater than the sum of their parts. Together these features would help regulate fresh and saltwater flows, protect against substrate erosion, and provide important transitional estuarine habitat between upland and marine environments. Restoring lost wetlands, protecting existing wetlands, and reducing the profound environmental and habitat loss across the study area could help support the NED RP recommendations. Part of the area's vulnerability to hurricane storm surge damages is directly related to the significant loss of wetlands the area has experienced. Restoring these important habitats helps to reduce the ability of coastal floodwaters to work their way into the communities that need risk reduction measures to help reduce damages from hurricane storm surge. Wetlands provide a buffer between ever-growing open water areas that allow water (and surge) to permeate further inland and thus more directly affect the surrounding infrastructure such as roads, residences, businesses, and critical infrastructure (i.e. electrical, water, sewer, and drainage facilities). Implementing the NER RP could help increase the effectiveness of the NED RP. Wetlands provide important habitat that directly supports the viability of threatened and endangered species; commercially important species such as alligator, shrimp, and crabs; and the economy through the creation of and support for industries that depend on wetlands such as fishing and hunting guides, bait/tackle shops, birding enthusiasts, or eco-tourism. Wetlands are a unique yet imperiled ecosystem in the Nation and coastal Louisiana has experienced a tremendous loss of this important habitat.

Resource Significance—Institutional, Public, and Technical

Significance of Benefits

The NER RP would benefit a total of 15,448 net acres (Table 4-3). The significance of benefits for the NER RP is substantially greater than just the net acres restored and/or protected. Compared to the "No Action Alternative", implementing the marsh restoration, chenier reforestation, and shoreline protection/stabilization features of the NER RP would result in positive effects on resources which are institutionally, technically, and publicly recognized. Restoration supports the global, national, state, and locally significant resources within the area would contribute to the unique services, functions, and values provided by these resources.

Implementing the NER RP would reduce some forms of habitat degradation and land loss reestablishing processes that contribute plant production replenishing 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. T&E 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 335 acres of designated critical habitat for the threatened piping plover and important habitat for the threatened rufa red knot.

There would also be benefits to various resources such as 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.

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. 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. While human populations in and near the wetland areas are moderate, 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 important national industries, especially the offshore oil and gas fields, being forced to abandon their communities and move further inland.

A resource is considered significant if it is acknowledged in three categories:

1. *Institutional*—the resource is acknowledged in the laws, adopted plans, or other policy statements of public agencies or private groups;
2. *Public*—the resources are recognized as important by some segment of the general public as evidenced by people engaged in activities that reflect an interest or concern for that particular resource; and/or
3. *Technical*—the resources are determined to be important based on technical or scientific criteria.

Institutional Recognition

Human Environment resources (socioeconomics and human resources) within the project area are institutionally significant. Of particular relevance is the degree to which the proposed action could positively affect the public health, safety, and economic well-being; and the quality of the human environment by providing hurricane storm surge risk reduction by implementing nonstructural measures (elevating, relocating, or flood proofing structures) and coastal restoration (marsh restoration, shoreline protection/stabilization, and chenier restoration). Institutional significance is exemplified because the NER benefits are recognized in laws and policy and acknowledgment is given to the restoration and protection of these resources in the project area by the following (for example): the National Environmental Policy Act of 1969, our basic national charter for protection of the environment and involvement of the public in decisions, such as this proposed action, which could beneficially affect the quality of the human environment; the Estuary Protection Act of 1968; Clean Water Act of 1972 and amendments, etc.

Restoration of water environment resources within the project area exemplifies institutional significance because of law and policy and the acknowledgment given to these resources by the following: National Environmental Policy Act of 1969; Clean Water Act of 1972 and amendments; Coastal Barrier Resources Act; Rivers and Harbors Act of 1899; Watershed Protection and Flood Prevention Act of 1954; Submerged Land Act of 1953; Coastal Zone Management Act of 1972; and the Estuary Protection Act of 1968.

Benefits from the proposed action would result in restored and protected wetland marshes, barrier shorelines, and chenier vegetation which provide essential and critical habitat for various fish and wildlife, endangered species (e.g., piping plover), and numerous species of neotropical migrating birds. Restored coastal wetlands and vegetation resources serve as the basis of productivity, contribute to ecosystem biodiversity, provide various essential and critical habitat types, and are an indicator of the health of coastal habitats. Natural environment resources are institutionally significant because restoration of these areas is exemplified by the law and policy recognition and acknowledgment given to these resources in the project area. Significance is supported by many laws, plan, policies, and treaties. The following provides an example of species and their associated laws:

Endangered Species Act of 1973, as amended;

Piping Plover (Charadrius melodus)	Threatened
Red knot (Calidris canutus rufa)	Threatened
Red-cockaded woodpecker (Picoides borealis)	Endangered
Sprague's pipit (Anthus spragueii)	Candidate
Gulf sturgeon (Acipenser oxyrinchus desotoi)	Threatened
West Indian Manatee (Trichechus manatus)	Endangered

Green sea turtle (Chelonia mydas)	Threatened
Hawksbill sea turtle (Eretmochelys imbricata)	Endangered
Kemp's ridley sea turtle (Lepidochelys kempii)	Endangered
Leatherback sea turtle (Dermochelys coriacea)	Endangered
Loggerhead sea turtle (Caretta caretta)	Threatened

The Migratory Bird Treaty Act of 1918;

Egret: Cattle, Bubulcus ibis, Little, Egretta garzetta, Reddish, Egretta rufescens, Snowy, Egretta thula
Bluebird: Eastern, Sialia sialis
Bunting: Indigo, Passerina cyanea
Chickadee: Carolina, Poecile carolinensis
Mallard, Anas platyrhynchos

Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended:

Red Drum
Lane Snapper,
Cobia,
Bull shark.

The study area supports many different significant species and habitats that are institutionally significant as supported by the following:

Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Estuary Protection Act of 1968; Wild Bird Conservation Act of 1992; North American Wetlands Conservation Act of 1989; Fish and Wildlife Coordination Act of 1958, as amended; Marine Mammal Protection Act of 1978; and E.O. 13186 Responsibilities of Federal Agencies for Protecting Migratory Birds.

Public Recognition

Restored and protected coastal wetland resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value. Restoration of this coastal habitat positively affects the long-term health of the coastal Louisiana ecosystem which supports the well-being of the southwest Louisiana human culture, with the attendant positive monetary impacts of wetland-related human uses. Restoration helps support the fisheries industry which 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).

This resource is publicly significant because the public demands reduced risk of damage from hurricane storm surge, protection of estuaries and floodplains, and because the public demands clean water and healthy wildlife and fishery species for recreational and commercial use. Outdoor activities are very popular throughout the study area and include such activities as bird watching, recreational fishing, hunting, boating and other forms of aquatic recreation, cooking and food preparation (especially utilizing the various species that utilize the surrounding marshes and wetlands), and through cultural events such as the Marshland Festival held each July. The loss of or a reduction in the extent of the coastal ecosystem threatens the unique southwest Louisiana culture, which is closely tied to surrounding ecosystem. Numerous comments and letters were received supporting the NER RP, with many calling for even more restoration features to be included. Some significant commenters including Cameron Parish Gravity Drainage Districts No. 4 & 5 and the Audubon Society each representing thousands of individuals.

Human environment resources are publicly significant because of the direct experience by southwest coastal Louisiana citizens regarding human health, welfare, and the decline of the economic and social well-being due to adverse impacts associated with coastal land loss and hurricane storm surge damages throughout the project area. Some of the effect of this condition could be lessened by the proposed NED and NER RPs.

Technical Recognition

The loss of this habitat affects an entire ecosystem that serves as important nursery grounds for numerous species, stop-over habitat for migrating birds, and as a complex and inter-related food chain. The scarcity of this habitat is becoming more pronounced as thousands of wetland acres are eroded away each year. Water environment resources are technically significant because the proposed NED RP and NER RP could reduce the adverse impacts of hurricane storm surge damage to the human and natural environment. Water quality would be improved by wetland creation which supports most physical, chemical, geological, and biological processes throughout the entire southwest coastal Louisiana estuarine system. A collapsed ecosystem cannot support the diverse number of species that rely on the study area for their survival. Restoration of wetlands would play an important role in increasing the survival, distribution, and benefits to plants, wildlife, and fisheries resources and would increase biodiversity in the study area.

Human environment resources are technically significant because the proposed action could reduce the costs associated with hurricane storm surge flooding. Coastal wetland restoration would provide a buffer for hurricane storm surge and could help offset the impacts of hurricane storm surge damage by elevating or otherwise flood proofing structures throughout the study area. This would positively affect the social and economic welfare of citizens within the study area and the Nation.

Scarcity

Scarcity is a measure of a resource's relative abundance within a specified geographic range. Coastal wetlands are limited in range throughout the United States and are imperiled throughout their range. The Louisiana coastal area represent 40 percent of the wetlands in the nation and accounts for 90 percent of national wetland loss. The study area represents approximately 30 percent of the Louisiana wetlands total. The Southwest Coastal Louisiana area is unique in its composition of wetlands, ridges, and coastal wetlands. The area is composed of complete beachfront, coastal cheniers, and estuarine complex. The coastal geomorphology formed by the coastal cheniers is unique to the nation.

Representativeness

The study area exemplifies a natural coastal estuarine wetland habitat. There is a significant abundance of representative species and coastal landforms, because of the unique nature of the coastal cheniers in close association with estuarine complexes. The cheniers are similar in form and scale as they were prior to human settlement. The cheniers retain a large number of native oak and other hardwood tree and shrub species.

Connectivity

The connectivity of this transitional coastal estuarine system extends well beyond the study area. For example, the estuary provides nursery, foraging, hiding cover, and other essential fish habitats for marine aquatic organisms that utilize both the gulf and the estuary for various life stages and requirements. These estuaries also provide important, critical, and essential habitats for species that migrate throughout the gulf (Manatee, Bottlenose Dolphin, Gulf Sturgeon, Cobia, King Mackerel, Sea Turtles, commercial and recreational fisheries), continental (Mallard, Teal, Pintails, Redhead, Shovelers, and others), and hemisphere (Neotropical migratory birds; humming birds, warblers, sparrows, birds of prey, dabbling and diving ducks). Restoration within the study area would nourish and protect the continued and improved use of important critical and essential fish and wildlife habitats.

Limiting Habitat

This is habitat that is essential for the conservation, survival, or recovery of one or more species. The RP is protecting gulf shoreline beach which is designated critical habitat for the threatened piping plover and also used by the threatened rufia sub-species of the red knot which is critical for the survival and recovery of these two species.

The RP also restores cheniers which provides important stopover habitat for neotropical migratory birds. The area also contains 72,000 acres of Wetland Conservation area designated for an experimental population of threatened Whooping Crane. There are 84 miles of shoreline habitat designated for the threatened Piping Plover within the study area as well. The RP provides resilience that supports the sustainability of these habitats.

Biodiversity

This study area is extremely diverse and is utilized by resident as well as migratory fish and wildlife species. For example the study area is part of the central flyway for migratory waterfowl and neotropics which consists of hundreds of species and millions of individuals. This study area hosts a large percentage of this population. The study area has freshwater, estuarine, and migratory fisheries consisting of hundreds of species. That diversity in numbers is exemplified in the numbers of recreational users utilizing the area.

Status and Trends

Although the coastal wetlands and forested chenier habitats in the study area are declining at a rate less than the remainder of coastal Louisiana, the loss of these transitional estuarine wetlands and cheniers continues to threaten the terrestrial and aquatic organisms that utilize the area. This continued loss further exacerbates the nationwide scarcity of coastal wetlands and continues impairing the connectivity between the Gulf, transitional estuaries, and interior terrestrial habitats.

4.2.9 Synergy of the NED/NER Plans and Management of Residual Risk

Integration of the NED/NER Plans

The integration of the SWC NED and NER RP's is rooted in the evaluation of critical landscape features identified tin the Louisiana Coastal Protection and Restoration (LACPR) study. Work undertaken in the LACPR study to review the ADCIRC storm surge modeling output for the 100-year, 400-year, and 1,000-year base condition runs allowed the identification of landscape components that tend to produce significant effect on surge. These landscape features currently exist independent of any proposed alternative action. While some of these features might be incorporated directly into alternative risk reduction plans, the fact that they are already existing contributors to systemic risk reduction demonstrates that there are landscape benefits being derived even with no action. This also indicates that maintenance of these features, independent of any proposed alternative risk reduction plan, would be beneficial to a system of comprehensive risk reduction. The LACPR report suggested that these landscape features would merit priority, or focus for restoration, based on their identifiable contribution to risk reduction wherever they might have been incorporated into an alternative plan, or for maintenance wherever they represent elements of existing publicly-supported projects. While the performance of the NED RP is not dependent on any of these landscape features, their continued function would serve to increase the reliability and resilience of other NED risk reduction features.

The features identified in the LACPR effort ranged from critical wetland segments to natural ridges to manmade embankments. The features generally demonstrated performance in altering storm surge across all surge conditions (100-year, 400-year, and 1,000-year). The effects of these features observed in the LACPR effort are generally either a relatively rapid decrease, or a pronounced "stacking" preceding a decrease, in the forecast surge elevation. It is reasonable to suggest that these marked changes in surge elevation, and the landscape components associated with them, represent a beneficial restriction to the movement of surge further inland. These observed landscape effects are based on the modeling and output of multiple storm tracks and intensities, which subsequently represent statistical water surface effects. The actual performance of any landscape features varies widely when considering the impacts of individual storm tracks and intensities.

In the Southwest Coastal area (LACPR, Planning Unit 4), the critical landscape features identified included the entire barrier-shoreline, Grand Chenier, and the wetland areas between Vermilion Bay and the GIWW, the Freshwater Bayou channel bank, and Highway 82. In this area, the modeling indicates consistent stacking of surge at the coast with significant reduction of surge elevation inland from that point. Grand Chenier

contributes to this effect along the entire eastern portion of the planning unit. The wetland area between Vermilion Bay and the GIWW, Freshwater Bayou and Highway 82 at the eastern end of the area provides a similar effect and results in significant reduction of surge elevation in the interior of the basin. The SWC NER RP features tie into and support all of these identified critical landscape features, as well as other portions of the shoreline, connecting ridges and existing roadways .

The NER RP tiered implementation assures that those features will be implemented in a manner that will address the most potentially far reaching impacts. These impacts also represent the most likely threat to these critical features. The interface between the NER RP and these identified critical features produces additional resilience in the geomorphic structure and sustainability of the area and adds reliability in the ability of the landscape to support risk management. This in turn allows the NED RP features to perform in the most effective and efficient manner for the greatest possible duration.

Synergy of the NED/NER Plans with Parish Hazard Mitigation Plans

All three Parishes in the Southwest Coastal study area have updated their Hazard Mitigation Plans consistent with the State's Hazard Mitigation Plan in 2015. In addition to reducing life safety and property damage risk, each Parish, in identifying its hazard mitigation goals, lays out a theme of facilitating recovery and reducing risk to the infrastructure that supports recovery. The NED/NER RPs, and their integrated performance allow the direct management of the greatest identified risks and extend the performance and effectiveness of local hazard mitigation actions, as well as increase valuable ecosystem outputs. A general overview of the activities for each Parish is provided below.

The Calcasieu Parish Office of Planning and Development provides oversight for building permits and codes, land use planning, and all parish ordinances. Calcasieu Parish and its jurisdictions ensure that all adopted building codes are enforced and in compliance relating to the construction of any structure within the boundaries of the parish. Building permits are required prior to beginning any type of construction or renovation projects, installation of electrical wiring, plumbing, or gas piping, moving manufactured/modular or portable buildings, and reroofing or demolitions. While local capabilities for mitigation can vary from community to community, Calcasieu Parish as a whole has a system in place to coordinate and share these capabilities through the Calcasieu Parish Government and through their Parish Hazard Mitigation Plan. Calcasieu Parish lists only 15% of its total land area as urban/developed.

Calcasieu Parish has established hazard mitigation goals that include:

1. Reduce or prevent injury and loss of life;
2. Reduce or prevent damage to property and material assets;
3. Reduce or prevent future damage to critical facilities (fire, rescue, law enforcement, communications, command and control) essential for protection and public safety;
4. Reduce or prevent future damage to special facilities, including schools, nursing homes, health care facilities, prisons, and historical and cultural resources;
5. Reduce or prevent future damage to infrastructure, including stormwater conveyance structures, utility systems, pipelines, railroads, highways, bridges, and navigable waterways;
6. Reduce or prevent future damage to commercial facilities; and,
7. Reduce or prevent future damage to higher risk facilities that, if damaged, may result in significant loss of human life, damage to the environment, or significant harm to the local Economy. These facilities include hazardous material handling facilities, dams, flood control facilities, and other high security facilities.

Calcasieu Parish has completed actions to harden critical facilities, to acquire and elevate some properties, and has taken steps to reduce future floodplain development. The Parish, and various communities within the Parish, have also identified 120 additional actions, most with target dates of 5 years or less, to achieve their hazard mitigation goals.

Cameron Parish ensures that all building codes adopted are enforced and in compliance relating to the construction of any within the boundaries of the parish. The Cameron Parish Planning and Development Office is responsible for all building code, permitting, land use planning and ordinances. The Parish has a Flood Damage Prevention Ordinance, Coastal Use Permits, and a Coastal Zone Program that are followed. As a community, Cameron Parish has administrative and technical capabilities in place that may be utilized in reducing hazard impacts or implementing hazard mitigation activities. Such capabilities include staff, skillset, and tools available in the community that may be accessed to implement mitigation activities and to effectively coordinate resources. Cameron Parish lists only 1% of its total land area as urban/developed.

Cameron Parish has established hazard mitigation goals that include:

1. Reduce the loss of life or property;
2. Protect critical public facilities and thoroughfares;
3. Ensure post-disaster operability of strategic facilities and thoroughfares;
4. Develop incentive and community outreach/education programs that assist homeowners in protecting residential properties;
5. Provide a long term mitigation solution in locations which experience repetitive hazard damage;
6. Provide a cooperative, inter-jurisdictional / inter-agency solution to a problem;
7. Show development and implementation of comprehensive programs, standards, and regulations that reduce future hazard damage;
8. Avoid inappropriate future development in areas that are vulnerable to hazard damage;
9. Reduce the level of hazard vulnerability in existing structures and developed property; and,
10. Restore or protect natural resources, recreational areas, open space, or other environmental values

Cameron Parish has completed actions through FEMA to acquire and elevate some properties and has taken steps to reduce future floodplain development. The Parish is also pursuing 16 additional actions with target dates of 5 years or less to achieve their hazard mitigation goals.

Vermilion Parish and its jurisdictions' capabilities include planning, regulatory, administrative, technical, financial, and education and outreach resources. There are a number of mitigation-specific acts, plans, executive orders, and policies that lay out specific goals, objectives, and policy statements which already support or could support pre- and post-disaster hazard mitigation. Vermilion Parish and its jurisdictions ensure that all building codes adopted are enforced and in compliance, relating to the construction of any building within the boundaries of the parish. Some jurisdictions have extensive zoning regulations, which address use and height of buildings, density of populations, open space limitation, and lot and occupancy requirements. Before the Parish Council enacts or amends development regulations or takes any land use action, and before the Zoning Board may make any recommendation to the Parish Council regarding a proposed development regulation or land use action, the Planning Department, or other department responsible for providing findings, recommendations, papers, correspondence, and records related to the regulation, amendment, or action shall provide a written recommendation to the Council and Zoning Board regarding the consistency with the plan. The land use, zoning, and ordinance requirements address many different types of districts in the parish and its incorporated jurisdictions, ranging from suburban, conservation, and mixed-use to industrial. Vermilion Parish lists only 3% of its total land area as urban/developed.

Vermilion Parish has established hazard mitigation goals that include:

1. Identify and pursue preventative structural and non-structural measures that will reduce future damages from hazards;
2. Enhance public awareness and understanding of disaster preparedness;
3. Reduce repetitive flood losses in parish and municipalities;
4. Facilitate sound building practices in the parish and municipalities so as to reduce or eliminate the potential impact of hazards; and,
5. Improve the ability of the parish and municipalities to rapidly recover and restore facilities and services to the public.

Vermilion Parish, and various communities within the Parish, are pursuing 103 actions to achieve their hazard mitigation goals. Of those action 53 are currently ongoing. All of the actions have target completion dates of 5 years or less.

Synergy of the NED/NER Plans with the Oil and Gas Industry

The Port of Lake Charles has risen steadily from the 26th largest US port in 1980 to the 11th largest today primarily on the import and export of petroleum and natural gas products. Data from the Port of Lake Charles indicates that, in addition to significant existing oil and gas facilities, there is currently $41 billion in ongoing industrial development under construction, with an additional $97 billion pending approval. The New Orleans District has issued 5 permits specifically for LNG and petrochemical facilities over the last 5 years with an additional 4 permits in review. The estimated national economic impact of the port is $6.7 billion in GDP with and additional $4.8 billion projected over the next 10 years. In addition, the area contains major elements of the Strategic Petroleum Reserve (the West Hackberry storage facility contains one third of the total reserve) and the Henry Hub is the establish distribution point for setting the unit price of natural gas for the Nation.

Port of Lake Charles employment represents an estimated 36,000 jobs, or 31 percent of the Lake Charles MSA employment with an additional 13,000 statewide jobs outside the MSA. That is expected to increase by 25 percent over the next 10 years, roughly 9,000 additional jobs in Lake Charles and 12,000 additional jobs statewide. Population and housing data from the Parishes in the study area from 2000-2013 indicate an overall growth trend. Calcasieu Parish, the largest of the three, with the city of Lake Charles, has seen housing growth of 9.1 percent with 14.9 percent in the unincorporated areas. Vermilion Parish has seen housing growth of 12.9 percent with 21.6 percent in the unincorporated areas. This housing growth is significant given that it has occurred even before the recent, and forecast, increases in industrial development and job growth. The growth in housing in the unincorporated areas also underscores the utility of a comprehensive non-structural approach to risk management.

In a manner similar to the synergy between the function of the NED and NER RPs, the resilience and reliability of the extensive oil and gas infrastructure and attendant economy of the Southwest Louisiana area would benefit indirectly from the implementation of those plans. A significant key to the long-term performance of this oil and gas economy is the availability of human resources. The ability to assure these resources, and thereby the performance of this growing industry, is positively effected in two ways by the implementation of the SWC RP. First, as an immediate effect, it enables the more rapid reoccupation and recovery by residents, particularly those most at risk, following storm events. As a result, it also speeds the recovery of the workforce following those events. The recovery of the workforce is key for industries and businesses to return to normal operation, minimize production losses, and control secondary and third order impacts to the overall economy. Second, over the long-term, the availability and viability of housing necessary to support the workforce is enabled by the overall reduction in risk provided by the RP.

4.3 Implementation Requirements

PED and construction practices would 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 RPs are set forth below.

4.4 Cost Sharing and Non-Federal Sponsor Responsibilities

The CPRA Board 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 in a binding written agreement to comply with applicable Federal laws and policies and with all of the requisite non-Federal obligations, including, but not limited to the provision of all LERRDs deemed necessary by the Government for the construction and OMRR&R of the NED and NER RPs, as well as the OMRR&R of the NED and NER RPs. A more expansive list of NFS obligations can be found in Chapter 7.

4.4.1 Cost Apportionment

Table 4-7 contains a summary of estimated NED and NER costs and benefits for the full RP. Note that costs and benefit numbers have been updated compared to those described in Chapter 2 based on certified cost numbers received from the USACE Cost Engineering Mandatory Center of Expertise (see Appendix B for more details).

Table 4-7: RP summary.

	Storm Damage Risk Reduction (NED)	Ecosystem Restoration (NER)	Total
Project First Cost	$906,091,000	$2,485,025,000	$3,391,116,000
Average Annual Cost	$36,056,000	$66,642,000	$102,698,000
Equivalent Annual Benefits	$203,554,000	4,976 (AAHU's)	
Equivalent Annual Net Benefits	$167,498,000	15,448 (Net Acres)	
BCR	5.65:1	N/A	

Table 4-8 depicts the cost total and Table 4-9 depicts the cost apportionment for the NED and NER RPs. Since NER RP features (124d and 3c1) will be recommended to USFWS for its independent action to obtain Congressional authorization and funding for USFWS implementation, these features are not included in the recommended Corps Plan and will not be included among the NER RP features that USACE will cost-share with the NFS. As a result, this aspect of the NER RP requires two calculations: the total cost of all NED and NER RP features (the "Federal Plan") and the total cost of all NED and NER features that would be cost-shared between the USACE and the NFS (the "Corps Plan"). The Federal Plan cost represents the total Federal investment to fully fund the NED and NER RPs. The Corps Plan cost depicts the Federal Plan cost minus the design, construction, and management costs for the two NER features that would be constructed by USFWS if it chooses to seek and successfully obtains independent Congressional authorization and funding. Preliminary estimates by USACE indicate that the total cost for features 124d and 3c1 is approximately $296,839,000; however, it is likely that USFWS, should it choose to seek authorization and funding, will reevaluate the total cost necessary for implementation by USFWS rather than by USACE. In so doing, it is probable that USFWS would determine a different total cost for these features. The total ecosystem benefits associated with the two features are 1,492 acres and 611 AAHUs. The cost breakouts, and Federal and non-Federal cost apportionments, for both the Federal and Corps plans are provided in this section.

Table 4-8: Costs of the NED and NER RPs (Project First Costs)*.

	Storm Damage Risk Reduction (NED)	Ecosystem Restoration (NER)	Total (Federal Plan)[1]	Total (Corps Plan)[1]
PED	$39,440,000	$420,876,000	$460,316,000	$408,648,000
Construction	$788,900,000	$1,753,666,000	$2,542,566,000	$2,327,265,000
Lands, Easements, & ROW	$61,970,000	$10,932,000	$72,902,000	$72,100,000
Construction Management	$15,778,000	$236,744,000	$252,522,000	$223,456,000
Monitoring and Adaptive Management[2]	$---	$62,807,000	$62,807,000	$62,807,000
Total Project First Costs	$906,091,000	$2,485,025,000	$3,391,116,000	$3,094,276,000
Additional Studies (50/50 cost share)[4]				

CSC Salinity Barrier & Cameron Creole Spillway	$---	$6,000,000	$6,000,000	$6,000,000
Total Costs	$906,091,000	$2,491,025,000	$3,397,113,000	$3,100,276,000

** All table numbers have been rounded to the nearest thousand.*
1 – Construction of all RP features constitutes the 'Federal Cost'. The Federal Cost is 65% of all cost shared features plus 100% of the costs for Features 124d and 3c1 (to be constructed by USFWS). Costs for the 'Corps Cost', which constitutes the RP minus costs for features 124d and 3c1 are also presented.
2 – Details on AM&M cost ranges can be found in Appendix A, Annex L.

Table 4-9: NED and NER RP Cost Apportionment (Project First Costs)*.

	Federal Plan Federal Cost (65%)[1]	Corps Plan Federal Cost (65%)	Non-Federal Cost (35%)
PED	$317,289,000	$265,621,000	$143,027,000
Construction	$1,774,887,000	$1,559,568,000	$767,679,000
Lands, Easements, & ROW	$802,000[3]	$---[3]	$72,100,000
Construction Management	$174,343,000	$145,244,000	$78,210,000
Monitoring and Adaptive Management[2]	$40,825,000	$40,825,000	$21,982,000
Total Project First Costs	$2,308,116,000	$2,011,279,000	$1,082,997,000
Additional Studies (50/50 cost share)[4]			
CSC Salinity Barrier & Cameron Creole Spillway	$3,000,000	$3,000,000	$3,000,000
Total Costs	$2,311,116,000	$2,014,279,000	$1,085,997,000

** All table numbers have been rounded to the nearest thousand.*
1 – Construction of all RP features constitutes the 'Federal Cost'. The Federal Cost is 65% of all cost shared features plus 100% of the costs for Features 124d and 3c1 (to be constructed by USFWS). Costs for the 'Corps Cost', which constitutes the RP minus costs for features 124d and 3c1 are also presented.
2 – Details on AM&M cost ranges can be found in Appendix A, Annex L.
3 – Federal Plan cost consists of private lands required for construction of the two NER features partially located on USFWS property (124d and 3c1).
4 – The Calcasieu Ship Channel Salinity Barrier and the Cameron Creole Spillway are recommended as 3x3x3 compliant studies cost-shared 50/50.

4.5 Areas of Controversy and Issues Resolved for the Final Report

The 2013 Southwest Coastal Louisiana Draft Integrated Feasibility Report and Programmatic Impact Statement ("2013 Initial Draft Report") identified a Tentatively Selected Plan (TSP) for the National Economic Development (NED) and the National Ecosystem Restoration (NER) aspects of the study. However public and internal policy comments on the 2013 Draft Report identified significant issues requiring resolution prior to completing a final report. As a result, in March 2015, a Revised Integrated Draft Feasibility Report and Environmental Impact Statement ("2015 Revised Draft Report") was released with updated NED and NER TSPs that differed from those identified in 2013. Additional public and policy comment on the 2015 Revised Draft Report resulted in final modification of the recommended plans and their implementation. This final report ("2016 Final Report") updates and finalizes the 2015 Revised Draft Report (which concluded its public review in May 2015). This report contains the Recommended Plan (RP) for the NED and the NER components of the Study. Listed below are the significant areas of controversy identified in each successive reporting stage and the actions taken.

Areas of Controversy and Resolution
2013 Draft Integrated Feasibility Report and Programmatic Impact Statement

1. The 2013 Draft Report primary area of controversy was public demand for design and implementation of structural risk reduction measures (e.g., levees), not nonstructural measures (structure raising, flood proofing, etc.).

Resolution: Structural measures were reevaluated for the 2015 Revised Draft Report but were not found to be justified. Although this was considered the most significant comment on the 2013 Initial Draft Report, there is no reference to this comment with regard to the 2015 Revised Draft Report. The southwest coastal Louisiana area, with the exception of Lake Charles, is not densely populated. Rather, the population is scattered over a wide area. Developing a structural levee alignment that would provide sufficient risk reduction to the sparsely populated and widespread human populations and that would provide a positive benefit-to-cost ratio, was not possible. Consequently, the PDT developed what may be the largest nonstructural alternative the Corps has considered to date.

2. Controversy over perceived insufficient ecosystem restoration throughout the study area. The large study area has numerous areas in need of ecosystem restoration.

Resolution: The PDT took an approach to address those areas in greatest need. Although the public demands more acres of restoration to this area due to the rapid land loss being experienced incremental analysis of a broad range of restoration alternative scales did not support additional restoration at this time.

3. Controversy over an insufficient number of hydrologic/salinity control measures recommended in the TSP/RP, as well as controversy over recommending additional study of hydrologic/salinity control measures for future study instead of providing such measures for immediate construction.

Resolution: The NER Recommended Plan recommends future individual studies of the of key hydrologic/salinity measures as well as any alternative measures. As has been determined by the present and previous ecosystem restoration studies, hydrologic/salinity control measures are quite complex. The hydrologic connectivity within the study area has been significantly altered by natural processes as well as by Federal, state, parish and local entities for a number of often conflicting and opposing purposes. Consequently, such hydrologic/salinity measures must be given full consideration and analysis to determine how best to reestablish hydrologic connectivity and reduce salinity and hurricane storm surge impacts without further exacerbating existing problems. In addition, many hydrologic/salinity measures would involve authorized navigation waterways which must be maintained as authorized.

2015 Draft Integrated Feasibility Report and Environmental Impact Statement

4. The single-most important area of controversy is based upon over 2,540 oral and written comments and signatures on a petition to "PLEASE TAKE IT OUT!"; and to completely remove any and all reference or language related to 'eminent domain' and 'involuntary participation' from the study. The property owner's choice to remain at their 'own risk' or possibly without future assistance is considered the only appropriate course of action. Furthermore, the statement has been made that the goal of the plan is to restore and protect the coast and marshes, assist in preserving the unique culture, not remove people from their homes and family lands.

Resolution: The involuntary aspect of the NED TSP to remove structures that are located in the regulatory floodway, designated as 'Severe Repetitive Loss Structures' as defined by FEMA, or that present a life safety risk, has been removed from the RP. The NED RP is now 100% voluntary and there is no longer a need for the use of eminent domain to acquire structures that met these criteria in the 2015 Revised Draft Report.

5. Over 2,540 signatures on a petition and several oral and written comments requested that chenier reforestation measures be replaced by shoreline protection measures. As stated in the petition: "Shoreline protection would be a better investment for our coast's future."

Resolution: Both shoreline protection and reforestation of chenier ridges are warranted in the study area. The PDT prioritized ecosystem restoration measures and determined that, before the chenier ridges are lost, reforestation is necessary. However, the PDT also recognizes the importance and necessity of providing additional shoreline protection measures. Under the current evaluation and comparison of benefits reforestation features provide more incremental benefit than would be provided by additional shoreline protection measures for areas inland from the immediate shoreline.

6. Over 2,540 signatures on a petition and several oral and written comments request that a 'Local sponsor' be chosen to have an immediate 'voice' in the remaining planning process of the study. The petition states that local sponsors can assist in making valid and important corrections and local concerns could be immediately addressed. The PDT interprets this to mean including a local area (parish, town, other smaller area) representative on the PDT.

Resolution: Outreach efforts to interested stakeholders were increased after release of the draft report. These efforts included multiple conference calls, study update presentations to various local government officials, and progress updates to the CPRA Board.

7. Over 2,540 signatures on a petition and several oral and written comments stated that "our parish deserves 'protection'." Include Parish Priority Project and insert a list of all of the measures and projects proposed in the parishes' existing and proposed Coastal Restoration & Protection Plans. The stated purpose of this is that the inclusion of all such measures and projects will eliminate the unintentional exclusion of projects that were not tentatively selected and will clearly indicate the worthiness for future consideration for funding.

Resolution: Parish Priority Projects have been included as a separate and new appendix (Appendix P) to the Final Report and will include the following recommended statement: "Though not an endorsement of any project under this study effort, Parish Priority Projects that would be provided by the Parishes to the State for consideration as deemed necessary by the Coastal Master Plan for Louisiana and are included in this Appendix only as a reference for future planning under other study authorities."

8. Controversy over the lack of salinity and flood control measures to prevent the Calcasieu River from flooding areas upstream during storm surge events.

Resolution: This controversy is similar to controversy #3, above. The NER Recommended Plan recommends the CSC Salinity Control Structure as an additional long range study. Due to the complexity of the problem, additional study and significant modeling of the Calcasieu River navigation, salinity, and storm surge problems must be considered independent of the present proposed action.

2016 Final Integrated Feasibility Report and Environmental Impact Statement
9. A primary issue for resolution in the Final Report was the development of a prioritization for implementation of the NED RP. This Final Report recommends a strategy to implement the nonstructural Project for eligible structures. Structures that have been identified as preliminarily eligible as part of the NED RP are located across the 4,700 mile, three-parish study area.

Resolution: In order to effectively implement the NED RP, clusters of eligible structures that represent the highest risk for storm surge damages (i.e. those with a FFE below the 10-year stage) would be identified and prioritized for construction. Individual structures would be addressed based on a ranking of risk from highest to lowest within the cluster. The ranking of individual structures would be revisited as elevation work is completed, as additional funding is distributed, and as new clusters are identified. Addressing groups of structures within a small geographic area would be more cost-effective, efficient, and would also allow for a more strategic methodology for applying nonstructural measures to at-risk structures. However, it should be noted that the appropriate implementation strategy for the NED RP is highly dependent of the number and location of eligible structures whose owners desire to participate in the NED RP and upon the amount of

funding that the NED Project receives over time. For these reasons, additional work on this process is anticipated to be necessary during the design and implementation phase of the NED Project.

10. A second issue for resolution in the Final Report related to the costs of structure raising/flood proofing and the potential for significant inflation of these costs. For example, following Hurricane Katrina (2005) the reconstruction of the New Orleans HSDDR system was significantly affected by the increased costs of borrow material. As levee restoration and construction continued, the price of borrow escalated over pre-storm prices.

Resolution: The PDT developed a detailed risk analysis (see Appendix B) to determine if and how much contingency costs may be required to address the supply and demand costs for elevating structures.

4.6 USACE Campaign Plan

The USACE mission is to deliver vital engineering solutions, in collaboration with our partners, to secure our Nation, energize our economy, and reduce risk from disaster. The USACE has set several goals to help achieve this mission. Completing this Feasibility Study and Environmental Impact Statement works towards Goal 2 – Transform Civil Works (Deliver enduring and essential water resource solutions using effective transformation strategies), Goal 3 – Reduce Disaster Risks (Deliver support that responds to, recovers from, and mitigates disaster impacts to the Nation while ensuring sustainable operations), and Goal 4 – Prepare for Tomorrow (Build resilient People, Teams, Systems, and Processes to sustain a diverse culture of collaboration, innovation, and participation to shape and deliver strategic solutions).

4.7 USACE Environmental Operating Principles

The United States Army Corps of Engineers Environmental Operating Principles were developed to ensure that Corps of Engineers missions include totally integrated sustainable environmental practices. The Principles provided corporate direction to ensure the workforce recognized the Corps of Engineers role in, and responsibility for, sustainable use, stewardship, and restoration of natural resources across the Nation and, through the international reach of its support missions. The Environmental Operating Principles relate to the human environment and apply to all aspects of business and operations. Re-committing to these principles and environmental stewardship will lead to more efficient and effective solutions, and will enable the Corps of Engineers to further leverage resources through collaboration. This is essential for successful integrated resources management, restoration of the environment and sustainable and energy efficient approaches to all Corps of Engineers mission areas. It is also an essential component of the Corps of Engineers' risk management approach in decision making, allowing the organization to offset uncertainty by building flexibility into the management and construction of infrastructure.

The re-energized Environmental Operating Principles are:

- Foster sustainability as a way of life throughout the organization.
- Proactively consider environmental consequences of all Corps activities and act accordingly.
- Create mutually supporting economic and environmentally sustainable solutions.
- Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps, which may impact human and natural environments.
- Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.
- Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

The NED and NER RPs have been developed using the Environmental Operating Principles to guide and improve the development, formulation, and evaluation of alternatives under this study effort. Consideration of the environment has been essential in ensuring the hurricane storm surge damage risk reduction and ecosystem

restoration missions are developed appropriately, are responsive to area problems and needs, and are supportable by the public and stakeholders.

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 CEMVN will continue to coordinate with Federal and state resource agencies on the EIS. Status of compliance with the various laws and EOs 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 concluded	Anadromous fish species would not be affected by the proposed action. Coordination with NMFS is concluded.	Full compliance achieved upon publication and review of the Integrated Final Report & EIS
Bald and Golden Eagle Protection Action of 1940	Coordination concluded	The RP would have no effect on bald or golden eagles, or their critical habitat.	Full compliance achieved upon publication and review of the Integrated Final Report & EIS
Clean Air Act of 1970	Coordination concluded	In accordance with Section 309, NEPA and CEQ regulations EPA rated the Revised Draft EIS as "EC-1" i.e., EPA has environmental concerns and requests additional information in the Final EIS. Sec. 176: Project area currently in attainment of NAAQS. No general conformity determination required	Full compliance achieved following EPA review of Integrated Final Report & EIS.
Clean Water Act of 1977	Coordination concluded	Section 401: water quality certification from LDEQ requested for NER Plan; not required for NED Plan. Section 404: A 404(b)(1) Evaluation not required for NED Plan. 404(b)(1) evaluation prepared.	Full compliance achieved. NED RP would not affect waters of the U.S. NER RP Section 401 Water Quality Certification signed July 6, 2015; Section 404(b)(1) signed February 18, 2016
Coastal Zone Management Act of 1972	Coordination ongoing	Consistency Determination for NER RP submitted to LDNR for consistency review with the Louisiana Coastal Resource Program on January 5, 2016.	February 12, 2016 letter provides full consistency for NED RP and phased consistency for NER RP. Continued coordination with LDNR, OCM requesting additional clarifying letter, per HQ request, regarding specific outstanding issues necessary to be completed before full consistency is granted for NER RP.
Coastal Barrier Resources Act of 1982 and Coastal Barrier Improvement Act of 1990	Coordination concluded	By letter dated April 4, 2016 CEMVN requested USFWS to make a determination that the proposed NER RP breakwaters measures fall within an exemption to the limitation, under 16 USC 3505(a), prohibiting Federal expenditures on projects within a unit of the Coastal Barrier Resources Act (CBRA).	Full compliance achieved upon receipt of letter dated April 7, 2016 from the USFWS indicated their determination that the proposed breakwaters fall within the exception under 16 USC 3505(a) and publication and public review of the Integrated Final Report & EIS.
Endangered Species Act of 1973	Coordination concluded	A Biological Assessment (BA) for NER Plan submitted to USFWS on March 11, 2015; USFWS concurred on March 20, 2015. BA submitted to USFWS for NED RP on July 17, 2015; USFWS concurred on August 25, 2015. A BA for the NER RP was submitted to NMFS on March 12, 2015.	Consultation with USFWS concluded with their letters of concurrence dated March 20, 2015 (NER RP) and August 25, 2015 (NED RP). Consultation with NMFS concluded with their letter of concurrence dated January 26, 2016.
Estuary Protection Act of 1968	Coordination concluded	NED RP would not impact estuaries. NER RP would positively benefit estuaries via marsh restoration and shoreline protection; there would be no significant adverse impacts to estuaries.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.




Law, Regulation, or Policy	Status	Comments	Full Compliance Expected
Farmland Protection Policy Act of 1981	Coordination concluded	NRCS concurred with our determination by letter dated December 13, 2013 that the RPs will not "irreversibly" impact prime farmland and is therefore exempt from the rules and regulations of Section 1539-1549 of Farmland Protection Policy Act.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
Federal Water Project Recreation Act of 1965	Coordination concluded	Recreational opportunities have been analyzed and documented in Final EIS.	Full compliance achieved upon publication and public review of the Integrated Final Report & 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 draft CAR February 2015.	Full compliance achieved with receipt of Final FWCAR on February 3, 2016 and publication and review of Final Integrated Report & EIS.
Magnuson-Stevens Fishery Conservation and Management Act of 1976	Coordination ongoing	NMFS April 29, 2015 comment letter regarding use of BMPs during construction and updated list of EFH to be included in Appendix A and documented in the Final Report & EIS.	Full compliance achieved by receipt of NMFS January 28, 2016 letter of concurrence that proposed action is not likely to affect listed species under NMFS purview. USACE January 28, 2016 letter of response to NMFS comments on EFH.
Marine Mammal Protection Act of 1972	Coordination concluded	With implementation of the RP & BMP the West Indian Manatee and dolphin is not likely to be adversely affected.	Full compliance achieved by January 26, 2016 consultation letter of concurrence from NMFS; and, USFWS consultation letters of concurrence dated March 20, 2015 (NER RP) and August 25, 2015 (NED RP).
Marine Protection, Research, and Sanctuaries Act of 1972	Coordination concluded	No adverse impacts of the RP are anticipated to the resources under this Act.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
Migratory Bird Treaty Act of 1918 and Migratory Bird Conservation Act of 1929	Coordination concluded	Based on review of existing data and preliminary field surveys, the CEMVN finds that implementation of the RPs would have no adverse effect on colonial nesting water birds or other migratory species.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
National Environmental Policy Act of 1969	Coordination ongoing	Revised Draft EIS was released for 45-day public review and comment on March 24, 2015.	Full compliance achieved upon release of the Integrated Final Report & EIS for 30 day review and signing of the ROD.
National Historic Preservation Act of 1966, as amended	Consultation ongoing per executed Programmatic Agreements	Consultation with SHPO, ACHP, and federally-recognized Tribes is ongoing. Two Section 106 programmatic agreement documents have been executed for the Final EIS.	Full compliance Section 106 consultation achieved with signing and execution among parties (USACE, SHPO, ACHP) for Programmatic Agreements for both NED and NER RPs on February 26, 2016.
Submerged Lands Act of 1953	Coordination concluded	Impacts coordinated with LDNR (Coastal Zone Management) and LDEQ and EPA (Clean Water Act) for activities in state waters and federal waters; also coordinated through NEPA with release of Draft EIS.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
Rivers and Harbors Act of 1899	Coordination concluded	Coordinate dredging activities in navigable waters including Calcasieu River & Pass, Freshwater Bayou, Mermentau River and Vermilion River and Bay; coordination through Clean Water Act Sections 401 and 404, and release of Integrated Final Report and EIS.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
Resource Conservation and Recovery Act of 1976; Comprehensive Environmental Response, Compensation, and	Coordination concluded	For NER RP an HTRW Phase I ASTM-compliant site assessment completed July 2015. NED RP, a Phase I Environmental Site Assessment will be conducted for each structure to confirm the absence of HTRW	Full compliance achieved for NER RP with July 2015 HTRW Phase I ASTM compliant assessment completed. The NED RP HTRW Phase I would

Law, Regulation, or Policy	Status	Comments	Full Compliance Expected
Liability Act of 1980; Toxic Substances Control Act of 1976		prior to implementation of nonstructural measures.	be completed on a structure-by-structure basis to confirm absence of HTRW prior to implementation of nonstructural measures. If any HTRW would need to be resolved by structure owner or could not participate in project.
Wild and Scenic River Act of 1968	Coordination concluded	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 actions.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
EO 11514 Protection and Enhancement of Environmental Quality,1970	Coordination concluded	The impacts to the quality of the environment due to implementation of the NED RP and NER RP were reported to the public in the NEPA documentation of the Draft EIS.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
EO 11988 Floodplain Management, 1977	Coordination concluded	Coordination accomplished through identification of flood hazards and actions taken to avoid long and short term impacts associated with occupancy and modification of the floodplain and to avoid floodplain development as disclosed in the Draft EIS and copy of report to Floodplain Manager for parishes in study area.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
EO 11990 Protection of Wetlands, 1977	Coordination concluded	Measures to avoid, minimize, and reduce impacts to wetlands will be maximized to the extent possible. The NER Plan provides wetland restoration. No compensatory mitigation for unavoidable impacts is anticipated for either the NED RP or NER RP.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
EO 12898 Environmental Justice for Low Income and Minority Populations, 1994	Coordination concluded	No disproportionate adverse impacts to EJ communities (see Appendix A, Annex O) were identified.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
EO 13112 Invasive Species, 1999	Coordination concluded	The project is not expected to lead to propagation of invasive species.	Full compliance achieved upon publication and public review of the Integrated Final Report & EIS.
EO 13175 Consultation and Coordination with Tribal Governments, 2000	Coordination ongoing	Consultation with federally-recognized Tribes is ongoing. Consultation would continue through all phases of implementation of the RPs.	Full compliance achieved upon execution of the PAs and implementation of the terms of the Section 106 agreements.
EO 13186 Responsibilities of Federal Agencies to Protect Migratory Birds, 2001	Coordination concluded	No compensatory mitigation for unavoidable project-induced impacts to bird and wildlife habitat is anticipated.	Full compliance achieved upon publication and public review of the Integrated Final Report & 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 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, the 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 later 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 on the final NED and NER Recommended Plan (RP) are provided in its February 3, 2016 Final CAR. Those recommendations, along with CEMVN's responses, are set forth below:

Service Position and Recommendations on Integrated Final Report and EIS and USACE Responses

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: CEMVN will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to further refine a design that minimizes adverse impacts.

2. Marsh creation measures should avoid, to the degree practical, areas of dense submerged aquatic vegetation.

RESPONSE: CEMVN will work closely with the USFWS and other interested natural resource agencies during the PED and construction phases to further refine 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: The voluntary NED RP is not anticipated to require any monitoring. Regarding the NER RP, as documented in the Adaptive Management and Monitoring Plan (Appendix A, Annex L) monitoring performance measures are described for pre-construction/baseline data, during construction, and post-construction monitoring that will be utilized to determine restoration success. Monitoring of each element will continue until the trajectory of ecological change and/or other measures of project success are determined to have been attained, as defined by project-specific objectives. However, in accordance with the provisions of Section 2039 of the Water Resources Development Act of 2007, Federal participation in the cost of such monitoring is limited either to a period of 10 years from the date of the completion of initial construction of each element, or to the date upon which minimum restoration success is determined to be achieved, whichever date first occurs. All cost of monitoring that extends beyond 10 years from the date of initial construction of each element is 100 percent the cost of the non-Federal sponsor. CEMVN will work closely with the USFWS and other interested natural resource agencies in refining monitoring criteria and in review of monitoring information.

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: Two marsh restoration measures, Features 124d and 3c1 are partially located on USFWS property (Sabine National Wildlife Refuge and Cameron Prairie National Wildlife Refuge, respectively) and are included in the NER RP. These features are vitally important to help preserve the Calcasieu Lake rim and prevent vast new expanses of open water from forming should the lake rim be breached by erosional forces. All NED and NER RP features (including those recommended for appropriation and construction by USFWS) represent the "Federal Plan". Because USFWS is ultimately responsible for managing its refuge lands, USACE is not seeking authorization and funding for Features 124d and 3c1 (the USFWS features). The NED RP and the subset of NER features that are recommended for authorization and appropriation by USACE (all features minus 124d and 3c1) represent the "Corps Plan". Rather, USACE supports USFWS in seeking its own authorization and appropriation to construct the USFWS features and offers USFWS the information that USACE developed under this study effort as a starting point for USFWS efforts to obtain independent authorization and funding for the USFWS features of the Federal Plan. These two USFWS features are not included in the LERRDs necessary for the construction and OMRR&R of the Corps Plan.

5. All planning, design, or other construction-related activities (e.g., surveys, geotechnical borings, etc.) conducted on National Wildlife Refuges (NWRs) will require the Corps to obtain a Special Use Permit

from 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: Two marsh restoration measures, Features 124d and 3c1 are partially located on USFWS property (Sabine National Wildlife Refuge and Cameron Prairie National Wildlife Refuge, respectively) and are included in the NER RP. These features are vitally important to help preserve the Calcasieu Lake rim and prevent vast new expanses of open water from forming should the lake rim be breached by erosional forces. All NED and NER RP features (including those recommended for appropriation and construction by USFWS) represent the "Federal Plan". Because USFWS is ultimately responsible for managing its refuge lands, USACE is not seeking authorization and funding for Features 124d and 3c1 (the USFWS features). The NED RP and the subset of NER features that are recommended for authorization and appropriation by USACE (all features minus 124d and 3c1) represent the "Corps Plan". Rather, USACE supports USFWS in seeking its own authorization and appropriation to construct the USFWS features and offers USFWS the information that USACE developed under this study effort as a starting point for USFWS efforts to obtain independent authorization and funding for the USFWS features of the Federal Plan. These two USFWS features are not included in the LERRDs necessary for the construction and OMRR&R of the Corps Plan.

6. The Corps should contact the Louisiana Department of Wildlife and Fisheries prior to conducting any work on Rockefeller Refuge (337-491-2593).

RESPONSE: The CEMVN will contact the Louisiana Department of Wildlife and Fisheries (LDWF) at 337-491-2593, well in advance of conducting any work on the Rockefeller Refuge; however the non-Federal sponsor bears all responsibility for obtaining right of entry from DWF and the performance of any relocations necessary for the construction and OMRR&R of this feature of the project.

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: The CEMVN 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. CEMVN notes that the eligibility of any structure to participate in the non-structural measures of the NED RP is dependent, in part, upon the absence of any threatened or endangered species that would be impacted by the applicable flood proofing measure.

8. We recommend the Corps coordinate with the Service, LDWF, 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: CEMVN will work closely with the USFWS, the LDWF, 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: CEMVN 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 11 through 14).

10. Because Calcasieu Lake is a public Oyster Seed Ground administered by the LDWF, the Corps should contact LDWF prior to conducting construction activities within Calcasieu Lake.

RESPONSE: The CEMVN will contact the LDWF prior to conducting construction activities within Calcasieu Lake, especially with regard to the Oyster Seed Ground area.

Service recommendations regarding specific ecosystem restoration measures are provided below:

11. 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 salts.
    c. To pump into eastern and western extremes of the designated fill area, the pipeline route should depart from that designated route only within the proposed fill area, and should be routed through unvegetated open water areas, to avoid impacting existing marshes.

Response: a. The CEMVN does not concur with the USFWS's recommendation that some of the open water areas not be filled. The CEMVN's experience with beneficial use of dredged material and other marsh restoration projects throughout coastal Louisiana has clearly demonstrated that the extensive coastal marsh and land loss driving factors, the different borrow sediment grain sizes and differential settling will rapidly erode and solid marsh platform resulting and naturally develop interior ponds and hydrologic connections with surrounding waters.

b. The CEMVN concurs with avoiding saltwater entrapment impacts, providing drainage and water exchange, and draining ponds and non-fill areas. However, the CEMVN reserves the right to determine and utilize best practical methods and BMP's will be utilized to avoid potential saltwater entrapment impacts, to avoid ponding of Gulf water effluent within or adjacent to the fill areas. The CEMVN does not anticipate having any enclosed non-fill areas.

c. The CEMVN will utilize BMPs to follow designated dredge pipeline route and, if it becomes necessary to deviate from designated route, to route pipeline through unvegetated open water areas and avoid impacting existing, non-targeted marshes.

12. Marsh creation along Freshwater Bayou Canal (measures 127c3 and 306a1)
    a. To avoid saltwater effluent impacts, we recommend 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.
    b. 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.

RESPONSE: a. The CEMVN concurs with avoiding saltwater effluent impacts. However, the CEMVN cannot, at this time concur with routing dredge borrow effluent, which may be slightly higher in salinity than the marsh restoration site, into Freshwater Bayou. The CEMVN believes the need to nourish adjacent highly degraded marshes would generally take precedence. However the CEMVN will work closely with the USFWS and other interested natural resource parties during PED and during construction phases to achieve a design that maximizes marsh restoration and nourishment, minimizes adverse impacts related to higher salinities waters in less saline marsh areas, and maintains hydrologic connectivity where appropriate and determined applicable to the specific locations.

b. The CEMVN will consider and work closely with the USFWS and other natural resource agencies during PED and construction phases if a containment dike is required adjacent to Freshwater Bayou Canal and to determine if allowing the containment dike to remain would provide greater benefits than degrading it.

13. 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.

RESPONSE: a. The CEMVN does not concur with leaving some open water areas. Please see response to #12 above.

b. The CEMVN concurs with designing and using BMPs to provide avoid saltwater entrapment impacts, to avoid ponding Gulf water effluent within or adjacent to the fill areas, and to have drainage channels to carry away Gulf water effluent to avoid concentration of salts. The CEMVN reserves the right to determine best practical methods, refined designs during PED and implementation during construction.

c. The CEMVN will utilize the best practical methods, determine refined designs during PED, best BMPs during construction implementation to avoid potential saltwater entrapment impacts and impaired drainage impacts regarding containment dikes along western and southeastern fill area boundaries. For a, b and c, the CEMVN will work closely with the USFWS and other interested natural resource parties during PED and construction phases to achieve a design that maximizes marsh restoration and nourishment, minimizes adverse impacts such as saltwater entrapment, avoid ponding of Gulf water effluent and maintain hydrologic connectivity where appropriate and determined applicable to the specific locations.

14. 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.

b. If funding is provided to the Service to construct this or other measures located on National Wildlife Refuges, that funding should include funding necessary to cover the necessary administration, engineering, and design work.

RESPONSE: a. CEMVN is not seeking authorization and funding for measure 124d. That measure will not be authorized or implemented as a part of the Corps Plan for the NER RP. Rather, the NER RP will recommend that information regarding measure 124d be submitted to USFWS for its decision to independently seek Congressional authorization and appropriation for implementation by USFWS.

b. Two marsh restoration measures, Features 124d and 3c1 are partially located on USFWS property (Sabine National Wildlife Refuge and Cameron Prairie National Wildlife Refuge, respectively) and are included in the NER RP. These features are vitally important to help preserve the Calcasieu Lake rim and prevent vast new expanses of open water from forming should the lake rim be breached by erosional forces. All NED and NER RP features (including those recommended for appropriation and construction by USFWS) represent the "Federal Plan". Because USFWS is ultimately responsible for managing its refuge lands, USACE is not seeking authorization and funding for Features 124d and 3c1 (the USFWS features). The NED RP and the subset of NER features that are recommended for authorization and appropriation by USACE (all features minus 124d and 3c1) represent the "Corps Plan". Rather, USACE supports USFWS in seeking its own authorization and appropriation to construct the USFWS features and offers USFWS the information that USACE developed under this study effort as a starting point for USFWS efforts to obtain independent authorization and funding for the USFWS features of the Federal Plan. It is assumed that if USFWS does determine to seek independent Congressional authorization and funding for the USFWS implementation of these measures, that it will request adequate funding necessary to address the cost of USFWS efforts to administer, design and implement such work.

This final report is submitted in fulfillment of the requirements of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and constitutes the final report of the Secretary of the Interior as required by Section 2(b) of that Act. This report has incorporated comments made by the National Marine Fisheries Service (see Appendix A) on our draft Coordination Act Report dated February 26, 2015. No comments on our February 2015 draft Coordination Act Report were received from the Louisiana Department of Wildlife and Fisheries.

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6.0 PUBLIC INVOLVEMENT (*NEPA REQUIRED)

The NEPA provides people, organizations, and governments an opportunity to review and comment on proposed major Federal actions. This occurs throughout the planning process beginning with scoping meetings and continues through comment periods on draft and final reports. Comments are accepted and considered throughout the planning process.

The SWC Draft Integrated Feasibility Report and Programmatic EIS was released in December 2013 ("2013 Initial Draft Report") and the public review was completed in February 2014. As a result of substantial public, technical, and policy comments received, the CEMVN performed additional analyses in 2014 which resulted in significant revisions to the NED and NER TSPs that warranted development and release of a Revised Integrated Draft Feasibility Report and EIS in March 2015 ("2015 Revised Draft Report") and a 45-day public review from March-May 2015. Public hearings were held in April 2015 and the study website was updated to reflect changes made in this Revised Integrated Report and EIS.

Engaging and receiving input from the public, interested parties, stakeholders, government agencies, and non-governmental organizations regarding the content of the Integrated Report and EIS in all of its' stages is critical to achieving the USACE objective of enhancing trust and understanding with customers, stakeholders, teammates, and the public through strategic engagement and communication. Public participation efforts began with the study NEPA scoping process and continues through the conclusion of the formal comment period on the Final Integrated Report and EIS. In addition to traditional mailings, a web site and other social media tools were used in an effort to broadly distribute study report information.

6.1 Notice of Intent and Public Scoping Meetings

The USACE, consistent with 40 CFR §1508.22, published a Notice of Intent (NOI) in the Federal Register (Volume 74, Number 38) on February 27, 2009, to prepare an EIS to evaluate a full suite of structural, nonstructural and coastal restoration measures to achieve hurricane protection and storm damage risk reduction within Calcasieu, Cameron and Vermilion Parishes in Louisiana. The NOI also notified that public scoping meetings would be held throughout the study area to determine the range of alternatives and significant issues to be addressed in the EIS.

Scoping, required by 40 CFR §1501.7 in preparation of an EIS, is an early and open process for determining the scope and significance of issues to be analyzed in depth in the EIS. The CEMVN invited the participation of affected Federal, State, and local agencies, any affected Indian tribe, the proponent of the action, and other interested persons (including those who might not be in accord with the action on environmental grounds). The scoping process was used to identify and eliminate from detailed study issues which are not significant or which have been covered by prior environmental review (§ 1506.3), narrowing the discussion of these issues in the statement to a brief presentation of why they would not have a significant effect on the human environment or providing a reference to their coverage elsewhere. The NOI also indicated the relationship between the timing of the preparation of environmental analyses and the agency's tentative planning and decision-making schedule. A scoping report was prepared following completion of the scoping meetings that included information about the public scoping meetings, scoping meeting notices, and comments made by citizens, other interested parties, and stakeholders who attend the scoping meetings.

Public Notification: The NOI indicated that public scoping meetings would be held March 24, 2009 from 6-9 p.m. in Cameron, Louisiana, March 25, 2009 from 6-9 p.m. in Lake Charles, Louisiana and March 26, 2009 from 6-9 p.m. in Abbeville, LA (see Table 6-1). In addition to the NOI, scoping meeting announcements requesting scoping comments was mailed to Federal, state, and local agencies, and interested groups and individuals on March 13, 2009. A media advisory announcing the scoping meetings was also 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. Each comment was categorized by subject and ranked in order of occurrence. A subject raised more than three times was classified as a "theme" and a total of 13 themes were 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 effects of other projects	53	13.9%
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%
7	Other*	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%
	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 Participating Agencies

The LDEQ and the LADNR also participated throughout the study process, 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.
- 2015 – April 14 thru April 16 – Various stakeholder meetings and presentations.

The primary interest of meeting participants was the potential levee alignments, impacts to communities, and the nonstructural involuntary aspect. 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 and Interested Parties letters were mailed to the CEMVN District stakeholder/NEPA mailing lists. A full list of both of the Draft Report recipients is available upon request (weblinks are provided in Appendix M). The following stakeholders received a copy of the 2013 Initial Draft Report and Programmatic EIS and the March 2015 Revised Draft Report and EIS:

Table 6-3: List of 2013 and 2015 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

Table 6-3: List of 2013 and 2015 draft report recipients.

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 Comments received on the 2013 Initial Draft Report and Programmatic EIS

The 2013 Initial Draft Report and Programmatic EIS 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 Initial Draft Report on:

- January 7, 2014 at the Lake Charles Civic Center - Contraband Room (2nd Floor), 900 Lakeshore Drive, Lake Charles, LA 70601.
- January 9, 2014 at the Vermilion Parish Library - Abbeville Branch Library, 405 E St Victor Street, Abbeville, LA.

In January 2014, 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.

6.7 Views of the public based upon public comments received on the 2015 Revised Draft Report.

The 2015 Revised Draft Report and EIS was made available for public review and comment from March 20, 2015 until May 4, 2015. The 2015 Revised Draft Report includes comments received on the 2013 Initial Draft Report. Three NEPA public meetings were conducted during public review of the 2015 Revised Draft Report and EIS. 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:

- April 14, 2015 at Abbeville High School, 1305 Wildcat Drive Abbeville, LA 70510
- April 15, 2015 at the Lake Charles Civic Center - Contraband Room (2nd Floor), 900 Lakeshore Drive Lake Charles, LA 70601.
- April 16, 2015 at the Cameron Parish Police Jury Building, 119 Smith Cir, Cameron, LA 70631

A total of 184 people signed in to the public hearings; however, more people were in attendance than had signed in for all three hearing sites. The CEMVN received a total of 2,752 comments, including: 2,540 signatures on petitions; 50 emails; 40 oral comments during the public hearings; 34 governmental (including Federal, state, parish, and local); 10 letters; 7 postcards; and 4 telephone comments received during the comment period. Most comments were comprised of several specific comments; a few of the comments provided attachments.

All comments received on the 2015 Revised Draft Report and EIS, whether or not the comment is thought to merit individual discussion, are included along with comment responses in Appendix J of this final report. The most numerous comments included:

- Request to include a list of all Parish Priority Projects and Coastal Restoration and Protection Plans in the report.
- Request that any and all reference to eminent domain and involuntary participation be removed from the study.
- Request that a 'Local Sponsor' be chosen and have immediate 'voice' in the remaining planning process.
- Request to replace reforestation measures be replaced by shoreline protection measures.

The Council on Environmental Quality regulations for Implementing the NEPA (40 CFR §1503.4(a)), requires an agency preparing an EIS to assess and consider all public comments, both individually and collectively, and respond by one or more of the means listed below, stating its response in the final statement:

- Modify alternatives including the proposed action.
- Develop and evaluate alternatives not previously given serious consideration.
- Supplement, improve, or modify analyses performed.
- Make factual corrections.
- Explain why the comments do not warrant further agency response, citing the sources, authorities or reasons which support the agency's position and, if appropriate, indicate those circumstances which would trigger agency reappraisal or further response.

Written comments and oral testimonies received on both the 2013 and 2015 Draft Integrated Reports and EISs and responses are included in Appendix J. Written comments and oral testimonies were reviewed and were considered in the preparation of this 2016 Final Report and EIS. Several comments warranted revisions to each of the draft and final reports including but not limited to: the removal of the nonstructural involuntary component of the NED RP that called for the acquisition and demolition of structures located within the FEMA Regulatory Floodway, inclusion of the 0-25-year floodplain for the NED Plan, and the development of additional and sufficient detail to make both the NED RP the NER RP features constructible as opposed to programmatic. All registered commenting meeting participants, as well as those providing written comments, will be provided a copy of this Final Report. In addition, the 2013 Initial and 2015 Revised Draft Reports will be posted at: http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx.

7.0 RECOMMENDATIONS

7.1 NED Recommended Plan

The RP (Nonstructural 0-25-Year Floodplain Plan – Modified Plan 8) proposes implementing measures across the 4,700 square mile study area to reduce coastal storm surge damages to 3,462 residential structures, 342 commercial structures and public buildings, and 157 warehouses. This will be achieved by elevating residential structures, dry flood proofing non-residential structures, and constructing localized storm surge risk reduction measures around warehouses. Residential structures will be elevated to the BFE predicted to occur in the year 2075. Non-residential structures will have flood proofing measures applied generally up to 3 ft above ground level. Localized storm surge risk reduction measures will be less than 6 ft in height. Any structure that requires raising more than 13 ft above ground level would be ineligible to participate due to engineering and risk related factors. The NED RP is 100% voluntary. The expected equivalent annual net benefits are approximated at $167.4 million dollars, with $906.1 million in project first costs, and a BCR of 5.65:1. The Federal share of the project first cost of the NED RP features would be $588,959,000 (65 percent). The non-Federal share of the first costs of NED Plan would be $317,132,000 (35 percent).

Among other things, the NFS is required to prepare and implement a Floodplain Management Plan in coordination with the USACE to maintain the integrity, purpose and functionality of the project, to participate in and comply with floodplain management programs, provide annual notifications regarding the extent of risk reduction afforded by the project, and prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the level of risk reduction the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function.

This Final Report recommends a strategy to implement the nonstructural project for eligible structures. Structures that have been identified as preliminarily eligible as part of the NED RP are located across the three-parish study area. Eligible structures are located in the 0-25-year floodplain and are individually economically justified (i.e. the costs to apply a particular nonstructural measure are less than the flood damages predicted to occur to that structure over the 50-year period of analysis). In order to effectively implement the NED RP, clusters of eligible structures that represent the highest risk for hurricane storm surge damages (i.e. those with a FFE below the 10-year stage) would be identified and prioritized for construction. Individual structures would be addressed based on a ranking of risk from highest to lowest within the cluster. The ranking of individual structures would be revisited as elevation work is completed, as additional funding is distributed, and as new clusters are identified. Addressing groups of structures within a small geographic area would be more cost-effective, efficient, and would also allow for a more strategic methodology for applying nonstructural measures to at-risk structures. Additional work on this process would occur during the design phase of the project and would result in owners being contacted to ascertain their interest in applying the appropriate nonstructural measure to their structure. More details on this process can be found in Appendix L.

No mitigation is required for the NED RP.

By and large, hurricane storm damage risk reduction projects positively contribute to public safety. This is particularly true for structural plans where for the most frequent surge events, the incidence of inundation is reduced for communities and other developed areas. However, for less frequent and more severe hurricane surge events in coastal areas that are characteristic of the study area, structural plans could have a negative effect on public safety. This may arise from some among the public who do not abide by mandatory evacuation orders in advance of an approaching storm, but who otherwise would, believing that the structural levee may provide greater protection from storm surge than may be warranted. Thus the total population exposed to storm surge in the event of overtopping or breach could be greater under with-project conditions. However, for nonstructural plans, no change is expected in evacuation behavior since the potential exaggerated expectations of performance afforded to structural measures is not present, and awareness of storm damage risk is not abated. Similarly, residual risk to critical infrastructure (i.e. hospitals, evacuation routes, public buildings) is not

expected to be different from without-project conditions since much of this infrastructure is already built and designed to operate in dire situations, especially those of greater frequency such as hurricanes and their associated flood potential.

7.2 NER Recommended Plan

The NER RP is Plan CM-4 "Small Integrated Restoration", which focuses on stabilizing perimeter geomorphology and consists of 49 ecosystem restoration features recommended for construction (9 marsh restoration features; 35 chenier reforestation features; and 5 shoreline protection features). The NER RP is the least-cost, cost-effective, comprehensive ecosystem restoration plan that addresses land loss and ecosystem degradation. The NER RP contains features to restore 15,448 acres of wetlands; restore and protect 335 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 Control Structure and the Cameron-Creole Watershed Spillway are recommended as additional long-range studies. Each study would be subject to a Federal/non-Federal cost share of 50 percent.

Two marsh restoration measures, Features 124d and 3c1 are partially located on USFWS property (Sabine National Wildlife Refuge and Cameron Prairie National Wildlife Refuge, respectively) and are included in the NER RP. These features are vitally important to help preserve the Calcasieu Lake rim and prevent vast new expanses of open water from forming should the lake rim be breached by erosional forces. All NED and NER RP features (including those recommended for appropriation and construction by USFWS) represent the "Federal Plan". Because USFWS is ultimately responsible for managing its refuge lands, USACE is not seeking authorization and funding for Features 124d and 3c1 (the USFWS features). The NED RP and the subset of NER features that are recommended for authorization and appropriation by USACE (all features minus 124d and 3c1) represent the "Corps Plan". Rather, USACE supports USFWS in seeking its own authorization and appropriation to construct the USFWS features and offers USFWS the information that USACE developed under this study effort as a starting point for USFWS efforts to obtain independent authorization and funding for the USFWS features of the Federal Plan. These two USFWS features are not included in the LERRDs necessary for the construction and OMRR&R of the Corps Plan.

USACE estimates total project costs of $296,839,000 for the two NER RP features that would be submitted to USFWS for its consideration and implementation (after first securing independent Congressional authorization and appropriations). However, it is likely that USFWS, should it choose to seek authorization and funding, will reevaluate the total cost necessary for implementation by USFWS rather than by USACE. In so doing, it is probable that USFWS would determine a different total cost for these features.

The NER RP features comprise an integrated restoration plan that would have synergy with other ecosystem restoration projects and would facilitate hydrologic and geomorphic stability and resilience. The NER RP total project first cost estimate is $2.485 billion. The Federal share of the Federal Plan is $1.719 billion (which represents 65% of all cost-shared features plus the entire cost of the two USFWS features); The Federal share of the Corps Plan, for which authorization is being recommended is $1.422 billion. The Non-Federal share of either NER plan is $766 million. Additionally, the two long range studies recommended under the NER RP are estimated to cost $6,000,000 with a 50/50 cost share.

7.3 Federal and Non-Federal Cost-Sharing

For each of the two long-range studies at Calcasieu Ship Channel Salinity Control Structure and the Cameron-Creole Watershed Spillway, it is anticipated that the CPRAB would be the NFS for each study effort, with a cost share for each study of 50 percent Federal and 50 percent non-Federal.

The State of Louisiana acting through the CPRAB will be the NFS for design, construction, operation, maintenance, repair, rehabilitation and replacement of that portion of the project that constitutes the Corps Plan (hereafter the Project). The cost share for the design and construction of the project will be 65 percent Federal and 35 percent non-Federal. Among other responsibilities, the CPRAB must provide all project

LERRDs required for the project and submit any work-in-kind (WIK) request for approval by the Federal government for the PED phase of the project. WIK associated with the construction of localized storm surge risk reduction system components of the project will be negotiated with the NFS, contingent upon approval at the Assistant Secretary of the Army for Civil Works (ASACW) (or appropriate designee) in accordance with applicable guidance and regulations. The OMRR&R cost of the project is estimated to cost on an average annual basis $5,963,000 and is a 100% NFS responsibility. The estimated total project cost for the Federal Plan (the Federal NED and NER RPs, including projects that will be submitted to USFWS for its consideration to seek independent Congressional authorization and funding) is $3,391,113,000 at FY 2016 price levels. The estimated total project cost for the Corps Plan, for which authority is being recommended, is $3,094,276,000 at FY 2016 price levels.

7.4 Federal Responsibilities for the Corps Plan Project (the Project)

Since implementation by USFWS of features 3c1 and 124d of the NER RP is subject to independent authorization and funding by USFWS, this section and section 7.6 will not attempt to outline the Federal and non-Federal responsibilities for the construction and OMRR&R of those features. References to the "Project" refer only to those features of the Federal NED and NER RPs that will be implemented by USACE (the Corps Plan).

The Federal government (USACE) will be responsible for PED and construction of the project in accordance with the applicable provisions of Public Law 99-662 (WRDA of 1986), as amended. The Government (USACE), subject to Congressional authorization, the availability of funds, and the execution of a binding agreement with the NFS in accordance with Section 221 of the Flood Control Act of 1970, as amended, and using those funds provided by the NFS, shall expeditiously construct the Project, applying those procedures usually applied to Federal projects, pursuant to Federal laws, regulations, and policies.

7.5 Non-Federal Responsibilities for the NED Recommended Plan

Federal implementation of the Project would be subject to the NFS agreeing in a binding written agreement to comply with applicable Federal laws and policies, and to perform the following non-Federal obligations, including, but not limited, to the following:

a. Provide 35 percent of total hurricane storm surge risk reduction project costs as further specified below:

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

2. Provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to hurricane storm surge risk reduction features of the project;

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, maintenance, repair, rehabilitation and replacement of the hurricane storm surge damage risk reduction features of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total hurricane storm surge risk reduction costs;

b. Do 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; provided however, that the NFS shall have no obligation to address loss or risk reduction due to relative sea level rise through the repair, rehabilitation or replacement of components associated with the construction of localized storm surge risk reduction measures around non-residential warehouse structures, nor shall the NFS be obligated to OMRR&R those nonstructural flood proofing measures that constitute elevation of individual residential structures or dry flood proofing of non-residential commercial or public structures;

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, including those lands, structures and interests necessary for the implementation of all of the non-structural components of the project as described in this report;

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 acknowledge that if the Government in its sole discretion elects to accomplish the requested betterment or additional work, or nay portion thereof, the Government shall so notify the non-Federal sponsor in writing that sets forth any applicable terms and conditions.

7.6 Non-Federal Responsibilities for the NER Recommended Plan

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

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

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

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 ecosystem restoration features of the project;

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

b. Do 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; and,

n. 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.

7.7 Recommendation

The recommendations herein reflect the information available at the time and current Department of the Army policies governing the formulation of individual projects. They do not reflect programming and budgeting priorities inherent in the formulation of national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently the recommendations may be modified before they are transmitted to Congress as proposals for implementing funding. However, prior to the transmission to Congress, the state, Federal agencies and other parties will be advised of any modifications and afforded the opportunity to comment.

Richard L. Hansen
Colonel, US Army
District Engineer