CALCASIEU LOCK LOUISIANA FEASIBILITY STUDY WITH INTEGRATED ENVIRONMENTAL IMPACT STATEMENT

FINAL REPORT

JUNE 2014

US Army Corps
of Engineers®
New Orleans District

CALCASIEU LOCK LOUISIANA
FEASIBILITY STUDY
WITH INTEGRATED
ENVIRONMENTAL IMPACT STATEMENT

EXECUTIVE SUMMARY

ES.1. SUMMARY AND INTRODUCTION OF STUDY INFORMATION

The Calcasieu Study addresses navigation improvement planning for the Gulf Intracoastal Waterway (GIWW) at and in the vicinity of Calcasieu Lock, Calcasieu Parish, LA. This Study was developed from the results of the GIWW Locks, Louisiana reconnaissance report, completed in May 1992. The 1992 comprehensive Study involved a systems analysis of the GIWW locks west of the Mississippi River. The report documented the need for replacements or improvements at Bayou Sorrel, Calcasieu, and Port Allen locks. This resulted in a 905(b) reconnaissance report specifically for the Lock that was completed in 2001 and which found justification and Federal interest in further feasibility level study of the navigation delays and potential solutions at Calcasieu Lock.

ES.2. PROBLEMS, OPPORTUNITIES AND OBJECTIVES OF ACTION FOR THE CALCASIEU LOCK PROJECT

The principal problem to be addressed is the delays to navigation induced through operation of the Calcasieu Lock for drainage of the Mermentau River Basin as part of its authorized purpose. The delays result in approximately $1 to $3 million in damages to the Nation on an average annual basis. The primary opportunities are to reduce or eliminate commercial traffic delays and improve the national and regional economic conditions. The need to maintain the effectiveness of Calcasieu Lock as a salinity barrier for the Mermentau Basin is critical. While the problem and opportunities are localized physically at the lock, the range of alternatives has potential impacts at multiple scales. Hydraulically, impacts are local and regional in nature as the operation of the Lock is done in conjunction with other structures in the Mermentau Basin. Therefore, potential alterations to existing operations and drainage patterns must be evaluated at those scales. Potential environmental impacts are localized in nature but given the dynamic coastal environment Calcasieu Lock is located in, the Chenier Plain sub region of the coast must be considered. Opportunities exist to increase navigation efficiency through improved operational routines and potential modification of the existing structure to accommodate existing and future traffic. Further opportunities exist to reduce or eliminate navigation delays due to drainage by redirecting completely or partially drainage flows away from the existing lock. Such opportunities might reduce or eliminate the delays that result.

The Federal objective of water and related land resources planning is to contribute to the National Economic Development (NED) consistent with protecting the Nation's environment. Study goals, objectives, and constraints were developed to comply with the Study authority and to respond to Study area problems and opportunities. The overall Study goal reflects the role Calcasieu Lock plays in a critical navigation system as well as an integral part to a water management system (Mermentau Basin) that requires both drainage capacity and an effective barrier to salinity intrusion.

Therefore, the overall Study goal is to:

- maximize the efficiency of the Calcasieu Lock, thereby contributing to the overall efficiency of GIWW as a nationally significant navigation system, while continuing to provide water management capability and salinity control to the Mermentau River Basin.

To support accomplishment of the Study goal, a specific planning objective was developed:

- reduce drainage event induced navigation delays at Calcasieu Lock while minimizing the impacts to the surrounding area

ES.3. AFFECTED ENVIRONMENT

Calcasieu Lock is located on the GIWW, just east of the Calcasieu River, in Calcasieu Parish, LA, approximately 10 miles south of Lake Charles, LA (figure ES-1).

Significant resources considered within the development of this Study included soils; coastal vegetation; wildlife; fisheries; plankton; benthos; essential fish habitat; threatened and endangered species; hydrology (including flow and water levels, and sediment); water quality; recreation; cultural and historic resources; air quality; socioeconomic and human resources (including population; infrastructure; employment and income; navigation; commercial fisheries; and flood control and hurricane protection). In addition, the characterization of noise and hazardous, toxic, and radioactive waste in the Study area are presented.

Figure ES-1. Calcasieu Lock Study Area

ES.4 ALTERNATIVES

Management measures were developed to address Study area problems and to capitalize upon Study area opportunities. Management measures were derived from a variety of sources including prior studies, the National Environmental Policy Act public scoping process, and the multidisciplinary, Interagency Project Delivery Team. Through a rigorous screening process a final array of five action alternatives in addition to the No Action alternative were developed. They are:

- **No Action - (Future Without Project Condition)**
- **Alternative 1 – A 75-foot Sluice Gate South of the Existing Lock**
- **Alternative 2 – A 3,700 cfs Pumping Station South of the Existing Lock**
- **Alternative 3 – Supplemental Culverts at Black Bayou**
- **Alternative 4 – A 2,000 cfs Pumping Station at Black Bayou**
- **Alternative 5 - A 3,700 cfs Pumping Station at Black Bayou**

ES.5 EVALUATION AND SELECTION OF THE RECOMMENDED PLAN

The final array of alternatives was evaluated and compared based on the economic and environmental costs associated with each alternative. The range of costs is as follows:

Table ES--1. Alternative Cost Estimates

	Total First Cost
Alternative 1 - South 75' gate	$16,700,000
Alternative 2 - South 3,700 cfs Pump	$104,537,293
Alternative 3 - Black Bayou Culverts	$18,370,444
Alternative 4 - Black Bayou 2,000 cfs Pump	$66,445,539
Alternative 5 - Black Bayou 3,700 cfs Pump	$95,171,622

The estimate for Alternative 1 above represents a feasibility level of design completed after Alternative 1 was selected as the recommended plan. Alternative 1 was found to have the highest net benefits of $191,000 and is therefore the NED Plan. The estimate for Alternative 1 above represents a feasibility level of design completed after Alternative 1 was selected as the recommended plan. For comparison of alternatives, the cost estimate for Alternative 1used in this analysis was $16,500,707.

ES.6 RECOMMENDATION

As a comprehensive approach to address navigation delays resulting from drainage events in the Mermentau Basin the District Commander recommends the construction of a sluice gate structure to the south of the existing Calcasieu Lock and associated channel excavation. Additionally, mitigation of 11.5 acres of Forested Spoil Bank Habitat is required. The Project First Cost for the Project is estimated to be $16,700,000, inclusive of associated investigation, environmental, engineering and design, construction, supervision and administration, and contingency costs. Construction will be 50/50 with the Inland Water Way trust fund. The operations and maintenance of this Project will be assumed by the Federal Government as part of the Calcasieu Lock at 100 percent Federal cost. The United States Federal government will be responsible for the acquisition of lands, easements, rights of way, relocations, and disposal and borrow areas as the Corps deems necessary for the construction, operation & maintenance of the recommended plan.

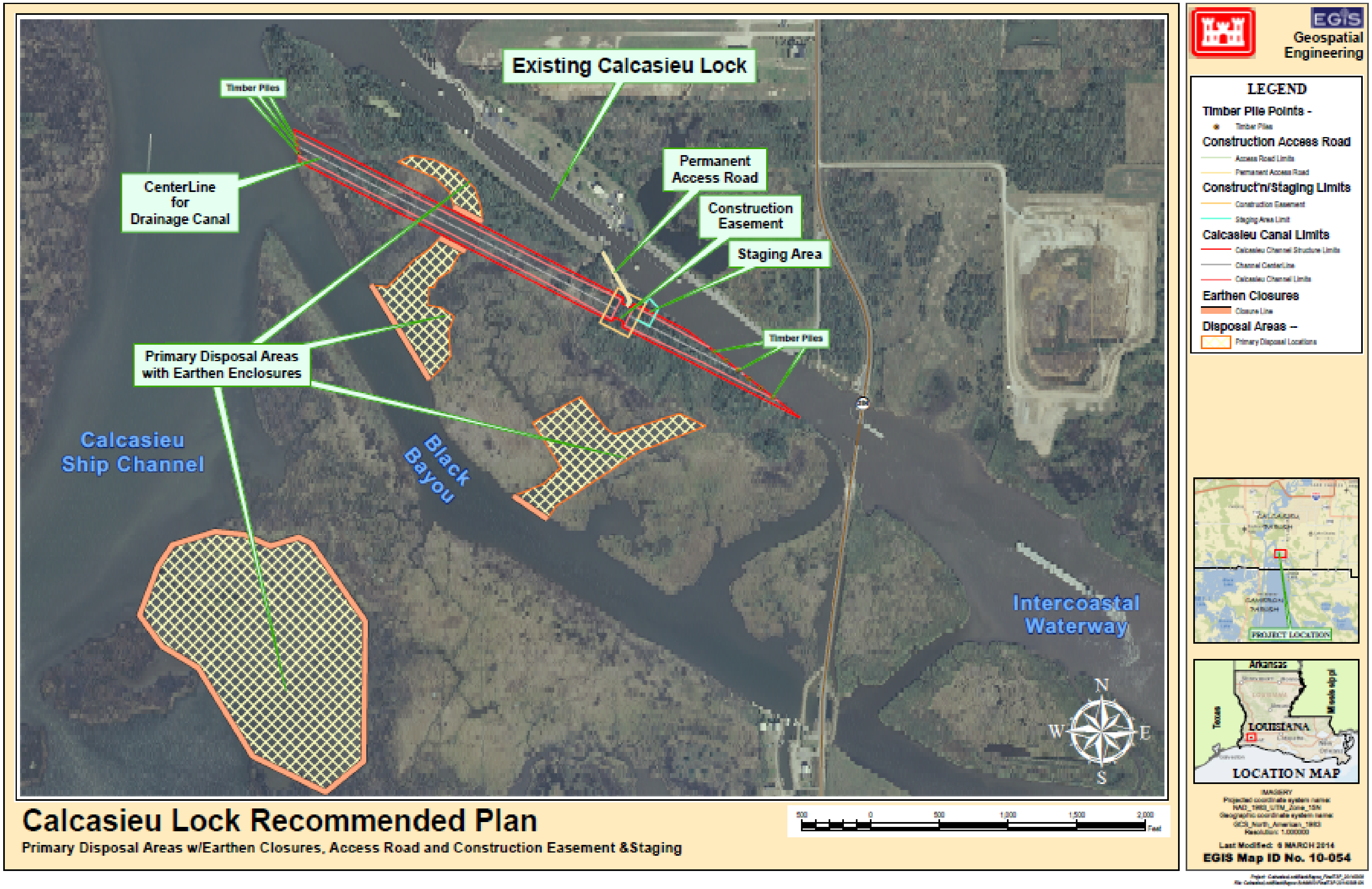

Figure ES 2. Recommended Plan (Proposed Forested Mitigation shown in the Main Report, Figure 21)

CALCASIEU LOCK LOUISIANA
FEASIBILITY STUDY

* Indicates traditional National Environmental Policy Act required chapters

APPENDICES

FIGURES

TABLES

PHOTOGRAPH

Calcasieu Lock Louisiana
Feasibility Study

1.0. STUDY INFORMATION

1.1. Study Authority. Authorization for the Gulf Intracoastal Waterway (GIWW) originally occurred in 1925 and has been modified and supplemented numerous times since then. The Calcasieu Lock was authorized as part of the *Mermentau River, Louisiana Flood Control, Irrigation and Navigation Project* (Mermentau Project) in the Rivers and Harbor Act of 24 July 1946, Public Law No. 525, 79th Congress, 2nd Session, in accordance with the plan outlined in Senate Document No. 231. This document recommended modifying the existing project for the GIWW to provide for a salt water guard lock in the waterway. The document included other closely related improvements for flood control, navigation, and salt water intrusion in the Mermentau River and Basin. The plan of improvement pertaining to the GIWW as contained in the Senate Document No. 231is as follows:

> "Gulf Intracoastal Waterway. An earth-chambered salt water guard lock, 425 by 75 by 12 feet, at or near Grand Lake Ridge, Mile 231 west of Harvey Lock."

The Calcasieu Lock, Louisiana Feasibility Study (Study) is being performed by the US Army Corps of Engineers (Corps), New Orleans District (MVN), under the authority of the following resolutions:

> A resolution at the request of Senators Long and Edwards of Louisiana, adopted by the Committee on Public Works of the United States Senate on September 29, 1972, that the "Board of Engineers for Rivers and Harbors, be, and is hereby, requested to review the reports on the Gulf Intracoastal Waterway (Louisiana-Texas Section, including the Morgan City-Port Allen Route) submitted in House Document 556, 87th Congress, Second Session, and subsequent reports, with a view to determining the advisability of modifying the existing project in any way at this time, particularly with regard to widening and deepening the existing and/or authorized channel."

> A resolution at the request of Congressman Jack Brooks of Texas, adopted by the Committee on Public Works of the United States House of Representatives on October 12, 1972, that the "Board of Engineers for Rivers and Harbors, be, and is hereby, requested to review the reports on the Gulf Intracoastal Waterway (Louisiana-Texas Section, including the Morgan City-Port Allen Route) submitted in House Document 556, 87th Congress, second session, and subsequent reports, with a view to determining the advisability of modifying the existing project in any way at this time, particularly with regard to widening and deepening the existing and/or authorized channel."

This Study was originally funded in Fiscal Year 1999 with $100,000 for accomplishment of the reconnaissance phase, which was completed in 2001.

1.2. Purpose and Scope.* This Study addresses navigation improvement planning for the GIWW at and in the vicinity of Calcasieu Lock, Calcasieu Parish, LA. This Study was developed from the results of the GIWW Locks, Louisiana Reconnaissance Report, completed in May 1992. The Reconnaissance Report involved a systems analysis of the GIWW locks west of the Mississippi River. It documented the need for replacements or improvements at Bayou Sorrel, Calcasieu, and Port Allen locks and resulted in a 905(b) Reconnaissance Report specifically for Calcasieu Lock. The 905(b) Reconnaissance Report for Calcasieu Lock was completed in 2001 and found justification for and Federal interest in further feasibility level study of the navigation delays and potential solutions at Calcasieu Lock (Lock).

The principal problem to be addressed is the delays to navigation induced through operation of the Calcasieu Lock for drainage of the Mermentau River Basin as part of the lock's authorized purpose. The primary opportunities are to reduce or eliminate commercial traffic delays and improve the National Economic Development (NED) and Regional Economic Development (RED) economic conditions. The need to maintain the effectiveness of Calcasieu Lock as a salinity barrier for the Mermentau Basin is critical. While the problem and opportunities are located in the immediate vicinity of the lock, the range of alternatives has potential impacts at multiple scales.

1.3. Study Area. Calcasieu Lock is located on the GIWW, just east of the Calcasieu River, in Calcasieu Parish, LA, approximately 10 miles south of Lake Charles, LA (figure 1). Calcasieu Lock, along with its location in the Chenier Plain and as the junction of the Mermentau and Calcasieu River Basins, is a critical component of the Louisiana portion of the GIWW. Therefore, although the primary Study area is the Lock and its immediate vicinity, a broader approach was taken to assess environmental, hydraulic, and economic conditions and their potential impacts:

- Potential direct environmental impacts are usually localized, but given the dynamic coastal environment in which the Calcasieu Lock is located, the Chenier Plain sub region of the coast was also evaluated for indirect impacts.

- Potential hydraulic impacts are both local and regional in nature as the operation of the Lock is done in conjunction with other structures in the Mermentau Basin. Therefore, the Mermentau Basin and certain adjacent drainage areas were evaluated.

- The economic evaluation area includes the entire Louisiana portion of the GIWW.

1.4. Planning Process and Report Organization. This Study followed the Corps' six-step planning process specified in Engineering Regulation (ER) 1105-2-100. The planning process identifies and responds to problems and opportunities associated with the Federal objective and specified state and local concerns. This integrated report includes elements of both the planning process and sections specific to the National Environmental Policy Act (NEPA) evaluation of the project. The chapter headings and order in this report generally follow the outline of the required NEPA documentation for an Environmental Impact Statement (EIS). In the table of contents, those sections of an EIS which are required by the Council on Environmental Quality Regulations (40 CFR 1500-1508) implementing the NEPA are designated with an asterisk (*). The six-step planning process is as follows:

1. Identify Problems and Opportunities. The specific problems and opportunities are identified, and the causes of the problems discussed and documented. Planning goals are set, objectives established, and constraints identified.

2. Inventory and Forecast Resource Conditions. This step characterizes and assesses conditions on the GIWW, Chenier Plain and Calcasieu Lock as they currently exist and forecasts the most probable *future without-project condition* (FWOP), also known as the No Action Alternative, over the period of analysis. This assessment gives the basis by which to compare various alternative plans and their impacts. The *FWOP* refers to Calcasieu Lock's anticipated uses over the 50-year planning period if no measures are implemented. *With-project condition* refers to the Lock's anticipated uses if efficient measures are implemented.

3. Formulate Alternative Plans. Alternative plans are developed in a systematic manner to ensure that reasonable alternatives are evaluated. In addition to the no action alternative, a full range of navigation efficiency alternatives are developed.

4. Evaluate Alternative Plans. The evaluation of each alternative consists of measuring or estimating the NED benefits, costs, technical limitations, and social effects of each plan, and determining the difference between the without- and with-project conditions.

5. Compare Alternative Plans. Alternative plans are compared, focusing on the differences among the plans identified in the evaluation phase and through engagement of industry and the public.

6. Select Recommended Plan. Both the NED and a Recommended Plan are identified. Following public input and review throughout the Corps, a Recommended Plan is selected and justification for plan selection is prepared. If no viable alternative is identified, the Recommended Plan will be the No Action Alternative.

While these steps do follow a progression, they are iterative, i.e., as additional information was learned in subsequent steps, it was often necessary to back up and repeat portions of a previous step(s).

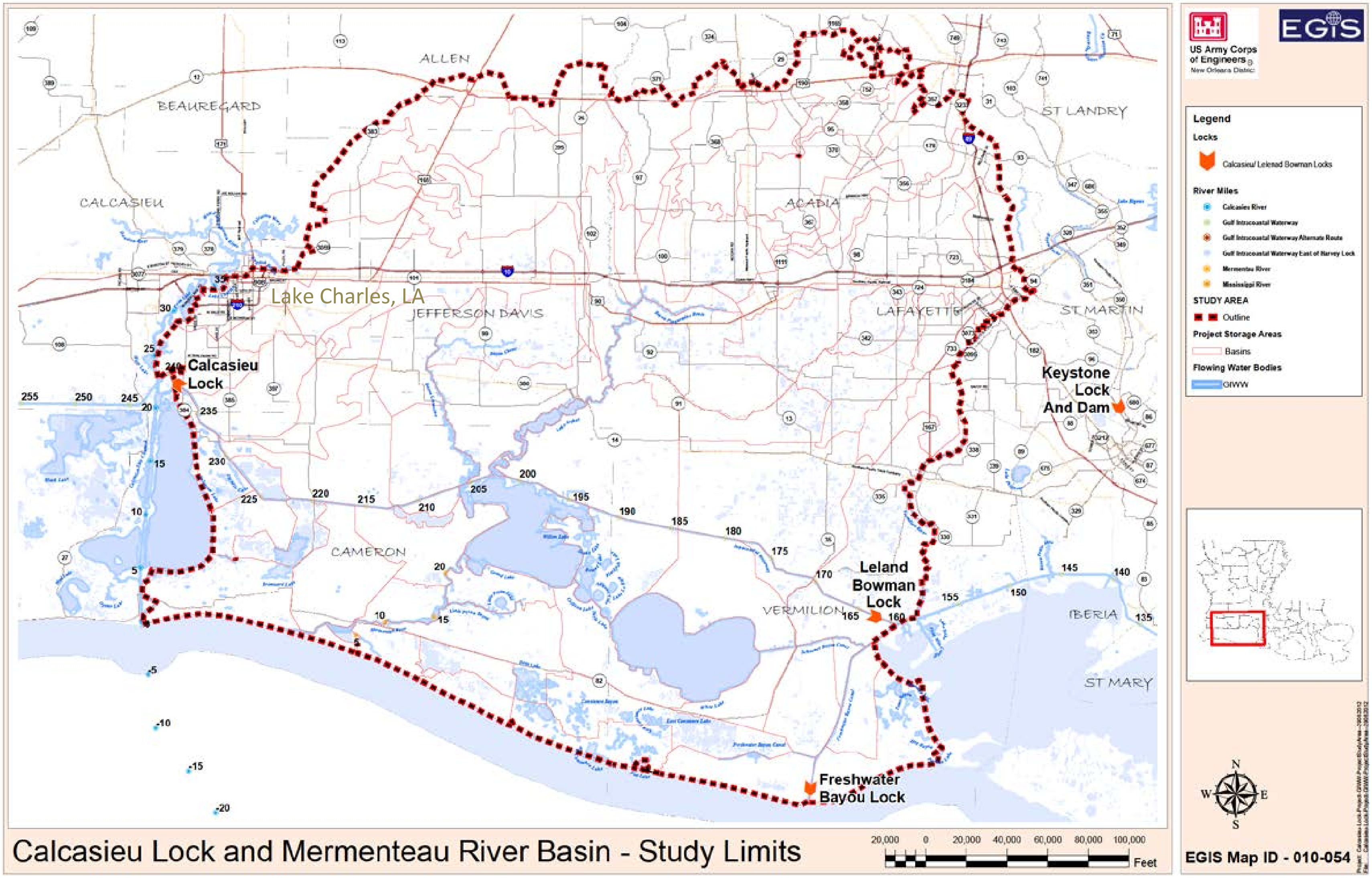

Figure 1. Calcasieu Lock Study Area

2.0. BACKGROUND, EXISTING PROJECTS, AND PRIOR REPORTS

2.1. Background. The Calcasieu Lock is an integral part of the operational plan for the Mermentau Project and it is a modification of the existing GIWW. The authorization for the Mermentau Project, including the Calcasieu Lock, also responded to public concerns about saltwater intrusion arising from the deepening of the Calcasieu Ship Channel (CSC) from Lake Charles to the Gulf of Mexico. The channel deepening, which had been approved prior to authorization of the Mermentau Project, would result in increasing saltwater intrusion into the Mermentau basin via the GIWW. As part of the authorized purposes of the Mermentau Project, Calcasieu Lock is operated as a drainage structure to pass high flows from the Basin into the Calcasieu River. Calcasieu Lock is also located in an ecologically and socially dynamic environment that is constantly changing and the subject of Federal interest in NED and National Ecosystem Restoration (NER) efforts. The Cameron Parish Police Jury serves as the non-Federal sponsor for the existing Calcasieu Lock, in accordance with the Act of Assurance that was signed in 1947. Cameron Parish Police Jury will remain responsible for fulfilling the non-federal obligations for this lock, including the provision of lands, easements and rights of way and indemnification relative to the construction, operation and maintenance of the lock. By contrast, the Recommended Plan is considered single purpose inland waterway project for which the U.S. will be 100% responsible for all obligations

The description of existing projects that follows, describes that multiple use context. Understanding the inter-relationship among the existing projects is important to understanding the water resource problems described in Section 3.0, *Need for and Objectives of Action*.

2.2. Existing Projects

2.2.1. Calcasieu Ship Channel. The Calcasieu River and Pass Ship Channel is located in southwest Louisiana in Calcasieu and Cameron Parishes, extending from Lake Charles, LA, southward into the Gulf of Mexico. The existing Calcasieu River and Pass Ship Channel project provides deep-draft navigation access to oil refineries, chemical plants, liquefied natural gas (LNG) plants, and other facilities along the Calcasieu River.

The Calcasieu River and Pass Ship Channel project provides a 35- to 40-foot project depth channel from deep water in the Gulf of Mexico (figure 8). The gulf reach of the channel is 42 feet deep, 800 feet wide, and extends about 32 miles from the minus 42-foot NAVD 88 contour to the Gulf shore. A 40 x 400-foot channel extends from the gulf shoreline about 34 miles upstream to the wharves of the Port of Lake Charles, and a 35x 250 foot channel that extends further upstream another 2 miles to the vicinity of the Interstate 10 bridge in Lake Charles, LA. Turning basins are located at Mile 29 and Mile 36. There are two spur channels located off the Calcasieu River and Pass Ship Channel. The 40 x 400-foot Calcasieu River at Devils Elbow Channel leaves the Calcasieu River and Pass Ship Channel at Mile 22.6 and extends eastward for about 2.5 miles. It provides access to industrial facilities, including an LNG terminal. The 40- by 200-foot Calcasieu River at Coon Island Channel leaves the Calcasieu River and Pass Ship Channel at Mile 31.9 and extends westward about 1.3 miles, again to provide access to industrial facilities. The GIWW crosses the Calcasieu River and Pass Ship Channel at Mile 22.6, near GIWW Mile 240, west of Harvey Lock.

There is extensive port-related development along the Calcasieu River and Pass Ship Channel concentrated primarily in a 15-mile reach generally between the GIWW and Lake Charles, LA. A significant portion of the channel's deep draft tonnage is crude oil, refined petroleum products, industrial chemicals, and other bulk cargo. Traffic between 1998 and 2005 averaged three inbound and outbound vessels per day. The majority of vessel types during this period were dry cargo (yearly average of 36,000 tons), tanker cargo (6,000 tons), and tows or tugs (3,000 tons). During this time period, vessels from two companies (CITGO and ConocoPhillips) accounted for about half of all traffic.

2.2.2. Gulf Intracoastal Waterway. The GIWW is often referred to as the most remarkable artery of transportation in America. The GIWW extends westward to Brownsville, Texas, at the Mexican border, and eastward to Apalachicola, Florida. There are numerous open-water and wetland areas located along the ship channel which are productive fish and wildlife habitats. This vital inland waterway was constructed from the 1920s to 1949. The Louisiana segment stretches for 302.4 miles from the Texas-Louisiana state line in the west to the Louisiana-Mississippi state line in the east. The GIWW Alternate Route from Port Allen to Morgan City adds another 64 miles to its length for a total of 366.4 miles.

In Louisiana, the MVN operates and maintains the GIWW and its six locks for both navigation and agricultural purposes. The Corps maintains channel dimensions in the GIWW to 12 feet depth and 125 feet width from the Mississippi River west, and 12 feet depth and 150 feet width from the Inner Harbor Navigation Canal to the Rigolets. Channel enhancements and additions continue to this day. A complete description of the navigation system and associated structures can be found in Appendix K, *Economics.*

2.2.3. Mermentau Basin Project. As shown in figure 1, the Mermentau River Basin begins just north of Oakdale and Ville Platte, and extends south to the Gulf of Mexico. The lower portion of the basin is bounded on the west by Louisiana Highway 27 and on the east by the Freshwater Bayou Canal. The basin encompasses a total area of about 4.2 million acres and contains highly productive agricultural lands and a variety of beautiful natural environments. The operation of five navigation locks and control structures by the MVN helps maintain a freshwater reservoir for agricultural use while preserving the basin's sensitive environments from the detrimental effects of saltwater intrusion from the Gulf. The Leland Bowman and Calcasieu Locks are part of the GIWW Louisiana portion and are operated in conjunction with Freshwater Bayou and Catfish Point and Schooner Bayou structures (table 1).

Table 1. Mermentau Basin Project Structures

Navigation Structure	Date Completed	Dimensions	Annual Avg Tonnage	Annual Avg Lockages
Calcasieu	1950	1200' x 75' (-13NAVD 88 sill depth)	46 million tons	6,558
Leland Bowman	1986	1200' x 75' (-13NAVD 88 sill depth)	43 million tons	5,311
Freshwater Bayou	1968	600' x 75' (-13NAVD 88 sill depth)	5 million tons	15,826
Catfish Point	1951	56' wide (-13 NAVD 88 sill depth)	220 tons	1,058
Schooner Bayou	1951	75' wide (-13 NAVD 88 sill depth)	80,450 tons	1,195

The Catfish Point and Schooner Bayou control structures were constructed to release floodwater from Grand and White lakes and reduce tidal inflow. Catfish Point Control Structure (photograph 1) is located on the southwest side of the basin where the Mermentau River exits Grand Lake. Schooner Bayou Control Structure can be found on the east side of the basin in the old GIWW between Freshwater Bayou and White Lake. The target water level inside the basin is 2.0 feet above NAVD

88, and the five structures are operated in concert to maintain this level. A complete description of the Mermentau Basin can be found in Appendix K, *Economics*.

2.2.4. Navigation. The Inland Waterway Project (Old Intracoastal Waterway) was authorized by the River and Harbor Act of 1907. It provided for a 5-foot-deep x 40-foot-wide channel from Franklin to the Mermentau River, with a saltwater guard lock in Schooner Bayou. It was the earliest Federal navigation project in the basin. This project was replaced by the GIWW and Mermentau River projects, authorized by the River and Harbor Act of 1946. In addition, as recently as 1960, Congress authorized the Freshwater Bayou Canal project extending from the GIWW to the Gulf of Mexico.

Photograph 1. Catfish Point Control Structure

2.3. Related Prior Reports

2.3.1. Federal

Grand and White Lakes Water Management Study Initial Evaluation Report. This September 1983 Study investigated problems relating to flood control, water management, and water quality in the Mermentau Basin. One portion of the Study dealt with the feasibility of placing a flood control structure near Calcasieu Lock on the GIWW to reduce stages in the Mermentau Basin. The results of the preliminary analysis indicated that the plan would have little effect on reducing stages throughout the basin. The Study was terminated in the feasibility phase because a Federal interest could not be established.

Black Bayou Diversion 905(b). The Black Bayou Diversion, LA Reconnaissance Report was completed in October 1996. The Report investigated problems associated with prolonged high water levels in the Mermentau Basin. Potential solutions included a diversion structure parallel to the Calcasieu Lock. The Report recommended proceeding to the feasibility phase, but there is no local sponsor.

Gulf Intracoastal Waterway Locks, Louisiana 905(b). The reconnaissance Report was completed in May 1992. This comprehensive Study involved a systems analysis of the GIWW locks west of the Mississippi River. The Report documented the need for replacements or improvements at Bayou Sorrel, Calcasieu, and Port Allen Locks. A Feasibility Study of the Bayou Sorrel Lock was completed in 2002 and Pre-construction, Engineering and Design Activities were begun. In 2013, revised cost estimates for the lock replacement resulted in the project no longer being economically justified.

***Louisiana Coastal Protection and Restoration (LACPR) Technical Report,* 2009.** The LACPR Final Technical Report presents a suite of alternatives and implementation options for further consideration of tradeoffs. The Report identifies five or six technically viable plans for each of the five planning units across the State. Each plan requires a different set of economic, social, and environmental tradeoffs to achieve some corresponding level of risk reduction. Calcasieu Lock falls within one of these coastal planning units. However no actions in the vicinity of the Calcasieu Lock were identified.

***Southwest Coastal Louisiana Feasibility Study*, ongoing.** Based on the Reconnaissance Report (2005), this Study was approved to advance to the feasibility phase in 2007. This Study is designed to integrate hurricane and storm damage risk reduction and coastal restoration efforts while addressing the problems and opportunities of Southwest Coastal Louisiana. Numerous regional and area-specific investigations have been conducted in the Chenier Plain study area. A Report of the Chief of Engineers is scheduled for September 2014.

Calcasieu River and Pass Navigation Dredged Material Management Plan (DMMP). The project was authorized by the River and Harbors Act of 1946 and subsequent amendments. The DMMP was being developed under the Operations & Maintenance (O&M) of the Calcasieu River and Pass project. Dredged material management planning for all Federal harbor projects is conducted by the Corps to ensure that maintenance dredging activities are performed in an environmentally acceptable manner, use sound engineering techniques, are economically warranted, and that sufficient confined disposal facilities are available for at least the next 20 years. These plans address dredging needs, disposal capabilities, capacities of disposal areas, environmental compliance requirements, and potential for beneficial use of dredged material, and indicators of continued economic justification. The Final Report and Supplemental Environmental Impact Statement were completed in November 2010. They identified 23 disposal sites from Lake Charles to the Gulf along with 6 beneficial use sites. Two placement sites are near the Calcasieu Lock Project.

***Calcasieu River Basin Feasibility Study,* ongoing.** The goal of this Study is to investigate the feasibility of flood risk reduction from fluvial rainfall events in nine watersheds in Calcasieu Parish, LA, near and within the Cities of Lake Charles and Sulphur. Flooding from storm surges in the Gulf of Mexico that propagate up the Calcasieu River will not be considered; however, downstream tail water conditions for streams that are affected by tidal surges take into account the likely storm surge that would occur simultaneously with the various rainfall events. The Calcasieu River Basin Feasibility Study was initiated in 2005 by the Corps and the Calcasieu Parish Police Jury. Work on this project began with the signing of the Feasibility Cost Share Agreement (FCSA) by the Calcasieu Parish President and MVN's Chief Engineer in May of 2005. The Corps shall perform the Hydraulic Modeling. As of February 2008, the Corps has completed preliminary modeling for Phase I streams which includes the upper reaches of Bayou Contraband, Prien Lake Channel, Henderson Bayou, Hippolyte Coulee, Black Bayou, Bayou Choupique, Bayou d'Inde, and Kayouchee Coulee. The preliminary modeling for Phase II includes the remaining reaches of these streams and was completed in February 2009. Pending funding, an economic analysis and cost estimate will follow on streams that showed flood stage lowering. Possible measures include clearing and snagging, channel modifications (to include widening and deepening), detention pond construction, and pump station construction.

***Coastal Wetlands Planning, Protection and Restoration Act,* ongoing.** The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) is Federal legislation enacted in 1990 that is designed to identify, prepare, and fund construction of coastal wetlands restoration projects. Since its inception, 151 coastal restoration or protection projects have been authorized, benefiting over 110,000 acres in Louisiana. The legislation (Public Law 101-646, Title III CWPPRA) was approved by the U.S. Congress and signed into law by former President George H. W. Bush. For more detail, please see the discussion of CWPPRA project and Table O-1 in Appendix O, *Cumulative Impacts*.

2.3.2. State

***Louisiana's 2012 Coastal Master Plan,* 2012.** The Master Plan was developed to fulfill the mandates of Act 8, which was passed by the Louisiana Legislature in November 2005. The Act created the Coastal Protection and Restoration Authority of Louisiana (CPRA) and charged it with coordinating the efforts of local, state, and Federal agencies to achieve long-term and comprehensive coastal protection and restoration. Act 8 also requires that the CPRA establish a clear set of priorities for making comprehensive coastal protection a reality in Louisiana. Toward that end, the CPRA set five major goals:

1. Present a conceptual vision for a sustainable coast.
2. Be a living document that changes over time as understanding of the landscape improves and technical advances are made.
3. Emphasize sustainability of ecosystems, flood protection, and communities.
4. Integrate flood control projects and coastal restoration initiatives to help both human and natural communities thrive over the long-term.
5. Be clear about unknowns. There is a need for additional scientific and technical advancements to better predict the future of the coast.

In 2007, a Comprehensive Plan was developed. Per the authorizing legislation, the Master Plan was updated in 2012. The Plan identifies hundreds of projects across south Louisiana. Two primary factors drove the State's decision about future projects that should be in the 2012 Coastal Master Plan.

1. How well did the projects reduce flood risk?
2. How well did the projects build new land or sustain the land we already have?

The Plan identifies four Bank Stabilization, four Hydraulic Restoration and two Marsh Creation Projects in the vicinity of Calcasieu Lock with most being in and around Calcasieu Lake and the GIWW channel. The Calcasieu Lock Feasibility Study does address one project in the

Hydrologic Restoration category, Project 004.HR.02 - GIWW Lock West of Calcasieu Ship Channel. The Master Plan can be found at http://www.coastalmasterplan.louisiana.gov/

***Coast 2050 Plan,* 1999.** In 1998, the State of Louisiana and its Federal partners approved a coastal restoration plan entitled *Coast 2050: Toward a Sustainable Coastal Louisiana*. That document presented strategies jointly developed by Federal, state, and local interests to address Louisiana's massive coastal land loss problem. For the first time, solutions were proposed to address fundamental ecosystem needs in order to prevent the loss of this natural treasure. By implementing the Plan's regional ecosystem strategies, it is envisioned that a sustainable ecosystem will be restored in coastal Louisiana, in large part by utilizing the same natural forces that initially built the landscape.

2.3.3. Local

Louisiana Speaks. Long Term Recovery Planning (2007). Following Hurricane Rita, Cameron Parish developed a comprehensive recovery plan addressing environmental; housing and community development; economic and workforce development; public health and healthcare; transportation and infrastructure; education; public safety; human services; and flood protection and coastal restoration. Relevant goals for the plan included:

- implementing needed marsh creation and flood protection measures using the beneficial dredge materials from the Shipping Channel and Old River Loop within 2 years;
- beginning implementation of programs and best practices for the GIWW which balances the needs of industry/commerce with preserving the hydrological/ecological health of the Calcasieu, Sabine and Mermentau basins within the next 5 years;
- beginning to restore and protect the sand cheniers in lower Cameron by restoring degraded areas and reducing the future amount of sand mining within 12 to 24 months;
- protecting 60 miles of Cameron Parish's Gulf Coast Shoreline, between Vermilion and Texas border, through the construction of segmented nearshore breakwaters over the next 5 years;
- creating regional emergency storm water management plans, within 12 to 24 months, at the watershed level, aimed at reducing the duration and negative impacts of floodwaters during storms; and
- conducting an elevation monitoring survey within 12 to 24 months to establish accurate elevation benchmarks, replacing the ones lost due to subsidence in Cameron, and which are necessary for community recovery and rebuilding.

One project, "Restore the GIWW," was identified in the effort that pertains to Calcasieu Lock. This project seeks to restore the degraded condition of the GIWW banklines, improve tidal interaction and improve navigation efficiency. In the above-referenced Calcasieu Lock Feasibility Study, the Corps and Calcasieu Parish Police Jury are addressing the navigation component. No other elements have been completed.

3.0. NEED FOR AND OBJECTIVES OF ACTION *

3.1. National Objectives. The Corps' planning process is based on the economic and environmental Principles and Guidelines promulgated in 1983. The Principles and Guidelines provide for development of reasonable plans that are responsive to Federal state, and local concerns. Planning project benefits are quantified in this process as NED output, NER output, or a combination of NED/NER output.

For water and land resources planning, the Federal objective is to contribute to NED while protecting the Nation's environment and adhering to national environmental statutes, Executive Orders (EOs), and Federal planning requirements. NED contributions are increases in the net value of the national output of goods and services, expressed in monetary units. These NED outputs are the direct net benefits that accrue in the planning area and the rest of the Nation. Contributions to NED may include increases in the net value of marketed and non-marketed goods and services.

The NED information provides a measurement of the monetary impacts to the national economy. These impacts include both positive and negative effects. The positive impacts associated with various alternatives are primarily transportation efficiencies (measured as transportation cost savings). The negative impacts include primarily the costs required to implement and operate each alternative, including site-specific and system mitigation costs.

The financial impacts to the navigation industry resulting from the adverse effects during Project construction are also included as negative NED impacts. Captured over the period of analysis, both positive and negative impacts are expressed as average annual equivalent values that incorporate standard discounting techniques and the current Federal discount rate. Annual net benefits are defined as the difference between annual benefits and annual costs. Positive net benefit numbers represent benefits to the Nation, and negative net benefit numbers represent a loss to the Nation.

This Study is a single purpose, i.e. NED, project. As such, ecosystem restoration alternatives will not be formulated nor will an NER plan be identified. The Environmental Quality account will be used as part of the assessment of alternatives and selection of the NED plan. In this report, impacts to Environmental Quality are described in Chapter 4, *Affected Environment;* Chapter 5, *Alternatives;* and Chapter 6, *Environmental Consequences.*

3.2. Corps Campaign Plan. The Corps has developed a Campaign Plan with a mission to "provide vital public engineering services in peace and war to strengthen our Nation's security energize the economy and reduce risk from disasters." This Campaign Plan is shaping Corps command priorities, focusing transformation initiatives, measuring and guiding progress, and helping the Corps adapt to the needs of the future. This Project addresses Goals 2 and 3 of the Campaign Plan. Goal 2 is addressed in that this Project is an integral component of the long-term economic health of the Gulf Coast. Goal 3 is addressed through the application of the planning process to formulate, analyze, and evaluate alternative designs in pursuit of an innovative and sustainable infrastructure.

Goals and Objectives Summary

- **Goal 2. Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders**
  - Objective 2a: Deliver integrated, sustainable, water resources solutions

  - Objective 2b: Implement collaborative approaches to effectively solve water resource problems
  - Objective 2d: Enable Gulf Coast recovery

- **Goal 3. Deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation**
  - Objective 3a: Deliver sustainable infrastructure via consistent and effective military construction and real estate support to customers
  - Objective 3b: Improve resilience and lifecycle investment in critical infrastructure
  - Objective 3c: Deliver reliable infrastructure using a risk-informed asset management strategy
  - Objective 3d: Develop and apply innovative approaches to delivering quality infrastructure

3.3. Environmental Operating Principles. In 2002 and again in 2012, the Corps formalized a set of Environmental Operating Principles (EOP) applicable to decision making in all programs. The principles are consistent with NEPA; the Army Strategy for the Environment; other environmental statutes; and the Water Resources Development Acts (WRDA) govern Corps activities. The EOPs inform the plan formulation process and are integrated into all project management processes. Alternatives were formulated for this Project consistent with the EOPs, which are to:

- 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; and
- employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

3.4. Problems and Opportunities. The first step in the planning process is identifying problems and opportunities. Problems are undesirable, negative conditions that the Study will address. Opportunities are desirable conditions that could be achieved in the future. Study area problems and opportunities were drawn from prior comprehensive planning studies, the 905(b) reconnaissance report and from public input and interagency information exchange. Through the NEPA public scoping process, the Study team solicited input on problems and opportunities from members of the public, government resource agencies, and other stakeholders. A discussion of general Study area problems and opportunities follows.

3.4.1. General Problem Statement. Delays to navigation at lock facilities typically fall into two categories, insufficient capacity for existing and/or future commodity movements and/or insufficient reliability of the physical structure to accommodate that traffic. The Calcasieu Lock Reliability Report (2011) (accomplished as part of this study) indicates that the current structure is in good condition and that major rehabilitation is not anticipated during the period of analysis. Likewise, the capacity of the existing structure is adequate for the current volume of traffic (Appendix K, *Economics*).
Navigation delays at Calcasieu Lock are primarily related to hydrologic conditions and how they affect the tonnage passing through the lock. The Lock was constructed as a saltwater barrier, and it is operated to keep salt water from moving west to east into the Mermentau Basin, and to drain flood flows from east to west to the Calcasieu River. During periods when saltwater intrusion is not a concern, such as when stages inside the Mermentau Basin (east of the Lock) are higher than outside stages, the Lock may be left in an open pass condition. In this situation, with all gates open, it is not necessary for vessels to lock through. Delays generally result from either of two conditions. When outside stages exceed inside stages, the Lock is closed to prevent the introduction of salt water into the basin. This forces vessels to lock through, and can result in delays. Alternatively, significant delays can occur whenever Calcasieu Lock is used to drain the Mermentau basin, which is the primary issue being addressed in this Study.

The Corps uses Calcasieu Lock for drainage by opening the gates whenever the head differential is less than 0 (flow is from east to west) and the east gage is greater than 2 feet, which occurs approximately 50 percent of the year. This is considered the open pass condition. However, when the head differential is less than or equal to -.50 feet, and the east gage is greater than 2 feet (occurs 20 percent of the year), large east bound tows find it difficult to transit the Lock due to the heavy flow of draining water. These tows then tend to wait until the tide changes to an extent that will allow them to transit safely. The current Lock sector gates are 75 feet wide and serve to constrict flow during drainage events resulting in the flow of water through the Lock being too strong for some tows to safely transit, causing them to wait until the flow lessens. A drainage event occurs when a rainfall or storm surge event within the Mermentau Basin results in a 3-foot reading at the Calcasieu East gage. This causes operations at Calcasieu Lock to switch from a locking operation with sector gates closed; preventing salinity intrusion, to a drainage operation with sector gates open forcing tows to wait to transit the Lock until the gage moves below 3 feet. The current velocities under such conditions often prohibit negotiation of the Lock by tows, so that the Lock must be operated to permit vessels to pass through safely. The relationship between current speeds in the Lock chamber and delays to tows was assessed at five Drainage Impact Levels (DIL):

Level 0 – Current speed below 2 mph
Level 1 – Current speed equal to or above 2 mph and below 4 mph
Level 2 – Current speed equal to or above 4 mph and below 6 mph
Level 3 – Current speed equal to or above 6 mph and below 8 mph
Level 4 – Current speed equal to or above 8 mph

These relationships were developed as part of this study in consultation with Corps staff and navigation industry users and correlate stages at the Calcasieu streamflow gage (east) with current speeds in the Lock chamber. Documentation can be found in the Gulf Navigation Investment Model documentation located in Appendix K, *Economics*. Using 2007-2009 as representative samples, table 2 shows the respective DIL and the percentage of time during a given year that those conditions existed at the lock.

Table 2. Drainage Impact Analysis

Drainage Impact Level	2007 Days Duration	2008 Days Duration	2009 Days Duration
0	81.4%	89.8%	73.7%
1	4.0%	3.4%	4.5%
2	10.0%	4.2%	15.2%
3	4.3%	2.0%	6.5%
4	0.3%	0.6%	0.2%

During years when rainfall in the Mermentau Basin is below normal, as was the case in 2008, the percentage of time when the traffic does not experience drainage delays is near 90 percent. In wetter years, such as in 2009, the DILs that cause delays are experienced nearly a 25 percent of the year. Significant delays are caused by drainage events and can result in economic losses to the Nation.

3.4.2. Study Area Opportunities. Opportunities exist to increase navigation efficiency through improved operational routines and potential modification of the existing structure to accommodate existing and future traffic. Further opportunities exist to reduce or eliminate navigation delays due to drainage. Such opportunities include:

- **Navigation Efficiency.** Altering the existing lock structure to decrease the impacts of drainage events on transiting tows will result in shorter lockage times and delays for tows staging at either segment of the GIWW (east or west). Fewer barge reconfigurations to allow for transit during drainage events will increase cycling times of tows through the lock. An additional or wider lock chamber would allow for passing of flows through the old lock or through a new wider lock that can accommodate drainage events and lockages.
- **Hydraulic Distribution.** Redirecting completely or partially drainage flows away from the existing lock will reduce or eliminate the delays that result.

3.5. Planning Constraints. Formulation and evaluation of alternatives for the proposed Project are constrained by the following factors:

- **Flood Risk Management.** Alteration of drainage patterns to improve navigation efficiency must be accomplished while avoiding and/or minimizing significant flood impacts to the Mermentau Basin.
- **General Infrastructure.** A state highway, bridge and several local roads, as well as a few residences are found in the Study area. Adverse effects to the existing infrastructure will be minimized to the extent practicable.
- **Salinity Control.** The primary Project purpose of the existing lock is to prevent saltwater intrusion into the Mermentau via the GIWW. Measures considered must not compromise this capability or increase salinity levels in the Mermentau Basin.
- **Coastal Marsh Loss.** Alteration of drainage patterns or new features to improve navigation efficiency must be accomplished while avoiding and/or minimizing significant impacts to adjacent coastal marshes. Unavoidable impacts will be mitigated.
- **Impacts to Navigation Industry.** With limited alternative routes for bulk cargos being shipped through Calcasieu Lock, excessive lock (waterway) closures that are unacceptable to the navigation industry are to be avoided.

3.6. Project Goals and Objectives. ER 1105-2-100 stipulates that "The Federal objective of water and related land resources planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment…"

Contributions to NED are the direct net benefits that accrue in the Study area and the rest of the Nation. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. Study goals, objectives, and constraints were developed to comply with the Study authority and to respond to Study area problems and opportunities. The overall Study goal reflects the role Calcasieu Lock plays in a critical navigation system as well as an integral part to a water management system (Mermentau Basin) that requires both drainage capacity and an effective barrier to salinity intrusion. Therefore, the overall goal is:

- to maximize the efficiency of the Calcasieu Lock, thereby contributing to the overall efficiency of GIWW as a nationally significant navigation system, while continuing to provide water management capability and salinity control to the Mermentau River Basin.

To support accomplishment of the Study goal, the following specific planning objective was developed for the Calcasieu Lock Feasibility Study:

- reduce drainage event induced navigation delays at Calcasieu Lock while minimizing the impacts to the surrounding area.

4.0. AFFECTED ENVIRONMENT (EXISTING CONDITIONS) *

4.1. Environmental Setting of the Study Area

4.1.1. Location. The Study area for environmental purposes is defined as the area within a distance of 3 miles from the Calcasieu Lock. The Chenier Plain encompasses all of the Study area, and conditions within the Chenier Plain are similar to that of the Study area. This includes large portions of Calcasieu and Cameron Parishes. All direct construction impacts would occur within this area.

4.1.2. Climate. The climate of the Study area is subtropical marine, with long humid summers and short moderate winters. The climate is strongly influenced by the water surface of many bays, lakes, and the Gulf of Mexico, as well as seasonal changes in atmospheric circulation. During the fall and winter, the Study area experiences cold continental air masses which produce frontal passages, resulting in large temperature drops. During the spring and summer, the Study area experiences tropical air masses which produce a warm, moist airflow conducive to thunderstorm development. The Study area is also subject to periods of both drought and flood.

The Chenier Plain is also susceptible to tropical waves, tropical depressions, tropical storms, and hurricanes. These weather systems can cause considerable property and environmental damage and loss of human life. Historical data from 1899 to 2008 indicate that 34 hurricanes and 39 tropical storms have made landfall along the Louisiana coastline (Roth 2010). The largest recent hurricanes in the Chenier Plain region were Hurricane Rita in 2005 and Hurricane Ike in 2008, both of which caused devastating damage in the Study area.

The Chenier Plain, with its low-lying coast and exposure to the Gulf of Mexico, could also be directly impacted by rising sea levels as a result of climate change. The Intergovernmental Panel on Climate

Change (IPCC) estimates that the global average sea level for the 20th century has risen at a rate of 0.07 inch per year (1.7 millimeter per year) and projects a rise between 0.6 and 2 feet in the next century (IPCC, 2007). This rise in sea level, along with subsidence in the area, could have a significant effect on the Chenier Plain by inundating wetlands and increasing the salinity of rivers and other waterways further inshore, which could also impact agricultural interests.

4.1.3. Geomorphic and Physiographic Setting. The Lake Charles vicinity is rural and mostly undeveloped. One of the main geographical features of the area is East Atchafalaya Basin Protective Levee, which runs generally north-south and separates the Atchafalaya Basin Floodway from the protected land to the east. Undeveloped land is almost entirely cypress swamp and bottomland hardwood forest. The community of Bayou Sorrel lies mainly along the high bank of Lower Grand River, just outside of the Atchafalaya Basin Floodway. Development in the area is severely limited by the lack of land with sufficient elevation to avoid flooding. Although protected from floodwaters of the Atchafalaya Basin Floodway, the community of Bayou Sorrel is occasionally threatened and sometimes sustains minor damages from high water levels of Lower Grand River.

The Chenier Plain began evolving 3,000 to 4,000 years ago as a sequence of mudflats that were intermittently reworked into sandy or shell ridges to form the modern topography. Fine-grained sediment transported to the Chenier Plain in the mudstream from the Mississippi River was brought into coastal estuaries and marshes and deposited along the shore to form mudflats (Gagliano and van Beek, 1993). The newly formed land was then colonized by wetland vegetation, which further promoted the land-building process. Wave action and occasional storm events also deposited sand and shells onto the newly built land.

As the Mississippi River changed course and active delta-building switched to the eastern Deltaic Plain, or extended to the edge of the continental shelf or beyond (as its current course), the mudstream ceased to carry sediment to the Chenier Plain and the Gulf shore became subject to erosion. Periods of erosion winnowed out fine-grained materials, leaving the deposits of sand and shell to form the Gulf beaches. Beach deposits were subsequently shaped by waves and coastal currents to form elevated ridge systems. Once the mudstream returned and land-building continued seaward, these elevated ridges were stranded inland where deciduous vegetative growth (e.g., live oak [*Quercus virginiana*] trees) occurred. The relict shell beach ridges and cheniers (forests atop relict beach ridges) blocked drainage and saltwater inflows from the Gulf of Mexico, resulting in the development of large freshwater basins on the landward side of the ridges. On the seaward side, a zone of brackish to saline marshes developed as a result of tidal influences from the Gulf.

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 in the 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.

4.2. Significant Resources. Corps planning guidance (ER 1105-2-100) requires planning documents to consider all significant resources in evaluating alternative plans. Guidance states that significance will be derived

> "…from institutional, public or technical recognition. Institutional recognition of a resource or effect means its importance is recognized and acknowledged in the laws, plans and policies of government and private groups. Technical recognition of a

> resource or an effect is based upon scientific or other technical criteria that establish its significance. Public recognition means some segment of the general public considers the resource or effect to be important."

Accordingly, Sections 4.2.1 through 4.2.14 detail the significant resources in the Calcasieu Lock Study area, and, as appropriate, provide a basis for institutional, public, and technical recognition.

4.2.1. Soils and Waterbottoms - Historic and Existing Conditions. As identified by the Council on Environmental Quality memorandum dated August 11, 1980, entitled *Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act; "Executive Order 11990 – Protection of Wetlands; and the Agriculture and Food Act of 1981* (Public Law 97-98) containing the Farmland Protection Policy Act (PL 97-98; 7 U.S.C. 4201 *et seq.*), soils are an institutionally important resource.
The following information is taken from the USDA NRCS Soil Surveys of Calcasieu Parish (Roy and Midkiff, 1988):

> The Parish consists generally of three major physiographic areas. They are the forested terrace uplands in the northern part of the Parish, the Gulf Coast Prairies in the central and southeast parts of the Parish, and the Gulf Coast Marsh lying mostly in the southwest corner of the Parish.
>
> The terrace uplands make up about 44 percent of the Parish. The soils are mainly loamy. They are generally low in natural fertility, but crops respond well to fertilizer and lime. These soils are used mainly as woodland or cropland. Some areas are used as pasture or homesites. Wetness is a limitation on many of these soils. Erosion is a hazard on the sloping soils.
>
> The Gulf Coast Prairies make up about 45 percent of the Parish. The soils range from loamy to clayey. They are generally medium in natural fertility. These soils are used mainly for cultivated crops. Some areas are used for urban development or as pasture. Wetness is a limitation on most of these soils. The Gulf Coast Marsh (including the swamps) makes up the most of the remaining 11 percent of the Parish. These soils range from soft organic soils to firm mineral clayey soils. They are all very poorly drained and subject to flooding. These soils are used mainly as habitat for wildlife and recreation. Some of the firmer marsh areas are used as rangeland for cattle.
>
> About 500,847 acres, or 72 percent, of Calcasieu Parish meets the soil requirements for prime farmland. This prime farmland is scattered throughout the Parish. About 246,000 acres is cultivated crops, mainly soybeans, rice, grain sorghum, and wheat. Soils that have limitations, such as high water table or flooding, may qualify as prime farmland if these limitations are overcome by such measures as drainage or flood control. The following map units meet the soil requirements for prime farmland except where the use is urban or built-up land.

Ac	Acadia silt loam, 1 to 3 percent slopes
Cd	Caddo-Messer silt loams
Ch	Cahaba fine sandy loam, 1 to 3 percent slopes
Cr	Crowley-Vidrine silt loams
Ge	Glenmora silt loam, 1 to 34 percent slope
Gy	Guyton-Messer silt loams

Ju	Judice silty clay loam
Kd	Kinder-Messer silt loams
Lt	Leton silt loam
Mb	Malbis fine sandy loam, 1 to 3 percent slopes
Mh	Messer-Guyton silt loams, gently undulating
Mn	Midland silty clay loam
Mr	Morey loam
Mt	Mowata-Vidrine silt loams
Vn	Vidrine silt loam, 1 to 3 percent

Urban and built-up land is any contiguous unit of 10 acres or more that is used for residences, industrial sites, commercial sites, institutional sites, public administration sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures and spillways, and similar uses.

The following information is taken from the USDA NRCS Soil Survey of Cameron Parish (Midkiff and Roy, 1995):

The major physiographic areas that make up the Parish are the coastal marshes and cheniers in the Gulf Coast Marsh major land resource area and the prairies in the Gulf Coast Prairies major land resource area. The marshes and cheniers border the Gulf of Mexico and the large lakes in the Parish. The marshes include soft or very fluid, organic and mineral soils. The soils are ponded most of the time and are frequently flooded. Most of the acreage is used as habitat for wildlife and for recreational purposes. A small acreage is used as rangeland for cattle. The rangeland in the marshes is entirely in areas of the firm or slightly fluid, mineral soils.

The cheniers make up about 6 percent of the land area in the Parish. The ridges are broad or are long and narrow. They parallel the coast of the Gulf of Mexico. The soils on the ridges are sandy or loamy and are poorly drained, somewhat poorly drained, or somewhat excessively drained. They are subject to flooding by tidal surges during tropical storms. Most of the acreage is used as rangeland, as habitat for wetland wildlife, or for recreational purposes. A small acreage has been developed for urban uses.

The prairies are in the northern part of the Parish. They make up about 12 percent of the land area. The native vegetation was tall prairie grasses. Today, the prairies are used chiefly for crops, mainly rice and soybeans. A small acreage is used for pasture or urban development. The soils generally are level, loamy or clayey, and poorly drained or somewhat poorly drained. About 107,126 acres, or 8.9 percent, of Cameron Parish meets the soil requirements for prime farmland. The following map units meet the soil requirements for prime farmland except where the use is urban or built-up land.

Cw	Crowley-Vidrine silt loams
Hb	Hackberry loamy fine sand
Ju	Judice silty clay
Kd	Kaplan silt loam
Lt	Leton silt loam
Mn	Midland silty clay loam

Mr Morey silt loam
Mt Mowata-Vidrine silt loams

Urban and built-up land is any contiguous unit of 10 acres or more that is used for residences, industrial sites, commercial sites, institutional sites, public administration sites, railroad yards, small parks, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures and spillways, and similar uses. Public land is not available for farming in National forests, National parks, military reservations and state parks.

The soils in the Study area that fall outside these Parishes share characteristics and formative processes which are very similar to those described above.

4.2.2. Hydrology: Historic and Existing Conditions. Hydrologic connectivity in the Chenier Plain has been disrupted by several activities (table 3), most notably the creation of navigational channels, such as the Sabine/Neches Waterway; the Calcasieu Ship Channel; the GIWW; the Mermentau Ship Channel; and the Freshwater Bayou Canal Navigational Channel, and the creation of water control structures, such as the Calcasieu and Leland Bowman Locks; the Freshwater Bayou Canal Lock; the Schooner Bayou Canal Structure; and the Catfish Point Control Structure.

Table 3. Events Contributing to Hydrologic Alteration in the Vicinity of Calcasieu Lock

Year	Activity
1874	Calcasieu Ship Channel first dredged to 5ft deep and 80 ft wide
1880s	Calcasieu Ship Channel re-dredged 5 times because of siltation
1893	Dredged lake bars at head of Calcasieu Pass to 8 ft deep
1908	The Sabine-Neches Channel completed (9ft deep by 100 ft wide)
1912	Inland Waterway (old Intracoastal Waterway) completed. 5ft deep by 40 ft wide channel
1913	Schooner Bayou Lock completed. Later replaced by Schooner Bayou Control Structure
1924-1944	GIWW extended along the northern edge of region
1933	Vermillion Lock completed. Later replaced by the Leland Bowman Lock
1936	Louisiana Hwy 27 - 14 miles of road from Creole to 5.4 north of the GIWW
1941	Calcasieu Ship Channel completed (30ft. deep by 250 ft. wide)
1950	Calcasieu Lock completed
1951	Calcasieu Ship Channel enlarged to 35ft deep
1951	Catfish Point Control Structure completed
1951	Schooner Bayou Control Structure completed
1958	Louisiana Hwy 82 - 32 miles of road from Pecan Island to Grand Chenier
1968	Calcasieu Ship Channel enlarged to 40 ft deep and 400 ft wide
1968	Freshwater Bayou Canal Lock completed
1985	Leland Bowman Lock completed

Navigational channels were first dredged in the region in the late 19th century, with further deepening and widening throughout the 20th century (LDNR, 2002). These channels disrupted the hydrology of the region by increasing saltwater intrusion and tidal action into the interior marshes. Water control structures were subsequently constructed in part to control the amount of saltwater intrusion into the interior, but further altered the hydrology by managing water flow. Together, these alterations have acted to change the hydrologic pattern of the Chenier Plain.

Historically, the Mermentau Basin acted as a low-salinity estuary with a north-south river and tidal-driven hydrologic pattern. However, with the construction of navigational channels and water control structures, it has shifted to an east-west system that drains through the GIWW. Additionally, due to water control structures that manage water and salinity levels in the region, the Mermentau Lakes Sub-basin, which historically acted as a low-salinity estuary, now functions more like a freshwater reservoir.

Like the Mermentau Basin, the Calcasieu/Sabine Basin is historically a low-salinity estuary. However, with the construction of navigational channels, such as the Calcasieu Ship Channel, Sabine/Neches Waterway, and other human activities, this hydrologic pattern has been altered, resulting in more saltwater entering the historically freshwater interior. Since their construction in the late 19th century, both channels have been expanded incrementally to the extent that the present day cross-sectional areas are more than 40 times larger than when they were first dredged in the late 1800s (LDNR, 2002, table 2-5). Additional studies are ongoing to determine the feasibility of widening and deepening the Calcasieu Ship Channel further to accommodate larger ship traffic.
Historically, the Calcasieu and Sabine Basins were separated, but with the construction of the GIWW they are now connected, further altering the hydrology of the region and compounding saltwater intrusion in the region. Currently, water flows via a north-south gradient through the Calcasieu and Sabine Rivers, with an east-west flow also through the GIWW and existing canals on the Sabine NWR. Riverine freshwater inflows, Gulf tides, precipitation, and wind effects dominate hydrologic influences in the region (LDNR, 2002).

Through the creation of dredge material banks, roads and highways, and flood protection levees, some wetland habitats within the Chenier Plain have also become hydrologically isolated. During extreme weather events, such as tropical storms, these habitats are particularly vulnerable due to their slow drainage patterns. In such cases, the typical result has been ponding of water over the wetlands, often with high salinity content. When properly managed, these may be important habitat for waterfowl. However, excessive ponding over an extended period of time in certain types of wetland habitats can kill the vegetative communities and result in eventual wetland loss (conversion to open water).

4.2.2.1. Sedimentation and Erosion - Historic and Existing Conditions. Calcasieu Lake, located south of the Calcasieu Lock, is one of the major watersheds in the Chenier Plain. The Calcasieu Ship Channel passes through the Calcasieu Lake and connects the port of Lake Charles to the Gulf of Mexico. The ship channel is getting deeper and wider and thus altered the circulation of the lake water significantly, thus causing some problems. One of the problems is the excessive sedimentation found in the ship channel. Millions of dollars have to be spent each year to remove the unwanted sediments (Zhang 2010).

Recent analysis and classification by the US Geological Survey (USGS) show land area change estimates from 1956 to 2006 (table 4). Since 1956, land cover in the Chenier Plain has decreased from approximately 1,077,132 acres (4,359 km²) to 854,984 acres (3,460 km²), while water cover has increased from approximately 233,588 acres (945.3) km² to 455,687 acres (1,844.1 km²). This trend is similar to trends in other parts of the state, which have also seen a decrease in land cover and increase in water cover (Barras et al., 2008). Major reasons for this land loss in the Chenier Plain include shoreline erosion, subsidence, and saltwater intrusion.

Recent analysis and classification by the USGS have also compared habitat cover in the region pre- and post Hurricane Rita. Habitat cover of most marsh types decreased between 2004 and 2005, while water cover increased (Barras, 2006). However, Barras notes that the 2005 estimates might be slightly skewed since they were evaluated after Hurricane Rita when much of the area was still inundated and some of those areas may have recovered.

Table 4. Land Cover Estimates in Louisiana for 1956 and 2006
All units are in acres (ac) with square kilometers (km^2) listed in parentheses.[1]

Year	Coastal Louisiana		Chenier Plain[a]		Marginal Deltaic Plain[b]		Deltaic Plain[c]	
	Land	Water	Land	Water	Land	Water	Land	Water
1956	3,744,660 (15,154)	3,573,786 (14,463)	1,077,132 (4,359)	233,589 (945)	455,687 (1,844)	473,602 (1,917)	2,211,840 (8,951)	2,866,595 (11,601)
2006	2,881,298 (11,660)	4,437,148 (17,957)	855,034 (3,460)	455,687 (1,844)	444,814 (1,800)	484,475 (1,961)	1,581,450 (6,400)	3,496,986 (14,152)

Source: Barras et al., 2008.
[a] Chenier Plain extends from Freshwater Bayou west.
[b] Marginal Deltaic Plain extends from the Atchafalaya River to Freshwater Bayou.
[c] Deltaic Plain extends from the Atchafalaya River east.

[1] Office of Coastal Protection and Restoration and US Army Corps of Engineers 2010

Within the past 25 years, similar numbers can be seen. Figure 2 shows the change in sedimentation and erosion around the Study area. Most areas north of the GIWW are experiencing sedimentation, while areas south of the GIWW are generally experiencing erosion. There are exceptions to this, but this can generally be seen through the region and coincides with USGS determination that the major reasons for land loss in the Study area include shoreline erosion, subsidence and saltwater intrusion.

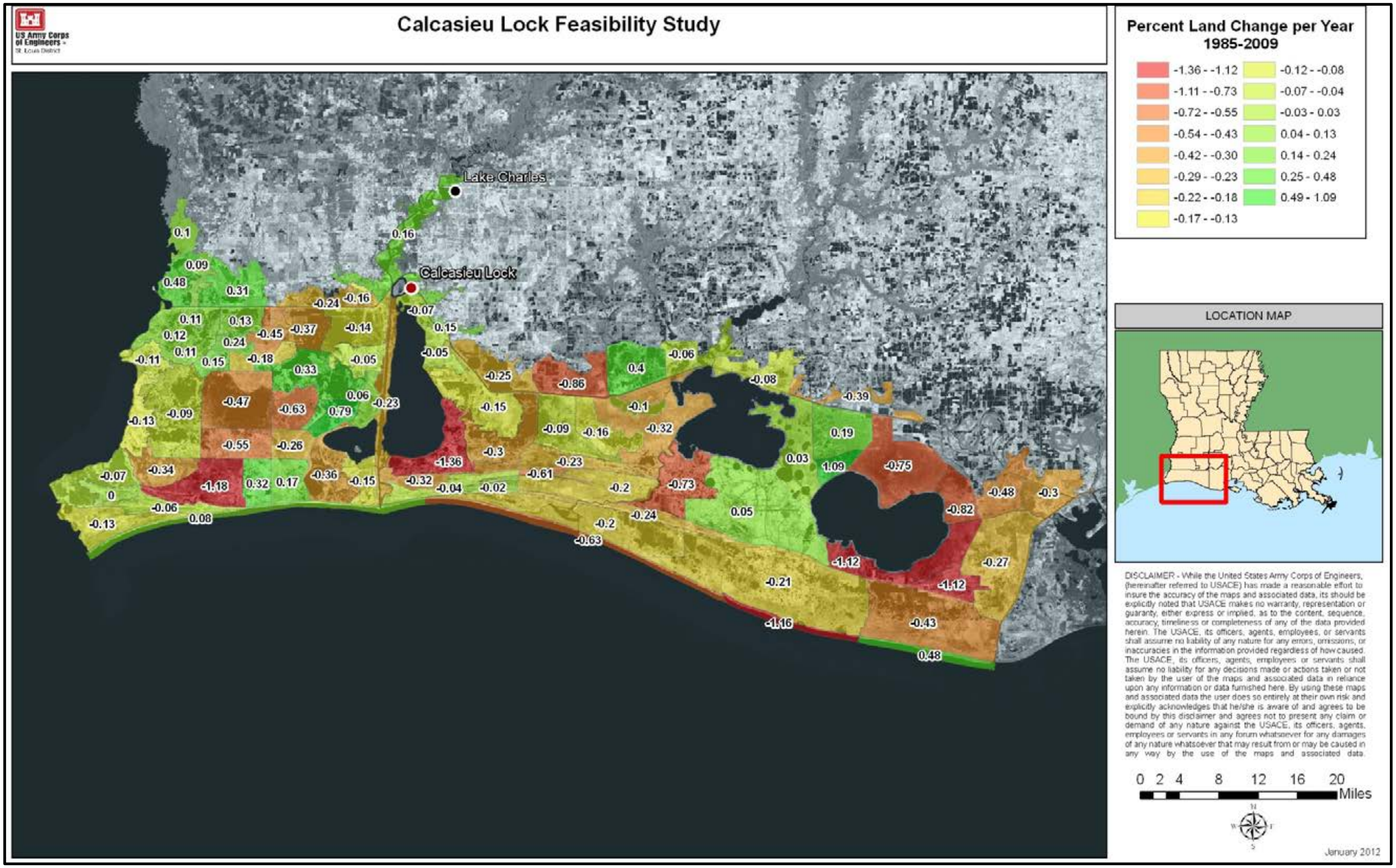

Figure 2. Percent Land Change Per Year, 1985 to 2009, From Lake Charles South to the GIWW

4.2.2.2. Water Use and Supply - Historic and Existing Conditions. Two major hydrologic basins are located in the Chenier Plain: the Mermentau Basin and the Calcasieu/Sabine Basin. The Mermentau River is the primary freshwater supply for the Mermentau Basin, while the Calcasieu, Sabine, and Neches Rivers are the main sources for the Calcasieu/Sabine Basin. As will be discussed in Section 4.2.2.3, 28 freshwater groundwater wells are located within Calcasieu and Cameron Parishes.

An existing saltwater barrier across the Calcasieu River at Lake Charles divides the upper and lower basins and prevents saltwater intrusion from degrading this major source of irrigation water supply for rice production. In addition, Lake Charles does not serve as part of the municipal water supply in Calcasieu Parish. Other projects within the area such as Mermentau Basin Project are currently being developed to address the demand for a reliable fresh water supply for agricultural use in conjunction with the locks such as Calcasieu Lock to prevent salt water intrusion.

4.2.2.3. Groundwater - Existing and Historic Conditions. Large quantities of fresh ground water are available in Calcasieu Parish. Fresh water is present in sand of Recent, Pleistocene, Pliocene, and Miocene ages, although locally only small supplies for rural or stock use can be obtained from the shallow sand lenses of Recent and Pleistocene ages. The principal fresh-water-bearing sands are the 200-foot, 500-foot, and 700-foot sands of the Chicot aquifer of Pleistocene age, from which 105 million gallons is pumped daily. A yield of as much as 4,500 gallons per minute has been obtained from a single well. The sands are typical of the Chicot aquifer throughout southwestern Louisiana in that generally they grade from fine sand at the top to coarse sand and gravel at the base of the aquifer. The coefficient of permeability of the principal sands in Calcasieu Parish ranges from 660 to about 2,000 gallons per day per square foot and averages 1,200 gallons per day per square foot.

The permeability of the sands generally varies with textural changes. The maximum depth of occurrence of fresh ground water in Calcasieu Parish ranges from about 700 feet to 2,500 feet below mean sea level; locally, however, where the sands overlie structures associated with oil fields, the maximum depth is less than 300 feet. Pumping has caused water levels to decline, at varying rates, in all the sands. In the 200-foot sand they are declining at a rate of about 2 feet per year. In the industrial district of Calcasieu Parish, levels in the 500-foot sand are declining at a rate of about 5 feet per year, and in the 700-foot sand at a rate of about 3.5 feet per year.

Salt-water contamination is accompanying the water-level decline in the 700-foot sand in the central part of the Parish. Quality-of-water data indicate that water from wells screened in the Chicot aquifer generally is suitable for some uses without treatment but would require treatment to be satisfactory for other uses. The temperature of the water ranges from 70^{o} F to 79^{o} F. The lenticular sands of Pliocene and Miocene ages have not been used as a source of fresh ground water in Calcasieu Parish; however, north of the Houston River these formations contain fresh water, and the water contained in these formations in other parts of southwestern Louisiana is known to be soft and suitable for most purposes (USGS 1960).

The local groundwater wells for Calcasieu Parish are shown in table 5 and figure 3; the local groundwater wells for Cameron Parishes are shown in table 6 and figure 4.

Table 5. Local Groundwater Wells Within Calcasieu Parish (USGS Louisiana Water Science Center 2012)

Network wells depicted on the Calcasieu Parish, LA location map

Note: Color shading in the table below indicates multiple wells that plot as a single point on the state location map above.

Note: BLS = Water Level in Feet Below Land Surface, RVD = Water Level referenced to a vertical datum

Map Index	Site ID	Site Name	Most Recent Measurement	Date	Well Depth	Local Aquifer
1	300353093210201	Cu- 787	52.74 BLS	9/8/2011	734	500-foot Sand Of Lake Charles Area
2	300534092564401	Cu- 970	50.60 BLS	6/23/2011	780	Chicot Aquifer, Lower
3	300534092564402	Cu- 971	45.45 BLS	6/23/2011	500	Chicot Aquifer, Upper
4	300634093400401	Cu- 994	39.90 BLS	6/17/2011	757	
5	300643093044701	Cu- 947	64.76 BLS	6/16/2011	600	500-foot Sand Of Lake Charles Area
6	300643093044702	Cu- 854	69.10 BLS	6/16/2011	430	
7	300718093220001	Cu- 963	61.56 BLS	6/16/2011	399	
8	301031093204902	Cu- 960	86.94 BLS	9/21/2011	598	500-foot Sand Of Lake Charles Area
9	301036093124401	Cu- 767	71.73 BLS	9/7/2011	850	
10	301141093123501	Cu-1020	87.19 BLS	6/17/2011	375	500-foot Sand Of Lake Charles Area
11	301213093191701	Cu- 851	83.66 BLS	11/2/2011	555	500-foot Sand Of Lake Charles Area
12	301336093183002	Cu- 771	55.62 BLS	9/21/2011	241	
13	301409093120301	Cu- 978	72.79 BLS	6/7/2011	645	
14	301941093035601	Cu- 972	44.66 BLS	6/23/2011	595	
15	301941093035602	Cu- 975	36.98 BLS	6/23/2011	237	
16	301944093170401	Cu- 958	47.41 BLS	11/2/2011	707	
17	301944093170402	Cu- 977	49.02 BLS	11/2/2011	515	500-foot Sand Of Lake Charles Area

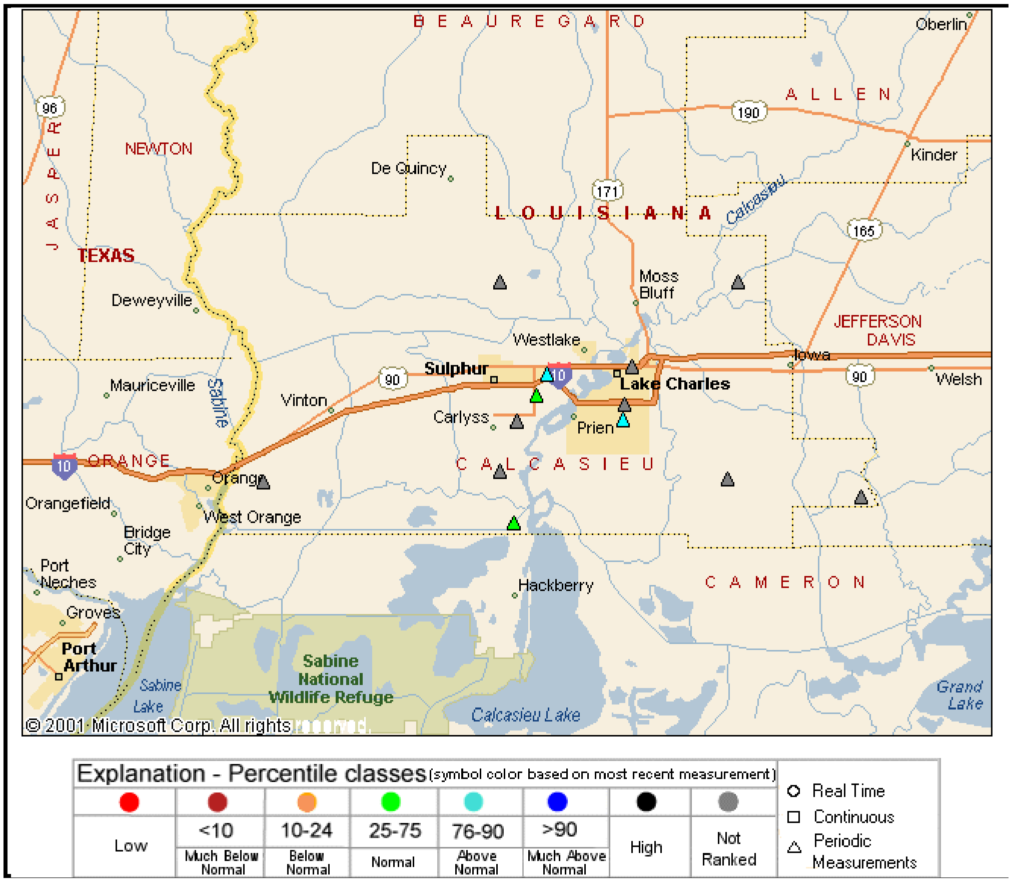

Figure 3. Location of Local Groundwater Wells in Calcasieu Parish and Percentile Classes as of 01/14/2012 (USGS Louisiana Water Science Center 2012)

Table 6. Local Groundwater Wells Within Cameron Parish (USGS Louisiana Water Science Center 2012)

Network wells depicted on the Cameron Parish, LA location map

Note: Color shading in the table below indicates multiple wells that plot as a single point on the state location map above.

Note: BLS = Water Level in Feet Below Land Surface, RVD = Water Level referenced to a vertical datum

Map Index	Site ID	Site Name	Most Recent Measurement	Date	Well Depth	Local Aquifer
▲ 1	294543093391401	Cn- 94	37.15 BLS	6/9/2011	1118	
▲ 2	294615093004201	Cn- 118	21.57 BLS	6/10/2011	638	Chicot Aquifer, Upper
▲ 3	294709093174301	Cn- 93	19.48 BLS	6/10/2011	360	Chicot Aquifer, Upper
▲ 4	294709093174302	Cn- 119	24.56 BLS	6/10/2011	910	500-foot Sand Of Lake Charles Area
▲ 5	295611093044801	Cn- 90	34.94 BLS	9/7/2011	396	
▲ 6	295721093115701	Cn- 120	40.67 BLS	6/16/2011	764	500-foot Sand Of Lake Charles Area
▲ 7	300040093161801	Cn- 121	51.49 BLS	6/16/2011	691	500-foot Sand Of Lake Charles Area
▲ 8	300055093093004	Cn- 88L	49.44 BLS	9/7/2011	804	500-foot Sand Of Lake Charles Area
▲ 9	300104093015601	Cn- 92	44.12 BLS	9/7/2011	443	
▲ 10	300120093320802	Cn- 86L	37.07 BLS	9/8/2011	642	500-foot Sand Of Lake Charles Area
▲ 11	300125092382504	Cn- 81L	36.96 BLS	11/1/2011	478	Chicot Aquifer, Upper

Figure 4. Location of Local Groundwater Wells in Cameron Parish and Percentile Classes as of 01/14/2012 (USGS Louisiana Water Science Center 2012)

4.2.3. Water Quality and Salinity - Existing and Historic Conditions. This resource is institutionally important because of the Clean Water Act (CWA) of 1977. Lakes, rivers, and streams are technically important because they provide habitat for various species of wildlife, finfish, and shellfish. Lakes, rivers, and streams are publicly important because of the desire of the public for recreational use for fishing, boating, and bird watching.

Water quality issues in the Chenier Plain include pollution, especially from the large petrochemical industry located along the Calcasieu River in Lake Charles; nutrient enrichment, caused by agriculture and other point and non-point sources; dredging, which can bring up heavy metal deposits and disperse them into the water column; saltwater intrusion, which has increased the amount of saltwater in the historic freshwater interior; and the presence of obstructions, mainly left over from construction activities and debris from Hurricanes Rita and Ike, which are a major concern for boaters who frequent the region's waterways.

Although not directly influencing the Chenier Plain, hypoxia off the coast is another water quality concern for the region. Hypoxia, or low dissolved oxygen (DO) levels (less than 2 milligrams per liter [mg/L]), causes mobile organisms to leave the hypoxic waters for areas with higher DO levels, while less mobile organisms may be seriously harmed or killed. Hypoxia has a direct impact on Gulf waters off the Chenier Plain due to the "dead zone," which is an area in the Gulf of Mexico where oxygen levels drop seasonally. The decomposition of phytoplankton, stimulated by nutrients from the Mississippi and Atchafalaya Rivers, consumes oxygen faster than it can be replenished. In 2008 the "dead zone" covered 8,000 sq mi of Gulf of Mexico seabed from the Mississippi River to the Texas coast.

4.2.4. Air Quality - Historic and Existing Conditions. Calcasieu Parish was designated under Section 107 of the 1977 Clean Air Act as nonattainment for the National Ambient Air Quality Standards for ozone on September 11, 1978. The State Implementation Plan for the Parish was first adopted in the early 1980s. Following the Federal Clean Air Act Amendments of 1990, Calcasieu Parish was classified as a "marginal" ozone nonattainment area pursuant to sections 107 (d) and 181 (a) of the Clean Air Act Amendments (56 FR 56694) with an attainment date of November 15, 1993. On December 20, 1995, a redesignation request and an ozone maintenance plan were submitted to the US Environmental Protection Agency (USEPA). The USEPA redesignated Calcasieu Parish to attainment for the one-hour ozone standard and approved the ozone maintenance plan effective June 2, 1997 (62 FR 24036). On April 15, 2004, USEPA designated and classified areas for the 8-hour ozone National Ambient Air Quality Standards of 0.08 parts per million (ppm) (69 FR 23858, April 30, 2004). For most areas these designations became effective June 15, 2004. The USEPA designated Calcasieu Parish as attainment/unclassifiable for the 8-hour ozone standard effective June 15, 2004 [Louisiana Department of Environmental Quality (LDEQ) 2007].

As of 2006, Calcasieu Parish is still designated as an attainment area for all criteria pollutants under the National Ambient Air Quality Standards, which were developed under the Clean Air Act of 1970, as amended. Standards have been identified for seven criteria pollutants: lead, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, particulate matter less than 10 microns in diameter, and particulate matter less than 2.5 microns. Currently, the only non-attainment area in Louisiana surrounds the City of Baton Rouge and includes the parishes of Iberville, West Baton Rouge, East Baton Rouge, Livingston, and Ascension, all in non-attainment for ozone. (USEPA 2011).

More recently, "the Lake Charles Metropolitan Statistical Area is vulnerable to being designated as non-attainment for ozone in the next few years. The Imperial Calcasieu Regional Planning & Development Commission (IMCAL), 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 have applied for and been accepted by USEPA into the EPA Ozone Advance program. The Ozone Advance program is a collaborative effort between USEPA, 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 further reflects the sensitivity of ozone levels in the area, and the need for federally-funded projects in the study area to consider emissions which contribute to the formation of ozone." (per USEPA comment letter dated December 3, 2013, Appendix G, *Public Involvement*).

4.2.5. Noise - Historic and Existing Conditions. Noise levels in the Calcasieu area are generally low due to its rural nature. The primary generators of noise are cars and trucks on the highway, small boats operating in the bayous, and tows operating in the GIWW. The Lake Charles Regional Airport is within the vicinity of the Study area and contributes to the ambient noise levels.

In the last few years, seismic companies, searching for oil and gas reserves have been operating extensively in much of south Louisiana, including the Study area . These companies rely heavily on airboats for access to undeveloped sites. The airboats are extremely loud, and can be heard for a long distance.

The Lake Charles community lies directly northeast of the GIWW. Tugboat operators sometimes push their tows up against the bank while waiting to transit the lock. In previous studies, noise from barge tows has been expressed as a concern for nearby residences. Normally, tugs leave their generators running constantly and often leave their main engines running while waiting for the lock. At other locks within the GIWW system, lock operators have received calls from disgruntled residents requesting lock operators to instruct towboat captains to move their vessels or turn off their engines.

4.2.6. Vegetation Resources

4.2.6.1. Historic and Existing Conditions. This resource is institutionally important because of the CWA of 1977; EO 11990 of 1977; the Coastal Zone Management Act (CZMA) of 1972; and the Estuary Protection Act of 1968. Wetlands are technically important because they provide necessary habitat for various species of plants, fish, and wildlife; they serve as groundwater recharge areas; they provide storage areas for storm- and floodwaters; they serve as natural water filtration areas; they provide protection from wave action, erosion, and storm damage; and they provide various consumptive and non-consumptive recreational opportunities. Wetlands are publicly important because of the high value the public places on the functions and values wetlands provide.

The Study area consists of open water ponds and lakes, cheniers, Gulf shorelines, and freshwater, intermediate, brackish, and saline marsh. Figure 5 shows the amount of brackish marsh, freshwater marsh, intermediate marsh, saline marsh, swamp, and open water in the region for 2007. 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 *Panicum hemitomon* (maidencane) and *Sagittaria lancifolia* (bulltongue arrowhead); Intermediate marsh as *Cladium jamaicense* (sawgrass), *Spartina patens* (saltmeadow cordgrass), and *Schoenoplectus californicus* (California bulrush); brackish marsh as saltmeadow cordgrass, *Schoenoplectus americanus* (chairmaker's bulrush), *Schoenoplectus robustus* (sturdy bulrush); and saline marsh as *Spartina alterniflora* (smooth cordgrass), *Juncus roemerianus* (needlegrass rush), and *Distichlis spicata* (saltgrass). Submerged aquatic vegetation (SAV), such as *Ruppia maritima* (widgeongrass), also occurs in the area.

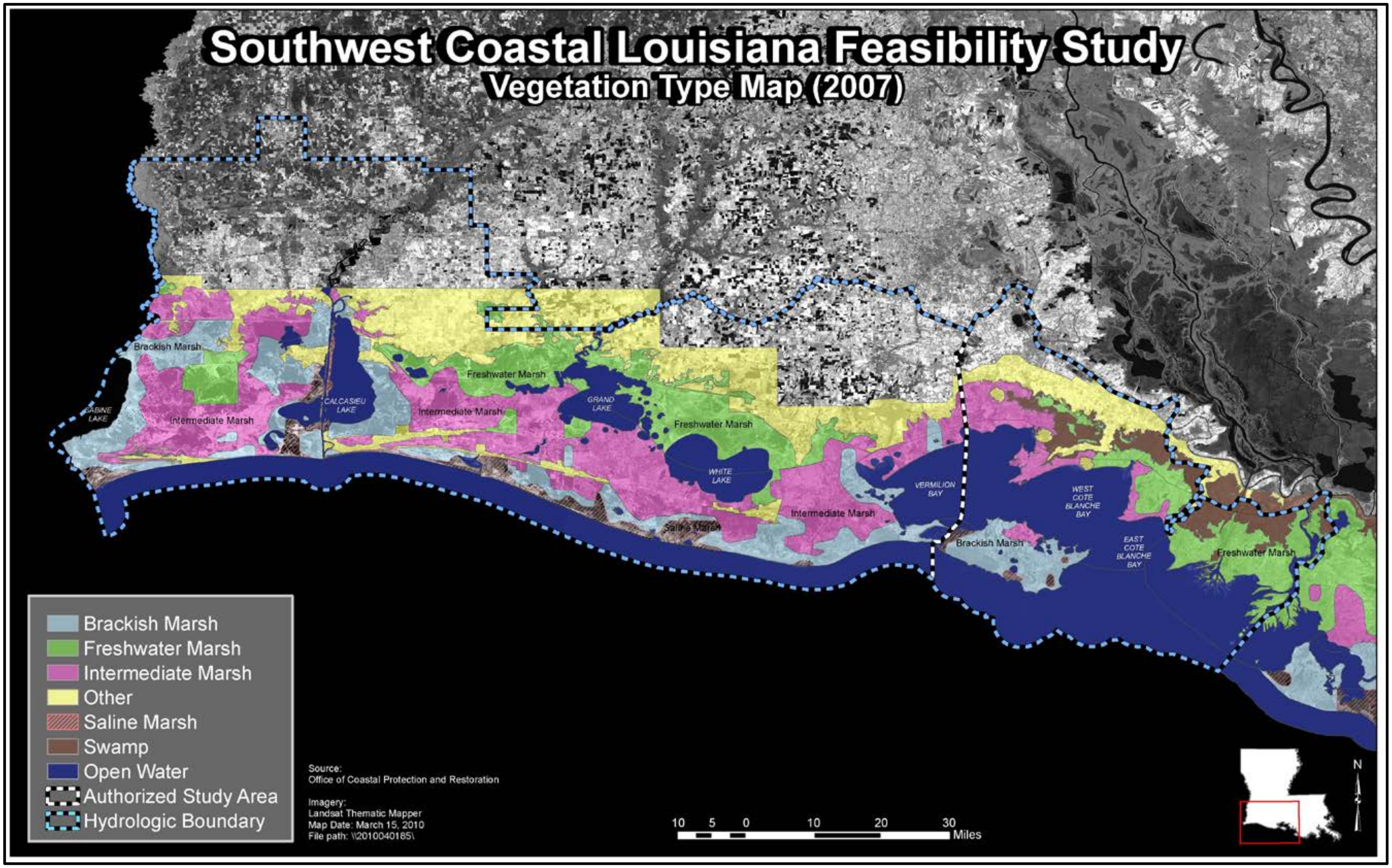

Figure 5. Vegetation Types in Southwest Coastal Louisiana in 2007
(Office of Coastal Protection and Restoration and United States Army Corps of Engineers 2010)

Additionally, the following four communities, documented by the Louisiana Natural Heritage Program, are important in that they contribute to the diversity and stability of the coastal ecosystem and may be present within the Study area.

- **Coastal Live Oak-Hackberry Forest.** Also known as chenier maritime forest, this natural community formed on abandoned beach ridges primarily in southwest Louisiana. Composed primarily of fine sandy loams interbedded with sand and shell debris, these ridges range in height from 4 to 5 feet above sea level. Live oak and hackberry are the dominant canopy species. Other common species include red maple, sweet gum, water oak, green ash, and American elm. Of the original 100,000 to 500,000 acres in Louisiana, only 2,000 to 10,000 acres remain.

- **Coastal Dune Grassland.** Coastal dune grasslands occur on beach dunes and elevated backshore areas above intertidal beaches. Louisiana's coastal dunes are poorly developed because of the high frequency of overwash associated with hurricanes and storms, and a limited amount of eolian-transported sand. Vegetative cover ranges from sparse to fairly dense and is dominated by salt spray tolerant grasses. Coastal dune grasslands are estimated to have occupied less than 2,000 acres in pre-settlement times, and 50 to 75 percent was thought to remain prior to the 2005 hurricanes. Some of the most extensive examples of coastal dune grasslands in Louisiana occur in the Chenier Plain.

- **Coastal Prairie.** The Coastal Prairie can be divided into two main types, upland dry to mesic prairies at the northern end of its range, and marsh fringing prairies on "islands" or "ridges" in the marsh at the southern end of its range. The soil conditions and frequent burning from lightning strikes prevented invasion by woody trees and shrubs and maintained the prairie vegetation. Coastal prairie vegetation is extremely diverse and dominated by grasses. Remnant Louisiana coastal prairies, once covering an estimated 2.5 million acres, have been reduced to less than 1 percent of the original extent. Some of the larger prairie remnants are marsh fringing, wet prairies found in Vermilion and Cameron Parishes.

- **Freshwater Marsh.** Freshwater marsh is generally located adjacent to intermediate marsh along the northern extent of the coastal marshes. Salinities are usually less than 2 parts per thousand (ppt) and normally average about 0.5-1 ppt. Freshwater marsh has the greatest plant diversity of any of the marsh types. Although the freshwater marshes, as previously described, compose a large amount of the entire coastal marsh acreage, the Louisiana Natural Heritage Program ranks this community as imperiled because it has undergone the largest reduction in acreage of any of the marsh types over the past 20 years due to saltwater intrusion. Some of the largest contiguous tracts of freshwater marsh in Louisiana occur in Vermilion and Cameron Parishes.

4.2.6.2. Invasive Species – Vegetation. Invasive plants have been recognized as playing a large part in the loss of wetland and coastal habitats. Invasive species often increase and spread rapidly because the new habitat into which they are introduced is often free of competitors and disease that are natural controls in their native habitats. In the Study area, water hyacinth, alligator weed, hydrilla, and Chinese tallow tree are well-known examples of invasive vegetative species.

4.2.7. Wildlife and Habitat

4.2.7.1. Historic and Existing Conditions. This resource is institutionally significant because of the Fish and Wildlife Conservation Act of 1980, the Fish and Wildlife Coordination Act

(FWCA) of 1958, as amended, the Migratory Bird Conservation Act, the Migratory Bird Treaty Act, the Endangered Species Act (ESA) of 1973, and EO 173186 Migratory Bird Habitat Protection. Wildlife resources are technically significant because they are a critical element of the various coastal habitats, they are an indicator of the health of various coastal habitats, and many wildlife species are important commercial resources. Wildlife resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

Coastal Louisiana's wetlands support millions of neotropical and other migratory avian species such as rails, gallinules, shorebirds, wading birds, and numerous songbirds, as well as many different furbearers, rabbits, deer, and alligators. Louisiana coastal wetlands provide neotropical migratory birds an essential stopover habitat on their annual migration route. The coastal wetlands in the Study area provide important and essential fish and wildlife habitats used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements.

The Chenier Plain provides habitat for a large variety of wintering waterfowl, breeding wading birds, and migratory land birds. 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 also 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.

Both resident species and non-resident migratory species of birds are found in the Calcasieu River area. The forested lands and cheniers provide nesting habitat for songbirds including the mockingbird, yellow-billed cuckoo, brown thrasher, and northern parula. At least 82 species of migratory birds regularly use these wooded habitats as important stop-over habitat during annual migrations (Lester et al. 2005). The marshes provide important areas for winter grounds and resting and feeding grounds for migratory waterfowl including green-winged teal, blue-winged teal, mottled duck, gadwall, American widgeon, and lesser scaup. Year round resident bird species include wild turkey, doves, bobwhite quail, swallows, and sparrows. Birds of prey include owls, red-tailed and red-shouldered hawks, and kestrels. Wading and aquatic birds such as anhinga, great egret, and great blue herons typically occur in wooded swamp and scrub-shrub habitat. White and brown pelicans, herons, egrets, ibises, and gulls are also found feeding in the estuarine marshes and open water habitats in the Study area. Other non-game species including boat-tailed grackle, red-winged blackbird, olivaceous cormorant, belted kingfisher, and sedge wren also utilize estuarine marshes.

The Mermentau River basin also provides habitat for similar species of wintering waterfowl, breeding wading birds, and migratory land birds. Over 300 species of birds have been recorded in the basin. Trans-Gulf migrant warblers, vireos, tanagers, thrushes, and other birds are found in large numbers during peak migration (April to May and August to October).

Mammals present in the Study area include important game species such as white-tailed deer, eastern cottontail and swamp rabbits, and gray and fox squirrels; furbearers such as river otter, muskrat, and nutria; and other mammal species such as striped skunk, coyote, nine-banded armadillo, and Virginia opossum. Smaller mammals including the cotton rat, marsh rice rat, and white-footed mouse provide a food source for both larger mammals and avian carnivores.

Reptiles found in the Study area include the American alligator and the diamond-backed terrapin. Reptiles which use the forested uplands in the previously used disposal areas and other higher elevations include the ground skink, five-linked skink, green anole, western ribbon snake, and numerous other species. Small-mouthed salamander, green tree frog, bullfrog, and southern leopard frog are some of the amphibians that are known to occur in the vicinity of the Study area.

The following information on bald eagles, colonial nesting waterbirds, and brown pelicans was obtained by letter from the USFWS dated 16 February 2012.

- Although scrub-shrub and forested areas in the project vicinity may provide habitat for bald eagles and colonial nesting waterbirds, project-associated impacts to those species are unlikely because they are not known to occur in the vicinity of the proposed Study area.
- Brown pelicans (*Pelecanus occidentalis*) may feed in open water habitats of the Study area and its vicinity. Their closest known nesting site is Rabbit Island in Calcasieu Lake. In spring and summer, nests are built in mangrove trees or other shrubby vegetation, although ground nesting may also occur. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

4.2.7.2. Invasive Species – Wildlife. Table 7 summarizes nonindigenous aquatic animal species that have been found in the Lower Calcasieu and Mermentau drainage basins [(USGS 2011; Louisiana Department of Wildlife and Fisheries (LDWF) 2005].

Table 7. Nonindigenous Aquatic Animal Species in the Lower Calcasieu and Mermentau Basins

Common Name	Scientific Name	Habitat
Grass carp	*Ctenopharyngodon idella*	Freshwater
Silver carp	*Hypophthalmichthys molitrix*	Freshwater
Nutria	*Myocastor coypus*	Freshwater
Asian clam	*Corbicula fluminea*	Freshwater
Zebra mussel	*Dreissena polymorpha*	Freshwater
Australian spotted jellyfish	*Phyllorhiza punctata*	Marine

The following three paragraphs on nutria are taken from the LDWF, 2005.

> Nutria are large, herbivorous, aquatic mammals with large orange incisor teeth. They were introduced to Louisiana from Argentina between 1900 and 1940 for fur farming. However, when some fur farms failed, the nutria were released into the wild, and it was thought they would act as a biocontrol for invasive water hyacinth (LeBlanc 1994).
>
> Nutria are prolific breeders and they exacerbate coastal wetland loss by digging into soft wetland soils and eating the roots of marsh vegetation. As the vegetation dies, the soft soils become open water; these holes in the marsh are called “eat-outs” (USGS, National Wetlands Research Center 2000). Historically, fur demand meant that hunters and trappers kept populations somewhat in check. After the price of nutria pelts plummeted in 1989, however, nutria populations began to grow unbounded (USGS 2000).
>
> The Coastwide Nutria Control Program, approved under the CWPPRA in 2002, is designed to remove approximately 400,000 nutria annually through an incentive payment program designed to encourage nutria harvesting. A summary of numbers of nutria harvested in Calcasieu and Cameron Parishes and herbivory damage estimates can be found in table 8 (Wiebe and Mouton 2011).

Table 8. Nutria Harvested and Herbivore Damage Estimates by Parish in Years 2004-2011 of the Coastwide Nutria Control Program [1] (Wiebe and Mouton 2011)

	2004-2005		2005-2006		2006-2007		2007-2008		2008-2009		2009-2010		2010-2011	
Parish	**Harvest**	**Acres of Damage**	**Harvest**	**Acres of Damage**	**Harvest**	**Acres of Damage**	**Harvest**	**Acres of Damage**	**Harvest**	**Acres of Damage**	**Harvest**	**Acres of Damage**	**Harvest**	**Acres of Damage**
Calcasieu	448	0	58	0	19	0	19	0	0	0	0	0	0	0
Cameron	16,617	0	3,744	233	1,725	167	649	0	1,245	120	1,177	0	1,076	0
Statewide Total	**297,535**	**14,260**	**168,843**	**14,868**	**375,683**	**9,244**	**308,212**	**6,471**	**334,038**	**5,422**	**445,963**	**2,260**	**338,512**	**1,679**

[1]Acres of damage estimates represent damage along sampling transects only. Actual coastwide damage is approximately 3.75 times larger than the area estimated by the survey.

4.2.8. Aquatic Resources

4.2.8.1. Historic and Existing Conditions

4.2.8.1.1. Plankton Resources. This resource is institutionally significant because of the NEPA of 1969, the CZMA, and the Estuary Protection Act. This resource is technically significant because plankton provide a major, direct food source for animals in the water column and in the sediments; phytoplankton are responsible for at least 40 percent of the photosynthesis occurring on the earth; plankton are important for their role in nutrient cycling; plankton productivity is a major source of primary food-energy for most estuarine systems throughout the world; and phytoplankton production is the major source of autochthonous organic matter in most estuarine ecosystems (Day et al. 1989). This resource is publicly significant because plankton form the lowest trophic food level for many larger organisms important to commercial and recreational fishing. In addition, there is a public health concern with noxious phytoplankton blooms (red and brown tides) that produce toxins, and large-scale blooms can lead to hypoxic conditions, which can result in fish kills.

Plankton communities serve an important role in the coastal waters of Louisiana. The plankton are composed of three groups: bacterioplankton, phytoplankton, and zooplankton (Knox 2001). 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). Microzooplankton appear to be important consumers of bacterioplankton, which are typically enumerated primarily by culture and microscopic techniques. Culture techniques are selective and invariably underestimate bacterial densities (Day et al. 1989).

Phytoplankton are tiny, single-cell algae that drift with the motion of water. The dominant groups are diatoms and dinoflagellates, and other important groups include cryptophytes, chlorophytes (green algae), and chrysophytes (blue-green algae). In Louisiana, eutrophic conditions can lead to noxious blooms of blue-green algae, often dominated by single species of the genus *Anabaena* or *Microcystis.* Some species produce toxins, and large scale blooms can lead to hypoxic conditions, which result in fish kills in some cases. Such blooms tend to occur in fresh or oligohaline waters, up to approximately 7 ppt salinity.

Phytoplankton in more saline environments can cause a different kind of bloom; *Karenia breve* (formerly known as *Gymnodinium breve*), for example, is a dinoflagellate that has been associated with red tides. Red tides are so named because the prolific growth stains the water red. Toxins associated with red tides are capable of killing fish and shellfish. Red tide populations well below the fish kill level pose a serious problem for public health through shellfish contamination. Bivalve shellfish, especially oysters, clams, and coquinas, can accumulate so much toxin that they become toxic to humans. Public health concerns also emerge from studies that show that the presence of airborne toxins resulting from red tide toxins have an impact on the human respiratory system (Mote Marine Lab website: http://www.mote.org/index.php?src=news&refno=101&category=Newsroom).

Zooplankton are faunal components of the plankton, including small crustaceans such as copepods, ostracods, euphausiids, and amphipods; the jellyfishes and siphonophores; worms, mollusks such as pteropods and heteropods; and the egg and larval stages of the majority of benthic and nektonic animals (Rounsefell 1975). Zooplankton are weakly swimming animals comprised of two broad categories: holoplankton, which are planktonic species as adults, and meroplankton, which are organisms that occur in the plankton during early life stages before becoming benthic or nektonic (most common are immature forms of benthic invertebrates). Zooplankton serve as food for a variety of estuarine consumers, but also are important for their role in nutrient cycling. Although there are no clear general patterns of zooplankton abundance in estuaries, some regional seasonal patterns have been described (Day et al. 1989). The zooplankton of many estuarine water bodies are dominated by copepods of the genus *Acartia*. Cyclopoid copepods and cladocerans are often abundant in low salinity waters of Louisiana (Hawes and Perry 1978). Zoeae (a larval stage in some crustaceans) can make up a large component of the meroplankton. Zooplankton in Louisiana waters are in some cases dominated by zoeae of the mud crab *Rithropanopeus harrisii*.

4.2.8.1.2. Benthic Resources. These resources are institutionally significant because of the NEPA; the CZMA; and the Estuary Protection Act. These resources are technically significant because the bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is called a "benthic effect." Benthic animals are directly or indirectly involved in most physical and chemical processes that occur in estuaries (Day et al. 1989). Benthic resources are publicly significant because members of the epibenthic community (e.g., oysters, mussels, etc.) provide commercial and recreational fisheries as well as create oyster reef habitats used by many marine and estuarine organisms.

Within a salt marsh, less than ten percent of the above-ground primary production of the salt marsh is grazed by aerial consumers. Most plant biomass dies and decays and its energy is processed through the detrital pathway. The major consumer groups of the benthic habitat include bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink 1993).

Benthic community structure is not static; it provides a residence for many sessile, burrowing, crawling, and even swimming organisms. The benthic community is a storehouse of organic matter and inorganic nutrients, as well as a site for many vital chemical exchanges and physical interactions. Day et al. (1989) describe the functional groups of estuarine benthic organisms. These groups include: macrobenthic (e.g., molluscs, polychaetes, decapods); microbenthic (e.g., protozoa); meiobenthic (e.g., nematodes, harpacticoid copepods, tubillaria), epibenthic; infauna (e.g., most bivalves); interstitial fauna (e.g., beach meiofauna, tardigrades); suspension-feeders (e.g., bryozoa and many bivalves); filter-feeders (e.g., porifera, tunicates, bivalves); nonselective deposit feeders (e.g., gastropods); selective deposit feeders (e.g., nematodes, sand dollars, fiddler crabs); raporial feeders and predators (e.g., star fish and gastropod drills); and parasites and commensals (e.g., parasitic flatworms and copepods, pea crabs).

According to Mitsch and Gosselink (1993), the salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary. They point out that in some cases exported marsh detritus is more important to the estuary than the phytoplankton-based production in the estuary. Detritus export and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish. Salt marshes have been shown at times to be both sources and sinks of nutrients, particularly nitrogen.

4.2.9. Fisheries. Fishery resources are institutionally significant because of the FWCA of 1958, as amended; the ESA of 1973; the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Magnuson-Stevens Act Reauthorization of 2006; the CZMA; and the Estuary Protection Act. Fishery resources are technically significant because they are a critical element of many valuable freshwater and marine habitats, they are indicators of the health of various freshwater and marine habitats, and many species are commercially important. Fishery resources are publicly significant because of the high priority placed on their aesthetic, recreational, and commercial value.

4.2.9.1. Historic and Existing Conditions. Louisiana's coastal estuaries are the most productive in the Nation. Louisiana has historically been an important contributor to the Nation's domestic fish and shellfish production, and one of the primary contributors to the Nation's food supply for protein. Most of the economically important saltwater fishes and crustaceans harvested in Louisiana spawn offshore and then use estuarine areas for nursery habitat (Herke 1995). Landings in 2010 for commercial fisheries in coastal Louisiana, estimated at one billion pounds, were the largest for any state in the contiguous U. S. and second only to Alaska [National Marine Fisheries Service (NMFS) 2011]. These landings represent over 12 percent of the total landings in the U.S., with a value of approximately $247.9 million. Total fish and shellfish landings for ports in the vicinity of the Study area (Cameron and Intracoastal City) were 411 million pounds in 2010 with a dockside value of approximately $38 million (NMFS Fisheries Statistics Division 2011 – personal communication).

The Chenier Plain is also a popular destination for recreational fishing. The area's diverse wetland ecosystems provide habitat for a variety of fresh- and saltwater fish and shellfish, including shrimp, crawfish, blue crab, spotted sea trout, red drum (redfish), and red snapper. Freshwater sport fish include largemouth bass, crappie, bluegill, and catfish. Furthermore, the Study area provides important habitat for a variety of smaller fishes and crustaceans (e.g., grass shrimp, silversides, anchovies), which are important prey items for many of the commercially and recreationally important species.

4.2.9.1.1. Finfish. By far the top position in landings of finfish, by weight, for the State of Louisiana is held by Gulf menhaden, which contributed more than 85 percent of the total finfish landings in 2010 (NMFS Fisheries Statistics Division 2011 – personal communication). Gulf menhaden spawn up to five times in the Gulf of Mexico from October to April. The eggs hatch and larvae drift into estuaries from January to April. Juveniles then develop in shallow, lower-salinity estuarine and wetland habitats, moving in dense schools. Eventually, the menhaden migrate to deeper waters and then move offshore and become harvestable in their second year of life (Guillory et al. 1983). Immatures and adults migrate into estuarine waters from April to October (Christmas et al. 1982).

Behind Gulf menhaden, the top finfish landings, by weight, for the State of Louisiana in 2010 were buffalofishes, black drum, blue catfish, and sharks (NMFS Fisheries Statistics Division 2011 – personal communication).

For ports in the immediate vicinity of the Study area (Cameron and Intracoastal City) confidentiality considerations prevent reporting of specific landing weights and dockside values. However, Gulf menhaden were by far the top finfish landed in 2010 for these ports. Other species landings reported include dolphinfish, black drum, flounder, garfishes, mullet, sheepshead, and catfish.

An extensive database of fishery independent sampling data for fish and shellfish is maintained by the LDWF. The database contains information on extensive sampling conducted in the coastal marshes, bayous, and lakes in and around the Study area. Corps personnel requested fish and shellfish species information from LDWF for all sampling stations in the vicinity of the Study area. Due to the size of the database and lack of any summarized information, data from 2000 to 2010 for sampling stations located near the Study area utilizing different capture techniques were chosen to characterize the fish assemblage. The most abundant finfish species collected in Calcasieu Lake, the Calcasieu River and Ship Channel, and the GIWW were Atlantic croaker, Gulf menhaden, striped mullet, spotted seatrout, and black drum. White shrimp, brown shrimp, and blue crab were commonly collected as well.

4.2.9.1.2. Shrimp. Brown and white shrimp spawn in the Gulf of Mexico. Larvae drift into estuarine waters as postlarvae and inhabit coastal wetlands. After becoming juveniles, the shrimp move offshore where they become adults. There may be up to three spawns per year in Louisiana (Gaidry and White 1973) with females each producing from a half million to a million eggs. Brown shrimp wash into estuaries mainly from February to April (White and Boudreaux 1977) while white shrimp come in from late spring to autumn when temperatures are above 25°C (Baxter and Renfro 1967). White shrimp spawn in shallower Gulf water and move further into estuarine nursery areas [up to 160km (99 miles)] as postlarvae and juveniles than brown shrimp (Turner and Brody 1983). Brown shrimp leave the estuaries to the Gulf of Mexico from May through August (Lassuy 1983) whereas white shrimp leave from September to December (Muncy 1984). Recruitment of shrimp to the fishery is not dependent on parent stocks the year before because environmental conditions are the overriding factor (Muncy 1984). Recruitment of brown shrimp increased in the Gulf from 1960-1986 despite a two-fold increase in catch effort and catch. White shrimp showed similar trends, but the catch per unit effort declined slightly, indicating that recruitment cannot maintain a stable catch per unit effort as effort increases (Nance and Nichols 1988). The optimum salinity for brown shrimp survival and growth in the estuary appears to be around 19 ppt, but salinities from 15 to 20 ppt are very favorable (Barrett and Gillespie 1973). White shrimp can apparently do well in water with lower salinities than this. Both species prefer shallow, soft-bottomed estuaries (Muncy 1984; Lassuy 1983). Water temperatures over 20°C after the first week in April are also important.

Shrimp yields have been related to wetland habitat quantity (Turner 1992) and land-water interface. The land-water interface relationship suggests that shrimp yields will decrease when the land-water interface declines. Browder et al. (1989) predicted that brown shrimp catches in the Barataria, Timbalier, and Terrebonne Basins would peak around the year 2000 and may fall to zero within 52 to 105 years. This prediction seems to follow the catch trends observed in recent years as brown shrimp landings for Louisiana have generally been declining since 2001, with 2010 landings being less than 30 percent of 2001 landings (NMFS Fisheries Statistics Division 2011 – personal communication). White shrimp landings for the same period were fairly stable.

Gulf region landings of shrimp in 2010 were the Nation's largest with 176.4 million pounds and 68 percent of the national total (NMFS 2011). In Louisiana, a total of 17.3 million pounds of brown shrimp and 55.8 million pounds of white shrimp were landed in 2010, with a dockside value of $22.1 million and $86.0 million, respectively (NMFS Fisheries Statistics Division 2011; personal communication). For ports in and around the Study area, a total of 2.5 million pounds of brown shrimp and 7.8 million pounds of white shrimp were landed in 2010, with a dockside value of $2.8 million and $14.9 million, respectively (NMFS Fisheries Statistics Division 2011; personal communication).

4.2.9.1.3. Blue Crab. Blue crabs occupy all estuarine aquatic habitats at some time during their life cycle, tolerating a wide array of salinities and temperatures, but preferring lower to moderate salinity (Perry and McIlwain 1986). Temperatures above 30°C for prolonged periods are stressful. Blue crabs are benthic omnivores, feeding on various crustaceans, mollusks, fish, and detritus. Eggs are produced in two batches averaging 1,500,000 eggs in each. Larval blue crabs reach their peak during February and March (Adkins 1972). Juveniles are most abundant from November to May and occur in the northern portions of the estuaries. The juveniles prefer areas with soft, mud substrate. After 1 to 1.5 years, the crabs then move from shallow areas into larger bays and bayous as adults where they live for at least one more year. Mating occurs in the spring after which time the females migrate southward to higher salinity waters (Adkins 1972; Perry 1975).

Louisiana is one of the leading blue crab producers, by weight, in the U.S., producing 15.4 percent of the Nation's total in 2010 (NMFS Fisheries Statistics Division 2011 – personal communication). Statewide, a total of 30.8 million pounds of blue crab were landed in 2010, with a dockside value of $30.5 million (NMFS Fisheries Statistics Division 2011 – personal communication). For ports in and around the Study area, a total of approximately 3.7 million pounds of blue crab were landed in 2010, with a dockside value of approximately $3.6 million (NMFS Fisheries Statistics Division 2011 – personal communication).

4.2.9.1.4. Oyster. The eastern oyster is indigenous to coastal Louisiana and provides a rich ecological and commercial resource. Salinity plays a key role in oyster sustainability. Adult oysters can tolerate salinities from 0 to 42 ppt, but the optimal range is 5 to 15 ppt. Fresher waters fail to support biological function, and more saline waters promote disease and predation. Adult oysters are more prone to impacts from changes in water quality than commercially harvested fishes and crustaceans because they are sessile and cannot relocate in response to changes in water quality parameters.

The Gulf region led the U.S. in oyster production in 2010 with 15.5 million pounds, 55 percent of the national total (NMFS 2011). In Louisiana, a total of 6.8 million pounds of oyster were harvested in 2010, with a value of $24.7 million (NMFS Fisheries Statistics Division 2011; personal communication). Production of oysters in Louisiana has been relatively stable for the last 50 years, with harvest from public beds replacing the decreasing harvest from private leases. However, increasing coastal land loss is reducing the amount of marsh that provides shelter to reefs, and saltwater intrusion is exacerbating disease and predation.

There are no oyster leases located within the Study area . The nearest leases are located in the southeast corner of Vermilion Parish. Oyster seed grounds within the Study area are located in Calcasieu Lake. The seed grounds are managed by the LDWF to produce a ready supply of seed oysters that can be planted on private leases for later harvest. Figure 6 shows the locations of oyster seed grounds in the vicinity of the Study area.

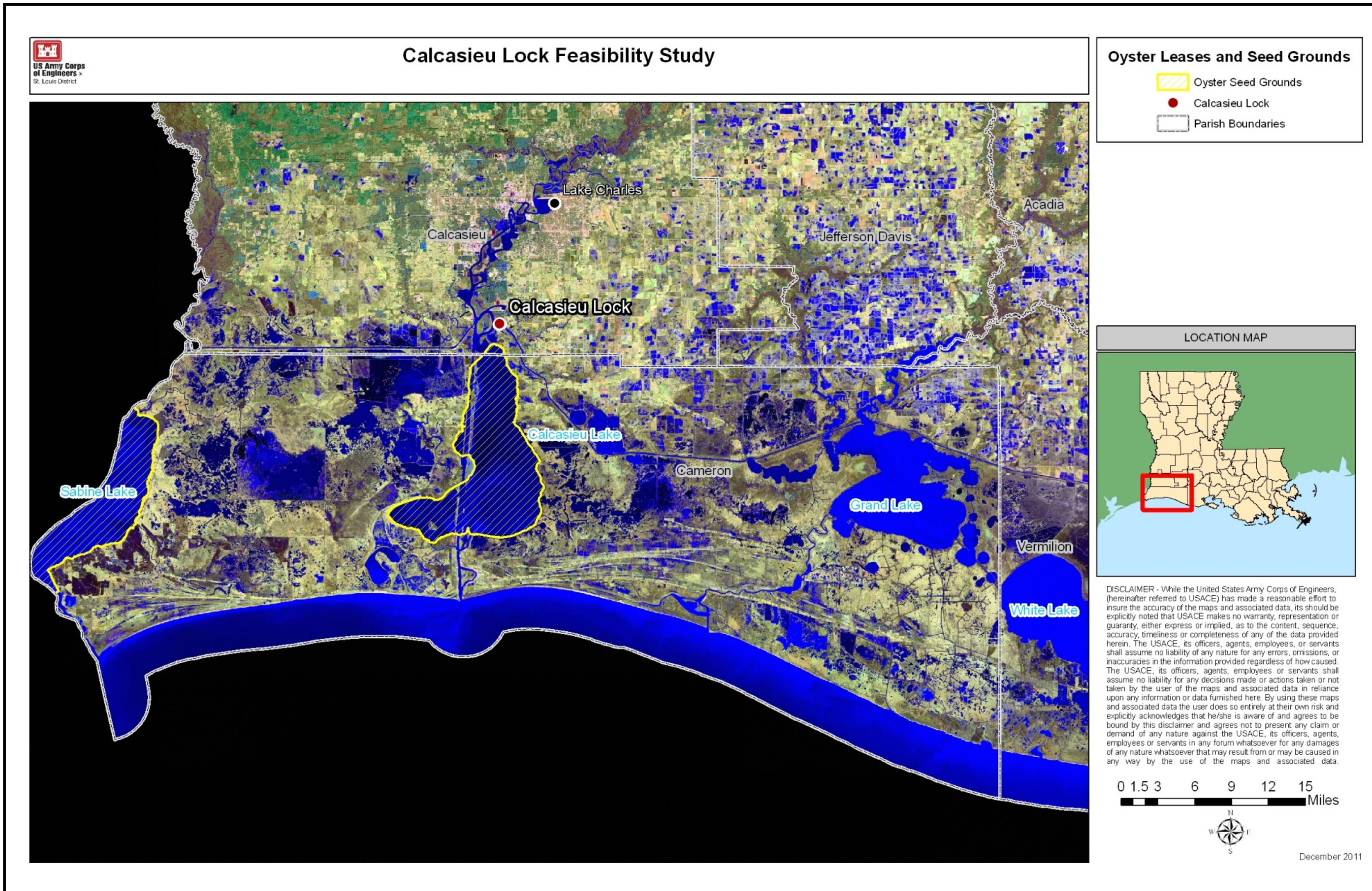

Figure 6. Oyster Seed Grounds
(October 2011 LDWF data)

4.2.10. Essential Fish Habitat. This resource is institutionally significant because of the Magnuson-Stevens Act of 1996 (Public Law 104-297). Essential Fish Habitat (EFH) is technically significant because, as the Act states, EFH is "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." Essential Fish Habitat is publicly significant because of the high value that the public places on the seafood and the recreational and commercial opportunities EFH provides.

Estuary habitats in the Study area are designated as essential fish habitat for brown shrimp, white shrimp, and red drum. Table 9 lists examples of EFH for various life stages of these species.

4.2.11. Threatened and Endangered Species. This resource is institutionally significant because of the ESA of 1973, as amended, and the Marine Mammal Protection Act of 1972. Threatened (T) and endangered (E) species are technically significant because the status of such species provides an indication of the overall health of an ecosystem. These species are publicly significant because of the desire of the public to protect them and their habitats.

Within Calcasieu and Cameron Parishes, there are several animal species (some with critical habitats) under the Federal jurisdiction of the USFWS and/or the NMFS, presently classified as endangered or threatened (table 10).

The following information on threatened and endangered species was obtained by letter from the USFWS dated 16 February 2012.

- Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) have been occasionally observed along the Louisiana Gulf coast (primarily in southeast Louisiana). The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

- Endangered and threatened sea turtles forage in the nearshore waters, bays and sounds of Louisiana. The NMFS is responsible for aquatic marine threatened or endangered species. When sea turtles leave the aquatic environment and come onshore to nest, however, the Service is responsible for consultation.

- Federally listed as a threatened species, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months annually. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation (figure 7).

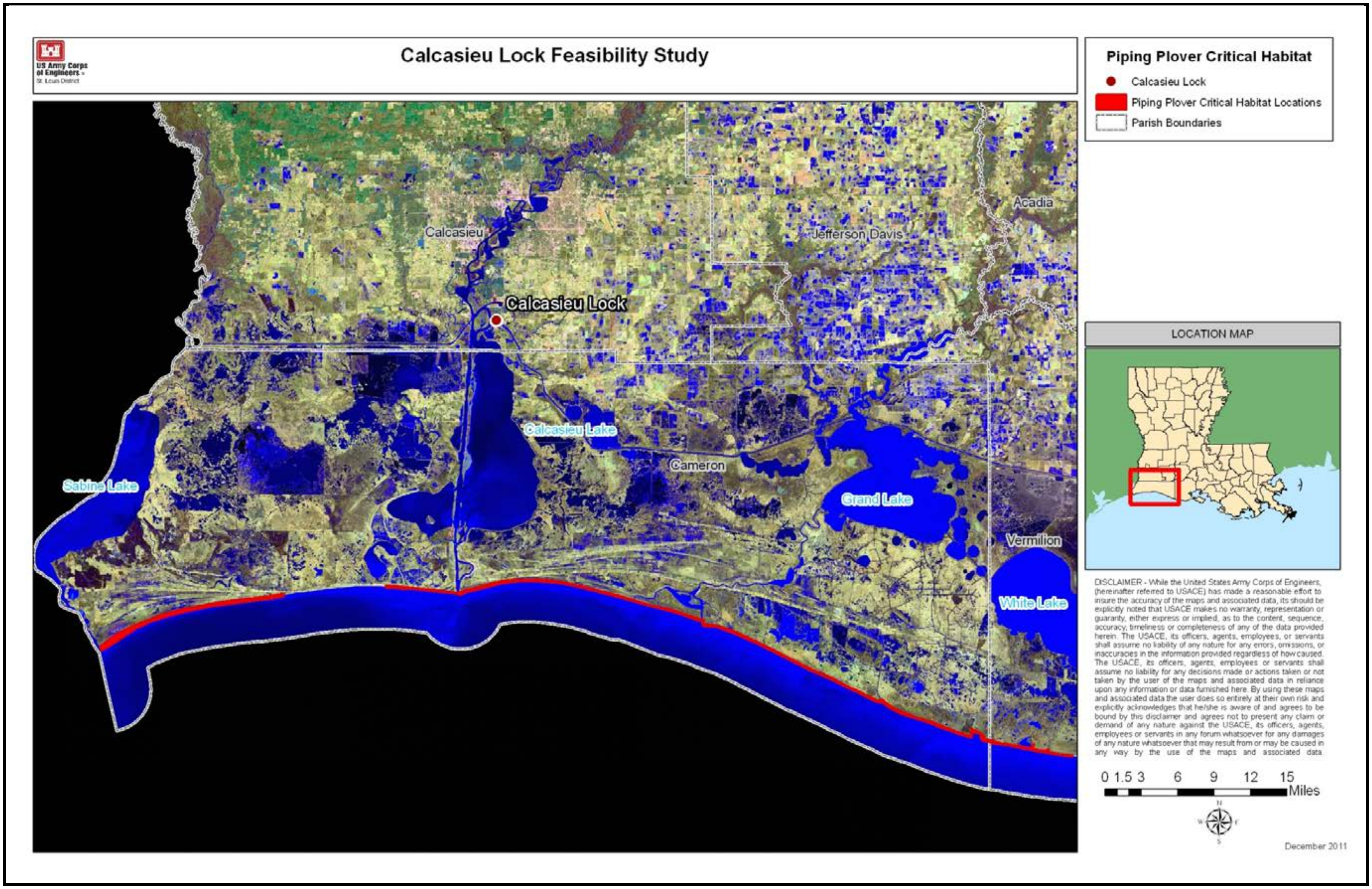

Figure 7. Piping Plover Critical Habitat (U.S. Fish and Wildlife Service data)

- The proposed project area would be located in a Parish known to be used by the Sprague's pipit (*Anthus spragueii*), a candidate species for Federal listing as a threatened or endangered species. Candidate species are those taxa for which the Service has on file sufficient information regarding biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions. Sprague's pipit is a small (4 to 6 inches in length) passerine bird with a plain buffy face, a large eye-ring, and buff and blackish streaking on the crown, nape, and under parts. It winters in Louisiana, arriving from its northern breeding grounds in September and remaining until April. Migration and wintering ecology of this species is poorly known, but Sprague's pipit exhibits a strong preference for open grassland (i.e., native prairie) with native grasses of intermediate height and thickness, and it avoids areas with too much shrub encroachment. Its use of an area is dependent upon habitat conditions. This species is a ground feeder and forages mainly on insects but will occasionally eat seeds.

- The Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), federally listed as a threatened species, is an anadromous fish that occurs in many rivers, streams, and estuarine waters along the northern Gulf coast between the Mississippi River and the Suwannee River, Florida. In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain basin, and adjacent estuarine areas; it is possible that they may also occasionally occur in coastal waters of southwest Louisiana. Spawning occurs in coastal rivers between late winter and early spring (i.e., March to May). Adults and sub-adults may be found in those rivers and streams until November, and in estuarine or marine waters during the remainder of the year. Sturgeon less than two years old appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. Habitat alterations such as those caused by water control structures that limit and prevent spawning, poor water quality, and over-fishing have negatively affected this species.

- The American alligator is also found in the Study area, but is classified as "threatened due to similarity of appearance"; alligators are not biologically endangered or threatened.

Table 9. Essential Fish Habitat for Various Life Stages of Brown Shrimp, White Shrimp, and Red Drum (Gulf of Mexico Fisheries Management Council 2004)

Species	Life Stage	Zone	Essential Fish Habitat
Brown Shrimp	Larvae / Postlarvae	Marine/Estuarine	0-82 meters; planktonic, sand/shell/soft bottoms, SAV, emergent marsh, oyster reef
	Juveniles	Estuarine	0-18 meters; sand/shell/soft bottoms, SAV, emergent marsh, oyster reef
White Shrimp	Larvae / Postlarvae	Marine/Estuarine	1-82 meters; soft bottoms, emergent marsh
	Juveniles	Estuarine	1-30 meters; soft bottoms, emergent marsh
Red Drum	Larvae / Postlarvae	Estuarine	Planktonic, sand/shell bottoms, SAV, soft bottoms, emergent marshes
	Juveniles	Estuarine/Marine	0-5 meters; emergent marshes, SAV, soft bottoms, hard bottoms, sand/shell bottoms
	Adults	Estuarine/Marine	1-70 meters; hard bottoms, pelagic, emergent marshes, sand/shell bottoms, SAV, soft bottoms

Table 10. Threatened and Endangered Species Potentially Occurring in the Study Area

	Status		Jurisdiction		
Species	**Federal**	**State**	**USFWS**	**NMFS**	**Critical Habitat**
American Alligator (*Alligator mississippiensis*)	T	--			
West Indian Manatee (*Trichechus manatus*)	E	E	x		
Piping Plover (*Charadrius melodus)*	T	T	x		X (foraging, sheltering, and roosting habitat of wintering populations)
Sprague's pipit (*Anthus spragueii*)	Candidate Species				
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	T	T	x	x	
Hawksbill sea turtle (*Eretmochelys imbricata*)	E	E	x	x	
Kemp's Ridley sea turtle (*Lepidochelys kempii*)	E	E	x	x	
Leatherback sea turtle (*Dermochelys coriacea*)	E	E	x	x	
Green sea turtle (*Chelonia mydas)*	T	T	x	x	
Loggerhead sea turtle (*Caretta caretta)*	T	T	X	X	

4.2.12. Cultural and Historic Resources - Historic and Existing Conditions. The area comprised by the Calcasieu Lock and adjacent environs are low-lying, flat coastal wetlands within Pleistocene-era, chenier plains (Smith, et al. 2002:9). "The landscape is dominated by marsh and mudflats that have aggregated to slightly above sea level…" (Barrett Smith, et al. 2002:9), having no to low potential for containing prehistoric historic properties. Conversely, the cheniers (prehistoric beach lines) are located outside of the Study area, and have moderate to high potential for containing significant historic properties of all cultural/temporal periods found in coastal Louisiana.

The Calcasieu Lock (zone 15, 471775 easting, 3328340 northing) is located on the GIWW, east of Choupique Island and the Calcasieu River, in Section 21, Township 11 South, Range 9 West on the 1994 USGS. 7.5' *Moss Lake, LA* topographical quadrangle. The existing GIWW replaced the original navigable channel between 1948 and 1950 through Black Bayou immediately to the south (Kuranda and Celven 2005:iii, Smith, et al. 2002:40). The Calcasieu Lock is part of the Calcasieu River Saltwater Barrier project which is operated by the MVN to maintain a freshwater reservoir for commercial agricultural (primarily rice and crayfish) use while preserving the basin's sensitive environments from the detrimental effects of saltwater intrusion from the Gulf.

The Calcasieu Lock, associated buildings, appurtenant structures, and esplanade were determined to be ineligible to the National Register of Historic Places (NRHP) due to the lack of significance and integrity (Kuranda and Cleven 2005:23-29) and correspondence signed by the State Historic Preservation Officer, dated 21September 2005) concurring with this determination (Appendix I, *Mitigation Plan*). A site visit by the Calcasieu Lock Replacement Study Project Delivery Team Meeting occurred on May 27, 2011. Rock Island District Archeologist Ron Deiss interviewed Lockmaster Kevin Galley of the MVN, who stated that the Calcasieu Lock esplanade was constructed of fill, possibly made from the removal of construction material during lock construction in the late 1940s and early 1950s (Galley, personal communication May 27, 2011).

Approximately 2,000 feet southeast of the Lock is the Black Bayou (Big Lake Road) Pontoon Bridge on State Highway 384. This pontoon bridge was built in 1979 (LA Dept of Transportation State Structure Number #07103820402351, status: bridge presently under rehabilitation). This bridge is under 50 years of age, it does not meet eligibility criteria for listing on the NRHP, as promulgated under 36 CFR Part 60(d).

Therefore, the existing cultural resource conditions indicate that the Calcasieu Lock, esplanade, and all appurtenant structures and buildings and the Black Bayou (Big Lake Road) Pontoon Bridge are ineligible to the NRHP. Since all of the surrounding land is either open water or marsh (wetlands), the lack of potential for archeological resources indicate that the project as proposed would not affect any know or undocumented historic properties.

4.2.13. Socioeconomic and Human Resources. The Parish of Cameron, LA has experienced population decline since 2000. This population decline has led to decreases in the number of housing. In the same time period, the Parish of Calcasieu has shown an increase in both. Table 11 contains the U.S. Census Bureau data for 1990, 2000, and 2010.

Average persons per household in Cameron Parish were 2.76 and 2.66 for 2000 and 2010, respectively. Average persons per household in Calcasieu Parish were 2.16 and 2.55 for 2000 and 2010, respectively.

Table 11. Population and Housing Units

Cameron Parish	1990	2000	2010	% change 1990-2000	% change 2000-2010
Population	9,260	9,991	6,839	+7.9%	-31.5%
Housing Units	5031	5336	3,593	+6.1%	-32.7%

Calcasieu Parish	1990	2000	2010	% change 1990-2000	% change 2000-2010
Population	168,134	183,577	192,768	+9.2	+5.0
Housing Units	66,426	75,995	82,058	+14.4	+8.0

In 2010, Cameron Parish's racial composition consisted of the following: White, 95.7 percent; Black, 1.7 percent; American Indian and Alaska Native, 0.5 percent; and Asian, 0.1 percent. Persons reporting two or more races were 1.1 percent. Calcasieu Parish's racial composition consisted of the following: White, 70.8 percent; Black, 24.8 percent; American Indian and Alaska Native, 0.5 percent; and Asian, 1.1 percent. Persons reporting two or more races were 0.9 percent. In comparison, the State of Louisiana reported the following racial composition: White, 62.6 percent; Black, 32.0 percent; American Indian and Alaska Native, 0.7 percent; Asian, 1.5 percent; and persons reporting two or more races were 1.6 percent (U.S. Census Bureau, 2011).

Educational attainment in Cameron Parish shows 82.0 percent of the population age 25 years or older having graduated high school and 12.9 percent having obtained a bachelor's degree or higher in 2005 to 2009. Educational attainment in Calcasieu Parish shows 81.2 percent of the population age 25 years or older having graduated high school and 19.3 percent having obtained a bachelor's degree or higher in 2005 to 2009. In comparison, educational attainment for the State of Louisiana shows 80.5 percent of the population age 25 years or older having graduated high school and 20.6 percent having obtained a bachelor's degree or higher for the same period.

Table 12 shows the major industries employing residents in Calcasieu and Cameron Parishes in 2000.

Table 12. Profile of Industry in Calcasieu and Cameron Parish: Year 2000 (by percent)

Industry	Calcasieu Parish	Cameron Parish
Agriculture, forestry, fishing and hunting, and mining	2.1	16.6
Construction	9.3	11.2
Manufacturing	14.9	7.1
Wholesale trade	2.8	3.4
Retail trade	11.5	10.2
Transportation and warehousing, and utilities	4.9	9.5
Information	2.3	1.2
Finance, insurance, real estate, and rental and leasing	4.3	3.7
Professional, scientific, mgmt, administrative, and waste mgmt services	6.7	4.9
Educational, health and social services	19.9	16.2
Arts, entertainment, recreation, accommodation and food services	11.5	6.4
Other services (except public administration)	5.5	5.1
Public administration	4.2	4.4

The estimated 2009 median household income for Cameron Parish was $55,117, and in this same time period the percentage of the population living below the poverty level was 12.3. Calcasieu Parish had an estimated 2009 median household income of $43,534 and in this same time period the percentage of the population living below the poverty level was 16.4. By comparison, median household income and poverty level in the state of Louisiana are $42,460 and 17.6 percent, while the U.S. has figures of $51,425 and 13.5 percent for the same time period (U.S. Census Bureau, 2010).

Environmental Justice. Environmental Justice (EJ) is institutionally significant because of EO 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995, direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations.

Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population.

Low-income populations as of 2000 are those whose annual income are at or below $23,850.00 for a family of four and are identified using the Census Bureau's statistical poverty threshold. The Census Bureau defines a "poverty area" as a Census tract with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. This is updated annually at http://aspe.hhs.gov/poverty/14poverty.cfm .

This resource is technically significant because the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the proposed actions. This resource is publicly significant because of public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental and human health consequences of federal laws, regulations, policies, and actions.

A potential disproportionate impact may occur when the percent minority (50 percent) and/or percent low-income (20 percent) population in an EJ study area are greater than those in the reference community. The primary study area is the Calcasieu Lock and its immediate vicinity. For purposes of this analysis, all of Census Tract ID 22019001801 is defined as the EJ study area. The EJ reference community is identified as including the Calcasieu and Cameron Parishes. Calcasieu Lock is located on the GIWW, just east of the Calcasieu River, in Calcasieu Parish, LA, approximately 10 miles south of Lake Charles, LA.

To identify low-income and minority populations within the project area the USEPA mapping tool was used (http://www.epa.gov/environmentaljustice/mapping.html).

Existing Conditions. The proposed Calcasieu Lock project area is located in Calcasieu Parish, Louisiana. The total population of this parish, according to the 2010 U.S. Census Bureau is 6,839. According to the 2010 U.S. Census, the Calcasieu Lock project boundary in Cameron Parish is located within Census Tract ID 22019001801. The census tract information indicates 11.49 percent minority population and 5.26 percent of the population was below the poverty level.

The 2010 Census demographic profile records indicate that the minority populations in Cameron and Calcasieu Parishes respectively were 3.12 percent and 29.91 percent of the total populations and the low-income populations were 11.56 percent and 16.24 percent of the total population. The profiles for the census tract, both parishes, the State of Louisiana, and the United States are as follows:

	Census Tract ID 22019001801	Cameron Parish	Calcasieu Parish
% below poverty	5.26	16.24	11.56
percent minority	11.49	29.91	3.12
Total Population (2010 census data)	2016	6,839	192,768

Analyses of the above information show that while the percentage of the population that is minority is comparable to that of Parish figures, the percent below poverty populations are lower than Parish figures. Because there are few residential neighborhoods in the proposed project area, and based on the aforementioned 2010 U.S. Census figures, it has been determined that the proposed Calcasieu Lock Recommended Plan will not have a disproportionate impact on minority and/or low income populations per EO 12898.

4.2.14. Hazardous, Toxic, and Radioactive Waste. In an effort to facilitate identification of potential problems associated with hazardous, toxic, and radioactive waste (HTRW) which may be located within Study boundaries (within a 1-mile radius per ASTM 1527-05 requirements), or may affect or be affected by the proposed project, an Initial Hazard Assessment (IHA) was performed in 2002 (Goodwin & Associates, Inc. 2002) to satisfy, among other things, the requirements of ER 1165-2-132, *Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance for Civil Works Projects* (USACE 1992).

The investigation identified and documented, to the extent reasonably ascertainable, the available existing and historic information regarding potential HTRW sites in the area. The investigation was performed in a manner consistent with American Society for Testing and Materials (ASTM) E-1527-97, *Standard Practice of Environmental Site Assessments: Phase I ESA Process* (ASTM 1997): (Note: For the purposes of this document, the terms IHA and Phase I ESA are synonymous.) In general, the IHA investigation process involved:

- the USEPA, the LDEQ, and local regulatory or response agencies for licensed/permitted actions, any violation, enforcement, and/or litigation against local property owners, and general information about localized HTRW issues including illegal dumping and existing or past contamination;

- visual survey for potential HTRW. Evidence of contamination such as local commercial/industrial/residential operational practices, surface or partially buried containers, discolored soils, seeps, film on water, abnormal or dead vegetation or animals, suspect odors, dead end pipes, abnormal grading, fills, or depressions; and

- records searches (Federal, state, private), interviews, and on-site evaluation for possible HTRW. The principal databases reviewed included:
  - National Priorities List;
  - the Treatment-Storage-Disposal category and Large Quantity Generator category of the RCRAInfo database;
  - the Comprehensive Environmental Response, Compensation, and Liability Information System;
  - Toxic Release Inventory;
  - LDEQ records (enforcement actions, leaking underground storage tanks, solid waste facilities, etc.); and

- National Response Center spill reports.

The results of the investigation identified no significant recognized environmental conditions (REC) within the Study area. However, since the original investigation, more recent ASTM E-1527 requirements (ASTM 2005) which have been deemed compliant by the USEPA regarding the provisions of the "all appropriate inquiries" final rule provide that more current information in connection with the proposed site is required for prior assessments exceeding one year to document whether or not conditions have changed materially. Accordingly, an update to the prior investigation was completed in June 2013 which can be found in Appendix M. That assessment did not reveal any evidence of RECs and found the likelihood of encountering HTRW materials in connection with this project unlikely.

4.3. Calcasieu Lock and GIWW Navigation Existing Conditions. The Calcasieu Lock is located on the GIWW (figure 8). In order to assess the usage of the Calcasieu Lock the relevant portion of the GIWW system needs to be evaluated in total. The current level of vessel traffic passing through the Lock at Calcasieu is influenced by the other locks on the GIWW system. Much of the traffic that is present along the system is similar in nature with what moves through Calcasieu Lock. For example, with the exception of Inner Harbor Lock, over half of the tonnage at all the locks in the system is similar to the tonnage transiting the Calcasieu Lock. A complete description of this commonality of traffic can be found in Appendix K, *Economics,* Attachment 2; Addendum B K.2.1.10. In addition, a complete description of the historic and existing conditions for navigation that is summarized in Sections 4.3.1 through 4.3.3 can be found in Appendix K.

4.3.1. Historical Trends. This section presents the Waterborne Commerce Statistics Center data for the three waterway system segments are germane to Calcasieu Lock:

GIWW Mississippi River, Louisiana to Sabine River, TX
GIWW Louisiana Portion
GIWW Morgan City-Port Allen, LA

The emphasis is on the historical trends of vessel trips and cargo tons.

4.3.1.1. Segment 1 - GIWW Mississippi River, Louisiana to Sabine River, Texas. Table 13 contains the total annual cargo tons for the GIWW Mississippi River, LA to Sabine River, TX for the period 1990 through 2011. For the period 1990 through 2008, total annual cargo tons remained nearly the same at about 67 million. Total annual cargo tons increased to 68 million by 1995/1996 and then declined to 59 million by 2002, thereafter increasing to the mid to upper 60 million ton range. Recently, the total annual cargo tons declined from 70 million in 2006 to nearly 63 million in 2011. The three largest commodity groups in terms of annual tons are petroleum and petroleum products, chemicals, and crude materials. Overall, there has been little if any sustained growth in total annual cargo tons for the GIWW segment between the Mississippi River, LA and the Sabine River, TX.

Figure 8. South Louisiana Inland Navigation System

Table 13. GIWW Mississippi River, Louisiana to Sabine River, Texas:
Annual Total Commodity Tons, 1990 to 2011

Year	Total Tons
1990	67,758
1991	65,949
1992	66,178
1993	65,241
1994	67,688
1995	68,203
1996	68,665
1997	66,739
1999	60,979
2002	58,933
2003	64,851
2004	69,458
2005	65,970
2006	70,104
2007	69,663
2008	66,731
2009	62,862
2010	64,556
2011	63,384

Source: Waterborne Commerce Statistics Center

4.3.1.2. Segment 2 - GIWW Louisiana Portion. Table 14 shows the total annual cargo tons for the GIWW Louisiana Portion for the period 1997 through 2011. Total annual tons declined from 83 million in 1997 to 71 million in 2002 and then increased to 82 million in 2004 and 2006 but then declined to nearly 74 million tons in 2011. The three largest commodity groups in terms of annual tons are shown for petroleum and petroleum products, chemicals, and crude materials.

Table 14. GIWW Louisiana Portion:
Annual Total Commodity Tons, 1997 to 2011

Year	Total Tons
1997	83,399
1999	75,123
2002	71,509
2003	76,751
2004	82,368
2005	77,855
2006	82,322
2007	80,674
2008	76,680
2009	72,177
2010	76,177
2011	73,734

Source: Waterborne Commerce Statistics Center

4.3.1.3. Segment 3 - GIWW Morgan City to Port Allen, LA. Table 15 shows the total annual cargo tons for the GIWW Morgan City-Port Allen, LA, for the period 1990 through 2011. As shown, total annual cargo tons declined from 29 million tons in 1990 to only 17 million tons in 2011. In 2011, the decline was mainly due to the waterway being closed due to flooding. The three largest commodity groups in terms of annual tons are shown for petroleum and petroleum products, chemicals, and crude materials.

Table 15. GIWW Morgan City-Port Allen, LA:
Annual Total Commodity Tons, 1990 to 2011

Year	Total Tons
1990	29,287
1991	24,532
1992	23,606
1993	27,097
1994	24,461
1995	25,416
1996	25,056
1997	26,428
1999	23,187
2002	20,798
2003	24,253
2004	24,313
2005	23,584
2006	22,494
2007	22,830
2008	23,289
2009	16,402
2010	20,502
2011	16,985

Source: Waterborne Commerce Statistics Center

4.3.2.1. Calcasieu Lock Statistics. Table 16 contains the statistics for total lockages and total vessels transiting the Calcasieu Lock annually from 1999 through 2011. Total lockages rose slightly from a 1999 level of nearly 12,000 to nearly 13,000 by 2004 and then declined to fewer than 12,000 through 2011. Total vessels reflected a similar pattern, hovering around 15,000 annually until 2004 and then declining to about 14,000 and 13,000 and remained there through 2011.

Table 16. Calcasieu Lock Statistics, 1999 to 2011

Year	Total Lockages	Total Vessels
1999	11,954	15,090
2000	12,348	15,288
2001	13,592	16,210
2002	12,986	15,231
2003	12,546	15,730
2004	13,030	15,260
2005	11,744	14,431
2006	11,871	14,609
2007	12,984	15,378
2008	12,189	14,229
2009	11,379	12,969
2010	11,259	13,314
2011	11,139	13,598

Source: Waterborne Commerce Statistics Center

Figure 9 depicts the trends of lockages and vessels for Calcasieu Lock during the period 1999 through 2011. Total annual lockages and vessels were nearly constant during most of the period and then declined between 2007 and 2011.

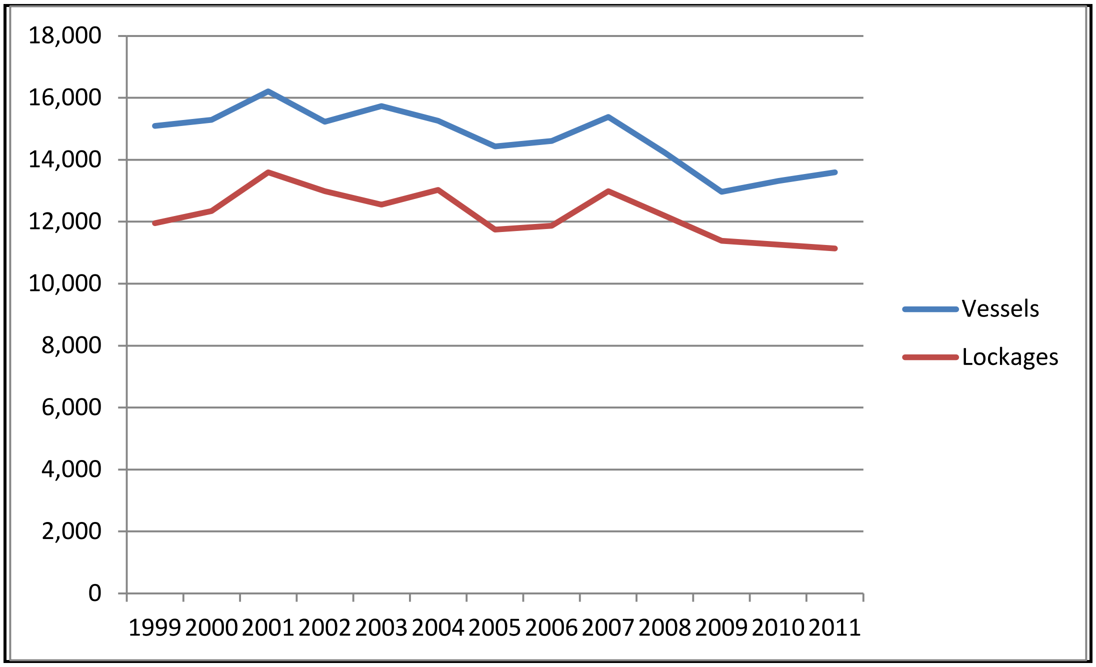

Figure 9. Calcasieu Lock Statistics, 1999 to 2011

Table 17 depicts the annual commodity tons for Calcasieu Lock for the period 1999 through 2011. The total annual tons were around 40 million from 1999 through 2003 and then increased in 2004 to 42 million. Total tons declined to nearly 402 million in 2004 and 2008 and subsequently declined to nearly 33 million in 2009 and rises to 37 million in 2011. Figure 10 shows the pattern of Calcasieu Lock total annual commodity tons, which increased from 2000 to a relative high in 2004, and then gradually declined to 2007 followed by a more sustained decline to 2009 with a small rise in 2010 followed by a leveling off.

Table 17. Calcasieu Lock Annual Commodity Tons, 1999 to 2011

Year	All Commodities
2000	38,820,484
2001	36,990,131
2002	37,127,096
2003	38,414,676
2004	41,995,766
2005	38,723,550
2006	39,997,909
2007	40,999,329
2008	37,839,539
2009	33,646,375
2010	37,033,000
2011	36,781,000

Source: Lock Performance Monitoring System

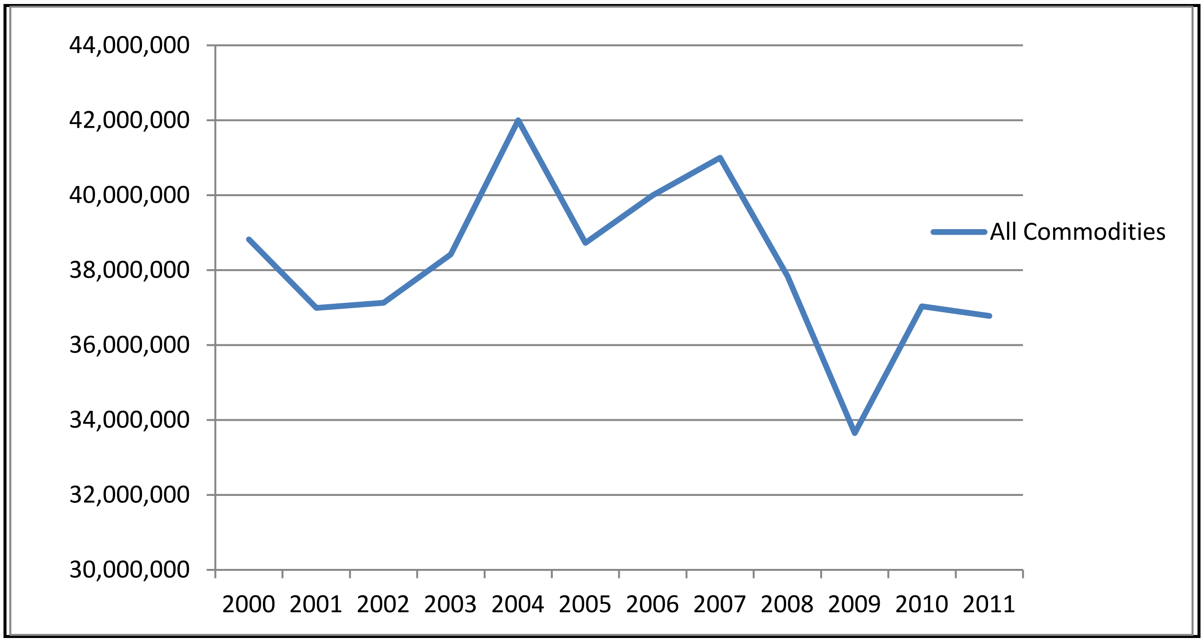

Figure 10. Calcasieu Lock Annual Commodity Tons, 1999 to 2011

4.3.2.2. Other GIWW System Lock Statistics. Table 18 shows the annual lock tonnages for Calcasieu Lock and the GIWW locks that are contiguous to the east: Leland Bowman, Bayou Sorrel, and Bayou Boeuf. Calcasieu and Leland Bowman tonnages move together and exhibit the same decline after 2007. Similarly, but to a lesser degree, Bayou Sorrel and Bayou Boeuf lock tonnages move together and exhibit a decline after 2008. For the GIWW system locks at Port Allen and Old River, the tonnages are relatively stable until 2008 when Port Allen declines. For the GIWW system locks at Harvey, Algiers, and Inner Harbor, the lock tonnages are different from the main stem GIWW. Algiers tonnages rose during the period 2000 to 2009, Harvey had a very slight decline in 2009 but rebounded thereafter, and Inner Harbor declined in 2008 and increased slightly in 2010 to 16 million tons, but declined again in 2011.

Table 18 Calcasieu Lock Waterway System Locks Total Commodity Tons (1,000s), 1999 to 2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Calcasieu Lock	40,146	38,675	39,260	40,121	44,078	41,999	41,375	41,778	38,446	33,070	37,033	36,718
Leland Bowman	41,181	39,121	39,166	40,247	43,821	42,115	41,338	41,879	38,092	32,537	36,284	36,380
Bayou Sorrel	22,048	22,617	19,439	23,479	23,686	24,367	23,987	24,017	22,916	15,909	19,909	15,739
Bayou Boeuf	24,179	19,822	23,701	24,731	27,466	25,530	25,950	26,245	25,595	25,461	13,353	13,943
Brazos East	21,307	19,565	17,825	19,709	21,415	20,640	20,443	20,673	17,745	16,285	18,573	18,997
Brazos West	21,156	19,430	17,786	19,651	21,322	20,647	20,458	20,240	17,672	16,189	18,643	18,994
Colorado East	20,818	19,305	17,368	19,070	20,682	20,089	19,945	19,808	17,249	16,032	18,390	18,672
Colorado West	20,446	19,056	16,989	18,715	20,267	19,481	19,403	19,161	16,756	15,497	17,632	17,515
Port Allen	24,106	24,073	20,460	24,492	25,294	25,364	25,146	25,133	24,168	16,900	20,819	17,035
Old River	9,154	8,027	7,929	7,377	7,124	7,378	9,161	7,773	6,253	7,729	7,092	7,007
Harvey	2,162	2,087	2,296	1,762	2,310	2,674	852	1,825	2,850	2,362	2,028	3,063
Algiers	20,001	22,884	23,521	24,182	26,839	24,078	26,543	25,356	24,832	25,291	24,013	26,429
Inner Harbor	17,066	16,624	17,571	17,290	18,663	16,308	16,681	17,412	12,791	14,210	16,350	15,150

Source: Lock Performance Monitoring System

4.3.3. Calcasieu Lock Major Shippers, Commodities and Tons. For future estimation of vessel traffic, it is crucial to gain an understanding of what commodities are being shipped on the waterway and, to a lesser extent, who is shipping these goods. The demand for a particular commodity is what will drive the estimation for waterborne transportation.

Table 19 contains the major commodity group tonnages transiting the Calcasieu Lock by the top 10 shippers for the period 2004 through 2008. The top 10 shippers account for nearly 40 percent of total annual lock tonnages during this period, ranging from 17.6 million tons in 2004 to 13.6 million tons in 2008. The major commodity groups of the top 10 shippers are petroleum products and chemicals. Petroleum products tonnages from the top 10 were relatively stable during the 2004 to 2008 period, close to about 10.5 million tons annually. Chemical tons were steady during the 2004 to 2008 period and then dropped substantially from about 4.6 million tons in 2007 to 3.0 million tons in 2008. Figure 11 depicts the ton trends for petroleum products and chemicals for the top 10 Calcasieu Lock shippers.

Table 19. Calcasieu Lock Top 10 Shippers Annual Commodity Tons, 2004 to 2008

Commodity	2004 Tons	2005 Tons	2006 Tons	2007 Tons	2008 Tons	Total
Aggregates	1,033,424	1,153,072	695,805	310,101	494,253	3,686,655
Chemicals	4,762,105	4,909,239	4,664,195	4,537,084	3,056,480	21,929,103
Coal	38,151	20,502	83,741	40,875	20,135	203,404
Crude Petroleum	1,042,392	498,670	647,404	245,643	206,037	2,640,146
Iron Ore and Iron & Steel	7,852				12,524	20,379
Non-Metallic Iron and Ores	7,142					7,142
Others	202			14,951	16,734	31,887
Petroleum Products	10,736,345	9,296,954	9,966,485	10,468,543	9,801,929	50,270,256
Total	**17,627,613**	**15,878,437**	**16,057,630**	**15,617,197**	**1,360,805**	**78,788,972**
Percent of All Commodities	**41.91%**	**35.94%**	**35.94%**	**38.07%**	**35.94%**	**39.45%**

Source: Waterborne Commerce Statistics Center and G.E.C., Inc

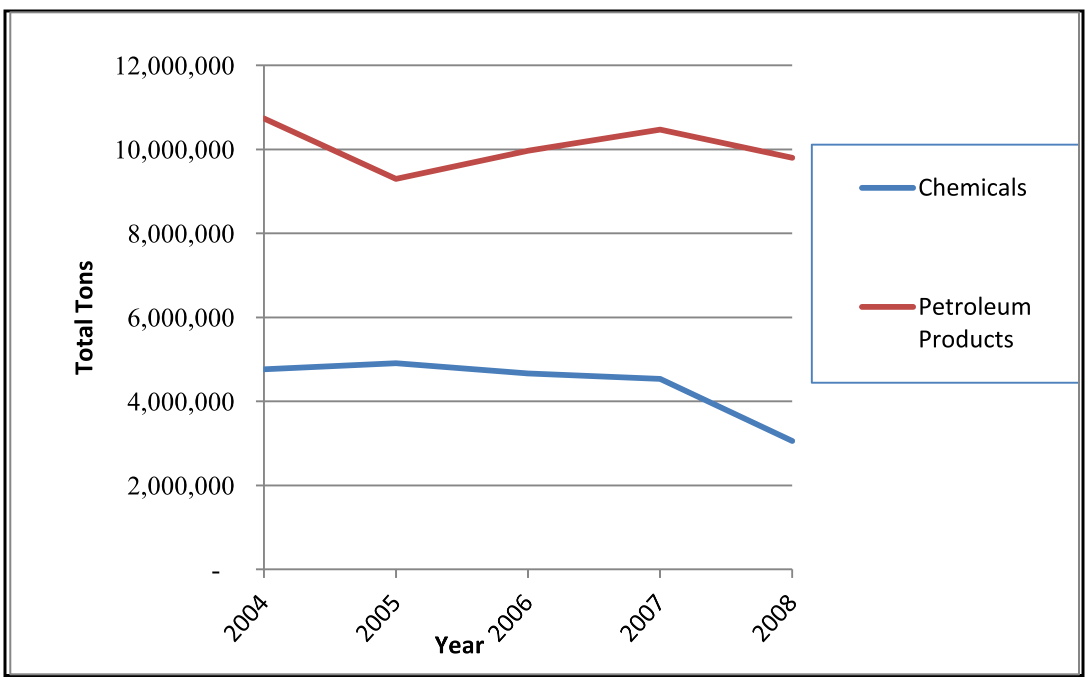

Figure 11. Calcasieu Lock Top 10 Shippers Commodity Tons, 2004 to 2008

5.0. ALTERNATIVES *

5.1. Plan Formulation

5.1.1. Plan Formulation Rationale. Alternative plans for the proposed action were formulated in consideration of Study area problems and opportunities, as well as Study goals, objectives and constraints.

5.1.2. Plan Formulation Criteria. As specified in ER 1105-2-100, four criteria were considered during alternative plan formulation: completeness, effectiveness, efficiency, and acceptability.

5.1.2.1. Completeness. Completeness is the extent to which an alternative plan provides and accounts for all investments and actions required to ensure the planned output is achieved. These criteria may require that an alternative plan considers the relationship of the alternative plan to other public and private plans if those plans affect the outcome of the project. Completeness also includes consideration of real estate issues, O&M, and monitoring.

5.1.2.2. Effectiveness. Effectiveness is defined as the degree to which the alternative plan will achieve the planning objective. The plan must make a significant contribution to the problem or opportunity being addressed.

5.1.2.3. Efficiency. The project must be a cost-effective means of addressing the problem or opportunity. The alternative plan outputs cannot be produced more cost-effectively by another institution or agency.

5.1.2.4. Acceptability. An alternative plan must be acceptable to Federal, state, and local government in terms of applicable laws, regulation, and public policy. The project should have evidence of broad-based public support.

5.2. Future Without-Project Condition- Navigation (No Action Plan). Identification of the most likely condition expected to exist in the future in the absence of any improvements to the existing navigation system is a fundamental first step in the evaluation of potential improvements. The Future Without Project (FWOP) Condition serves as a baseline against which alternative improvements are evaluated. The increment of change between an alternative plan and the future without project condition provides the basis for evaluating the beneficial or adverse economic, environmental, and social effects of the considered plan. Definition of the future without project condition is presented below. The forecast of the FWOP Condition reflects the conditions expected during the period of analysis.

The FWOP Condition identified for use in this Study includes the following analytical assumptions:

1. Operation and maintenance of all system locks will be continued through the period of economic analysis to ensure continued navigability.

2. All existing waterway projects or those under construction are to be considered in place and will be operated and maintained through the period of analysis.

3. Replacement of the IHNC Lock and Bayou Sorrel Lock was not assumed.

4. All system locks are using the most efficient locking policies.

5. Alternative non-system transportation means (rail and non-system water) are assumed to have sufficient capacity to move diverted system traffic at current costs over the period of analysis.

6. The capacities of system locks are as presented in Section 4 of Appendix K.

7. Traffic demands on the system will grow at the mid (most likely) growth rates.

8. The Calcasieu Lock was constructed as a saltwater barrier, and will continue to be operated to keep salt water from moving west to east into the Mermentau Basin.

9. The existing Black Bayou diversion structure, located east of the Calcasieu Lock at the junction of Black Bayou and the GIWW, will continue to be maintained by the Natural Resources Conservative Service (NRCS).

10. The existing Calcasieu Lock will continue to serve three purposes, consistent with the original project authorization:

- pass waterway traffic as a navigation lock on the GIWW;
- prevent saltwater intrusion from the Gulf of Mexico in the Mermentau River Basin; and
- serve as a flood way during high water in the Mermentau River Basin.

The ability of the gates to operate under differential water levels facilitates the capability of Calcasieu to serve as a flood-way. Operational rules at Calcasieu dictate that if the east gage exceeds 2.0 feet and the west gage is less than the east, then the Mermentau River Basin is "drained" by opening the sector gates on both ends of the Lock. This allows water to flow from east to west through the Lock chamber. This unrestricted flow of water has the potential to hinder or completely halt navigation due to excessive current speeds through the chamber.

Operational policy dictates that when the east gage reads between 2.0 and 2.5, eastbound tows can be accommodated by operating the Lock gates if the tows have insufficient power to "push the current". In this case, the sector gates are closed, stopping the flow of water through the lock, and allowing the tows to pass using standard locking techniques.

At east gage readings above 2.5 feet and west gage readings lower than the east, the Lock operates with a policy where the flood-way has priority over navigation. For purposes of this document, this operating condition is referred to as "full open pass". In full open pass, a vessel must have sufficient power to push the current. If they do not, they must do one of three things:

- reconfigure,
- call in a more powerful towboat, or
- wait for better current conditions

Any of these activities can cause significant delays to navigation attempting to traverse the Calcasieu Lock and it is these delays which this feasibility study will address via the with-project alternatives discussed in Appendix K, *Economics*.

Use of more powerful towboats for the entire trip was discussed. However, towboat horsepower strength used on the GIWW has remained fairly constant over time and is not likely to change in the foreseeable future. This is due to the fact that towboat horsepower use is primarily a function of the number and size of barges being pushed. In addition, on the GIWW, the U.S. Coast Guard imposes a maximum tow size (towboat plus barges must be < 1180 ft x 55 ft) for safety reasons because of the restrictive dimensions of the GIWW. Furthermore, it would be impractical from an economic perspective for shippers to employ larger horsepower towboats for the sole purpose of avoiding the delays at Calcasieu lock. First, delays caused by drainage events at Calcasieu lock occur randomly and infrequently, making it difficult for shippers to determine when more powerful towboats would be needed and second, the distances of a typical tow movement is quite long (several hundred miles), thereby making it cost prohibitive to use larger, more expensive horsepower tows for the entire trip.

5.2.1. Forecast - Vessel Traffic (Unconstrained). This section summarizes the long-term forecasts of unconstrained commercial traffic expected to transit Calcasieu Lock annually for the period 2009 through 2060. The forecast data presented here was prepared by Gulf Engineers & Consultants under contract with the Corps. For a more thorough discussion see Appendix K, Attachment 1, *Updated Vessel Traffic Forecast for the GIWW as It Relates to Calcasieu Lock.*

In this context, *unconstrained* means unconstrained by increases in future water congestion associated with increased levels of waterway traffic. Therefore, unconstrained traffic levels can also be viewed as levels of possible demand for waterway transportation on a particular waterway system, such as GIWW. The majority of the commercial cargo tons transiting Calcasieu Lock are related to the petrochemical industrial base that is contiguous to the Lock and the adjacent waterway network. Petroleum products, chemicals, and crude oil constitute over 75 percent of the total annual lock tonnage. A wide array of other dry bulk commodities constitute the remainder of the Lock cargo tonnages, primarily iron and steel products and aggregates.

The annual volumes of bulk liquids have been relatively stable for the last decade until declining in 2007 and 2008. The decline in liquid cargoes particularly characterizes bulk chemicals and to a lesser degree petroleum products. Dry bulk cargo volumes have fluctuated with no clear trends.

In 2010, the US Department of Energy, Energy Information Administration (EIA), issued the 25-year energy forecasts. These were used for forecasts of Calcasieu Lock tonnages related to liquid cargo and aggregates based on correlations between historical production/consumption estimates and lock tonnages. The EIA projections currently extend out to 2035. Moreover, the EIA most-likely expected energy forecasts are accompanied by low and high forecasts that are an important component for sensitivity analyses.

Calcasieu Lock projections for dry bulk commodities other than aggregates were based on average tonnages during the period 2000 to 2008. The dry bulks (other than aggregates) were not correlated to the energy related forecasts that corresponded with the other lock commodity tons (liquids and aggregates). The dry bulk categories displayed fluctuating and relatively low volumes of tons typically dominated by one or two specific commodities within each group such as iron and steel nonmetallic minerals (aluminum ores), coal (petroleum coke), grains (rice), and others (cement and waste water). The average tonnages of each dry bulk cargo were calculated from the period 2000 to 2008 and used to reflect annual values for the period 2009 to 2060.

Figure 12 depicts the total annual projected commodity tons for Calcasieu Lock for the period 2009 to 2060 for the major categories of liquid bulk, aggregates, and other dry bulks. Liquid bulk tonnages (petroleum products, chemicals, and crude petroleum) are projected to decline further from 2008 (29.167 million tons) to 2009 (27.042 million tons) and then rise to 29.510 million tons (2015) and thereafter remain at or near 29 million tons until 2034. Total liquid bulk tons are projected to decline from 28.945 million tons in 2034 to 26.351 million tons in 2060. Total lock tonnage is projected to closely follow the slow to no growth pattern of liquid bulk cargo tons. Total lock tonnage is projected to decline from 37.639 million tons in 2008 to 35.631 million tons in 2009 and then rise to 38.614 million tons in 2020 and remain less than 39 million tons until 2028. Total annual lock tonnage will remain at or near 39 million tons until 2042, decreasing very slowly thereafter to 38.614 million tons by 2060.

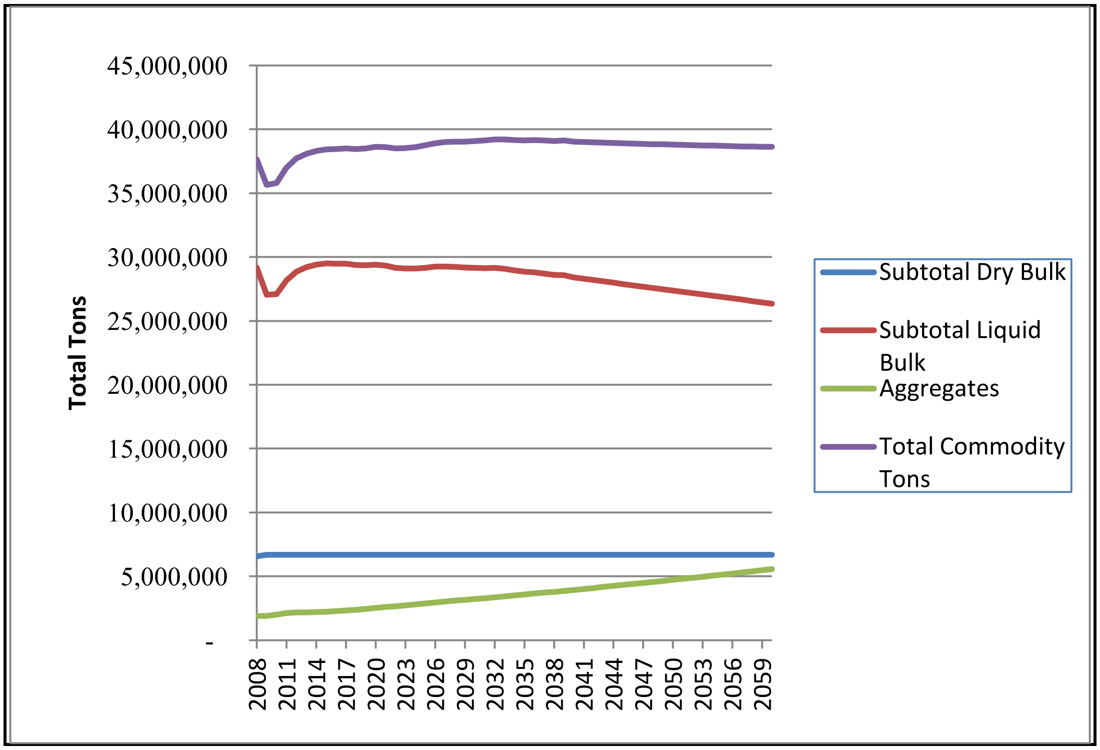

Figure 12. Annual Commodity Tons Projected for Calcasieu Lock, 2009 to 2060

The EIA forecasts used for most of the Lock tonnages (liquids and aggregates) are provided for a reference case and for high and low values of major inputs such as world oil prices and economic growth. The EIA alternative forecasts provide insight into the robustness of the reference case with respect to changes in major inputs. Usually, the reference case falls between the high and low values reflected in the alternative forecasts which allows for a measure of potential variability in the forecasts.

The EIA energy projections extend out 25 years, currently to 2035. Beyond 2035, the EIA projections have to be extrapolated based on trends in the out years. The EIA projections were extrapolated past 2035 for trends in the forecasts except for petroleum products, which displayed no clear trends among the individual product components. Consequently, petroleum product forecasts were fixed at the EIA 2035 ending year. Other forecasts for chemicals, crude oil, and aggregates were extrapolated out to 2060.

Overall, until at least 2035, the 2010 EIA outlook had conservative projections for U.S. energy use. Beginning in 2014 and extending through 2035, the EIA expects flat production of oil in the Gulf of Mexico, which constitutes a major input to Calcasieu Lock tonnage for crude, chemicals, and petroleum products. This, in effect, has made total traffic projections at Calcasieu Lock rather conservative as well. As shown in table 20, using the most likely traffic forecast, tonnage moving through Calcasieu Lock is expected to grow by only about 8 percent over the next 50 years.

Table 20. Calcasieu Lock Most Likely Traffic Forecasts (Total Tons)

Year	Tons
2010	35,801,187
2015	38,429,408
2020	38,614,962
2025	38,743,972
2030	39,087,124
2035	39,122,936
2040	39,034,922
2045	38,907,360
2050	38,794,394
2055	38,696,580
2060	38,614,495

Figure 13 compares the total annual tonnages forecasted for Calcasieu Lock for the period 2011–2061 as updated (2012) with the forecasted total annual lock tonnages from the previous (2010) forecast. The 2010 forecast exhibits a modest increase in total tonnage from 37.000 million in 2011 to 39.122 million by 2035 and then declining to 38.614 million by 2060. The updated (2013) forecast exhibits a slightly more but still modest increase in total tonnage from 37.983 million tons in 2011 to 42.123 million tons in 2035 and then very slow growth thereafter to 42.490 million tons in 2061. The slow growth for the updated forecast after 2035 is attributable to constant values for the two largest commodity groups, petrochemicals and chemicals, after 2035 while there is a slight decline in crude oil tons projected after 2035.

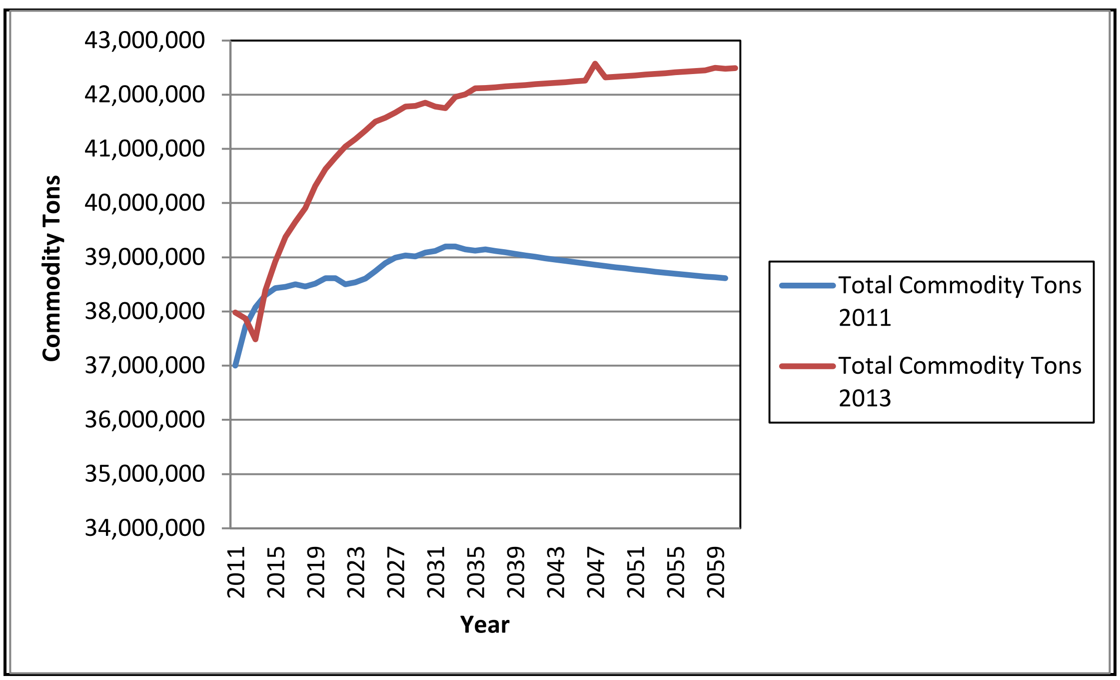

Figure 13. 2011 and 2013 Total Annual Forecasted Commodity Tons Transiting Calcasieu Lock, 2011-2061

5.2.2. Average Annual Costs. Table 21 displays the average annual cost of operating the Calcasieu Lock for the period 2011 to 2068. As shown, costs are divided into Federal costs (i.e.

the cost of maintaining and repairing the lock), and the cost to commercial transportation. With respect to the cost to commercial transportation, the disruptions due to scheduled maintenance services and unscheduled repair services are isolated and shown separately. As table 21 shows, drainage events cost the commercial navigation about $3.9 million on an average annual basis. Eliminating these costs would represent a savings to the navigation industry of the same amount.

5.2.3. Potential Relative Sea Level Rise Impacts to Navigation. Future drainage events that utilize the Calcasieu Lock are subject to changes in Relative Sea Level Rise (RSLR). Increases in RSLR have the potential to increase Gulf stages and therefore the head difference between the interior of the Mermentau Basin and the Gulf. This will potentially reduce the number of drainage events that cause delays. Conversely, due to the need to maintain salinity gradients within the Mermentau, lockages may increase. Current guidance on RSLR demands a sensitivity analysis of the final array of alternatives to better assess each alternative's robustness in dealing with future changes in RSLR. Given the potential impacts to RSLR to the FWOP, RSLR was incorporated into the above FWOP economic calculations for the low, intermediate and high RSLR forecasts. The effects of RSLR are presented in table 22. Additional details related to its incorporation into the economic models can be found in Appendix K.

Table 21. Existing/Without-Project Condition Costs and Impacts
(Avg Annual 3.75% discount / amortization. rate, 2018 base year, FY 2013 dollars)

Cost Category	Most-Likely /Expected (Reference)	Forecast Sensitivity: Minimum (low traffic forecast)	Forecast Sensitivity: Maximum (high traffic forecast)
Federal Costs (Calcasieu Lock only)			
Normal Operations and Maintenance	$303,840	*na*	*na*
Major Maintenance Repairs (scheduled)	$1,558,163	*na*	*na*
Unscheduled Repairs (i.e., hurricane)	$281,898	*na*	*na*
Sub-Total	**$2,143,901**		
Commercial Transportation Costs			
Transit Time Cost (no service disruptions) - At Calcasieu	$6,140,538	$5,376,955	$7,500,795
Transit Time Cost (no service disruptions) - Other Locks	$19,346,722	$12,505,238	$63,772,072
Major Maintenance Service Disruptions (scheduled) [1]	$6,608,370	$4,294,007	$8,525,535
Unscheduled Service Disruptions (i.e., hurricane) [1]	$3,180,312	$2,771,446	$3,905,903
Drainage Event Service Disruptions [2]	**$3,871,895**	**$3,146,730**	**$3,885,398**
Sub-Total	**$39,147,835**	**$28,094,376**	**$87,589,701**
GRAND TOTAL	**$41,291,737**	**$30,238,277**	**$89,733,603**

[1] Includes transit cost changes at all locks in the system and lost barge transportation consumer surplus from diverted tonnage.
[2] Impacts of disruption are from year 2015. Note, all these impacts are not recoverable given construction/implementation time.

Table 22. Existing/Without-Project Condition Costs and Impacts
Reference Demand Scenario – Sea Level Rise Sensitivity Test
(Avg Annual 3.75% discount / amortization. Rate, 2011-2068 with 2018 base year, FY 2013 dollars)

		Sea-Level Rise Sensitivity[2]		
Cost Category	**Existing Sea Level**	**Slow**	**Moderate**	**Rapid**
Federal Costs (Calcasieu Lock only)				
Normal Operations and Maintenance	$303,840	$303,840	$303,840	$303,840
Major Maintenance Repairs (scheduled)	$1,558,163	$1,558,163	$1,558,163	$1,558,163
Unscheduled Repairs (i.e., hurricane)	$281,898	$281,898	$281,898	$281,898
Sub-Total	**$2,143,901**	**$2,143,901**	**$2,143,901**	**$2,143,901**
Commercial Transportation Costs				
Transit Time Cost (no service disruptions) - At Calcasieu [3]	$6,140,538	$6,140,538	$6,140,538	$6,140,538
Transit Time Cost (no service disruptions) - Other Locks	$19,346,722	$19,346,722	$19,346,722	$19,346,722
Major Maintenance Service Disruptions (scheduled) [1]	$6,608,370	$6,608,370	$6,608,370	$6,608,370
Unscheduled Service Disruptions (i.e., hurricane) [1]	$3,180,312	$3,180,312	$3,180,312	$3,180,312
Drainage Event Service Disruptions [4]	**$3,871,895**	**$2,655,866**	**$1,170,577**	**$424,372**
Sub-Total	**$39,147,835**	**$37,931,806**	**$36,446,518**	**$35,700,313**
GRAND TOTAL	**$41,291,737**	**$40,075,708**	**$38,590,419**	**$37,844,214**

[1] Includes transit cost changes at all locks in the system and lost barge transportation consumer surplus from diverted tonnage.

[2] NIM was not exercised for this sensitivity analysis. Drainage event disruption costs were reduced based on a linear reduction of the open pass drainage event cost to zero based on the estimated open pass extinction year.

[3] Transit time costs at Calcasieu Lock will most-likely change as sea level rises. Sea level rise decreases the drainage event gage differential, benefiting vessel transit; however, overall open pass reduction increases transit as more vessels are required to lock.

[4] Impacts of disruption are from year 2015. Note, all these impacts are not recoverable given construction/implementation time.

5.3. Future Without Project Condition- Environment

5.3.1. Soils and Waterbottoms. In the FWOP Condition, most of the soils would remain in the current condition; however, a large portion of emergent wetlands would be converted to waterbottoms. This would result in reduced habitat for terrestrial species and benthic species typical of emergent wetlands. In addition, there would be a decrease of available nutrients and detritus present to estuarine communities.

5.3.1.1. Hydrology. While the Study area has periodically experienced localized flooding from excessive rainfall events, the primary cause of the flooding events has been the tidal surges from hurricanes and tropical storms. During the past seven years, the Study area was affected by the storm surges associated with four tropical events, which inundated structures and resulted in billions of dollars in damages. In the future, without implementation of hurricane risk reduction measures coupled with coastal restoration, the area would continue to experience flooding and damage from tropical storms and hurricanes.

The water level in the cheniers and especially the Mermentau Basin has risen at a rate of 0.84 inches per year as a result of water control structures, marsh impoundments, and agricultural drainage (Gosselink et al., 1979). In the FWOP Condition, this trend would be expected to continue.

5.3.1.2. Sedimentation and Erosion. In the FWOP condition, erosion along the Gulf shoreline is expected to continue at its present rate of 20 to 40 feet per year in the project area. Shoreline retreat is causing the loss of back-beach marshes and is threatening to alter the hydrology of interior marshes. Erosion is also a problem along the shores of Calcasieu Lake and the banks of the GIWW. In addition, breaching of the lake shores as a result of erosion threatens adjacent marshes with increased water exchange and saltwater intrusion. Flood control projects on the Mississippi and Atchafalaya Rivers, as well as construction of jetties on the Mermentau River, Calcasieu Ship Channel, and Sabine Pass have altered sediment transport and sediment availability.

5.3.1.3. Water Use and Supply. In the FWOP Condition, water use and supply will be directly linked to freshwater groundwater availability. Since saltwater intrusion is expected to continue as coastal shorelines, as well as shorelines within busy navigation canals, erode which may compromise freshwater groundwater wells, water use and supply will likely be reduced in future years primarily for agricultural uses.

5.3.1.4. Groundwater. In the FWOP Condition, water quality trends, especially salt water intrusion, are expected to continue. Best Management Practices would be expected to be encouraged and water quality improvement programs implemented by LDEQ and others would be expected to have some beneficial effects. However, without large restoration efforts, saltwater intrusion is expected to continue as coastal shorelines, as well as shorelines within busy navigation canals, erode which may compromise freshwater groundwater wells.

5.3.2. Water Quality. The Calcasieu River Basin is located in southwest Louisiana. Originating in headwaters in the hills west of Alexandria, LA, the Calcasieu River flows generally south for about 160 miles to the Gulf of Mexico. The river mouth is at Cameron, LA, approximately 30 miles east of Sabine Pass and the Texas-Louisiana state line. There are dramatic differences in land use between the Lower Calcasieu Lake/Estuary system (the lower 40 miles below the saltwater barrier) and the upper riverine system. Overall land use in the Calcasieu Basin (LDEQ 1990) is 50.8 percent forest, 26.4 percent agriculture, 11.8 percent wetland, 2.6 percent urban, and 5.7 percent water. The LDEQ divides the basin into subsegments. For example, LDEQ subsegment 04, located in the Lower Calcasieu Basin, includes Calcasieu Lake. Land use in subsegment 04 is 46.3 percent water and 43.2 percent wetland. Thus, land use in the southern-most region of the basin is markedly different from that in the upper basin (Waldon 1996).

The Lower Calcasieu Basin receives discharges from numerous municipal and industrial point sources (Duke 1985). Most of the dischargers are located in the area between the saltwater barrier and the GIWW. Municipal dischargers include the City of Lake Charles, the City of Sulphur, and the Town of Westlake. Industrial dischargers include Olin Corp.; PPG Industries; CITGO; W.R. Grace; Certain-Teed; Himont; and Firestone. A few dischargers are located south of the GIWW, particularly in the area of Cameron.

Section 304(l) of the CWA requires states to prepare lists of waterbodies which are not expected to achieve applicable water quality standards for toxic pollutants after technology based requirements have been met. Several segments of the Calcasieu Basin have been listed (LDEQ 1992). Listed segments include Bayou Verdine (030306), Bayou D'Inde (030901), Calcasieu River and Ship Channel (030301), and Prien Lake (030303). Causes for listing include halogenated aliphatic and aromatic priority pollutant organic chemicals, and, in Bayou Verdine, phenol and nickel. Point source dischargers listed under section 304(l) include PPG, Conoco, and Vista.

Salinity below the saltwater barrier is dependent on the intensity of freshwater inflow. Surface salinity is typically lowest near the saltwater barrier, and increases as the Gulf is approached (Duke 1985). Typically, a "saltwater wedge" is observed in the Ship Channel. The existence of this wedge affects circulation patterns, water quality, and biological indicators of water quality.

In the FWOP Condition, water quality trends are expected to continue. Best Management Practices would be expected to be encouraged and water quality improvement programs implemented by LDEQ and others would be expected to have some beneficial effects. However, without large restoration efforts, saltwater intrusion is expected to continue as coastal shorelines, as well as shorelines within busy navigation canals, erode.

5.3.3. Air Quality. In the FWOP Condition, the status of air quality in the Study area is a concern because of trends for continued population growth, further commercialization and industrialization, increased number of motor vehicles, and increased emissions from various engines. According to the USEPA (comment letter dated December 3, 2013), the Lake Charles Metropolitan Statistical Area is vulnerable to being designated as non-attainment for ozone in the next few years. The Imperial Calcasieu Regional Planning & Development Commission, representing Calcasieu Parish, Cameron Parish, and a number of other local entities, has applied for and been accepted by USEPA into the EPA Ozone Advancement Program. The Ozone Advance program is a collaborative effort 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. Ozone levels in the project area are a sensitive issue, and federally-funded projects in the study should consider emissions which contribute to the formation of ozone.

5.3.4. Noise. Vessel traffic projections indicate that waiting times for the Calcasieu Lock would increase if no action were taken, so there is the probability that noise impacts to residents from tugs would increase correspondingly. Additional noise would be expected in the areas currently used by tows waiting for the Lock and in areas beyond where they currently wait due to a higher frequency and length of delays. The noise from tows waiting south of the Lock does not impact residents because there are no residential structures located along the GIWW south of the Lock. To the north, additional delays would increase both the frequency that residents are exposed to vessel-generated noise and the number of residents exposed.

Without implementation of the project, noise patterns would likely follow current trends. Much of the Study area is remote and uninhabited marsh. Urban areas would continue to experience growth and therefore the noise associated with increased traffic and industrial activity. Other noise conditions would continue essentially the same.

5.3.5. Vegetation Resources. In the FWOP Condition, marsh habitat would continue to be restored through habitat restoration projects and programs such as those authorized for construction through CWPPRA, Coastal Impact Assistance Program (CIAP), and Louisiana Coastal Area (LCA) that would enhance existing vegetative communities but not at a large enough scale to completely restore natural processes and features vital to the long-term sustainability of the watershed. Also, wetlands would continue to convert to open water. As interior wetlands convert to open water, there would be an expected loss of species richness in both vegetation communities and wildlife communities. The continued loss and degradation of wetland habitat would likely result in a decrease in habitat diversity ultimately impacting other wildlife within the project area.

5.3.5.1. Coastal Live Oak-Hackberry Forest (Chenier Maritime Forest). In the FWOP Condition, the current use of the cheniers and natural ridges would continue. Chenier forests have historically been subject to human disturbance. It is the only high ground in the landscape and therefore is used for development, highways, access roads, infrastructures, oil and gas production, and agriculture. In a study conducted by Providence Engineering and funded by the LDNR on the cheniers and natural ridges, approximately 11 percent of the cheniers studied were undeveloped (PEEG 2009).

5.3.5.2. Freshwater Marsh. In the FWOP Condition, saltwater intrusion and drainage problems would continue, resulting in the conversion of freshwater marsh to intermediate and brackish marsh.

5.3.6. Wildlife and Habitat. In the FWOP Condition, marsh habitat would continue to be restored through habitat restoration projects and programs such as those authorized for construction through CWPPRA, and LCA that would benefit wildlife but not at a large enough scale to completely restore natural processes and features vital to the long-term sustainability of the watershed. Also, wetlands utilized as foraging, nesting, and overwintering habitat would continue to convert to open water. As interior wetlands convert to open water, there would be an expected loss of species richness. The continued loss and degradation of wetland habitat would likely result in a decrease in wildlife use of the area.

5.3.7. Aquatic Resources. In the FWOP Condition, marsh habitat would continue to be restored through other restoration projects and programs such as those authorized for construction through CWPPRA, CIAP and LCA that would benefit plankton resources but not at a large enough scale to completely restore natural processes and features vital to the long-term success of the watershed. This loss of wetlands would eventually result in a decrease of available nutrients and detritus, which could lead to the conversion of primarily estuarine-dependent plankton species assemblages to more marine and open water plankton species assemblages.

5.3.8. Fisheries. Coastal Louisiana supports one of the most productive fisheries in the Nation. However, it is believed that with no action, sharp declines in fisheries productivity are likely (Minello et al. 1994; Rozas and Reed et al.1993). Direct impacts to fisheries may result from events such as hypoxia, but are expected to be smaller in comparison to indirect impacts. Indirect impacts to fisheries may result from the expected continuation of land loss and further loss of habitat supportive of estuarine and marine fishery species. In the short-term, land loss and predicted sea level changes are likely to increase open water habitats available to marine species. In the long-term, as open water

replaces wetland habitat and the extent of marsh to water interface begins to decrease, fishery productivity is likely to decline (Minello et al. 1994; Rozas and Reed 1993). This may already be happening in the Barataria and Terrebonne estuaries. Browder et al. (1989) predicted that brown shrimp catches in Barataria, Timbalier, and Terrebonne Basins would peak around the year 2000 and may fall to 0 within 52 to 105 years.
Other considerations on the impact to fisheries are predator/prey relationships; water quality, salinity, and temperature; harvest rates; wetland development activities (dredge/fill); habitat conversion (e.g., wetland to upland); and access blockages. Habitat suitability, diversity, population size, and harvest rates also influence the future condition of fisheries. Habitat suitability for fisheries varies by species, and depends on different water quality and substrate types.

Habitat restoration efforts in the area (e.g., CWPPRA) have aided fisheries habitat, and are likely to continue. Economic interest in fisheries and interest in Louisiana as a fishery resource for the Nation has increased significantly. The increase is expected to continue, leading to changes in fishing technology, fishing pressure, and fishing regulations in order to maintain sustainable commercial fisheries. It is likely that construction of levees, water control structures, and hurricane protection features will continue and/or increase as coastal residents protect themselves and their property from hurricane damage and flooding. All of these structures alter water flow, potentially block fisheries access, and may directly convert habitat supportive of fishery species to unsupportive areas.

Although fisheries productivity has remained high (e.g., Caffey & Schexnayder 2002) as Louisiana has experienced tremendous marsh loss, this level of productivity may be unsustainable. As marsh loss occurs, a maximum marsh to water interface (i.e., edge) is reached (Browder et al. 1985). A decline in this interface will follow if marsh loss continues and the overall value of the area as fisheries habitat will decrease (Minello et al. 2003). Because fishery productivity has been related to the extent of the marsh to water interface (Faller 1979; Dow et al. 1985; Zimmerman et al. 1984), it is reasonable to expect fishery productivity to decline as the amount of this interface decreases.

As marsh and optimal habitat continue to erode, it is anticipated that oyster resources will experience a decline in the long-term and a shift in the area of greatest productivity. Although the conversion of marsh into open water will likely provide temporary new oyster habitat, the quality of this habitat is expected to decrease as populations become stressed by increased saltwater intrusion, predation, and lack of adequate shelter resulting from marsh erosion. Once buffered by interior and barrier wetlands, oyster reefs will be exposed directly to the gulf as surrounding marshes erode. This is likely to increase damages to reefs related to storm events. For example, following Hurricane Andrew in 1992, many oyster farmers requested Federal relief for decimated oyster beds.

5.3.9. Essential Fish Habitat. Although previous restoration efforts have helped maintain some categories of EFH, the cumulative impacts of land loss, conversion of habitats, sea level change, increased storm intensity, etc., are expected to lead to a net decrease in the habitat most supportive of estuarine and marine species. The direct losses of highly productive forms of EFH would lead to losses of shallow habitat due to the exposed nature of the shallow open water bottoms that are being formed. Shallow waters are likely to become deep waters, and salinity gradients would be less estuarine, with a sharper distinction between saline and freshwater habitat, as coastal residents further attempt to protect self and property with levees, flood gates, and other water control structures.

It is believed that marsh loss that has been experienced to date has increased this land/water interface and increased fishery production. As land loss continues, it is believed that this interface would approach a maximum and begin to decline. This would, in turn, result in a decline in fishery production. In some areas, continued marsh loss is already resulting in the reduction of this interface.

5.3.10. Threatened and Endangered Species. Degradation and loss of important and essential fish and wildlife habitats used by many different species of fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements is expected to continue in the FWOP Condition. The loss and deterioration of transitional wetland habitats would continue to impact, to some undetermined degree, all listed species that potentially utilize the project area including: West Indian manatee, piping plover, green sea turtle, hawksbill sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. Adverse cumulative impacts on listed species would be offset, to some degree, by the positive impacts of implementing Federal, state, local, and private restoration projects.

5.3.11. Ecosystem Restoration Projects To Be Constructed. The ongoing Southwest Coastal Louisiana Feasibility conducted an assessment of the CWPPRA projects likely to be constructed in the area. All constructed projects are included in the FWOP Condition unless they are small and lacking significant influence on the future landscape, e.g. small demonstration projects. Pending projects are only included in the FWOP condition if they are highly likely to be built. For example, CWPPRA projects in Phase I (Planning) are not included in the FWOP, but CWPPRA projects in Phase II (funded for construction) are included. There are Phase II projects within the Study Area that have been incorporated into the Hydraulic modeling. However, there are no Phase II projects within the immediate vicinity of Calcasieu Lock with the exception of Black Bayou which is described in the formulation of measures and alternatives in 5.5.1 below. Complete descriptions can be found at the CWPPRA website at http://www.mvn.usace.army.mil/Missions/Environmental/CWPPRA.aspx or at www.LaCoast.gov

The Southwest Coastal Study has identified preliminary measures and alternatives throughout the Study area. However, since a preferred alternative has not yet been identified or authorized by Congress, those alternatives are not included in the FWOP for the Calcasieu Study.

5.4. Planning Objectives. ER 1105-2-100 stipulates that "The Federal objective of water and related land resources planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment…"

Contributions to NED are the direct net benefits that accrue in the Study area and the rest of the Nation. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective (table 23). Study goals, objectives, and constraints were developed to comply with the Study authority and to respond to Study area problems and opportunities. The overall Study goal reflects the role Calcasieu Lock plays in a critical navigation system as well as an integral part to a water management system (Mermentau Basin) that requires both drainage capacity and an effective barrier to salinity intrusion. Therefore, the overall goal is:

- to maximize the efficiency of the Calcasieu Lock, thereby contributing to the overall efficiency of GIWW as a nationally significant navigation system, while continuing to provide water management capability and salinity control to the Mermentau River Basin.

To support accomplishment of the Study goal, the following specific planning objective was developed for the Calcasieu Lock Feasibility Study:

- reduce drainage event induced navigation delays at Calcasieu Lock while minimizing the impacts to the surrounding area

Table 23. Summary of the Problems, Opportunities, Goals, Objectives and Measures to this Point in the Planning Process

Problems and Opportunities	Overarching System Goal	Objective	Potential General Measures
Problem Navigation delays at Calcasieu Lock are primarily related to hydrologic conditions and how they affect the tonnage passing through the lock. The Lock was constructed as a saltwater barrier, and it is operated to keep salt water from moving west to east into the Mermentau Basin, and to drain flood flows from east to west to the Calcasieu River. Delays can occur when there are excessive stages within the Mermentau Basin. During floods, the Lock is frequently left open to drain water from the basin toward the Calcasieu River. During this situation, tows are forced to wait out the drainage event due to head differential in the Lock chamber. **Opportunities** • **Navigation Efficiency.** Altering the existing lock structure to decrease the impacts of drainage events on transiting tows will result in shorter lockage times and delays for tows staging at either segment of the GIWW (east or west). Fewer barge reconfigurations to allow for transit during drainage events will increase cycling times of tows through the lock. An additional or wider lock chamber would allow for passing of flows through the old lock or through a new wider lock that can accommodate drainage events and lockages. • **Hydraulic Distribution.** Redirecting completely or partially drainage flows away from the existing lock will reduce or eliminate the delays that result.	Maximize the efficiency of the Calcasieu Lock thereby contributing to the overall efficiency of GIWW as a nationally significant navigation system, while continuing to provide water management capability and salinity control to the Mermentau River Basin.	Reduce drainage event induced navigation delays at Calcasieu Lock while minimizing the impacts to the surrounding area.	New Lock Efficiency Measures Existing Lock Efficiency Measures • New Sector Gates • New Guide Walls/Kevels • Helper Boats • Scheduled Lockages Drainage Alteration • Pumping Station • South 110-foot Gate • South 75-foot Gate • Rehabilitate Black Bayou Drainage Structure • Modification of Black Bayou Drainage Structure • Suspension of Lock Drainage

5.5. With Project Navigation Alternative Plan Formulation

5.5.1. Management Measures

5.5.1.1. Value Engineering Study. A Value Engineering (VE) Team was assembled during feasibility and conducted the VE Study, found in Appendix H. Recommendations from the VE Study were used in the screening of management measures and formulation of alternatives discussed in the following sections. Due to the potential cost of any Action alternative, a second VE would need to be conducted during development of Plans & Specifications in accordance with ER 11-1-321.

5.5.1.2. Development of Management Measures. A management measure is a feature (a structural element that requires construction or assembly on-site) or an activity (a nonstructural action) that can be combined with other management measures to form alternative plans. Management measures were developed to address Study area problems and to capitalize upon Study area opportunities. Management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, and the multidisciplinary, Interagency Project Delivery Team.

Before alternative plans were formulated, the first step taken was to identify general locations and categories of potential improvements that would satisfy the objectives established previously. The process began with several discussions concerning the objectives discussed in the previous section. This yields an array of general measures from which specific measures were developed. The formulation of these specific measures involved an assessment of the measures as to whether they met the objectives of the Study and how likely they were to produce navigation efficiencies through reduction of lock delays due to drainage.

Finally, during this process, several specific measures were screened for a variety of reasons. They are not included as specific measures but are described in the screening section below, along with the necessary justification for their elimination from consideration. Upon finalization of specific measures, alternatives will be developed through combinations of specific measures.

5.5.1.3. Description of Management Measures. As each potential category of measures was developed, a corresponding list of criteria related to each potential measure was also developed. Below are listed the categories of actions to adequately address the navigation objectives. Measures are loosely defined in three categories that seek to address the primary problem of induced navigation delays through authorized operations of the Lock as a drainage structure and the associated opportunities for navigation efficiency and hydraulic distribution. The measures are as follows:

- **New Lock (NL) Efficiency Measures.** The use of the existing Calcasieu Lock for drainage purposes creates significant delays during said events. This category of measures looks at addressing this problem by 1) creating new lock facilities for navigation while the existing structure is used for drainage, and 2) creating a new lock facility that has the capacity to pass drainage events and accommodate eastbound tow traffic. Potential measures include new lock chambers at both 110-foot and 75-foot width dimensions and either continued use of the existing structure for drainage or closure of the current lock (figure 14). To more fully explore all options, both earthen lock chambers similar to the existing design and concrete chambers were identified with the primary difference being construction costs.

Figure 14. Potential New Lock Alignments

- **Existing Lock (EL) Efficiency Measures.** The use of the existing Calcasieu Lock for drainage purposes creates significant delays during said events. This category of measures looks at addressing this problem by 1) altering the existing lock to better pass drainage events while reducing delays to navigation, 2) providing measures to assist eastbound tows with transiting the Lock during drainage events and 3) implementing scheduled lockage times during drainage events to accommodate the need for both navigation and drainage. Potential measures include replacing the existing sector gates with wider gates that will allow the full width of the exiting chamber to be used for drainage, provision of aids to navigation and scheduling lockage during drainage events.

- **Drainage Alteration (DA) Measures.** The use of the existing Calcasieu Lock for drainage purposes creates significant delays during said events. This category of measures looks at addressing this problem by altering the drainage patterns so the Lock can be used for navigation during drainage events. Measures to be evaluated include pumping, bypass channels with gates, rehabilitation and or expansion of the Black Bayou CWPPRA project and no longer using the Lock for drainage.

- **Specific Measures.** Management measures that were carried forward for further evaluation are consistent with specific Corps policies for inland navigation, and Federal laws, regulations, and EOs. Reflecting the criteria outlined above and the constraints present at the project site, specific measures were developed within the broad categories of potential measures. These measures are intended to satisfy the objectives and reach the goals of the project.

5.5.1.4. New Lock (NL) Efficiency Measures

NLNA - North Lock Alignment 110 feet x 1,200 feet w/ original lock in place (drainage) [earthen]. This measure would involve construction of a new 110 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier north of the existing chamber. The chamber would be of earthen construction with interior and exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber. Due to the widening of the approach channel on the east side, the Highway 384 pontoon bridge will need to be replaced. A replacement bridge could be a new pontoon, lift or swings span bridge.

NLNB - North Lock Alignment 110 feet x 1,200 feet w/ original lock in place (drainage) [concrete]. This measure would involve construction of a new 110 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier north of the existing chamber. The chamber would be of concrete construction with exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber. Due to the widening of the approach channel on the east side, the Highway 384 pontoon bridge will need to be replaced. A replacement bridge could be a new pontoon, lift or swings span bridge.

NLNC - North Lock Alignment 75 feet x 1,200 feet w/ original lock in place (drainage) [earthen]. This measure would involve construction of a new 75 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier north of the existing chamber. The chamber would be of earthen construction with interior and exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber. Due to the widening of the approach channel on the east side, the Highway 384 pontoon bridge will need to be replaced. A replacement bridge could be a new pontoon, lift or swings span bridge.

NLND - North Lock Alignment 75 feet x 1,200 feet w/ original lock in place (drainage) [concrete]. This measure would involve construction of a new 75 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier north of the existing chamber. The chamber would be of concrete construction with exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber. Due to the widening of the approach channel on the east side, the Highway 384 pontoon bridge will need to be replaced. A replacement bridge could be a new pontoon, lift or swings span bridge.

NLSA - South Lock Alignment 110 feet x 1,200 feet w/ original lock in place (drainage) [earthen]. This measure would involve construction of a new 110 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of earthen construction with interior and exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber.

NLSB - South Lock Alignment 110 feet x 1,200 feet w/ original lock in place (drainage) [concrete]. This measure would involve construction of a new 110 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of concrete construction with exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber.

NLSC - South Lock Alignment 75 feet x 1,200 feet w/ original lock in place (drainage) [earthen]. This measure would involve construction of a new 75 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of earthen construction with interior and exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber.

NLSD - South Lock Alignment 75 feet x 1,200 feet w/ original lock in place (drainage) [concrete]. This measure would involve construction of a new 75 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of concrete construction with exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be used for drainage and be available as an auxiliary chamber during maintenance periods for the new main chamber.

NLSE - South Lock Alignment 110 feet x 1,200 feet (close existing lock) [earthen]. This measure would involve construction of a new 110 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of earthen construction with interior and exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be closed and filled in.

NLSF - South Lock Alignment 110 feet x 1,200 feet (close existing lock) [concrete]. This measure would involve construction of a new 110 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of concrete construction with exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be closed and filled in.

NLSG - South Lock Alignment 75 feet x 1,200 feet (close existing lock) [earthen]. This measure would involve construction of a new 75 x 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of earthen construction with interior and exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be closed and filled in.

NLSH - South Lock Alignment 75 feet x 1,200 feet (close existing lock) [concrete]. This measure would involve construction of a new 75 foot by 1,200-foot lock chamber for use as a navigation structure and salinity barrier south of the existing chamber. The chamber would be of concrete construction with exterior timber guidewalls. Sector gates would provide salinity control and access for navigation. The existing chamber would be closed and filled in.

5.5.1.5. Existing Lock (EL) Efficiency Measures

ELA - Existing Lock with New 82-foot Sector Gates. This measure would involve installation of new 82-foot (165-foot opening) sector gates at both ends of the existing lock chamber and subsequent removal of the existing gates and bays. The existing 37.5-foot gates (75-foot opening) serve to constrict water flows during drainage events. The larger gates will allow the entire width of the earthen chamber to be used for drainage. The cross section will increase from 75 feet to 165 feet (figure 15). The resulting lock chamber with the new sector gates will be longer than the current 1,200 feet; however, the maximum length of tows will still be limited to 1,200 feet. Construction of the gate bays can occur outside of the existing lock alignment. However, driving the foundation piles and placement of the sills will likely require coffer dams. Partial (time and width) closures are likely at a minimum with complete closures possible.

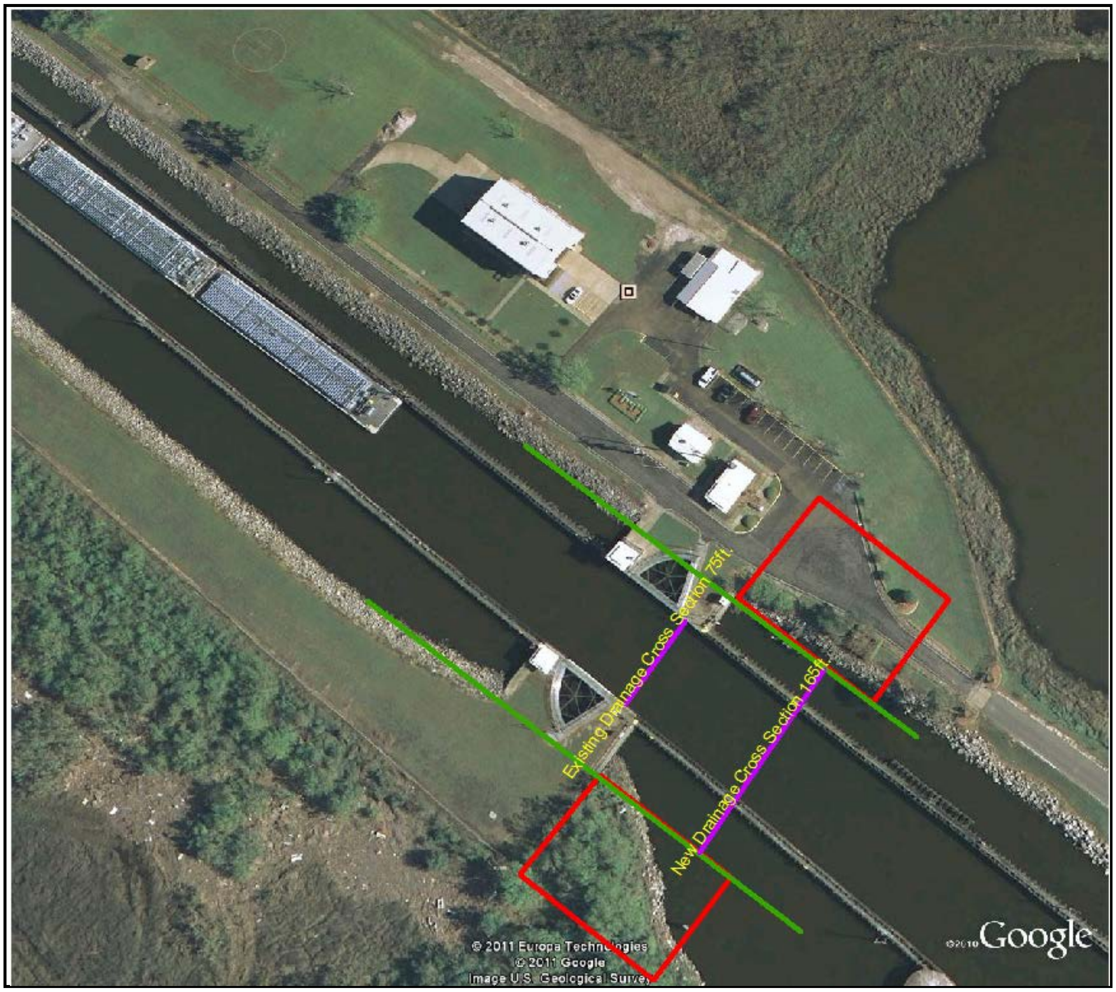

Figure 15. Measure ELA Showing Proposed New Sector Gate

ELB - New Guidewalls (1,200 feet) with Powered Traveling Kevels. Powered kevels are in use at numerous lock facilities throughout the Nation. They are typically used to transit unpowered cuts out of lock chambers when a tow has to be split for multiple lockages. The Upper Mississippi River-Illinois Waterway System Navigation Study's *Improved Tow Haulage Equipment* report described a comprehensive evaluation of the technology and its application at Corps locks. Several examples were found where due to the orientation of the Lock, high head wind conditions prevented unpowered cuts from being flushed out of the chamber. The powered kevels were able to pull the cuts out of the chamber under these conditions.

In the case of Calcasieu Lock, head differentials make it difficult for tows entering the chamber from the west. Modification of the existing guidewalls within the chamber to accommodate rail mounted traveling kevels would allow for cables to be attached to the lead barge of the tow and with the kevels and tow working in tandem, both push and pull the tow into the chamber. Mechanical equipment would be installed on the east sector gate bays. The existing east end guidewalls would be replaced with 1,200-foot guidewalls and rail mounted traveling kevels. Figure 16 shows the approximate layout of the proposed measure. Sheet pile cells at the ends of the guidewalls would house mechanical equipment. Cables would be attached to the bow of the lead barge and with the kevels and tow working in tandem, both push and pull the tow from the chamber during drainage events.

Figure 16. Measure ELB Showing Potential Guide Wall Extensions

ELC - Helper Boats. Certain tow configurations would allow for helper boats to be employed. These vessels would tie on to the stern of barge and assist the fleet tow with pushing the barges through the Lock chamber during drainage events. The helper boats will be government assets crewed by additional lock personnel. An assessment of the tow configurations that currently use the Lock needs to be conducted to determine to what extent helper boats are applicable. The large chemical and petroleum barges are usually coupled single file and would leave little room for an additional boat to be coupled. Finally, helper boats may need to be implemented in combination with new locks or gates in the event that out draft conditions result from the new structures.

ELD - Scheduled Lockage's During Drainage Events. During drainage events lockage's are limited to those tows able to transit the Lock chamber under high flow conditions, resulting in delays for smaller boats and the creation of a large backlog of vessels needing to transit after the drainage event. A scheduled period of lockages could be implemented during drainage events. For initial analysis, three options will be explored. a single 6-hour lockage period on a first come-first served basis; two 3-hour periods with a minimum 6-hour interval for drainage; and two 6-hour lockage periods with a minimum 6-hour interval for drainage. Both H&H and economic modeling will need to be conducted to determine the viability of this measure and if others scheduling regimes are cost effective. An additional increment to be evaluated would be a notification system in conjunction with the scheduled lockages.

5.5.1.6. Drainage Alteration (DA) Measures

DAA1 1,000 Cubic Feet per Second (cfs) & DAA2 3,700 cfs Pumping Station South. Reduction of flows through the existing lock chamber could be diminished by the aid of a pumping station generally within the alignment of the proposed south lock. Two increments will be evaluated; 1,000 and 3,700 cfs. The outfall will need to be excavated with material being beneficially used for marsh creation. For safety, suitable structures to prevent barges from being affected by cross currents will be placed.

DAB - South 110-foot Gate. This measure involves construction of a 110-foot gate structure south of the existing lock to divert drainage flows away from the existing lock chamber. The gate will only be used during drainage events. The type of gate structure will be determined by the ability to prevent saltwater intrusion into the Mermentau Basin. Typically where passage of vessels is not required, a sluice gate will be used. Machinery is normally hydraulic cylinders, one per gate (max 16 feet wide). Multiple gates can be run from the same hydraulic power unit if openings are staggered.

DAC - South 75-foot Gate. This measure involves construction of a 75-foot Gate structure south of the existing lock to divert drainage flows away from the existing lock chamber. The gate will only be used during drainage events. The type of gate structure will be determined by the ability to prevent saltwater intrusion in the Mermentau Basin. Typically where passage of vessels is not required, a sluice gate will be used. Machinery is normally hydraulic cylinders, one per gate (max 16 feet wide). Multiple gates can be run from the same hydraulic power unit if openings are staggered.

DAD - Rehabilitate Black Bayou Drainage Structure. The Black Bayou CWPPRA project was completed in 2006 by the NRCS. During the intervening period a prolonged drought has limited the structures effectiveness. Seepage under the structure resulted in the forebays of the structures being filled in the prevent undermining of the structure in 2011. This measure would involve complete replacement of the structure with adequate foundations and scour protection. The 10 culverts with 10 foot by 10foot opening design will be re-evaluated and adjusted as necessary to maximize reduction in navigation delays.

DAE - Modification of Black Bayou. Measures DAE1, DAE2 & DAE3, and DAE4,were developed to support this concept and are shown on figure 19.

DAE1 – Supplemental Culverts. Additional culverts with gates would be added to the Black Bayou NRCS structure to increase its capacity such that it provides the equivalent drainage capacity of what the current lock chamber. Excavation to the east and west of the structure would be needed as well as Black Bayou Dredging.

DAE2 & DAE3 – 1,000 & 3,700 cfs Pump Station. A pumping station would be constructed adjacent and north of the existing Black Bayou NRCS structure. The pump would likely be west of the road with pipes running under the roadway. Two increments will be evaluated; 1,000 and 3,700 cfs. The 3,700 cfs pump is a standalone feature and would not be combined with others. The 1,000 cfs pump would supplement the existing Black Bayou structure.

DAE4 – Black Bayou Dredging. This would include increasing depth and width of the Black Bayou channel as well as the confluence with the GIWW to the east of the structure.

DAE5 – Weir. A weir would be constructed immediately east of the NRCS structure and would maintain the water elevation on the GIWW to the minimum 2.0 NAVD 88.

DAF - Suspension of Lock Drainage. This measure would involve no longer using the Lock for drainage. This will induce flooding damages to the agricultural areas SA-030 and SA-106. For the 10-year event this impacts approximately 10,000 acres. Flowage easements would need to be purchased.

5.5.1.7. Screening of Measures. Screening of measures is a process whereby various criteria are evaluated to better characterize a specific measure and the likelihood that it can meet various planning objectives without violating established constraints. The outcome of this process can result in specific measures being dropped from further consideration. Measures that violate the planning constraints previously identified are likely to be eliminated. Reasons (screening criteria) for elimination of specific measures can include:

- **Objectives Supported.** Each measure can support the navigation objectives. All of the measures support the stated objective.
- **Hydraulics.** Measures that showed no significant decrease in lockage times during drainage events or the length of drainage events were eliminated from further consideration.
- **Salinity.** Measures that had the potential to increase salinity levels within the Mermentau Basin were eliminated from further consideration.
- **Cost.** All other factors being equal, measures that are likely to cost more than similar measures due to infrastructure relocations were eliminated from further consideration.

Hydraulic (HEC-RAS 4.0) modeling was utilized as a screening tool for all of the New Lock Efficiency Measures and Existing Lock Efficiency Measures DAB and DAC. These measures represented the most numerous, complex and costly measures to be evaluated. The hydraulic modeling of these measures would result in a smaller list of alternatives thereby reducing risk and uncertainty, study effort, cost and focus study efforts on only those measures that will likely produce benefits.

Initially, 14 alternatives were tested. This included a new channel either on the south side or north side of the existing lock and adjacent to it. Locking times for each alternative were then compared to base conditions to determine the time saved per locking at every hour.

After plotting the results, only four alternatives showed improved locking times: both of the proposed drainage gates and both of the earthen lock chambers on the south side. For more information, please see the Hydrology and Hydraulics Section of Appendix L

A matrix (table 24) was used to evaluate the each measure in relation to the planning constraints and the screening criteria. Table 25 details measures that were eliminated from further consideration.

Table 24. Screening Matrix of Measures

	PLANNING CONSTRAINTS				SCREENING CRITERIA			
Measure	**FRM Impacts**	**Infrastructure Impacts**	**Unavoidable Marsh Loss Requiring Mitigation**	**Unacceptable Navigation Impacts**	**Objective Supported**	**Hydraulic Benefit [2]**	**Salinity Intrusion**	**Cost Greater Than Similar Measure w/ Same Benefit**
NLNA	No	Yes	Yes	No	No	No	No	Yes
NLNB	No	Yes	Yes	No	No	No	No	Yes
NLNC	No	Yes	Yes	No	No	No	No	Yes
NLND	No	*Yes*	Yes	No	No	No	No	Yes
NLSA	No	No	Yes	No	No	No	No	Yes
NLSB	No	No	Yes	No	No	No	No	Yes
NLSC	No	No	Yes	No	No	No	No	Yes
NLSD	No	No	Yes	No	No	No	No	Yes
NLSE	No	No	Yes	No	Yes	Yes	No	Yes
NLSF	No	No	Yes	No	No	No	No	Yes
NLSG	No	No	Yes	No	Yes	Yes	No	Yes
NLSH	No	No	Yes	No	No	No	No	Yes
ELA	No	No	Yes	Yes	Yes	NA	No	No
ELB	No	No	No	No	Yes	NA	No	No
ELC	No	No	No	No	Yes	NA	No	No
ELD	Yes	No	No	No	Yes	NA	No	No
DAA1	No	No	Yes	No	Yes	No	No	No
DAA2	No	No	Yes	No	Yes	Yes	No	No
DAB	No	No	Yes	No	Yes	Yes	No	No
DAC	No	No	Yes	No	Yes	Yes	No	No
DAD[1]	NA	NA	NA	NA	NA	NA	NA	NA
DAE1	No	No	Yes	No	Yes	NA	No	No
DAE2	No	No	Yes	No	Yes	Yes	No	No
DAE3	No	No	Yes	No	Yes	Yes	No	No
DAE4	No	No	No	No	Yes	NA	No	No
DAE5	No	No	No	No	Yes	NA	No	No
DAF	Yes	No	No	No	Yes	No	No	No

[1] Moved to the FWOP Condition as it is being rebuilt by others. However, rehabilitation costs are NED costs and will be estimated in the with-project analysis.

[2] Stage differentials were converted to emptying and filling times for every hour of every event and for every alternative. Basically, there were four different chamber sizes, each having its own third or fourth order polynomial equation based upon head differentials.

Table 25. Specific Measures Screened from Further Consideration

Category	Specific Measure	Symbol	Justification for Elimination from Further Consideration
New Lock Efficiency Measure	North Lock alignment 110' x 1200' with orig'l lock in place (drainage) [earthen]	NLNA	Hydraulic Analysis indicated that lockage times would not be reduced and the length of drainage events would not be reduced; therefore, reduction in navigation delays and economic damages would not be realized. See the H&H portion of Appendix L for further information. The northern alignments would also require relocation of portions of the State Highway and construction of a new bridge over the GIWW. These represent additional costs over the Southern alignments for no appreciable benefit. Measures NLSE & NLSG were eliminated from further consideration. Based on the FWOP conditions (Navigation) the maximum supportable plan would be around $100 million. The maximum supportable plan is likely to be no more than $150 million. The new lock proposed for Bayou Sorel (MVN) which is currently undergoing design and is nearly identical to what is proposed in NLSE. The cost of that lock will likely exceed $200 million. Based on available information, new locks at Calcasieu are not going generate a positive benefit to cost. This was further supported by a recommendation from the VE team to screen these measures.
	North Lock alignment 110' x 1200' with orig'l lock in place (drainage) [concrete]	NLNB	
	North Lock alignment 75' x 1200' with orig'l lock in place (drainage) [earthen]	NLNC	
	North Lock alignment 75' x 1200' with orig'l lock in place (drainage) [concrete]	NLND	
	South Lock alignment 110' x 1200' with orig'l lock in place (drainage) [earthen]	NLSA	
	South Lock alignment 110' x 1200' with orig'l lock in place (drainage) [concrete]	NLSB	
	South Lock alignment 75' x 1200' with orig'l lock in place (drainage) [earthen]	NLSC	
	South Lock alignment 75' x 1200' with orig'l lock in place (drainage) [concrete]	NLSD	
	South Lock Alignment 110 feet x 1,200 feet (close existing lock) [earthen].	NLSE	
	South Lock alignment 110' x 1200' (close existing lock) [concrete]	NLSF	
	South Lock Alignment 75 feet x 1,200 feet (close existing lock) [earthen].	NLSG	
	South Lock alignment 75' x 1200' (close existing lock) [concrete]	NLSH	

Table 25. Specific Measures Screened from Further Consideration

Category	Specific Measure	Symbol	Justification for Elimination from Further Consideration
Existing Lock Efficiency Measure	Existing Lock with New 82 ft. Sector Gates	ELA	Discussion with E&C SMEs throughout MVD indicated that lock closures of 6 months to 1 yr related to sill installation would be required for installation of new Sector Gates. Also, a closure of the Lock is equivalent to closure of the waterway. The heavy traffic volumes found at the Lock and no reasonable alternative for all of the traffic during an extended delay would likely result in extensive economic damages.
	New Guidewalls (1200 ft) with Powered Traveling Kevels	ELB	The VE Team assessed the ability of existing powered kevel technology currently in use around the Corps. They determined that powered kevels would be unable to extract tows from Calcasieu Lock during drainage event due to the head differential in the chamber.
	Helper Boats	ELC	The PDT assessed the viability of helper boats. It was determined that industry already attempts to provide assistance to tows trying to transit the Lock during drainage events. This has not been successful and only the smallest tows are able to pass. It is considered part of the FWOP that this will be likely to continue. Additional helper boats will be unable to push the larger tows through the chamber during drainage.
	Scheduled Lockage's During Drainage Events	ELD	MVN HH modeled a proposed 12 hr locking/12 hr drainage scenario to determine if such a schedule would have impacts. The results indicated that for the 10 yr event water levels east of the Lock would increase .5 – 2.5 ft. above the existing condition that is causing delays. This would result in a significant increase in the backwater effect already present during drainage events and increase flood stages in the two hydrologic units east of Calcasieu Lock. This violates the planning constraint of not inducing additional damages within the Mermentau Basin.

Table 25. Specific Measures Screened from Further Consideration

Category	Specific Measure	Symbol	Justification for Elimination from Further Consideration
Drainage Alteration Measure	1,000 cfs Pumping Station South	DAA1	The 1,000 cfs pump at Black Bayou (DAE2) and South (DAA1) of the existing lock were evaluated with the HH model and it was determined that the Black Bayou location was more hydraulically efficient due to the presence of the NRCS structure. Therefore this measure was removed from further consideration.
	South 110-ft Gate	DAB	The HH results for the Lock and gate measures were further reviewed by the PDT. The difference between the 75-Foot Gate and the 110-Foot Gate is very small. The larger gate reduces average locking times by 36 seconds over the smaller gate and the reduction in average overall drainage event duration is only 2% more than the smaller gate. However, the structure and associated outfall is approximately 30% larger in size. It is reasonable to assume and based on best professional engineering judgment that the added costs for the larger structure will far outweigh the minor increment of benefits gained.
	Rehabilitation of Black Bayou Drainage Structure	DAD	Discussion with the State Engineer of the Louisiana NRCS indicated the structure will be redesigned and will be resubmitted for CWPPRA funding.
	Suspension of Lock Drainage	DAF	HH analysis indicates that approximately 10,000 acres of land would see increased flood heights and duration do to suspension of lock drainage. The number of parcels required for flowage easements would be excessive and time consuming to obtain. This would also violate a planning constraint of inducing additional flood risk and damages.

5.5.2. Measures To Be Studied Further. Alternative plans are combinations of management measures that collectively meet study goals and objectives within the defined study constraints. Alternative plans are assembled and compared against one another using performance outputs and costs. Alternative plans and their component management measures will be assessed relative to the objective of NED. Plans were developed by combining the remaining viable measures:

DAA2	3,700 cfs Pumping Station South
DAC	South 75-foot Gate
DAE1	Supplemental Culverts at Black Bayou
DAE2	1,000 cfs Pump Station at Black Bayou
DAE3	3,700 cfs Pump Station at Black Bayou
DAE4	Black Bayou Dredging
DAE5	Weir

Measures DAA2, and DAC are stand alone measures that are not combinable with any other. The 75-foot Gate and 3,700 cfs Pump provide enough drainage capacity to fully offset what is currently provided by Calcasieu Lock; therefore no other measures are required. Measures DAE1, DAE2 and DAE3 can be combined with DAE4 and DAE5. DAE1 and DAE2 provide only a portion of the drainage capacity currently present at Calcasieu Lock and are sized to work in combination with the existing Black Bayou structure to provide that total capacity. However, measures DAE 4 and 5 are not stand alone measures and must be combined with DAE1, DAE2, and/or DAE3. These measures provide no drainage benefit by themselves. DAE4 provides conveyance to and from the new structures represented in DAE1, DAE2, and DAE3. DAE5 is combinable with DAE1 and DAE2 and maintains a constant 2.0 MLG elevation to the east of the current Black Bayou structure and eliminates the need to manually open and close the gates at Black Bayou.

5.6. Final Array of Alternative

5.6.1. No Action (Future Without Project Condition). In the absence of Federal action, the Nation will continue to see delays to navigation from drainage events resulting in $1 to $3 million in annual damages.

5.6.2. Alternative 1 – A 75-foot Sluice Gate (DAC) that is generally within the alignment of the previously proposed south lock. The outfall and intakes will need to be excavated with material being beneficially place for marsh creation. For safety, a guide wall extension or some other suitable structure to prevent barges from being affected by cross currents will need to be evaluated. Figure 17 shows the general alignment for the proposed alternative.

Figure 17. Alternative 1 General Location

5.6.3. Alternative 2 – A 3,700 cfs Pumping Station (DAA2) would be constructed generally within the alignment of the previously proposed south lock. The outfall will need to be excavated with material being beneficially used for marsh creation. For safety, a guidewall extension or some other suitable structure to prevent barges from being affected by cross currents will need to be evaluated. Figure 18 shows the general alignment for the proposed alternative.

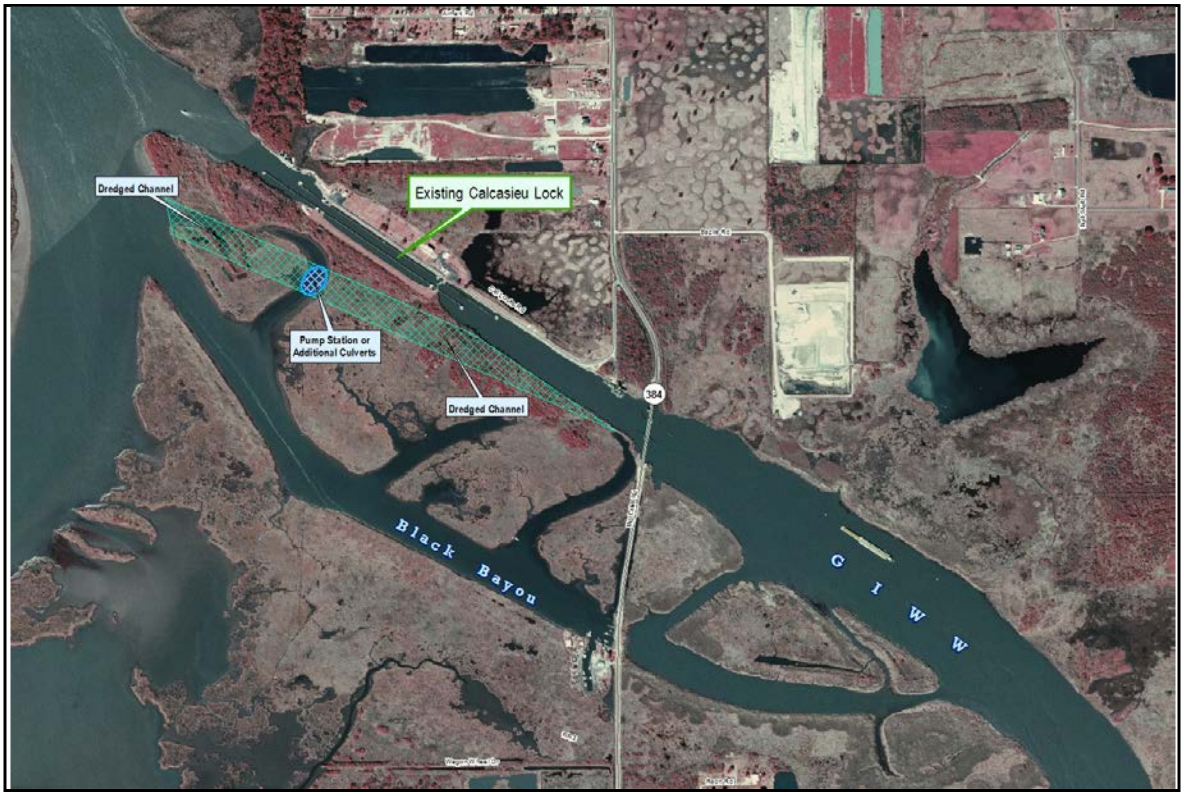

Figure 18. Alternative 2 General Location

5.6.4. Alternative 3 – Supplemental Culverts (DAE1) would be added to the Black Bayou NRCS structure to increase its capacity and operate in conjunctions with it. A weir (DAE5) would be constructed immediately east of the NRCS structure and would maintain the water elevation on the GIWW to the minimum 2.0 NAVD 88. Black Bayou Dredging (DAE4) to the east and west of the NRCS structure will also occur. Figure 19 shows the general alignment for the proposed alternative.

5.6.5. Alternative 4 – A 2,000 cfs Pumping Station (DAE2) would be constructed adjacent and north of the existing Black Bayou NRCS structure and operate in conjunction with it. The pump would likely be west of the road with pipes running under the roadway. A weir (DAE5) would be constructed immediately east of the NRCS structure and would maintain the water elevation on the GIWW to the minimum 2.0 NAVD 88. Black Bayou Dredging (DAE4) to the east and west of the NRCS structure will also occur. This alternative operates in conjunction with the Black Bayou structure. This will require the Corps to take over Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) of the structure once its 20-year project life under CWPPRA ends. After initial formulation, it was determined that a 1,000 cfs pump would be insufficient to overcome the natural tendency to drain through the Lock when the sector gates were open. Additional HH analysis indicated that a 2,000 cfs pump operating in conjunction with the Black Bayou structure would be sufficient to provide the drainage capacity the Lock currently provides. Figure 19 shows the general alignment for the proposed alternative.

5.6.6. Alternative 5 - A 3,700 cfs Pumping Station (DAE3) would be constructed adjacent and north of the existing Black Bayou NRCS structure. The pump would likely be west of the road with pipes running under the roadway. Black Bayou Dredging (DAE4) to the east and west of the

NRCS structure will also occur. This alternative operates independent of the Black Bayou Structure. Figure 19 shows the general alignment for the proposed alternative.

Figure 19. Alternatives 3, 4, and 5 General Location

5.7. Comparison of Alternative Plans. Comparison of the final array of alternatives was used to demonstrate the positive and negative effects of various plans. The evaluation of effects, or comparison of the with- and without-project conditions for each alternative, is a requirement of NEPA and ER-1105-2-100. The evaluation will be conducted by assessing or measuring the differences between each with- and without-project condition and by appraising or weighting those differences.

Benefit/Cost Analysis is conceptual framework for assessing tradeoffs between various project objectives and alternatives and measuring the effectiveness of various alternatives. Types of NED costs that need to be assessed include:

- Project implementation (construction) costs
- OMRR&R costs
- Interest during construction
- Any mitigation, monitoring or other environmental costs
- Land, Easements, Relocations, Rights-of-Way and Disposal/Borrow Areas (LERRD)

NED benefits less NED costs equals net NED benefits. The highest net NED benefits determines the NED plan. These values must be discounted to a present value and amortized over the period of analysis to find the average annual equivalent benefits and costs as required by policy.

In addition to contributions to the Federal Objective (NED), plans will be evaluated based on the following criteria: all relevant resources, outputs and plan effects, the Study goals and objectives, compliance with environmental protection requirements, the Planning Guidance Notebook's four evaluation criteria (completeness, effectiveness, efficiency and acceptability) and other criteria deemed significant by participating stakeholders. Any alternative plans that do not meet the Planning Guidance Notebook's four evaluation criteria will not be carried forward for further evaluation.

5.7.1 Cost Estimates. Rough cost estimates were developed to conduct the evaluation and comparison of the various alternative plans. Items included in the estimates include first of construction, real estate and mitigation, engineering and design during construction and supervision and administration of the construction contract. Additionally, an appropriate level of contingency (25 percent) was added to each alternative to reflect normal uncertainties related to this level of design. However, the existing Black Bayou structure which is required for Alternative 3 and 4 to be fully functional and provide benefits has serious design deficiencies. The estimates developed for Alternative 3 and 4 are based largely on the existing design which is flawed. During formulation the NRCS was evaluating the structure in order to determine if it could be made functional. The NRCS completed the evaluation in December 2013 and determined that the cost to repair the existing structure was slightly higher than the estimates used by the PDT to make the risk informed decision to proceed with Alternative 1.

Additionally as the estimates for the additional structures is based in part on that design, the need for additional geotechnical and structural elements will likely increase the costs significantly. This risk and uncertainty is reflected in an additional cost contingency of approximately 35 percent for Alternatives 3 and 4. The cost estimates are shown in table 26.

Table 26. Alternative Cost Estimates

	Total First Cost
Alternative1 - South 75' gate	$16,700,000
Alternative2 - South 3,700 cfs Pump	$104,537,293
Alternative3 - Black Bayou Culverts	$18,370,444
Alternative4 - Black Bayou 2,000 cfs Pump	$66,445,539
Alternative5 - Black Bayou 3,700 cfs Pump	$95,171,622

The estimate for Alternative 1 above represents a feasibility level of design completed after Alternative 1 was selected as the recommended plan. For the comparison of alternatives the cost estimate for Alternative 1used in this analysis was $16,500,707. These costs were annualized for the period of analysis (2018-2068) and are combined with the annualized costs for OMRR&R.

5.7.2. Operation, Maintenance, Repair, Rehabilitation, and Replacement Considerations OMRR&R is composed of normal annual operations and maintenance activities and cyclical operations and maintenance activities. These activities are summarized in table 27.

Table 27. Operation, Maintenance, Repair, Rehabilitation, and Replacement Costs

Alternative 1 South 75' Gate	Normal Annual O&M	O&M Rewiring & Machinery (20 yrs)	O&M Maintenance by Hired Labor (5 yrs)	O&M Dewatering & Monitoring/Major Repairs (10 yrs)	O&M Periodic Inspections (5 yrs)	O&M Sluice Gate Replacement (25 yrs)
	$50,000	$100,000	$250,000	$1,000,000	$60,000	$3,000,000

Alternative 2 South 3,700 cfs Pump	Normal Annual O&M	O&M Rewiring & Machinery (30 yrs)	O&M Maintenance by Hired Labor (3 yrs)	O&M Periodic Inspections (5 yrs)	O&M Pump Replacement (30 yrs)
	$250,000	$750,000	$675,000	$60,000	$5,000,000

Alternative 3 Black Bayou Culverts	Normal Annual O&M	O&M by Hired Labor (5 yrs)	O&M Dewatering & Monitoring/Major Repairs (10 yrs)	O&M Periodic Inspections (5 yrs)	O&M Flap Gate Replacement (20 yrs)
	$20,000	$250,000	$1,000,000	$60,000	$1,000,000

Alternative 4 Black Bayou 2,000 cfs Pump	Normal Annual O&M	O&M Rewiring & Machinery (30 yrs)	O&M Maintenance by Hired Labor (3 yrs)	O&M Periodic Inspections (5 yrs)	O&M Pump Replacement (30 yrs)
	$250,000	$750,000	$675,000	$60,000	$5,000,000

Alternative 5 Black Bayou 3,700 cfs Pump	Normal Annual O&M	O&M Rewiring & Machinery (30 yrs)	O&M Maintenance by Hired Labor (3 yrs)	O&M Periodic Inspections (5 yrs)	O&M Pump Replacement (30 yrs)
	$250,000	$750,000	$675,000	$60,000	$5,000,000

5.7.3. Mitigation Planning and Evaluation. The development of compensatory mitigation, monitoring or other environmental costs is based on a series of environmental analyses:1) identifying unavoidable habitat impacts or losses for each alternative; 2) conducting a habitat-based assessment of such impacts and any benefits for each project alternative; 3) formulating an array of mitigation alternatives that compensate for any remaining impacts; 4) developing cost estimates for each mitigation alternative, including implementation, monitoring, and any OMRR&R costs; and 5) identifying the least cost mitigation alternative. This habitat impact assessment and mitigation planning exercise was conducted to develop a reasonable level of any required mitigation costs for inclusion in the comparison of alternatives. The complete habitat impact assessment and mitigation planning exercise can be found in Appendix I, *Mitigation Plan and Monitoring and Adaptive Management Plan*, and Appendix P, *Wetland Value Assessment*.

5.7.3.1. Unavoidable Impacts by Project Alternative. For this project, there are unavoidable impacts to marsh and forested spoil bank habitats. These impacts are displayed by acres in table 28 and were identified using GIS by overlaying project alternative footprints (used at the December 2012 public meeting) on a project area habitat map.

Table 28. Unavoidable Habitat Losses and Benefits by Project Alternative (expressed in acres and AAHUs)

Alternative	Forested Spoil Bank Loss (ac/AAHU)	Marsh Loss (ac/AAHU)	Marsh Benefits (ac/AAHU)
Alt 1 - sluice gate, new channel	11/-7.2	14/-3.8[1]	35[3]/23.5[1]
Alt 2 - pump station, new channel	11/-7.2	14/-3.8[1]	35/23.5[1]
Alt 3 - supplemental culverts, Black Bayou modifications	0	34/-9.1[2]	35/16.6[2]
Alt 4 - 2,000 cfs pump station, Black Bayou modifications	0	34/-9.1[2]	35/16/6[2]
Alt 5 - 3,700 cfs pump station, Black Bayou modifications	0	34/-9.1[2]	35/16/6[2]

[1] brackish only
[2] brackish and intermediate
[3] 35 acres was used for initial evaluation and comparison of alternatives. Upon identification of Alternative 1 as the Recommended Plan, additional design and coordination resulted in 50 acres of marsh that is identified in *Appendix I, Mitigation Plan.*

5.7.3.2. Habitat-based Assessment of Impacts and Benefits. The habitat-based assessment is based on the application of the Wetland Value Assessment (WVA) Methodology, a suite of planning models approved for use in coastal Louisiana. A description of this methodology and the assessment for this project is provided in Appendix P, *Wetland Value Assessment*. The Coastal Marsh and Chenier Ridge Community models were employed. The WVA's outputs, expressed in average annual habitat units (AAHUs), are used to quantify these unavoidable impacts and any habitat benefits. Unavoidable habitat losses for forested spoil bank and marsh habitats are displayed as AAHUs in table 28.

Marsh habitat benefits could be attained for each of the alternatives by placing dredged material obtained from the project in nearby shallow open water areas to restore and create marsh habitat. Dredged material placement in this manner represents a least-cost environmentally acceptable disposal alternative. The quantity of dredged material available would allow for the creation and restoration of about 35 acres of marsh for each alternative. The WVA assessment of ecological benefits associated with dredged material disposed in this manner showed that marsh habitat benefits would more than offset the marsh habitat losses, as expressed in AAHUs (table 28). (These WVA outputs in AAHUs were based on the assumption that disposal sites would be planted with herbaceous marsh plantings shortly after construction to establish a vegetative cover and generate early habitat benefits. A subsequent WVA analysis without such plantings generated outputs that were about 2-4% less than those shown in table 28. Establishment of marsh vegetation through natural succession typically provides extensive vegetative cover over disposal sites within five years). Therefore, because marsh impacts would be offset by marsh benefits, no compensatory mitigation for marsh habitat impacts would be needed. However, despite the use of dredged material to offset impacts to marsh habitat, there would still be unavoidable impacts to forested spoil bank habitat that require compensation.

5.7.3.3. Compensatory Mitigation Alternatives. Three potential mitigation alternatives were examined for their ability to provide compensation for unavoidable losses: opportunities to compensate by replacing or providing substitute resources or environments either on-site or off-site; available in-lieu fee programs; and approved mitigation banks.

Mitigation Alternative 1 - Replacement or substitution. For forested spoil bank habitat losses, any replacement or substitution would need to be sited on the coastal side of the coastal zone boundary. In the vicinity of Calcasieu Lock, this means south of the GIWW.

Forested Spoil Bank: There are no on-site opportunities for replacement of forested spoil bank habitat. Marsh is the only available undeveloped land, and using marsh to create forested spoil bank habitat would result in the loss of marsh and require more mitigation. However, there is an opportunity to enhance forested spoil bank habitat not affected by this project along the south side of the lock. Regarding off-site opportunities south of the GIWW, this area is mainly coastal marsh, with scattered residences. A GIS-based search was conducted, and limited opportunities were identified.

Mitigation Alternative 2 - In-Lieu Fee Programs. Although Louisiana currently operates an In-Lieu Fee (ILF) program, it is only approved for marsh mitigation at this time. Therefore, no calculation for forested spoil bank habitat could be conducted.

Mitigation Alternative 3 - Mitigation Banks

Forested spoil bank: There are approved mitigation banks for impacts to bottomland hardwoods in the project area's watershed, but none specifically for forested ridge or forested spoil bank habitat. Because bottomland hardwoods habitat is similar habitat to forested spoil bank habitat, it is assumed that acquiring credits at a bottomland hardwoods bank is acceptable.

5.7.3.4. Unit Price Cost Estimates for Mitigation Alternatives

Mitigation Alternative 1 - Replacement or Substitution

Forested Spoil Bank: MVN-Environmental has used a planning level cost estimate of $220,000 per acre for replacing dry bottomland forest (2009 price), which is assumed to be representative for replacing forested spoil bank habitat. This estimate reflects both construction and real estate costs. As mentioned above, replacement opportunities are at best limited. Because forest enhancement opportunities exist on-site, a planning level cost estimate was developed. Based on current site conditions, native tree and shrub species composition could be improved by creating small forest openings and planting seedlings in these gaps, and invasions of exotic plant species such as Chinese tallow could be controlled using acceptable methods of chemical and mechanical removal. This enhancement cost is estimated to be $10,000 per acre, and reflects both construction and real estate costs.

Mitigation Alternative 2 - In-Lieu Fee Programs. *Not Applicable*

Mitigation Alternative 3 - Mitigation Banks

Forested Spoil Bank: MVN-Regulatory indicates that credits range from $30k to $50k per acre for forested wetland impacts. It is assumed these costs represent costs at bottomland forest banks. The higher price of $50k per acre is carried forward for analysis purposes.

5.7.3.5. Estimated Costs of Mitigation Alternatives

Forested Spoil Bank: Estimated mitigation implementation costs are displayed per acre in table 29 for each mitigation alternative, by project alternative. Because the WVA results for forested spoil bank habitat mitigation alternatives (specifically enhancement) were not available at the time mitigation costs were needed for comparison of alternatives by overall cost, total mitigation costs based on WVA results for these mitigation alternatives were not available.

Table 29. Estimated Costs (per acre) by Mitigation Alternative for Forested Spoil Bank Habitat

Alternative	Replacement	Enhancement	Bank
Alternatives 1 & 2	$220,000	$10,000	$50,000
Alternatives 3,4,5	Not applicable	Not applicable	Not applicable

Because estimates of total mitigation costs by mitigation alternative were not available, it was assumed that the mitigation requirement for forested spoil bank impacts was equivalent to the amount of unavoidable loss in acres. The mitigation alternative with the intermediate cost per acre was chosen to be used to develop Rough Order of Magnitude (ROM) mitigation costs. Table 30 represents compensatory mitigation costs that were reflected in the ROM costs.

Table 30. ROM Forested Spoil Bank Habitat Mitigation Estimates

	Total Estimated Cost
Alternative 1	$550,000
Alternative 2	$550,000
Alternative 3	$0
Alternative 4	$0
Alternative 5	$0

The mitigation cost estimate developed later for Alternative 1 (Recommended Plan) includes $139,869 for construction of 15 acres of on-site tree stand improvements; $42, 694 for monitoring and $89, 370 for adaptive management of this 15-acre area over a 10-year period; and $497,750 for the purchase of

9.1 mitigation bank credits. These costs total $769,683 for forested spoil bank mitigation; land costs are not included in this estimate.

5.7.3.6. Sensitivity Analysis. An ecological sensitivity analysis was performed for this project to evaluate uncertainties in the WVA marsh analyses. Reviewers of Version 1.0 of the Coastal Marsh Community WVA model suggested an alternative treatment for the HSIs for three model variables involved in WVA marsh models: Suitability Index Value (SIV)1 – Percent of wetland area covered by emergent vegetation, SIV2 – Percent of open water area covered by aquatic vegetation, and SIV3 – Marsh edge and interspersion. An Excel file named "Interim WVA V1.4.xlsx" has been developed for the purpose of conducting such a sensitivity analysis, and was employed for this project. The sensitivity of the WVA marsh model outputs to the suggested changes in SIV1, SIV2, and SIV3 was assessed for the marsh impact analyses as well as the marsh creation/restoration analysis. The sensitivity analyses are included in Appendix P, *Wetland Value Assessment*. Version 1.1 of the marsh model was used for this study. The difference between this version and Version 1.0 is limited to some changes in spreadsheet formatting and minor changes to the appearance of text; there are no changes in calculations.

For the marsh impact analysis associated with Alternatives 1&2 (loss of 14 acres brackish), the CWPRRA model produced an output of -3.8 AAHUs, whereas the alternative treatment of adding Emergent Marsh (EM) and open water (OW to the CWPRRA model produced an output of -4.6 AAHUs, or a difference in outputs of 21% .

For the marsh impact analysis associated with Alternatives 3-5 (loss of 11 acres brackish and 23 acres intermediate), the CWPRRA model produced an output of -1.6 AAHUs for brackish marsh and -7.5 AAHUs for intermediate marsh. The alternative treatment of adding Emergent Marsh (EM) and OW (open water) to the CWPRRA model produced an output of –2.1 AAHUs for brackish marsh and -12.0 AAHUs for intermediate marsh. These differences in outputs are 31% for brackish marsh and 60% for intermediate marsh. Therefore, applying the alternative treatment to the CWPRRA model would increase total impacts to marsh from -9.1 to -14.1 AAHUs, with a difference of 55%.

For the marsh creation/restoration analysis developed for Alternatives 1&2, based on placing dredged material into shallow open water areas to restore and create marsh 50 acres of brackish marsh, the CWPRRA model produced an output of 23.5 AAHUs. In contract, the alternative treatment of adding Emergent Marsh (EM) and OW (open water) to the CWPRRA model produced an output of 9.8 AAHUs, for a difference of 58%.

For the marsh creation/restoration analysis developed for Alternatives 3-5, based on placing dredged material into shallow open water areas to restore and create marsh 35 acres of brackish marsh, the CWPRRA model produced an output of 16.6 AAHUs. In contract, the alternative treatment of adding Emergent Marsh (EM) and OW (open water) to the CWPRRA model produced an output of 6.9 AAHUs, for a difference of 58%.

With respect to Alternatives 1&2, the overall effect of applying the alternative treatment to the CWPRRA model would not change the results of the habitat assessment. The ecological benefits generated from marsh restoration/creation using dredged material (9.8 AAHUs) would still outweigh the marsh losses (-4.6 AAHUs). There would be no need for compensatory mitigation, and the costs associated with these alternatives would not change.

With respect to Alternatives 3-5, the overall effect of applying the alternative treatment to the CWPRRA model would change the results of the habitat assessment. The ecological benefits generated from marsh restoration/creation using dredged material (6.9 AAHUs) would not outweigh the marsh losses (-14.1 AAHUs). There would be a need for compensatory mitigation to make up the difference of 7.2 AAHUs. The costs associated with Alternatives 3-5 would need to increase to account for this compensatory mitigation. A rough estimate of such costs is $1.2M, assuming 15 acres of marsh credits needed to be purchased from a mitigation bank.

The overall effect of applying the alternative treatment to the CWPRRA model would not change the selection of Alternative 1 as the Recommended Plan.

5.7.4. Alternative Benefits Assessment. Utilizing all available NED Benefits and Costs for Alternatives 1, 2, 3, 4, and 5 were run through the economic model (GulfNIM) to generate expected net benefits for the alternatives compared to the reference or most likely navigation FWOP.

Table 31 summarizes the annual costs, annual benefits, net benefits, and Benefit-Cost Ratio (BCR) for each alternative assuming the most likely scenario. In this analysis, the most likely scenario is defined as the reference (mid) traffic forecast with the moderate (mid) sea-level rise assumption. Total incremental benefits represent the drainage costs to navigation that will be avoided by constructing any of the five alternatives. Net benefits represent the difference between total annual benefits and total annual costs. Maximum net benefits define the NED plan. As table 31 shows, assuming the most likely scenario, only two of the five with-project alternatives are economically justified. Alternative 1 (Gated Structure) maximizes $0.19 million in net benefits, producing a BCR of 1.20 to 1.

Table 31. Average Annual Benefit - Cost Summary
MOST LIKELY SCENARIO - Mid Traffic Forecast and Mid Sea-Level Rise
(Millions of FY2013 dollars, 3.5% discount/amortization rate, 2015-2068 with 2018 base year)

	Alt 1 – South 75' Gate	**Alt 2 - South 3,700 CFS Pump**	**Alt 3 - Black Bayou Culverts**	**Alt 4 - Black Bayou 2,000 CFS Pump**	**Alt 5 - Black Bayou 3,700 CFS Pump**
Construction	$0.592	$3.900	$0.371	$2.181	$3.828
Engineering & Design (E&D)	$0.047	$0.312	$0.030	$0.175	$0.306
Supervisory/Administration (S&A)	$0.047	$0.312	$0.030	$0.175	$0.306
Mitigation	$0.024	$0.024	$-	$ -	$ -
Real Estate	$0.004	$0.004	$0.004	$0.004	$0.004
OMRR&R	$0.234	$0.551	$0.230	$0.602	$0.555
Rehab Existing Black Bayou Structure	NA	NA	$0.359	$0.365	NA
Total Cost	**$0.948**	**$5.103**	**$1.023**	**$3.501**	**$5.000**
Total Benefits	$1.141	$1.141	$1.141	$1.141	$1.141
Net Benefits	$0.193	$(3.962)	$0.118	$(2.360)	$(3.859)
Benefit-Cost Ratio (BCR)	1.20	0.22	1.12	0.33	0.23

5.7.5. Sensitivity Analysis. Given the nature and complexity of the benefit measurement procedures, an unavoidable component of uncertainty is implicit in the estimates of project benefits. A single change to any number of parameter values or assumptions holds the potential for significantly affecting benefit estimates and ultimately, in turn, project formulation. The role of sensitivity analysis is to identify those parameters and assumptions with the greatest potential for project formulation impact and to evaluate the magnitude of those impacts for discrete changes in the key parameters. The parameters identified as potentially significant, and consequently incorporated into the sensitivity analysis, include traffic projections, sea-level rise assumptions and the discount rate. In the following paragraphs of this section, the low and high impacts on project benefits and plan formulation resulting from alternative parameter values and assumptions are presented.

5.7.5.1. Low Scenario. For this analysis, the low scenario is defined as the low traffic forecast with the high sea-level rise assumption. As shown in table 32, both assumptions have a significant impact on the with-project benefits for each of the alternatives. Total average annual benefits decreased from $1.14 million in the most likely scenario to $0.34 million in the low scenario causing none of the alternatives to be economically justified.

5.7.5.2. High Scenario. The high scenario is defined as the high traffic forecast with a no sea-level rise assumption. As shown in table 33, both assumptions also have a significant impact on the with-project benefits for each of our alternatives. Total average annual benefits increased from $1.14 million in the most likely scenario to $3.88 million in the high scenario causing now three of the five alternatives to be economically justified with Alternative 1 still producing the highest net benefits.

5.7.5.3. Most Likely Scenario - Alternative Discount Rate – 7.0%. Throughout this study the Federal discount rate of 3.5% was used in determining average annual costs and benefits. In order to explore the implications on alternative interest rates on NED plan selection, the Office of Management and Budget (OMB) prescribed interest rate of 7.0% was applied and the results are presented in table 34. As shown, under the most likely scenario, only the recommended plan (Alternative 1) would remain economically justified at 1.04:1.

Two additional sensitivity analysis scenarios were developed which included a No Growth in Traffic and No Growth in Traffic after 20 Years Scenario. This information can be found in Appendix K.

Table 32. Average Annual Benefit - Cost Summary
Low Scenario - Low Traffic Forecast and High Sea-Level Rise
(Millions of FY2013 dollars, 3.5% discount/amortization rate, 2015-2068 with 2018 base year)

	Alt 1 – South 75' Gate	**Alt 2 - South 3,700 CFS Pump**	**Alt 3 - Black Bayou Culverts**	**Alt 4 - Black Bayou 2,000 CFS Pump**	**Alt 5 - Black Bayou 3,700 CFS Pump**
Construction	$0.592	$3.900	$0.371	$2.181	$3.828
Engineering & Design (E&D)	$0.047	$0.312	$0.030	$0.175	$0.306
Supervisory/Administration (S&A)	$0.047	$0.312	$0.030	$0.175	$0.306
Mitigation	$0.024	$0.024	$-	$ -	$ -
Real Estate	$0.004	$0.004	$0.004	$0.004	$0.004
OMRR&R	$0.234	$0.551	$0.230	$0.602	$0.555
Rehab Existing Black Bayou Structure	NA	NA	$0.359	$0.365	NA
Total Cost	**$0.948**	**$5.103**	**$1.023**	**$3.501**	**$5.000**
Total Benefits	**$0.344**	**$0.344**	**$0.344**	**$0.344**	**$0.344**
Net Benefits	**$(0.604)**	**$(4.759)**	**$(0.679)**	**$(3.157)**	**$(4.656)**
Benefit-Cost Ratio (BCR)	**0.36**	**0.07**	**0.34**	**0.10**	**0.07**

Table 33. Average Annual Benefit - Cost Summary
High Scenario - High Traffic Forecast and No Sea-Level Rise
(Millions of FY2013 dollars, 3.5% discount/amortization rate, 2015-2068 with 2018 base year)

	Alt 1 – South 75' Gate	Alt 2 - South 3,700 CFS Pump	Alt 3 - Black Bayou Culverts	Alt 4 - Black Bayou 2,000 CFS Pump	Alt 5 - Black Bayou 3,700 CFS Pump
Construction	$0.592	$3.900	$0.371	$2.181	$3.828
Engineering & Design (E&D)	$0.047	$0.312	$0.030	$0.175	$0.306
Supervisory/Administration (S&A)	$0.047	$0.312	$0.030	$0.175	$0.306
Mitigation	$0.024	$0.024	$-	$ -	$ -
Real Estate	$0.004	$0.004	$0.004	$0.004	$0.004
OMRR&R	$0.234	$0.551	$0.230	$0.602	$0.555
Rehab Existing Black Bayou Structure	NA	NA	$0.359	$0.365	NA
Total Cost	**$0.948**	**$5.103**	**$1.023**	**$3.501**	**$5.000**
Total Benefits	**$3.884**	**$3.884**	**$3.884**	**$3.884**	**$3.884**
Net Benefits	**$2.936**	**$(1.219)**	**$2.861**	**$0.383**	**$(1.116)**
Benefit-Cost Ratio (BCR)	**4.10**	**0.76**	**3.80**	**1.11**	**0.78**

Table 34. Average Annual Benefit - Cost Summary
MOST LIKELY SCENARIO - Mid Traffic Forecast and Mid Sea-Level Rise
(Millions of FY2013 dollars, 7.00% discount/amortization rate, 2015-2068 with 2018 base year)

	Alt 1 – South 75' Gate	**Alt 2 - South 3,700 CFS Pump**	**Alt 3 - Black Bayou Culverts**	**Alt 4 - Black Bayou 2,000 CFS Pump**	**Alt 5 - Black Bayou 3,700 CFS Pump**
Construction	$1.028	$6.881	$0.644	$3.849	$6.755
Engineering & Design (E&D)	$0.082	$0.550	$0.052	$0.308	$0.540
Supervisory/Administration (S&A)	$0.082	$0.550	$0.052	$0.308	$0.540
Mitigation	$0.042	$0.043	$-	$ -	$-
Real Estate	$0.007	$0.007	$0.007	$0.007	$0.007
OMRR&R	$0.205	$0.506	$0.193	$0.542	$0.509
Rehab Existing Black Bayou Structure	NA	NA	$0.623	$0.644	NA
Total Cost	**$1.446**	**$8.538**	**$1.571**	**$5.657**	**$8.351**
Total Benefits	**$1.509**	**$1.509**	**$1.509**	**$1.509**	**$1.509**
Net Benefits	**$0.063**	**$(7.028)**	**$(0.062)**	**$(4.148)**	**$(6.842)**
Benefit-Cost Ratio (BCR)	**1.04**	**0.18**	**0.96**	**0.27**	**0.18**

5.7.5.4 Cost and Schedule Risk Analysis. Project costs underwent a cost and schedule risk analysis to develop contingencies for alternative 1. Tables 35 and 36 summarize the refined project first costs and economic justification for alternative 1 using October 2014 price levels and a discount rate of 3.5%. The project first cost is now estimated at $16,683,000 and results in a BCR of 1.21 to 1. Table 37 uses the OMB prescribed interest rate of 7.0 percent. In this instance, the project is still justified with a BCR of 1.07 to 1.

Table 35. Calcasieu Lock Alternative 1 First Costs

Cost Category	Alt. 1 – South 75' Gate
Construction	$13,370,000
Engineering & Design (E&D)	$1,279,000
Supervisory/Administration (S&A)	$1,000,000
Environmental	$903,000
Real Estate	$131,000
TOTAL	$16,682,000

Table 36. Average Annual Benefit - Cost Summary
MOST LIKELY SCENARIO - Mid Traffic Forecast and Mid Sea-Level Rise
(Millions of dollars - Oct 2014 price level, 3.5% discount/amortization rate, 2015-2068 with 2018 base year)

	Alt 1 – South 75' Gate
Construction	$0.570
Engineering & Design (E&D)	$0.056
Supervisory/Administration (S&A)	$0.043
Environmental	$0.038
Real Estate	$0.006
O&M	$0.234
Rehab Existing Black Bayou	NA
Total Cost	$0.947
Total Benefits	$1.148
Net Benefits	$0.201
Benefit-Cost Ratio (BCR)	**1.21**

Table 37. Average Annual Benefit - Cost Summary
MOST LIKELY SCENARIO - Mid Traffic Forecast and Mid Sea-Level Rise
(Millions of dollars – Oct 2014 price level, 7.00% discount/amortization rate, 2015-2068 with 2018 base year)

	Alt 1 – South 75' Gate
Construction	$0.969
Engineering & Design (E&D)	$0.099
Supervisory/Administration (S&A)	$0.072
Environmental	$0.065
Real Estate	$0.009
O&M	$0.205
Rehab Existing Black Bayou Structure	NA
Total Cost	**$1.420**
Total Benefits	**$1.518**
Net Benefits	**$0.098**
Benefit-Cost Ratio (BCR)	**1.07**

5.7.6. Acceptability, Completeness, Effectiveness, and Efficiency. In addition to contributions to the Federal Objective (NED), plans have been evaluated based on the following criteria: all relevant resources, outputs and plan effects, the Study goals and objectives, compliance with environmental protection requirements, the Planning Guidance Notebook's four evaluation criteria (completeness, effectiveness, efficiency and acceptability) and other criteria deemed significant by participating stakeholders. The environmental impacts and costs associated with mitigation are consistent across all alternatives. Alternative 1 contributes to achieving all of the Study goals and objectives. Alternative 1 was formulated with the four P&G criteria in mind.

- **Completeness.** Alternative 1 is complete. Realization of the plan does not depend on implementation of actions outside the plan. Alternative 3 however, does require action by the NRCS and the CWPPRA task force to rehabilitate the existing structure.
- **Effectiveness.** Alternative 1 is effective. It addresses all the project objectives. Alternative 3 meets the planning objective; however it does not maximize the efficiency of the Calcasieu Lock in NED net benefits.
- **Efficiency.** Alternative 1 is efficient. It maximizes net benefits to the Nation and is a cost-effective solution to the stated problems and objectives. Alternative 3 has less net NED benefits than Alternative 1.
- **Acceptability.** Coordination to date indicates that both Alternatives 1 and 3 are acceptable to Federal, state, tribal, local entities, and the public.

5.7.7. Risk and Uncertainty. Alternative 1 presents a low level of risk that is commensurate with similar dredging and sluice gate construction conducted by the Federal Government in south Louisiana. However, the existing Black Bayou structure which is required for Alternative 3 to be fully functional and provide benefits has serious design deficiencies. The estimates developed for Alternative 3 were based largely on the existing design which is flawed. During formulation the NRCS was evaluating the structure in order to determine if it could be made functional. At the time the PDT had no confidence in what the outcome would be. The structure may not be useable or the cost to fix the structure may be higher than currently estimated. Additionally as the estimates for the additional structures is based in part on that design, the need for additional geotechnical and structural elements will likely increase the costs significantly. The NRCS completed the evaluation in December 2013 and determined that the cost to repair the existing structure was slightly higher than the estimates used by the PDT to make the risk informed decision to proceed with Alternative 1. This cost information was incorporated into the estimates used for alternative comparison of alternatives above.

5.7.8 Identification of the National Economic Development Plan. NED benefits less NED costs equals net NED benefits. The highest net NED benefits determines the NED plan. Alternative 1 provides the highest net benefit to the Nation of $.185 million. Based on the economic analysis and comparative environmental impacts described in Section 6, Alternative 1 is identified as the Recommended Plan.

5.8. Description of the Recommended Plan, Alternative 1. The Recommended Plan, Alternative 1, which is shown on figure 20, provides for the movement of flows from drainage events out of the Mermentau Basin consistent with the authorized purpose of the project. The project features are as follows.

Dredging. A new channel that would carry freshwater flows from the Mermentau Basin around the south side of the existing Calcasieu Lock to Bayou Choupique. This channel, constructed by hydraulic dredging, would be about 3,650 feet long and 200 feet wide at the top. The channel would be dredged to -12 NAVD 88, with a channel bottom width of 120 feet, and 1V on 3H side slopes. The channel will transition to -6.0 NAVD 88, with a channel bottom width of 150 feet at the structure. The transition will occur over 600 ft east and west of the structure at a 1V on 100H slope. Approximately 215,000 cy of dredged material would be generated from construction of the channel. Dredged material would be placed within the project area in areas of open water totaling about 50 acres. Placement of dredged material into these disposal sites is intended to convert open water to estuarine marsh. For disposal of dredged materials, a pipeline will be routed through the existing open water using floating and/or submerged pipeline.

Culvert Structure. A gated water control structure would be constructed inside the channel to control the passage of freshwater flows. The culvert structure consists of seven openings (9' x 14' each) that will allow for the passage of the additional flow. The structure is a pile-founded reinforced concrete box culvert with stainless steel sluice gates. The sluice gates will remain in the open position to drain the Mermentau Basin and can be closed when salinity levels in the Ship Channel exceed the allowable limits. The structure foundation consists of 50-ft long pre-stressed concrete piles. The structure is 114-feet wide and 110-feet long. The invert of the structure is (-)6.0, with the top of the culvert structure at (+)5.0. The top of the gate tower is at (+)14.0 NAVD88. The top of the culvert is higher than the anticipated flow line thru the area, so water cannot overtop the structure. The structure is placed in an area along the by-pass channel where the natural ground is above elevation (+)4.0 NAVD88, so water cannot flank the structure during drainage events. Trash screens will be provided to prevent large debris from clogging the culverts, which can prevent the gates from fully closing.

Riprap will be placed 200-feet on either side of the structure, only on the side slopes of the inflow and outflow channels. 50-feet of riprap will be placed on either side of the structure, along the channel bottom.

Steel bulkheads (stoplogs) will be provided so the structure can be dewatered for maintenance purposes. The bulkheads can be placed on either side of the gate tower to isolate the area from the rest of the structure.

The sluice gates have electric motors that will be operated either locally at the structure, or remotely at the Calcasieu Lock. Closed-circuit cameras will be provided at the structure for lock personnel to inspect the gate operations. Therefore, there is no requirement to man the structure during events in which the structure is opened.

Timber pile clusters will be constructed where the by-pass channel intercepts the GIWW and Bayou Choupique. The clusters are provided to prevent barge access into the by-pass channel.

Least Cost Environmentally Acceptable Disposal Features. As described above under Dredging, dredged material will be placed within the project area in several areas of open water totaling about 50 acres. This dredged material will be beneficially placed to restore degraded brackish marsh and create brackish marsh from shallow open water. These placement sites are least-cost, environmentally acceptable that will contribute to a sustainable environment while providing placement capacity for the material generated from construction of the new channel. Benefits from the 50 acres of beneficial use features will more than offset the unavoidable direct impact to 14 acres of brackish marsh from construction of the new channel. Therefore, no compensatory mitigation is proposed for Recommended Plan effects to brackish marsh. Monitoring and adaptive management if needed of beneficial use features are included as part of the Recommended Plan, and will be conducted to ensure that brackish marsh benefits offset losses. These features would consist of placement of about 233,000 cys of dredged material (including an estimated 1 ft of overdepth) into three disposal locations adjacent to the new channel and south of Black Bayou. The assumed existing elevation for the disposal locations is -1.5 to -2.0 NAVD 88, with an initial slurry elevation of +3.5 NAVD88 to achieve a final target elevation of +1.5 NAVD 88. To contain dredged material at these locations, earthen closures and weirs would be constructed around all disposal sites. All borrow material needed for closures and weirs would come from within the disposal sites. About 7,300 LF of earthen closures (7.5 cy/lf) would be constructed to elevation +5.0 NAVD 88, with a 5-foot crown, and 1V on 4H side slopes. About 16,500 LF of earthen weir containment (3.8 cy/lf) would be built along the existing marsh to elevation +3.0 NAVD 88, with a 5-foot crown, and 1V on 4H side slopes.

Compensatory Mitigation. A compensatory mitigation plan for project impacts has been developed to offset unavoidable losses from construction of the new channel to 11.5 acres of forested spoil bank habitat and is included as part of the Recommended Plan. The recommended mitigation plan would compensate for the Recommended Plan's losses in forest biological form and function by implementing tree stand improvements in about 15 acres of remaining forested habitat, plus the purchase of 9 acres of credits from an approved bottomland hardwood mitigation bank serving the project area. The amount of recommended mitigation was determined by the Coastal Chenier/Ridge WVA model and is the amount of forest that would need to be enhanced and restored to compensate for the mitigation target of 7 AAHUs. Monitoring and adaptive management if needed of the on-site mitigation area are included as part of the Recommended Plan, and will be conducted to ensure that forest benefits are realized.

Access/Staging. A 10-ft wide access road will be constructed from the Lock to the culvert structure for use by the Lock personnel. An access area and staging area will be established during construction in the vicinity of the access road.

5.8.1. Design, Environmental, and Construction Considerations

5.8.1.1. Design

Culvert Structure. Concrete and structural steel members were sized using preliminary design loadings. Further refinement of the structure will be conducted during Pre-Construction, Engineering and Design (PED). The structure foundation (pile sizes, spacing, and pile tip elevations) was designed with the use of pile capacity curves that were developed for similar soils in the area. Verification of the pile assumptions, along with any adjustments, will be conducted during PED.

Culvert Structure Dredging. Approximately 3,650 linear feet of dredging for the inflow and outflow channels will be required to tie the GIWW to Bayou Choupique. The channel would be dredged to -12 NAVD 88, with a channel bottom width of 120 feet, and 1V on 3H side slopes. The channel will transition to -6.0 NAVD 88, with a channel bottom width of 150 feet at the structure. The transition will occur over 600 ft east and west of the structure at a 1V on 100H slope. Approximately 215,000 cy of dredged material would be generated from construction of the channel. All material from the channel dredging will be placed in the open water areas adjacent to the channel and just south of Black Bayou. The material will be contained by earthen dikes/weirs and closures adjacent to the Bayou.

Access/Staging. Construction access to the site will be via barge. Construction contractor can either off-load equipment from barge to land or dredge access channel to the site. The dredged access channel will be within the limits of the new permanent channel. A staging area will be adjacent to the site between the Lock and culvert structure. There will be no impact to utilities in proposed location.

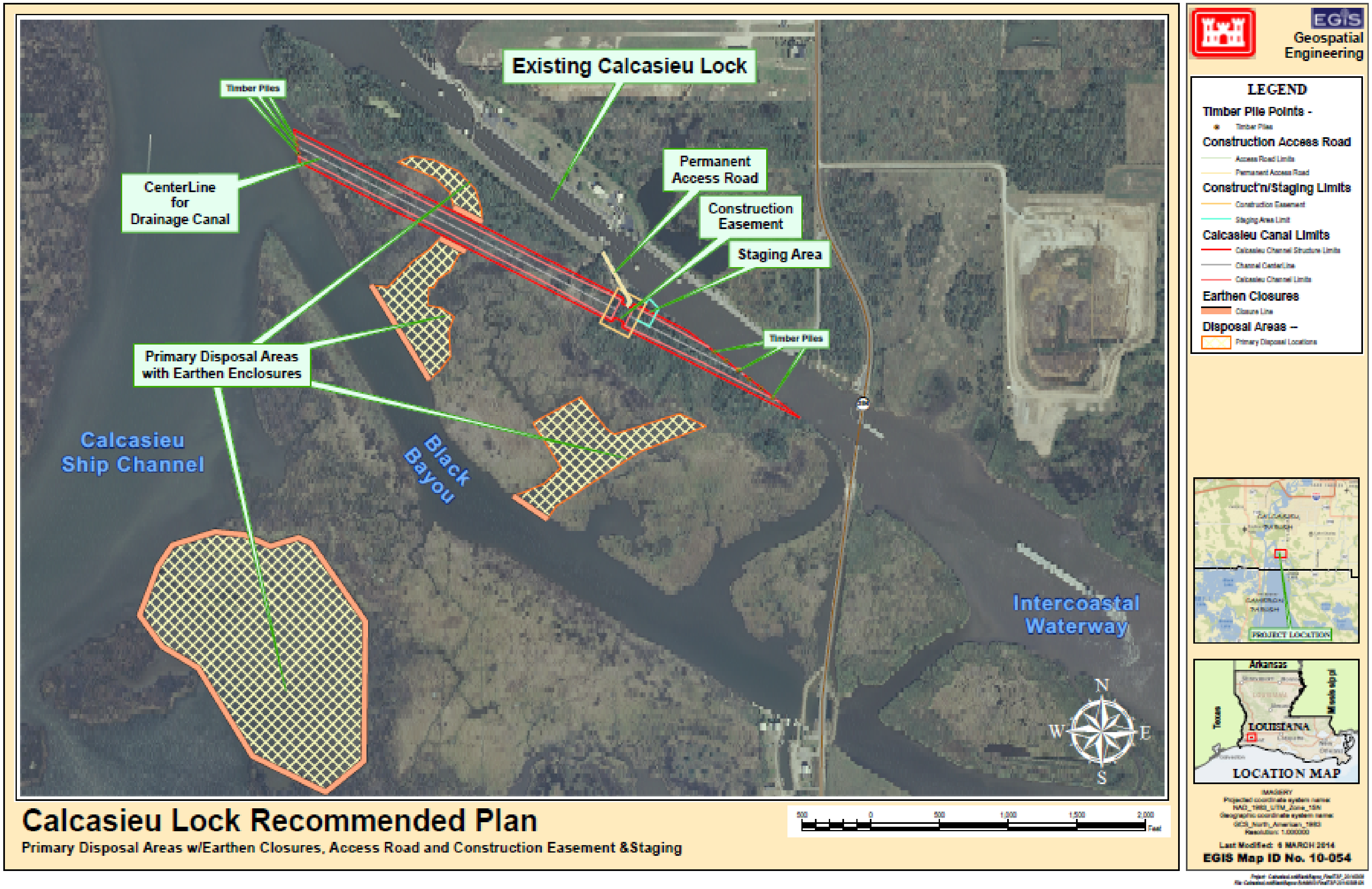

Figure 20. Alternative 1, the Recommended Plan

5.8.1.2. Environmental. During the preconstruction engineering and design phase, a variety of environmental considerations would take place. In general terms, such considerations include verification of compliance with environmental commitments made during the feasibility phase; providing environmental input during the development of project plans and specifications; detailing how the project would be constructed to minimize environmental impacts; identifying methods of construction; and specifying mitigation measures.

Various environmental commitments have been developed during this feasibility phase, and they reflect a number of considerations for avoiding and minimizing environmental impacts during construction. These commitments are described in Section 5.9.4, *Environmental Commitments*.

5.8.1.3. Construction. During PED, surveys will be taken of the channel alignment and the area of the culvert structure. This survey shall confirm quantities for dredging and earthwork for the structure. Disposal areas for dredge material shall be developed and constructed to satisfactorily contain dredge material from the approach channel alignment for the culvert structure per the mitigation plan. All access to this area requires floating plant and marine equipment. The new by-pass channel will be created by hydraulic dredging. A cofferdam will be constructed around the new structure to prevent water from entering the construction site. Upon completion of the excavation, foundation piling can be driven and the slab for the culvert structure constructed. Construction of the reinforced concrete structure can begin while electrical service is directed to the structure location. After the concrete work is completed miscellaneous metals and appurtenances for the metal gates can be installed. Concurrently, channel dredging, impact protection and remote operating machinery can be installed along with the finalization of the electrical delivery system. Upon completion of the concrete structure, structural backfill will be placed around the structure. Stone will be placed along the channel slopes while the structure is in the dry condition. Upon completion of the earthwork and stone placement, the cofferdam will be removed. The structure is then ready for use.

The proposed work is anticipated to occur during 2016-2017, with project completion by 2018. It is presumed that once construction has commenced, work would occur throughout the year to the extent practicable.

5.8.2. Real Estate Requirements. The project primarily impacts wetlands. It is estimated that five private landowners could be affected by the project. Details regarding the real estate requirements for the proposed project can be found in Appendix J, *Real Estate Plan*. Construction access to the site for Alternative 1 will be via barge. In addition, a permanent access road will be constructed from the Lock to the culvert structure for use by the Lock personnel. A standard perpetual Road Easement will be acquired for this feature. Tentatively, staging for Alternative 1 will be adjacent to the site between the Lock and culvert structure. A standard Temporary Work Area Easement will be acquired for the staging area.

A standard channel improvement easement will be acquired for creation of the inflow channel. A standard temporary work area easement will be acquired for and the proposed disposal areas. The culvert structure area will be acquired in Fee, Excluding Minerals (With Restrictions on Use of Surface).

The estimated cost of real estate required for the project is $131,000(project first costs at the 1 October 2014 Price Level). These costs include administrative costs associated with acquisition activities, including potential condemnations. This estimate includes a contingency.

The project is 100% federally funded, as it is considered a single purpose inland navigation project. As such, the U.S. will acquire any lands, easements, rights of way, relocations, and disposal/borrow areas as deemed necessary for the construction, operation and maintenance of the project. The project is not expected to induce flooding. The project does not propose to implement zoning ordinances in lieu of real estate acquisitions.

There are no active oil and gas wells located within the project study area. There are no crops affected by the project. There are no oyster leases located within the project study area.

The construction of project features for the Calcasieu Lock project can be conducted without impact to nearby utilities. There will be no required facility/utility relocations for the project.

A Phase I Environmental Site Assessment was conducted in June, 2013 on behalf of the Corps for the project. No HTRW materials or Recognized Environmental conditions were observed or discovered. The probability of encountering HTRW in the course of the project would be low, and direct significant adverse impacts would not be anticipated.

Community support for the project is high; however, the attitudes of the landowners who would be directly affected by the project are not known. It is anticipated that landowner support would be high.

Refer to Appendix J, *Real Estate Plan*, for complete details regarding the real estate requirements for the project in accordance with ER 405-1-12 (Chapter 12).

5.8.3. Operations and Maintenance Considerations. The OMRR&R activities will be generally in accordance with those activities shown in Table 22 above. Regular operations and maintenance for the structure will be staffed and conducted out of the Calcasieu Lock site. At periodic intervals rewiring of machinery, dewatering of the gate bays, and replacement of gates will occur; subject to periodic inspections and monitoring by lock staff.

5.8.4. Effectiveness of Recommended Plan in Meeting Goals and Objectives. The Recommended Plan meets the overarching system goal of maximizing the efficiency of Calcasieu Lock and the planning objective of reducing drainage event induced delays by moving the effects of drainage events away from the lock.

5.8.5. Effectiveness of Recommended Plan in Meeting Environmental Operating Principles. The formulation of all of the alternatives considered for implementation was done in accordance with the Environmental Operating Principles.

5.8.6. Compensatory Mitigation Measures. A mitigation plan has been developed (Appendix I, *Mitigation Plan*) which is summarized here. Close coordination among the Habitat Evaluation Team and the USFWS in particular, have resulted in a mitigation plan for the Recommended Plan. Utilizing WVA, the HET established that Alternative 1 results in -7.2 AAHU's of impact to the Forested Spoil Bank adjacent to the existing lock, and -3.8 AAHU's of impact to brackish marsh. The primary objective of the proposed mitigation plan for Alternative 1 is to restore in acres the equivalent of -7.2 AAHUs of forested spoil bank. Please see Appendix I for further information on the proposed mitigation. Because the creation of 50 acres of brackish marsh habitat more than offsets the loss of 14 acres of brackish marsh habitat, there is no need for any marsh mitigation

To meet the requirement of "in-kind" mitigation, the HET desired that for impacts to forested spoil bank, because this is a man-made habitat, there is no "in-kind" equivalent natural habitat that directly corresponds. Functionally, this habitat is similar to natural coastal levee or chenier forests. It is also similar to coastal bottomland hardwood forests. (The HET chose to use the WVA's chenier/ridge model rather than that method's bottomland hardwood forest model to assess forested spoil bank habitat impacts because the former was developed for forested spoil bank habitat assessment, whereas the latter was not.) Consequently the HET decided that mitigation planning strategies for forested spoil bank habitat would consist of either improvement of existing forested spoil bank habitat, restoration or creation of natural levee or chenier habitat, or acquiring credits from an approved bottomland hardwoods mitigation bank located in the Project's watershed. Therefore, to meet the "in-kind" requirement for forested spoil bank habitat, mitigation would take the form of one or more of these approaches.

The Recommended Mitigation Plan for Alternative 1 consists of the following:

- **Forested Spoil Bank Mitigation** (figure 21) to include 1) enhancing 15 acres of remaining habitat by implementing tree stand improvements (designated by the hatched area within the yellow polygon), and 2) acquiring 9.1 acres of credits from an approved bottomland hardwood mitigation bank located in the Project's service area.

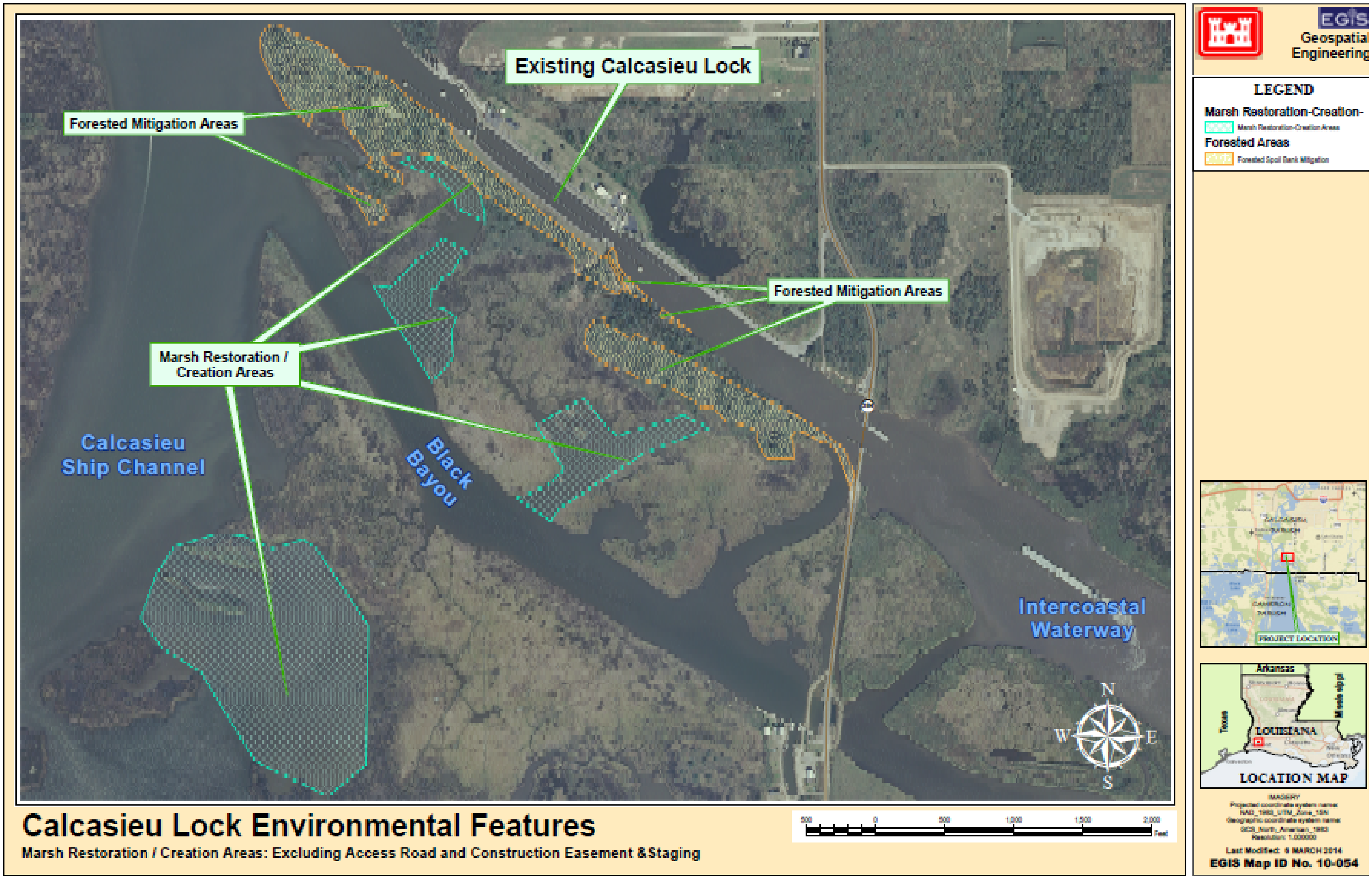

Figure 21. Forested Spoil Bank Mitigation Areas

This mitigation plan represents the least cost solution for addressing forested spoil bank habitat losses.

5.9. Plan Implementation and Requirements

5.9.1. Milestone Schedule and Procedures. The current schedule for completing the feasibility report is as follows:

Agency Decision Milestone	February 19, 2014
Civil Works Review Board	May 17, 2014
State and Agency Review begin	June 27, 2014 – July 28, 2014
Chief's Report Milestone	September 16, 2014

Upon completion of the Report of the Chief of Engineers, the report will also be submitted to Congress for Authorization in a future WRDA Act. If funds are made available by Congress, PED can begin. Additionally, the report will be reviewed by the Office of the Assistant Secretary of the Army (Civil Works) and the Office of Management and Budget for potential inclusion in future Administration budget requests.

5.9.2. Implementation Responsibilities. The Recommended Plan would be a single purpose inland navigation project. Section 102 of the WRDA of 1986 as amended, 33 USC 2212, specifically provides that all costs associated with implementation of inland navigation projects shall be 100 percent Federal, including construction as well as operation and maintenance. Moreover, the cost of construction for such projects is specifically defined to include the acquisition of real estate for the project.

The Recommended Plan will not affect the existing Calcasieu Lock or the ongoing obligations of the non-Federal sponsor (Cameron Parish Police Jury) relative to the lock, as set forth in the Act of Assurance that was signed in 1947 for the Calcasieu Lock.

5.9.3. Environmental Commitments. Throughout the planning process, efforts were made to avoid impacts to natural resources to the extent practicable. The Recommended Plan would impact approximately 14 acres of brackish marsh (wetland) habitat and 11.5 acres of terrestrial forested spoil bank habitat during construction of the new channel. However, all material obtained by hydraulic dredging to construct the channel would be placed into approximately 50 acres of shallow open water in the project area to restore or create brackish marsh. The creation of 50 acres of brackish marsh habitat would more than offset the marsh habitat lost from construction activities. Similarly, forested spoil bank impacts would be mitigated by implementing tree stand improvements in about 15 acres of remaining forest, and purchasing about 9.1 credits from an approved bottomland hardwood mitigation bank located in the Project's service area.

Section 2039 of WRDA 2007 directs the Secretary of the Army to ensure that, when conducting a feasibility report submitted to Congress for authorization, a project alternative shall not be selected unless such report:

a. contains a specific recommendation with a specific plan to mitigate fish and wildlife losses;

b. ensures that other habitat types are mitigated to not less than in-kind condition, to the extent possible; and:

c. requires mitigation plans comply with the mitigation standards and policies of the regulatory programs administered by the Secretary and require specific mitigation plan components. Among these components, the implementation guidance for Section 2039, in the form of a CECW-PB Memo dated August 31, 2009 (http://cw-environment.usace. army.mil/restore/riverrestoration/pdfs /WRDA% 20Sec_2039.pdf), requires monitoring until successful. For more information, see Appendix I, *Mitigation Plan*).

Best management practices would be included in construction specifications and they would be employed during construction activities to minimize environmental effects. Many of these best management measures are required by Federal, state, or local laws and regulations, regardless of whether they are specifically identified in this document or not. Project implementation would comply with all relevant Federal, state, and local laws, ordinances, regulations, and standards during the implementation of the Recommended Plan. Implementation of the environmental commitments would be documented to track execution and completion of the environmental commitments.

The environmental and related commitments made during the planning process and incorporated into the project plan are as follows:

- Ensure that a salinity barrier is maintained during the construction process.
- Ensure construction contractors limit ground disturbance to the smallest extent feasible.
- Use board roads where dredge pipelines or equipment would cross existing marsh.
- Conduct a search for bald eagle, brown pelican or other colonial nesting wading bird active nests within three-quarter of a mile from proposed disturbance activities prior to construction. Appropriate protective measures and no-work distance restrictions would be implemented to avoid or minimize nest disturbance if active nests are identified.
- Contact pipeline and gas well companies prior to construction activities to identify and avoid hazards (if any).
- Implement best management practices and measures contained in erosion control guidelines to control soil erosion from construction areas.
- Implement measures to control fugitive dust during construction.
- Implement a program to compensate for any losses of archaeological sites that may occur as a result of construction and operation of the proposed project.
- Implement a program to properly handle and dispose of any HTRW materials that may be encountered during construction.
- All retention dikes constructed for marsh creation/restoration features would contain an adequate opening and have a depth as deep as the deepest natural entrance into the disposal site in order to accommodate the escape of aquatic species.
- Ensure construction contractors are educated on the ESA and the species of concern. Measures to minimize and/or prevent the potential for entrapment for protected marine species such as sea turtles and manatees and separate measures for the protection of manatees will be implemented.

In addition to these commitments, the Corps concurs with the following USFWS positions and recommendations, as expressed in its final FWCA Report (Appendix B, *U.S. Fish and Wildlife Service Coordination Letter and Support*). The Service's analysis of project alternatives considered for the study area has revealed the potential for significant adverse effects on fish and wildlife resources. Construction of the Recommended Plan (Alternative 1) would result in the loss of approximately 11.5 acres of forested ridge habitat and 14 acres of brackish marsh, for a loss of 7.5, and 3.78 AAHUs respectively. The Service does not object to providing more efficient navigation through the GIWW provided the following fish and wildlife conservation measures are implemented concurrently with project implementation to help ensure that fish and wildlife conservation receives equal consideration with other project purposes:

- Fully compensate for unavoidable losses of important fish and wildlife habitat. The Corps shall provide in-kind mitigation (including beneficial disposal of material dredged during project construction to offset marsh habitat impacts) for impacts to forested ridge habitat, brackish and intermediate marsh habitat to the extent determined for the selected project plan. With construction of the Recommended Plan, approximately 11 acres of forested ridge habitat and 14 acres of brackish marsh would be impacted requiring mitigation for 7.2 AAHUs of forested ridge habitat and 3.78 AAHUs of brackish marsh. Calculation of benefits derived from the mitigation area(s) and design (e.g., size, etc.) of those areas presented in this report should not be considered final but preliminary (but sufficient for early feasibility level analysis) based upon existing information gathered. Final design and benefits produced from any mitigation site is contingent upon additional engineering (e.g., settlement curves, etc.) and environmental data, if needed, gathered in future planning/design stages.

- The assessment of mitigation options for marsh impacts should include an evaluation of the feasibility of disposing project-associated dredged material in a manner that would create marsh in the adjacent shallow open water areas of the project area or in open water to the south of the lock in an area known as the Garrison site. Dredged material that is in excess of that needed for marsh impact mitigation should be used beneficially to create marsh at either or both of these sites (or other adjacent suitable sites). Marsh created beneficially should follow the same design criteria (e.g., initial disposal height, duration till containment dike gapping, etc.) as that used for each specific mitigation site.

- Because of the expedited schedule, we recommend that the Corps continue to coordinate with the agencies during the remaining Feasibility phase and the Preconstruction, Engineering, and Design (PED) phase to ensure any new or changed project features, development of any operational plan (e.g., water control plan), further development of the mitigation plan (including monitoring and adaptive management) fully incorporate adequate fish and wildlife conservation measures and that those features can be adequately evaluated with regards to impacts to fish and wildlife resources and/or sufficiency in achieving mitigation.

- Future documentation of detailed project planning (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) and any mitigation plans, including adaptive management and monitoring plans should be coordinated with the Service and other natural resource agencies. The Service and other natural resource agencies should be provided an opportunity to review and submit recommendations on the all work addressed in those reports. The need to prepare a Fish and Wildlife Coordination Act report for any of these documents should be discussed with the Service prior to beginning the detailed design/plan formulation that would be presented in each document.

- The Service, LDWF, NMFS and other natural resource agencies should be consulted regarding the adequacy of any proposed mitigation (including beneficial disposal of material dredged during project construction to offset marsh habitat impacts). Draft mitigation plans should be developed in cooperation with those agencies prior to the release of any National Environmental Policy Act documentation. That plan should be consistent to the extent practicable with existing habitat restoration and protection plans for this region, and should address the 12-step process for developing a mitigation plan (Federal Register, Vol. 73, No. 70).

- The adequacy of mitigation measures (i.e., 1.5 acres of mitigation for every 1 acre of marsh impacts) to fully offset impacts to Essential Fish Habitat should be discussed with the National Marine Fisheries Service to determine if additional mitigation is needed to comply with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA, Magnuson-Stevens Act; P.L. 104-297, as amended) and its implementing regulations.

- Forested ridge clearing associated with project features should be avoided during the spring and fall to minimize impacts to staging or incoming migratory birds.

- Water control structures should be designed to allow opening in the absence of an offsite power source after a major storm passage and water levels return to pre-storm levels.

- There should be no changes to hydrology within the Mermentau Basin due to the proposed project that would adversely affect fish and wildlife resources.

- The Service and the NMFS request that during development of the PED Project Management Plan (or equivalent document) we be allowed to review the projected funding and schedule to ensure that that sufficient time and funds are available during PED for the Service and NMFS to complete all work needed to fulfill the 2(b) requirements of the FWCA.

5.9.4. Financial Requirements

5.9.4.1.Federal Responsibilities. Section 102 of the WRDA of 1986 as amended, 33 USC 2212, specifically provides that all costs associated with implementation of inland navigation projects shall be 100 percent Federal, including construction as well as operation and maintenance. Moreover, the costs of construction for such projects are specifically defined to include the acquisition of real estate for the project. See 33 USC 2212 (a) ("For purposes of this subsection, the term "construction" shall include planning, designing, engineering, surveying, the acquisition of all lands, easements, and rights-of-way necessary for the project, including lands for disposal of dredged material, and relocations necessary for the project."); 2212(b) ("The Federal share of the cost of operation and maintenance of any project for navigation on the inland waterways is 100 percent.").

5.9.4.2. Project Management Plan. A Project Management Plan will be prepared for the Recommended Plan to identify specific tasks to be accomplished during the preconstruction engineering and design phase and to identify construction activities for the construction phase. The PMP will include the following milestone:

- PED: Start October 2015

6.0. ENVIRONMENTAL CONSEQUENCES *

This section discusses effects to the existing environment that are expected from implementation of each proposed alternative. A summary of environmental consequences is displayed in Table 34. The assessments of environmental effects are organized by evaluating the No Action Alternative, and the "Action Alternatives" (Alternatives 1 and 3); the latter would entail actions on the part of the Federal Government.

6.1. Soils and Waterbottoms

6.1.1. No Action Alternative. Normal operations and maintenance activities at Calcasieu Lock are expected to continue into the future. Similarly, in the vicinity of Calcasieu Lock, the need for maintenance dredging in the GIWW is infrequent. These activities are not expected to affect any new undeveloped areas, including any areas considered to be prime or unique agricultural soils.

6.1.2. Action Alternatives. Soils affected by proposed construction activities of the Action Alternatives would consist of estuarine marsh soils or spoil material that was side cast when the Lock was completed in 1950. No prime or unique farmland would be affected. Soils formed from the placement of hydraulically dredged material for marsh restoration or creation would have a higher inorganic content than the naturally occurring soils typical of coastal marshes, and would likely be denser.

6.2. Hydrology. When rainfall occurs over the Mermentau Basin, freshwater drainage currently passes through the GIWW from east to west and goes through Calcasieu Lock. The Lock serves as a barrier to the intrusion of saltwater coming from the gulf, which moves northward through Calcasieu Lake and Calcasieu River, and from west to east along the GIWW and Black Bayou. Louisiana Highway 384 also serves as a barrier to saltwater intrusion.

6.2.1. No Action Alternative. Existing hydrodynamic conditions, as presented in Section 4.2.2, would not change as a result of the No Action Alternative. All interior drainage from the freshwater Mermentau Basin that currently passes through the GIWW from east to west through Calcasieu Lock would continue to do so. The Lock would continue to serve as a barrier to the intrusion of saltwater coming from the gulf, which at this location moves through the GIWW from west to east.

The Black Bayou CWPPRA project, a hydrologic restoration project located in the project area at the intersection of Black Bayou and Louisiana Highway 384, has experienced a design deficiency since construction in 2010 and is not currently functioning. That project's ten 10'x 10' concrete box culverts were intended to help with freshwater drainage from the Mermentau Basin to the Calcasieu

River. The construction of Highway 384 in the past had altered and effectively blocked the original drainage system from east to west. The CWPPRA project was to reopen the historic drainage pathway through Black Bayou in the vicinity of the Lock to alleviate excessive water levels experienced within freshwater marshes in the basin. In 2013, CWPPRA funding had been approved for developing and constructing the repair for this design deficiency. Under the No Action Alternative, it is assumed the repair would occur, but there is uncertainty about when it would actually take place.

6.2.2. Action Alternatives [1]. The Action Alternatives would alter existing hydrological patterns in the vicinity of the Lock that occur when interior drainage passes from the Mermentau Basin through the GIWW. To minimize navigation delays, freshwater flows would either be passed around the Lock via a new bypass channel (Alternatives 1&2), or be routed through the historic pathway represented by Black Bayou (Alternatives 3-5).

For these Action Alternatives, it would be desirable from an engineering perspective to maximize hydraulic efficiency of freshwater flows passing through a new bypass channel or along Black Bayou. To maximize hydraulic efficiency, it would be desirable to eliminate any places along these pathways where flow could be diverted or delayed from reaching the Calcasieu River. There are several such places in the project area, and they consist of meander remnants of the historic Black Bayou. The desired engineering solution for eliminating such points of hydraulic inefficiency would be to replace the open water feature with ‘land’ (i.e., marsh). Historic topographic maps of the project area displaying Black Bayou are included in Appendix M, *Hazardous, Toxic, and Radioactive Waste Initial Assessment Documentation*.

6.2.2.1. Alternatives 1&2. For Alternative 1 (Recommended Plan) and Alternative 2, the Lock would no longer be used for drainage. A new bypass channel would be constructed to divert freshwater drainage around the Lock to its south. The discharge end of the bypass channel would connect with the Calcasieu River, south of the GIWW and north of Black Bayou. To maximize hydraulic efficiency, the west-most meander remnant of Black Bayou that lies south of the Lock’s west gate would be eliminated by filling it with dredged material, as would the remnant to the east. These changes would result in a minor alteration to localized hydrological patterns.

The water control structure constructed in the new channel would be kept closed in between rainfall events over the Mermentau Basin to prevent saltwater intrusion.

6.2.2.2. Alternatives 3-5: For Alternatives 3-5, the Lock would no longer be used for drainage. The Black Bayou CWPPRA project would be supplemented with a new water control structure, and Black Bayou would be deepened and widened to divert freshwater drainage along this historic pathway. To maximize hydraulic efficiency, four remnants of the historic meandering Black Bayou channel would need to be eliminated - three on the west side of Highway 384 and one to the east - by filling them with dredged material. These changes would result in a minor alteration to localized hydrological patterns.

The new water control structure, in conjunction with the CWPPRA project’s water control structures, would be kept closed in between rainfall events over the Mermentau Basin to prevent saltwater intrusion.

[1] These action alternatives would not have any indirect adverse effects on drainage from the Mermentau Basin.

6.3. Water Quality and Salinity

6.3.1. No Action Alternative. The No Action Alternative is unlikely to worsen water quality conditions in the project area. Calcasieu Lock would continue to serve as a saltwater barrier, and would continue to be used to pass rainfall drainage from the Mermentau Basin to the Calcasieu River. This freshwater basin is expected to continue to support rice farming as well as a diversity of natural aquatic habitats, including extensive freshwater marshes interconnected with numerous open water bodies. Normal operations and maintenance activities at Calcasieu Lock are expected to continue into the future. The need for maintenance dredging in the GIWW in the vicinity of the Lock is expected to remain infrequent.

6.3.2. Action Alternatives. For all five Action Alternatives (1&2, 3-5), overall effects on water quality are anticipated to be minor. All hydraulically dredged material placed into disposal sites to restore or create marsh would be confined by the use of earthen containment berms and dikes. These berms and dikes would be temporary and not permanent structures. The use of these sites would affect water quality through localized, temporary elevations in suspended solids concentrations. Suspended solids would be released as these features are constructed to retain the dredged material, and as excess water from pumping dredged material is released from the sites.

The dikes around the disposal sites would be designed to slowly deteriorate and subside to the level of the adjacent marsh substrate, thereby promoting the tidal exchange of water. Part of the natural degradation of the dike may result from erosion, which could contribute to suspended solids in the area. In addition, wind and wave activity may cause erosion of these structures. These effects would occur primarily during the first year or two after the completion of dredged material placement at the sites. Earthen dikes may require mechanical degradation following sediment consolidation if natural erosive processes do not degrade them sufficiently to allow for fisheries and tidal access. The establishment of marsh vegetation on the dredged material through natural colonization as well as some planting would provide stability to the sediment and reduce erosion. The establishment of vegetation would rely on planting at the wetland mitigation site and natural recruitment at remaining disposal sites.

During land construction activities adjacent to the GIWW, Black Bayou, and the Calcasieu River, runoff from exposed bare earth would also result in localized, temporary elevations in suspended solids in these adjacent waters. Impacts associated with construction would be evident during construction operations and for a short time following construction.

Best management practices (BMPs) to reduce suspended solids from land runoff include installing silt fences and hay bales. Similarly, turbidity screens or silt curtains placed in water around construction sites would reduce the spread of waters with elevated concentrations of suspended solids. Actions to reduce long-term erosion and runoff include the establishment of permanent groundcover on new side slopes and disturbed areas with non-woody stemmed, drought-resistant vegetation.

The proposed water control structures would be kept closed in between rainfall events occurring over the Mermentau Basin to prevent saltwater intrusion. No effects on the salinity regime of the system would be expected.

6.3.3. Compliance with State Water Quality Standards. In a letter dated January 15, 2014, the LDEQ issued Water Quality Certification under Section 401 of the Clean Water Act for the project to USACE (New Orleans District). Because elevated levels of ammonia are common in anaerobic sediments underlying Louisiana's estuaries and waterways, special management practices would be employed during dredged material disposal operations to dissipate ammonia. Compliance with EPA Water Quality Criteria for ammonia would be accomplished by oxidation of ammonia by implementation of one or more management practices as follows: (1) attachment of a baffle plate to the end of the discharge pipeline to thoroughly expose slurry to oxygen during placement in a disposal area; (2) increase the retention time within the disposal area by routing slurry through interior dikes or by managing effluent discharge from the disposal area across a weir; and (3) if possible, routing the effluent across vegetated wetlands with the disposal area prior to discharge into adjacent receiving waters.

6.4. Air Quality. Although the project is located in an area which is in attainment for all criteria pollutants, the Lake Charles Metropolitan Statistical Area is vulnerable to being designated as non-attainment for ozone in the next few years.

6.4.1. No Action Alternative. Selection of the No Action Alternative would not change air quality. Tows transiting through Calcasieu Lock would continue to experience delays during drainage events passing through the lock from the Mermentau Basin. While awaiting transit through the lock, idling engines and running generators would continue to generate emissions that contribute to localized air quality impacts.

6.4.2. Action Alternatives. Short-term air quality impacts would occur during construction, and would include emissions of pollutants such as particulate matter, carbon dioxide, sulfur dioxide, and nitrate oxides. Without any emissions controls in place during construction, the project would not contribute to the current effort of the Imperial Calcasieu Regional Planning & Development Commission to reduce emissions in Calcasieu and Cameron Parishes in order to maintain the Lake Charles Metropolitan Statistical Area as in attainment for ozone.

In order to reduce potential short-term air quality impacts associated with construction activities, each of the Alternatives would need to include emission reducing measures to minimize construction-related air quality impacts to the surrounding area.

The Recommended Plan will include a Construction Emissions Mitigation Plan, as recommended by the USEPA in its comment letter dated December 3, 2013. In addition to all applicable local, state, or Federal requirements, the following mitigation measures will be made part of the Construction Emissions Mitigation Plan in order to reduce impacts associated with emissions of particulate matter, carbon monoxide, sulfur dioxide, nitrate oxides, and other pollutants from construction-related activities:

Fugitive Dust Source Controls: A Fugitive Dust Control Plan will be included to reduce Particulate Matter 10 and Fine Particulate Matter 2.5 emissions during construction and operations. The plan will include these general commitments:

- 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 earthmoving equipment to 10 mph.

Mobile and Stationary Source Controls

- Plan construction scheduling to minimize vehicle trips;
- Limit idling of heavy equipment to less than 5 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 will be used for project construction equipment to the maximum extent feasible;
- Lacking availability of non-road construction equipment that meets Tier 4 engine standards, USACE will 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 such as natural gas and electricity (plug-in or battery).

Administrative Controls

- Develop construction traffic and parking management plan that maintains traffic flow and plan construction to minimize vehicle trips.
- Identify any sensitive receptors in the project area, such as children, elderly, and the infirm, and specify the means by which impacts to these populations will be minimized (e.g. locate construction equipment and staging zones away from sensitive receptors and building air intakes).
- Include provisions for monitoring fugitive dust in the fugitive dust control plan and initiate increased mitigation measures to abate any visible dust plumes.

With the inclusion of this Construction Emissions Mitigation Plan, overall adverse effects of construction-related activities on regional air quality are expected to be minimal.

After construction, the project would contribute to a long term improvement to regional air quality because of the reduction in tow delays passing through the lock. Current tow delays at the lock due to drainage events are estimated to be one hour, which is an overall average that applies to all tows passing through the lock (figure k-24, Appendix K, *Economics)*. All with-project alternatives would decrease transit times for each tow by one hour. Therefore, idling engines and running generators of all tows awaiting passage would generate emissions on average for one hour less. Given that the number of vessels passing through Calcasieu lock has ranged from about 13,000 to 16,000 per year for the period 1999 through 2011 (table k-11, Appendix K, *Economics*), the resulting emissions from these sources would be reduced by roughly 13,000 to 16,000 fewer hours of operation per year.

6.5. Noise. Major sources of noise in the project area are limited to water-based transportation typically passing through Calcasieu Lock on the GIWW, and vehicular traffic on Louisiana Hwy 384 to the immediate east. When vessels or vehicles are not passing by, the project area is usually quiet.

6.5.1. No Action Alternative. The No Action Alternative would not change ambient noise levels in the project area. Tows transiting through Calcasieu Lock would continue to experience delays during drainage events passing through the lock from the Mermentau Basin. While awaiting transit through the lock, idling engines and running generators would continue to generate noise in the vicinity of the lock.

6.5.2. Action Alternatives. During construction, noise impacts to the natural and human environment are expected to be localized and short-term. Heavy equipment and engines from barges, dredges, and launches would contribute to noise at the project site during construction. Dredging activities can intermittently generate noise levels as high as 85 to 88 dBA (California Department of Water Resources, 2000) and heavy equipment can generate levels as high as 95 dBA at 50 feet. However, noise-sensitive areas (e.g., residences, schools, and hospitals) are not located in areas affected by construction and operation activities.

Underwater noise during construction could potentially affect echolocation receptors in marine mammals (i.e., dolphins), but such species are not likely to occur in the project area. If they were present, the effects would be short term and localized, and the animals could easily relocate to areas of less noise during such times.

Noise impacts during the operations phase of the project are as follows.

- **Alternatives 1&3.** A pump station is not included for either of these alternatives. During the operations phase of the project, there would be no noise associated with pump stations.
- **Alternatives 2, 4, and 5.** Because a pump station is a component of each of these three alternatives, during the operations phase of the project noise would be generated when the pump is used to move drainage from the Mermentau Basin past the lock. This noise is expected to be minor because noise-sensitive areas (e.g., residences, schools, and hospitals) are not located in the vicinity of the pump station locations.

The project would result in a long term reduction in noise generated in the vicinity of the lock because of the reduction in tow delays passing through the lock. Current tow delays at the lock due to drainage events are estimated to be one hour, which is an overall average that applies to all tows passing through the lock (figure k-24, Appendix K, *Economics*). All with-project alternatives would decrease transit times for each tow by one hour. Therefore, idling engines and running generators of all tows awaiting passage would be operated on average for an hour less. Given that the number of vessels passing through Calcasieu lock has ranged from about 13,000 to 16,000 per year for the period 1999 through 2011 (table k-11, Appendix K, *Economics)*, engine noise generated in the vicinity of the lock by idling equipment would be greatly reduced.

6.6. Vegetation Resources. Brackish and intermediate marshes are the predominant plant communities within the project area. According to the USGS (2007), 116,791 acres of wetlands in the Calcasieu-Sabine Basin have converted to open water since 1932 (USGS, 2007), resulting in the loss of the plant communities that were present on these wetlands. The LDNR (1998) estimated that of the 317,100 acres of marsh present in the Calcasieu-Sabine Basin in 1990, 50,840 acres would be lost by 2050 if no restoration efforts are undertaken.
A third plant community, upland forest located on dredge spoil material, is also present. Changes to the species composition and distribution of these plant communities would take place under the various alternatives.

6.6.1. No Action Alternative. Due to the combined effects of land subsidence and shoreline erosion, brackish marshes in the project area on the west side of Louisiana Highway 384 and intermediate marshes on the east side would continue to convert to open water at a relatively slow rate. For purposes of the Wetland Value Assessment analysis conducted for this project, the assumed rate of conversion is 0.2 percent per year (Appendix P, *Wetland Value Assessment*). For the upland vegetation resources that are present in the project area, which consist of forested spoil bank along the south side of the Lock, subsidence and shoreline erosion were assumed not to influence this resource. No existing or approved ecosystem or habitat restoration projects located in the Calcasieu-Sabine watershed were identified as likely to change the composition or distribution of the project area's plant communities.

The Louisiana Department of Wildlife and Fisheries considers brackish marsh (but not intermediate marsh) as becoming a rare natural community in the state (LDNR, undated).

6.6.2. Action Alternatives. The Action Alternatives would affect estuarine marsh. Under Alternative 1 (Recommended Plan) and Alternative 2, 14 acres of brackish marsh would be impacted; under Alternatives 3-5, 34 acres of brackish and intermediate marsh would be directly affected. For all alternatives, dredged material would be used in a least-cost environmental acceptable manner to create and restore estuarine marsh habitat in nearby shallow open water areas. For each alternative, the ecological benefit of created/restored marsh habitat would more than offset the associated marsh loss, based on the project's WVA marsh impact analysis (Appendix P, *Wetland Value Assessment*).

6.6.2.1. Alternative 1 (Recommended Plan) and Alternative 2. Construction of the new channel would directly impact about 14 acres of brackish marsh habitat (consisting of about 10 acres of emergent and 4 acres of open water), and about 11.5 acres of forested spoil bank habitat.

Regarding marsh impacts, all dredged material obtained from construction of the new channel would be disposed into shallow open water in the project area to restore and create about 50 acres of brackish marsh. Based on the marsh impact assessment using Version 1.1 of the Wetland Value Assessment's (WVA) Coastal Marsh Community Model, the loss of 14 acres of marsh habitat is represented by -3.78 Average Annual Habitat Units (AAHUs), whereas the restoration and creation of about 50 acres of marsh habitat is represented by 23.5 AAHUs. Because this impact assessment shows that the ecological benefits in AAHUs from marsh habitat restoration and creation more than offset the loss, no compensatory marsh mitigation would be needed. Monitoring and adaptive management of the marsh restoration and creation areas would be required to demonstrate that marsh habitat gains in the dredged material disposal areas actually occur. Marsh plantings would be implemented in a portion of the disposal areas to accelerate the establishment of a vegetative cover and generate ecological benefits. Plans for plantings, monitoring, and adaptive management are described in detail in Appendix I, *Mitigation Plan*.

Regarding forest impacts, the ecological value of the 11.5 acres of forested spoil bank habitat that would be lost is represented by -7.5 AAHUs, as determined using Version 1.1 of the WVA's Coastal Chenier Model. This loss of forested spoil bank habitat would require compensatory mitigation. To compensate for the loss of forested spoil bank habitat, a mitigation plan has been developed, and would be included as part of these alternatives, including the Recommended Plan. Within the project area on the south side of the lock, the remaining forested area (about 15 acres) would be enhanced or improved by implementing tree stand improvements. The intent of these measures is to increase the diversity of native tree and shrub species in the forest, and remove invasive species that are present. Based on the WVA analysis, about 3.0 AAHUs would be generated by this mitigation measure. To obtain the outstanding 4.5 AAHUs, the mitigation plan also includes the purchase of about 9.1 credits from an approved bottomland hardwood mitigation bank serving the project area's watershed. The compensatory mitigation plan for forested spoil bank habitat is described in detail in Appendix I, *Mitigation Plan*. The mitigation plan represents the most cost effective and least-cost solution to compensate for forested spoil bank habitat loss.

6.6.2.2. Alternatives 3-5. For each of these alternatives, improving Black Bayou would directly impact about 34 acres of marsh, including 11 acres of brackish marsh and 23 acres of intermediate marsh. Based on the marsh impact assessment using Version 1.1 of the Wetland Value Assessment's (WVA) Coastal Marsh Community Model, the brackish marsh and intermediate marsh losses are represented by -1.56 AAHUs and -7.51 AAHUs, respectively, for a combined loss of -9.07 AAHUs. Material obtained from dredging under these alternatives would be used to convert 50 acres of shallow open water in the project area to either brackish or intermediate marsh. Potential disposal sites were identified on both sides of Highway 384. Based on the marsh impact assessment, ecological benefits of 16.28 AAHUs would be generated by dredged material disposal. This benefit would more than offset the loss, and no compensatory marsh mitigation would be needed for these alternatives. No forested spoil bank habitat would be affected by any of these alternatives.

6.7. Wildlife and Habitat. The project area ecosystem serves as the primary wintering habitat for mid-continent waterfowl populations, as well as breeding and migration habitat for migratory songbirds returning from Central and South America, and also provides habitat for numerous resident wildlife species. Wildlife habitats in the project area that would be affected by the Action Alternatives include brackish aquatic habitats and terrestrial or upland forest occurring on old dredge material.

6.7.1. No Action Alternative. It is doubtful that the No Action Alternative would have any effect on terrestrial or aquatic animals, such as muskrat, waterfowl or other migratory birds that would be expected to use the area for resting, feeding, or nesting. Over time, the continued subsidence of coastal marshes would create more open water habitat, which although less productive than marsh, would be available for wildlife use. Normal operations and maintenance activities at Calcasieu Lock are expected to continue into the future. The need for maintenance dredging in the GIWW in the vicinity of the Lock is expected to remain infrequent.

6.7.2. Action Alternatives. About 40 acres of forested spoil bank habitat occurs on the south side of Calcasieu Lock. About half consists of trees and the remainder as scrub-shrub vegetation. Alternatives 1-2 would adversely affect about 11.5 acres of forested spoil bank habitat and about 14 acres of brackish marsh. Alternatives 3-5 would impact 34 acres of brackish and intermediate marshes. The effects on marsh and associated animal and plant resources are described in Section 6.6, Vegetation Resources; and Section 6.8, Aquatic Resources.

For each action alternative, permanent unavoidable impacts to wildlife resources would occur. A compensatory mitigation plan for forested spoil bank habitat would be included as part of Alternatives 1&2 to fully restore the ecological functions lost as a result of construction impacts. Mitigation planning and the forested spoil bank mitigation plan are described in detail in Appendix I, *Mitigation Plan*. Compensatory mitigation would not be needed for marsh habitat losses because all alternatives would use dredged material in a least-cost environmentally acceptable manner to restore and create marsh habitat in nearby shallow open water areas.

6.7.2.1. Alternative 1(Recommended Plan) and Alternative 2. The loss of about 11.5 acres of forested spoil bank habitat would adversely affect migratory bird species and other animals to a minor degree. Other forest dwelling wildlife species which would be directly impacted by Alternatives 1&2 include small mammals, reptiles, and amphibian species. The majority of mobile animals, including birds, would escape to the remaining forest or move to other areas of similar habitat once disturbances from grading, dozing, or construction commence. The displacement and/or reduction in the number of animals is not expected to severely impact local animal communities due to the presence of similar habitats adjacent to the project area and the likely abundance of displaced species elsewhere.

To mitigate for the loss of forested spoil bank habitat, the remaining forested area with trees (about 15 acres) would be enhanced or improved by implementing tree stand improvements. The intent of these measures is to increase the diversity of native tree and shrub species in the forest, and remove invasive species that are present. The compensatory mitigation plan also includes the purchase of about 9.1 credits from an approved bottomland hardwood mitigation bank serving the project area's watershed. These compensatory mitigation measures would offset the ecological loss of forested spoil bank habitat, as determined by the impact assessment using the WVA's Coastal Chenier Model.

Although the loss of marsh habitat in the project area could adversely impact migratory or resident waterfowl and wading birds, the impacts on marsh foraging habitat and ground nesting habitat would not be significant due to the presence of similar habitats adjacent to the project area, as well as replacement habitats by restoring and creating 50 acres of marsh habitat in nearby open water areas using dredged material.

The plans for forested spoil bank compensatory mitigation are described in detail in Appendix I, *Mitigation Plan*.

6.7.2.2. Alternatives 3-5. These Action Alternatives would adversely affect about 11 acres of brackish marsh and about 23 acres of intermediate marsh. Effects on migratory or resident waterfowl and wading birds are expected to be similar to those for Alternatives 1&2.

6.7.3. Protected Wildlife Species. Species protected under the Endangered Species Act are discussed in Section 6.11, Threatened and Endangered Species. Additional significance of wildlife resources is demonstrated by the multitude of legislative acts that exist to manage and conserve the resource. Pivotal among these are the NEPA; the Coastal Zone Management Act; the Estuary Protection Act; the Fish and Wildlife Coordination Act of 1958, as amended; the Migratory Bird Conservation Act of 1929, as amended; the Migratory Bird Treaty Act (MBTA); the Endangered Species Act of 1973, as amended; the Fish and Wildlife Conservation Act of 1980; the North American Wetlands Conservation Act; EO 13186 Migratory Bird Habitat Protection; and the Marine Mammal Protection Act (MMPA).

Bald Eagle. Regarding the Bald Eagle, the USFWS has indicated that there are no known bald eagle nests in the vicinity of the project area (see Appendix B, *USFWS Coordination Letter and Support*). Similarly, no nests were observed during site visits to the project area in December 2012 and November 2013. This bird is not known to use any trees in the project area for feeding, resting, or roosting. Therefore, none of the alternatives are likely to harm or harass the bald eagle.

Brown Pelican and Other Colonial Nesting Birds. Regarding colonial nesting birds, including the brown pelican, the USFWS has indicated that there are no known colonial nesting birds in the vicinity of the project area (see Appendix B, *USFWS Coordination Letter and Support*). The closest known nesting site of the Brown pelican is Rabbit Island in Calcasieu Lake (USACE, 2010b), about 15 miles to the southwest of the project area. Likewise, no colonial nests of any such species were observed in the project area during site visits in December 2012 and November 2013. Therefore, none of the alternatives are likely to disturb any colonial nesting birds.

Bottlenose dolphins are protected under the MMPA and may be found in the vicinity of the project area. With the utilization of the measures for reducing entrapment of this species (see Appendix A, *Biological Assessment*), no impacts are anticipated.

If conditions in the project area were to change in the future, potential direct impacts would be avoided in accordance with the Marine Mammals Protection Act, Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act by the use of best management practices (BMPs) and recommendations from USFWS and NMFS.

Potential for minimal indirect impacts to colonial nesting water birds, which are protected under the MBTA, could include disturbance of roosting or foraging birds due to construction activity and noise. Additionally, during nesting season, work would be required to take place outside of the USFWS and LDWF declared buffer zones (see below). Work within buffer zones may only take place during non-nesting season (September 1 to February 15).

No-work distance restrictions are as follows:

- Terns, Gulls, and Black Skimmers (650 feet)
- Colonial nesting wading birds (1,000 feet)
- Brown Pelicans (2,000 feet)
- Bald Eagles (660 feet)
-

6.8. Aquatic Resources

Freshwater. Although freshwater habitats are located in some areas on the north side of the GIWW in the vicinity of Calcasieu Lock, none would be affected by any of the Action Alternatives.

Brackish Water. Brackish water habitats are defined as having salinity concentrations ranging from 0.05 to 30 ppt (Hutchinson, 1957). Most of the open water within the Calcasieu estuary is brackish, and various brackish habitats occur in the project area. Therefore, brackish resources would be affected by the project.

Saline Water. Saline habitats (those with salinity greater than 30 ppt) could be found during periods of low rainfall and in the saltwater wedge at the bottom of the Calcasieu ship channel and GIWW. It is unlikely such saltwater conditions would be affected by any of the project alternatives.

6.8.1. No Action Alternative. Existing aquatic habitat conditions, as presented in Section 4.2.2, would not change as a result of the No Action Alternative. All interior drainage from the freshwater Mermentau Basin that currently passes through the GIWW from east to west through Calcasieu Lock would continue to do so. The Lock would continue to serve as a barrier to the intrusion of saltwater coming from the Gulf, which at this location moves through the GIWW from west to east. Thus, aquatic habitats and their salinity levels would not be affected.

6.8.2. Action Alternatives. The Action Alternatives would alter existing aquatic habitats in the vicinity of the Lock. To minimize navigation delays, freshwater flows from the Mermentau Basin would either be passed around the Lock via a new bypass channel (Alternative 1 [Recommended Plan] and Alternative 2), or be routed through the historic drainage pathway represented by Black Bayou (Alternatives 3-5). In terms of total direct impacts, Alternatives 1&2 would affect about 65 acres and Alternatives 3-5 about 135 acres.

6.8.2.1. Alternative 1 (Recommended Plan) and Alternative 2. For Alternative 1 (Recommended Plan) and Alternative 2, the Lock would no longer be used for drainage. A new bypass channel would be constructed to divert freshwater drainage around the Lock to its south. The water control structure constructed in the new channel would be kept closed in between rainfall events over the Mermentau Basin to prevent saltwater intrusion. Aquatic habitat directly impacted by the new channel includes about 4 acres of shallow open brackish water and about 10 acres of brackish emergent marsh.

Additional aquatic habitat directly affected by Alternatives 1&2 would include the open water disposal sites for dredged material. All hydraulically dredged material obtained from construction of the new channel would be placed in approximately 50 acres of brackish open water in a confined manner, converting it to brackish marsh.

6.8.2.2. Alternatives 3-5. For Alternatives 3-5, the Lock would no longer be used for drainage. The Black Bayou CWPPRA project would be supplemented with either a new water control structure or a pump station, and Black Bayou would be deepened and widened to divert freshwater drainage along this historic pathway.

Aquatic habitat directly affected by dredging includes approximately 51 acres of brackish open water and 5 acres of brackish emergent marsh on the west side of Louisiana Highway 384; and 23 acres of open water and 19 acres of emergent marsh on the east side of the highway, which experience lesser salinity levels.
Additional aquatic habitat directly affected by Alternatives 3-5 would include open water disposal sites located within the project area. All hydraulically dredged material obtained from construction of the proposed new channel would be placed in 50 acres of confined disposal sites to restore degraded brackish marsh or convert shallow open water to marsh.

6.9. Fisheries. Aquatic organisms in the project area reflect the great diversity of fish and invertebrate resources found in the surrounding coastal waters and the Gulf of Mexico. Benthic invertebrates are important in the food webs of an estuarine system. Additionally, invertebrates may provide indications of the quality of water and sediments. Many of the fishes of the Gulf of Mexico are estuarine-dependent; they depend on estuaries for reproduction, nursery areas, food production, or migrations. No oyster beds or oyster lease areas are present within the project area.

6.9.1. No Action Alternative. No direct impacts to fisheries and invertebrates would result from the No Action Alternative. Over time, the continued subsidence of marshes would create more open water habitat, which although less productive than marsh, would be potentially usable by fishes and invertebrates. Changes in sedimentation and suspended solids are not expected in the project area, which could lead to a change in the composition of the benthic invertebrate community.

6.9.2. Action Alternatives: Under the Action Alternatives, hydraulically dredged material would be disposed into open water habitats to restore or create marsh. Although benthic invertebrates would be temporarily eliminated by dredging and disposal, they would become reestablished within a short period of time. There is a potential for the construction activities to impact fish and/or shrimp larvae in the proposed areas of disturbance. Since adult and juvenile fishes and shrimp are mobile, it is expected that they would avoid the areas of disturbance and therefore would not be impacted.

The restoration and creation of wetlands through the placement of dredged material would have a beneficial effect on recreational and commercial fisheries. The National Marine Fisheries Service has stated that wetlands play an important role in providing habitat for foraging, spawning, rearing, and cover for most commercial fish and shellfish species and that approximately 98 percent of the commercial fishery landings in the Gulf of Mexico are estuarine-dependent (http://nmfs.noaa.gov/habitat/habitat conservation /publications). Recreational and commercial fisheries are of major importance to the local and state economies, and local communities depend on fishing to support the local economy. The shrimp fishery is directly dependant on the wetlands of an estuary; a greater amount of wetlands produce a greater amount of shrimp.

The disposal site located about 1 mile southwest of the Lock along the east shore of Calcasieu Lake is a popular recreational fishing area. Use of this site for disposal would have a minor effect on recreational fishing opportunities in Calcasieu Lake.

6.10. Essential Fish Habitat. Essential fish habitat within the project area is found in estuarine marshes and water bodies west of Louisiana Highway 384, including the GIWW, Black Bayou, the Calcasieu shipping channel, and Calcasieu Lake. Specifically, EFH consists of brackish marsh, the marsh-water interface (marsh-edge), mud/sand/shell/rock substrates, and the estuarine water column. EFH currently affected by operation and maintenance of Calcasieu Lock would include mud/sand/shell substrates and the estuarine water column within the GIWW; the marsh-water interface along the edges of this navigation waterway; and brackish marsh bordering the waterway, all west of the highway.

6.10.1. No Action Alternative: In the vicinity of Calcasieu Lock, the need for maintenance dredging in the GIWW is infrequent. Normal operations and maintenance activities are expected to continue to have minor effects on EFH. Occasional removal of debris from the GIWW after the passage tropical storms is also expected to have minor effects on EFH.

6.10.2. Action Alternatives: At least two life stages of brown shrimp, white shrimp, and red drum all have the potential to be present within the Calcasieu Lake estuary throughout the year. Dredging and other construction activities would adversely impact EFH used by red drum and shrimp. There is a potential for the construction activities to impact red drum and/or shrimp larvae in the areas of disturbance. However, based on the relative abundance of red drum larvae in the area during this life stage, the probability of encounter is very low. Since adult and juvenile red drum and shrimp are mobile, it is expected that they would avoid the areas of disturbance and therefore would not be impacted. The dredging of emergent marsh and open water areas would also result in the temporary loss of benthic organisms (prey species) in the vicinity of the construction. However, benthic organisms would recolonize available habitat within a relatively short time period. More mobile prey species would be expected to avoid the areas of disturbance and therefore would not be impacted. Based upon the project design, the impacts associated with the dredging, other construction, and the restoration and creation of marsh habitat using dredged material, the Action Alternatives *may adversely affect EFH* (Appendix C, *NOAA National Marine Fisheries Service Coordination*).

6.10.2.1. Alternative 1 (Recommended Plan) and Alternative 2. EFH directly affected by Alternatives 1&2 includes 14 acres impacted by construction of the proposed channel. This area is comprised of about 10 acres of emergent brackish marsh vegetation and 4 acres of shallow open water.

Additional EFH directly affected by Alternatives 1&2 would include the open water disposal sites, which are located west of the Highway 384. All hydraulically dredged material obtained from construction of the new channel would be placed in the identified confined disposal sites to restore degraded brackish marsh or convert shallow open water to marsh. The 50 acres of dredged material placement sites will be used to restore and create marsh. Containment berms and dikes surrounding these disposal sites will be degraded naturally or mechanically to allow organisms access to these areas.

The improvement in aquatic habitats resulting from the creation of approximately 50 acres of brackish marsh is expected to provide compensation for the loss of the EFH. Coordination with NMFS was completed on March 28, 2014 through a concurrence letter. A Record of Decision will not be signed until all agency coordination is complete.

6.10.2.2. Alternatives 3-5. The EFH directly affected by Alternatives 3-5 includes 56 acres impacted by dredging to deepen and widen Black Bayou. This area consists of about 5 acres of emergent brackish marsh vegetation and 51 acres of open water.

Additional EFH directly affected by Alternative 3 would include the 35 acres of open water disposal sites located on both sides of the highway. All hydraulically dredged material obtained from widening Black Bayou would be placed in confined disposal sites to restore degraded brackish marsh or convert shallow open water to marsh. About 31 acres of the dredged material placement sites would be located on the west side of the highway.

6.11. Threatened and Endangered Species. For the 12 protected species discussed in Section 4.2.11, *Threatened and Endangered Species*, a Biological Assessment was prepared in September 2013 and included in Appendix A, *Biological Assessment*, as part of the draft report made available for public review in late 2013. At that time, only one of these species was considered as potentially occurring in the project area:

- Sprague's pipit (*Anthus spragueii*), a candidate bird species proposed for Federal listing;

In response to the public review, the U.S. Department of the Interior, on behalf of the USFWS, submitted a comment letter dated November 13, 2013, that stated "sea turtles are known to occur at least as far inland as the north shore of Calcasieu Lake and could potentially occur in the project area." In addition, with regard to the West Indian manatee, the letter also stated that "it has been sighted northward of the project area in Calcasieu River and Pass and could potentially occur in the project area." The Biological Assessment prepared in September 2013 did address potential project effects on sea turtles and the manatee, but without the benefit of this information.

In response to this letter, the Biological Assessment was revised to reflect this additional information about sea turtles and the manatee. Based on the revised Biological Assessment, the additional species considered as potentially occurring in the project area include:

- Kemp's Ridley sea turtle (*Lepidochelys kempii*), an endangered species
- West Indian manatee (Trichechus manatus), an endangered species

6.11.1. No Action Alternative. Maintaining the existing conditions and operations of Calcasieu Lock would have little, if any, effect on protected species of the area.

6.11.2. Action Alternatives. The revised Biological Assessment (BA) was prepared in accordance with the provisions of Section 7 of the Endangered Species Act of 1973, as amended. The revised BA concluded that the project may affect but is not likely to adversely affect Sprague's pipit and the West Indian manatee. It is USACE's opinion that these alternatives, including Alternative 1 (Recommended Plan), would have "no effect" on the other species, including all turtle species.

The revised BA was submitted to USFWS for coordination on March 27, 2014 (Appendix A *Biological Assessment*). In a letter dated March 27, 2014, USFWS concurred with USACE's determination of not likely to adversely affect for the manatee (see Appendix B, *U.S. Fish and Wildlife Service Coordination Letter and Support*). A Record of Decision will not be signed until all agency coordination is complete.

Effects of the various Action Alternatives on threatened and endangered species would not differ. Because of the potential for protected marine species such as sea turtles and manatees to become entrapped within construction sites in coastal Louisiana waters, projects that utilize shallow open water areas for the construction of enclosed facilities and wetland creation, such as this one, will utilize measures to minimize and/or prevent the potential for such entrapment. These measures are included as an addendum to the revised BA. Similarly, procedures have been recommended by the USFWS for use in situations where in-water construction activities potentially could occur where manatees may be present. These procedures are also included in the revised BA as an addendum. These two sets of procedures would be included as part of any alternative, including Alternative 1 (Recommended Plan).

6.12. Cultural and Historic Resources. The Recommended Plan (Alternative 1) would not have adverse construction or implementation-related effects on historic, cultural, or sacred sites/traditional properties within the Project impact area as documented within this report, promulgated under NEPA. Environmental consequences of construction activities are mainly concerned with the inadvertent discoveries within the APE. If any unrecorded or unreported cultural resources are discovered during the construction of the Project, the Corps or its contractor(s) will halt all construction activities at the discovery area and resume coordination with the Louisiana State Historic Preservation Officer, and other consulting and interested parties. Any forgoing consultation or coordination will proceed under Section 106 of the National Historic Preservation Act, as amended, and will coordinate our responsibilities with this section with their emergency discovery responsibilities under section 106 of the National Historical Preservation Act (16 U.S.C. 470 (f) et seq.), 36 CFR 800.11 or section 3 (a) of the Archeological and Historic Preservation Act (16 U.S.C. 469 (a-c)). Compliance with these regulations does not relieve Federal agency officials of the requirement to comply with section 106 of the National Historical Preservation Act (16 U.S.C. 470 (f) et seq.), 36 CFR 800.11 or section 3 (a) of the Archeological and Historic Preservation Act (16 U.S.C. 469 (a-c)). The Recommended Plan, while not specifically identified at the time, falls within the area of effect identified in the 2012 consultation with the SHPO.

6.13. Socioeconomic and Human Resources

6.13.1. No Action Alternative. The No Action Alternative is not anticipated to affect or contribute to Socioeconomic and Human Resources in the region.

6.13.2. Alternative 1. Although there may be some short-term positive impacts on employment and potential increase in demand for housing during construction, Alternative 1 is not expected to have impacts on the socio-economic and Human Resources.

6.13.3. Alternative 3. Although there may be some short-term positive impacts on employment and potential increase in demand for housing during construction, alternative 3 is not expected to have impacts on the socio-economic or human resources.

6.14. Hazardous, Toxic, and Radioactive Waste

6.14.1. No Action Alternative. The No Action Alternative is not anticipated to affect or contribute to HTRW in the region.

6.14.2. Action Alternatives. The project would not result in any adverse effects associated with HTRW. A search for HTRW materials or recognized environmental conditions within a 2-mile radius of the project site did not reveal any concerns (Appendix M, *Hazardous, Toxic, and Radioactive Waste*).

In the event that any HTRW is encountered during construction or found in dredged materials or at dredged material placement sites, it would be remediated in accordance with local, state and Federal laws.

6.15. Unavoidable Adverse Effects. All alternatives evaluated have unavoidable adverse direct and indirect environmental effects that are discussed in this document.

Under the No Action Alternative, the conversion of brackish and intermediate marshes to open water would continue at a relatively slow rate. This would result in reduced habitat for aquatic species and benthic species typical of emergent wetlands. In addition, there would be a decrease of available nutrients and detritus present to estuarine communities. Additionally, saltwater intrusion and drainage problems would continue, resulting in the conversion of freshwater marsh to intermediate and brackish marsh.

The selection of the Recommended Plan was the culmination of a process to select an alternative plan that addresses navigation improvement planning for the GIWW at and in the vicinity of Calcasieu Lock while minimizing adverse effects to the socioeconomic and natural environment. Re-routing the freshwater flows around the Lock via a new bypass channel or Black Bayou, would be result in a minor alteration to localized hydrological patterns. Dredge and disposal activities associated with construction would result in the loss of forested spoil bank and brackish and intermediate marsh habitat. Alternative 1 (Recommended Plan) and Alternative 2 would directly impact about 14 acres of brackish marsh (consisting of about 10 acres of emergent and 4 acres of open water), and about 11.5 acres of forested spoil bank. Alternatives 3-5 would directly impact about 34 acres of marsh, including 11 acres of brackish marsh and 23 acres of intermediate marsh; no forested spoil bank would be lost.

Essential fish habitat, consisting of mud/sand/shell substrates, the estuarine water column, the marsh-water interface, and brackish marsh, would also be impacted. Essential fish habitat directly affected by Alternatives 1&2 includes 14 acres impacted by construction of the channel. This area is comprised of about 10 acres of emergent brackish marsh vegetation and 4 acres of shallow open water. Additional EFH directly affected by Alternatives 1&2 would include the open water disposal sites, which are located west of the highway. The EFH directly affected by Alternatives 3-5 includes 56 acres impacted by dredging to deepen and widen Black Bayou. This area consists of about 5 acres of emergent brackish marsh vegetation and 51 acres of open water. Additional EFH directly affected by Alternatives 3-5 would include the open water disposal sites located west of the highway.

6.16. Irreversible and Irretrievable Commitment of Resources. The No Action Alternative would involve irreversible or irretrievable losses of funding, energy and labor from delays to transportation due to the inability of tows to move through the lock during drainage events. All Action Alternatives would require irreversible and irretrievable commitments. The expenditure of funding, energy, labor, and materials would be required for each Action Alternative, including Alternative 1, the Recommended Plan.

The current operation of Calcasieu Lock would not cause the permanent removal or consumption of any renewable resources. Although original construction of the authorized project may have induced changes in land use, no appreciable additional changes are expected to result from the continuance of current operations.

Project implementation would irreversibly and irretrievably commit some lands, including open water, wetlands, and upland habitats, to additional development, including a new channel, a water control structure, and other features consisting of confined disposal areas for the restoration and creation of brackish marsh.

6.17. Mitigation. Corps policy is to ensure that adverse impacts to significant resources have been avoided or minimized to the extent practicable and that remaining, unavoidable impacts have been compensated to the extent justified.

In the development of the Action Alternatives, features or measures that were incorporated to compensate for potential adverse environmental effects to significant resources include the use of hydraulically dredged material to offset marsh impacts by wetland restoration or construction. Using dredged material in this manner would address the following planning objective recommended by the USFWS in its Planning Aid Report for this project (Appendix B, *U.S. Fish and Wildlife Service Coordination Letter and Support*): “Beneficially use any dredged material, not necessary for project construction, for wetland construction.”

The disposal of dredged material into shallow open water sites to restore and create marsh habitat is a least-cost environmentally acceptable disposal alternative that would more than offset marsh habitat losses resulting from any of the Action Alternatives, including marsh habitat losses associated with construction of the new channel for Alternative 1 (Recommended Plan). Therefore, no compensatory mitigation for marsh habitat would be required for any of the Action Alternatives, including Alternative 1 (Recommended Plan).

6.17.1. Protected Species. Construction contracts issued by the Corps for this project would require contractors to comply with procedures to protect any marine mammals, sea turtles, bald eagle nest, or brown pelican or other colonial waterbird nesting areas that might be present in the project area in the future (none are present currently). Protective measures for these species are briefly described in Section 6.11, *Threatened and Endangered Species*, and in more detail in Appendix A, *Biological Assessment*.

6.17.2. Upland Forested Habitat. Construction of the new channel would result in the unavoidable loss of about 11.5 acres of forested spoil bank upland habitat for Alternative 1 (Recommended Plan) and Alternative 2. To mitigate for this loss, a compensatory mitigation plan has been developed and would be included as part of these alternatives. The remaining forested area (about 15 acres) would be enhanced or improved by implementing tree stand improvements. The plan also includes the purchase of about 9.18 credits from an approved bottomland hardwood mitigation bank serving the project area’s watershed. Based on the WVA habitat impact analysis, the approximately 3.0 AAHUs generated by tree stand improvements and the 4.5 AAHUs from mitigation bank credits would compensate for the -7.5 AAHU habitat loss.

The forested spoil bank habitat mitigation plan is described in detail in Appendix I, *Mitigation Plan.*

6.17.3. Essential Fish Habitat. Essential fish habitat (EFH) affected by Alternative 1 (Recommended Plan) and Alternative 2 includes 14 acres impacted by construction of the proposed channel. This area is comprised of about 10 acres of emergent marsh vegetation and 4 acres of shallow open water. Additional EFH affected by these two alternatives includes the shallow water disposal sites located west of the highway. All hydraulically dredged material obtained from construction of the new channel would be placed in the identified disposal sites to restore degraded brackish marsh or convert shallow open water to marsh. The improvement in aquatic habitats resulting from the restoration or creation of approximately 50 acres of brackish marsh is expected to provide compensation for the loss of EFH.

6.17.4. Water Quality. Construction companies contracted to build the new channel and water control structure would be required to follow standard BMPs to minimize the introduction of suspended solids into surrounding waters. These BMPs include such practices as the use of siltation fences and hay bales to reduce erosion at construction sites. Dredging contractors would be required similarly to adhere to BMPs for dredging operations and dredged material disposal. Requirements to comply with BMPs would be included in and made part of construction and dredging contracts.

6.18. Environmental Consequences Summary. To provide compliance with the Council on Environmental Quality Regulations, 40 CFR Part 1502.14, a summary of the environmental consequences that would result from implementing Alternatives 1&2 and Alternatives 3-5 is presented in table 38. A full explanation of environmental impacts of the alternatives can be found throughout Section 6.0.

Table 38. Summary of Environmental Consequences

Resource	No Action Alternative	Alternative 1	Alternative 3
Hydrologic Conditions	No effect	Freshwater flows would be passed around the Lock via a new bypass channel. These changes would result in a minor alteration to localized hydrological patterns.	Freshwater flows would be routed through the historic pathway represented by Black Bayou. These changes would result in a minor alteration to localized hydrological patterns.
Geology	No effect	No effect	No effect
Soils	No effect	Soils formed from the placement of dredged material would likely be denser than naturally occurring soils, and would have a higher inorganic content. No effect on prime or unique farmland soils.	Soils formed from the placement of dredged material would likely be denser than naturally occurring soils, and would have a higher inorganic content. No effect on prime or unique farmland soils.
Water Quality	No effect; salinity barrier maintained	Construction activities and placing dredged material for beneficial use could result in short-term elevated levels of suspended solids and nutrients. Salinity barrier maintained.	Construction activities and placing dredged material for beneficial use could result in short-term elevated levels of suspended solids and nutrients. Salinity barrier maintained.
HTRW	No effect	No effect	No effect
Air Quality	No effect	No overall adverse effects on regional air quality. Emissions generated during construction by equipment; potential for generation of dust at land-based staging areas and during land clearing operations.	No overall adverse effects on regional air quality. Emissions generated during construction by equipment; potential for generation of dust at land-based staging areas and during land clearing operations
Wetlands	Continued conversion of estuarine marsh to open water at a relatively slow rate due to subsidence & shoreline erosion.	Loss of about 14 acres of brackish marsh. Beneficial use of dredged material would re-store/create about 50 acres of marsh in project area.	Loss of about 11 acres of brackish marsh and 23 acres of intermediate marsh. Beneficial use of dredged material would nourish, re-store, or create up to 50 acres of marsh in project area.
Essential Fish Habitat	No effect	Loss of about 10 acres of emergent brackish marsh vegetation and 4 acres of shallow open water. Additional EFH directly affected by Alternative 1 would include the proposed open water disposal sites located west of Hwy 384.	Loss of about 5 acres of emergent brackish marsh vegetation and 51 acres of open water. Additional EFH directly affected by Alt 3 would include the same proposed open water disposal sites located west of Hwy 384.
Oyster Grounds	No effect	No effect	No effect
Threatened & Endangered Species	No effect	No adverse impacts	No adverse impacts
Recreation	No effect	Recreational fishing is expected to improve as a result of the marsh restoration/creation. Minor loss of recreational fishing opportunity if disposal site SW of lock were used.	Recreational fishing is expected to improve as a result of the marsh restoration/creation. Minor loss of recreational fishing opportunity if disposal site southwest of lock were used.
Cultural Resources	No effect	No effect	No effect
Noise	No effect	Temporary, minor increases in noise during construction	Temporary, minor increases in noise during construction
Socioeconomics	No effect	No effect	No effect

6.19. Indirect Impacts. Indirect impacts "are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." (40 CFR Section 1508.8). Indirect impacts are also known as secondary or induced impacts. Secondary impacts associated with the proposed project are described in each section of this document discussing specific resources or issues. In summation, the action would offer benefits to the socioeconomic and natural environments. First, the regional and national economy is expected to benefit by the reduction in delays to navigation traffic currently passing through the lock, which transport necessary goods (e.g., petroleum, natural gas, etc.) to the east and to the west on the GIWW.

Second, the project would be beneficial to the Mermentau Basin to the north and east because it would facilitate drainage of the basin's freshwater around the lock and over to the Calcasieu River and Calcasieu Lake. Agricultural production occurring within the basin in the form of rice farming would benefit by the increased ability for drainage from rice fields. Natural environments within the basin, consisting principally of freshwater marshes and numerous open water bodies, would also benefit similarly. These natural habitats are currently experiencing elevated and prolonged freshwater flooding due to impaired natural drainage pathways. Improving drainage in the vegetated habitats would help restore a greater diversity to native plant communities and minimize plant mortality due to stress and drowning. Associated animal communities are also expected to benefit indirectly.

Lastly, the use of dredged material to restore degraded marsh and create marsh in shallow open water areas would result in greater habitat diversity, additional estuarine habitat for economically important species, and improved recreation. Because marsh has been shown to provide a greater reduction in hurricane storm surge than open water, created and restored marsh would offer a benefit in minimizing hurricane damage.

6.20. Relationship Between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity. Socioeconomic benefits and adverse environmental impacts represent tradeoffs between the local short-term use and the long-term stability and productivity of the environment. This navigation improvement for the Gulf Intracoastal Waterway would maximize the efficiency of the Calcasieu Lock, thereby contributing to the overall efficiency of GIWW as a nationally significant navigation system, while continuing to provide water management capability and salinity control to the Mermentau River Basin. The GIWW is a large shallow draft inland navigation system that interfaces with the regions deep draft navigation system. Calcasieu Lock is the busiest Lock on the GIWW and 11^{th} in the Nation.

By re-routing the freshwater flows around the Lock, implementation of Alternative 1 (Recommended Plan) and Alternative 2 would result in the loss of forested spoil bank and brackish marsh habitat. Alternatives 3-5 would directly impact brackish and intermediate marsh. Impacts to forested spoil bank and marsh habitats would be offset by the implementation of mitigation measures for forested spoil bank habitat, and marsh creation and restoration measures using dredged material. These measures have been developed to replace lost habitat functions and values, thereby enhancing long-term productivity of the estuarine environment.

6.21. Cumulative Impacts. Section 1508.8 of Title 40 of the Code of Federal Regulations, promulgated by the President's Council on Environmental Quality to implement the National Environmental Policy Act, defines cumulative impact as:

> "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

A cumulative impacts analysis has been conducted and is summarized here. Further information can be found in Appendix N, *Cumulative Impacts*. This Feasibility Report/EIS includes considerations of the effects of creating a new freshwater bypass around Calcasieu Lock, and dredged material placement on natural resources of the area, including essential fish habitat, coastal wetlands, and protected species. The cumulative impacts analysis focuses on the primary issue affecting natural resources--land loss due to coastal subsidence and shoreline erosion, and plant community changes due to saltwater intrusion.

Although the project area is limited to the Calcasieu Lock and vicinity, cumulative impacts involve the broader coastal basin. The analysis was conducted for the Calcasieu-Sabine Basin in Louisiana's Chenier Plain. Impacts from past actions began with the construction of navigation channels in the Calcasieu and Sabine Rivers in the early 1870s and 1880s, respectively.

Although cumulative impacts associated with past actions have produced a natural environment that is markedly different from that of 140 years ago, the Calcasieu estuary is still a valuable ecosystem. The project would maintain a saltwater barrier at the lock, would not affect the overall dimensions of the GIWW, and therefore would not exacerbate existing salinity issues. The project would result in the loss of about 14 acres of marsh, but also includes the restoration or creation of about 50 acres of marsh through the placement of dredge material in a beneficial use-like manner. The environmental effects of the proposed project would not contribute adverse increments to the cumulative effects of past, present, and reasonably foreseeable actions.

6.22. Environmental Consequences: Environmental Justice

6.22.1. The No-Action Alternative (FWOP Condition)

Direct. No disproportionately high or adverse human health or environmental impacts on minority or low-income populations would occur.

Indirect. No disproportionately high or adverse human health or environmental indirect impacts on minority or low-income populations would occur.

Cumulative. There would be no cumulative impacts on minority and/or low-income communities within the study area per 2010 U.S. Census information and requirements of EO 12898. The No-Action Alternative would not contribute to any additional EJ issues when combined with other Federal, state, local, and private restoration efforts.

6.22.2. With Project: All Alternatives

Direct. Pursuant to EO 12898, no minority and/or low income communities have been identified within the proposed study area per 2010 U.S. Census who will be subjected to disproportionately high or adverse human health or environmental impacts by implementation of the Recommended Plan.

Indirect. Pursuant to EO 12898, no minority and/or low income communities have been identified within the proposed study area per 2010 U.S. Census who will be subjected to disproportionately high or adverse human health or environmental impacts by implementation of the Recommended Plan.

Cumulative. Pursuant to EO 12898, no minority and/or low income communities have been identified within the proposed study area per 2010 U.S. Census who will be subjected to disproportionately high or adverse human health or environmental impacts by implementation of the Recommended Plan and no additional EJ issues when combined with other Federal, state, local, and private restoration efforts.

7.0. PUBLIC INVOLVEMENT

7.1. National Environmental Policy Act Scoping. In compliance with Corps policies and the NEPA, input on projects is solicited from the public and other government agencies. A Notice of Intent (NOI) to prepare a Draft Environmental Impact Statement for the Calcasieu Lock, LA, Feasibility Study was published in the Federal Register on March 23, 2001. The NOI invited the public to comment during the scoping process and during a public meeting. Comments were solicited for this document during the public comment period. A public scoping meeting was held in the Calcasieu Parish Police Jury Administrative Building in Lake Charles, LA, the evening of April 3, 2001. Approximately 30 people ,including elected officials and representatives of elected officials, representatives of government agencies, landowners, fishing guides, and the general public attended the meeting. The input from the public and agency personnel resulted in a wide array of comments on issues, concerns, and potential alternatives for reducing navigation delays caused by drainage events at the Calcasieu Lock. To update the public on the status of the Study and to seek additional public input, a press release was issued on December 4, 2012, to announce the holding of a second public meeting in the Police Jury Administrative Building in Lake Charles the evening of December 12, 2012. Several questions were answered by the Study team. The only significant comment was from navigation industry supporters who were disappointed that a new lock was not part of the final array. The Notice of Intent and scoping reports from both public meetings are included in Appendix G, *Public Involvement.*

7.2. Distribution List for Draft Report/EIS. The report/EIS was distributed to Federal, state, parish, and local agencies; Tribes; businesses; libraries; museums; universities; environmental organizations, and groups and individuals. The complete distribution list is located in Appendix G, *Public Involvement.*

7.3. Interagency Coordination. Although separate interagency meetings have not been held to coordinate development of this project, periodic coordination has taken place by mail, telephone and electronic mail since 2011. The USFWS updated the initial Planning Aid Report prepared in 2001 and provided a revised one in February 2012; furnished a draft FWCA Report on August 22, 2013; and a final FWCA Report on March 27, 2014 (see Appendix B, *U.S. Fish and Wildlife Service Coordination Letter and Support*). In late 2012 Federal and state resource agencies were invited to attend the December 2012 public meeting, and representatives were also invited to participate in bi-weekly project conference calls to discuss the plan formulation process, evaluation of alternatives, and other issues. Notified agencies include the USFWS, the USEPA, the National Marine Fisheries Service, the

Natural Resources Conservation Service, the Louisiana DNR, the Louisiana Department of Wildlife and Fisheries, the Louisiana Department of Environmental Quality, and the Louisiana Department of Transportation and Development.

7.4. Public Comments on the Draft Environmental Impact Statement

A Notice of Availability for the Draft Feasibility/EIS report was published in the Federal Register on October 4, 2013. Due to the Federal government shutdown in early October, an amended Notice of Availability was published in the Federal Register on November 8, 2013. The amended 45-day public comment period for the draft report began on October 4 and ended on December 2, 2013. One public meeting was held to receive comments on November 19, 2013, in Lake Charles, Louisiana. Fewer than five people attended. No public comments were submitted by letter or electronic email, nor were verbal comments made at the public meeting. Comment letters submitted in response to public review of the draft report were received from the National Marine Fisheries Service, U.S. Department of the Interior (on behalf of the USFWS), USEPA, Louisiana Department of Wildlife and Fisheries, and Louisiana Department of Culture, Recreation, and Tourism. Agency comments and written responses provided by CEMVN can be found in Appendix G, *Public Involvement*.

8.0. COORDINATION AND COMPLIANCE

8.1. Corps Principles and Guidelines. The guidance for conducting Civil Works planning studies (ER 1105-2-100) is based on the P&G adopted by the Water Resources Council. The P&G comprises two parts: the *Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies* and the *Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies.* The P&G requires the systematic formulation of alternative plans to ensure all reasonable alternatives are evaluated.

The P&G also include guidance on the development and structure of the studies and reports for projects requiring specific authorization. Under the Study guidance for projects requiring specific authorization, the Feasibility Study requirements include documentation of the planning process and environmental compliance. The feasibility report is required to document the planning process and all assumptions made during plan formulation along with the rationale for decision making. The report should culminate in a Recommended Plan along with documentation of how the plan relates to the NED, NER, or a combined NED/NER plan. If the project deviates from those plans, the degree and reasons for the deviation must be documented. The Feasibility Study is also required to document compliance with applicable environmental laws and regulations which can be included as an EA or EIS included with the Feasibility Study or an integrated Feasibility Study document with NEPA information.

Planning for this Feasibility Study has been conducted in accordance with the ER 1105-2-100 guidance. This report is an integrated Feasibility Study and EIS. Policy reviews have been conducted to ensure compliance with applicable Corps policies.

8.2. Environmental Coordination and Compliance. Coordination and evaluation of required compliance with specific Federal acts, executive orders, and other policies for the various alternatives was achieved, in part, through the coordination of this document with appropriate agencies and the public. Table 39 describes the level of compliance with those statutes, orders, and policies

The USFWS has submitted the Final FWCA Report (dated March 27, 2014). The National Marine Fisheries Service has submitted a concurrence letter (dated March 27, 2014) concerning Essential Fish Habitat conservation. In a letter dated January 15, 2014, the Louisiana Department of Environmental Quality stated the project will not violate water quality standards in Louisiana and issued a Water Quality Certification for the project. In a letter dated February 14, 2014, the Louisiana Department of Natural Resources (Office of Coastal Management) stated that the project is consistent with the Louisiana Coastal Resources Program in accordance with Section 307 (c) of the Coastal Zone Management Act of 1972, as amended. In a letter dated November 12, 2013, the Louisiana Department of Culture, Recreation, and Tourism (Office of Cultural Development) concurred that no historic properties will be impacted by this project. See Table 39 below for a complete list of legal and regulatory compliance.

9.0. RECOMMENDATION

The District Commander has considered all the significant aspects of this study including the environmental, social, and economic effects; the engineering feasibility; and the comments received from other resource agencies and the public and has determined that the Recommended Plan presented in this report is in the overall public interest and a justified expenditure of Federal funds. As a comprehensive approach to address navigation delays resulting from drainage events in the Mermentau Basin the District Commander recommends the construction of a sluice gate structure to the south of the existing Calcasieu Lock and associated channel excavation. Additionally, mitigation of 11.5 acres of Forested Spoil Bank Habitat is required.

The Project First Cost is estimated to be $16,700,000 inclusive of associated investigation, environmental, engineering and design, construction, supervision and administration, and contingency costs. The operations and maintenance of this Project will be assumed by Federal Government as part of the Calcasieu Lock. The Total Project Cost (Fully Funded Cost) is estimated to be $17,492,000.

The Recommendation contained herein reflects the information available at this time, March 2014 price levels, and current Corps policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program, nor the perspective of higher levels of review within the Executive Branch. Consequently, the Recommendation may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

Richard L. Hansen

RICHARD L. HANSEN
Colonel, EN
Commanding

Table 39. Compliance with Environmental Laws, Regulations, and Executive Orders Relative to the Recommended Plan

Law, Regulation, or Policy	Status	Comments
Clean Air Act of 1970	Full compliance	**Sec. 309:** Draft EIS has been coordinated with the public and agencies. EPA rated the document as **"EC-2"**, i.e., EPA has "environmental concerns and requests additional information" in the Final Environmental Impact Statement (FEIS). Additional information added to FEIS. **Sec. 176:** No permanent sources of air emissions are part of the Recommended Plan. Recommended Plan will include a Construction Emissions Mitigation Plan to minimize air impacts
Clean Water Act of 1977	Full compliance	404(b)(1) Evaluation signed by USACE in March 2014 is located in App D; WQC was granted by LDEQ on Jan. 15, 2014 (App. D); public notice comment period was held Dec. 16 to Dec. 26, 2013; NPDES non-point source permit will be required and obtained before construction commences.
National Environmental Policy Act of 1969	Full compliance	Draft EIS has been coordinated with the public and agencies. The amended 45-day public comment period began on Oct. 4 and ended on Dec. 2, 2013; *Notice of Availability of the Draft EIS* appeared in the Federal Register on Nov. 8. EPA rated the document as "EC-2"..
Fish & Wildlife Coordination Act of 1958	Full compliance	FWS is an active team participant and has provided input on fish and wildlife resources in the project area. A final FWCAR was received on 27, 2014.
Endangered Species Act of 1973	Full compliance	A revised BA was submitted to USFWS after release of the draft EIS with a "may affect, but is not like to adversely affect" Sprague's pipite. USFWS concurred by letter dated March 27, 2014
Magnuson-Stevens Fishery Conservation and Management Act of 1976	Full compliance	An EFH assessment is incorporated into the report/EIS in Section 6.10. By comment letter dated March 27, 2014, NMFS stated that the report/EIS adequately evaluates potential project impacts to EFH (Appendix G).
Fishery Conservation and Management Act	Full compliance	The project has been coordinated with NMFS.
Coastal Zone Management Act of 1972	Full compliance	A determination that the proposed action is consistent, to the maximum extent practicable, with the State of Louisiana's Coastal Resources Program, was approved by LADNR on Feb. 14, 2014 (App. E).
Coastal Barrier Resources Act and Coastal Barrier Improvement Act	Not applicable	There are no designated coastal barrier resources in the project area that would be affected by this project. These Acts do not apply.
Marine Mammal Protection Act	Full compliance	Not likely to adversely affect West Indian Manatee. Reference Appendix A, revised Biological Assessment.
Marine Protection, Research and Sanctuaries Act	Full compliance	Disposal of dredged material must comply with the Act.
Estuary Protection Act of 1968	Full compliance	It is anticipated that estuaries would be benefited by this project.
Anadromous Fish Conservation Act	Full compliance	Anadromous fish species would not be affected. The project has been coordinated with NMFS.

Table 39. Compliance with Environmental Laws, Regulations, and Executive Orders Relative to the Recommended Plan

Law, Regulation, or Policy	Status	Comments
Migratory Bird Treaty Act and Migratory Bird Conservation Act	Full compliance	Potential adverse effects to migratory birds would be avoided by seasonal restrictions on tree clearing. Loss of forested spoil bank habitat compensated by mitigation plan (App. I).
Wild and Scenic River Act of 1968	Not applicable	No designated Wild and Scenic river reaches would be affected by project related activities.
Federal Water Project Recreation Act	Full compliance	The principles of this Act (PL 89-72) have been fulfilled.
Submerged Land Act of 1953	Full compliance	Coordination with LDNR and LDWF has been ongoing.
Rivers and Harbors Act of 1899	Full compliance	Work would not obstruct navigable waters of the US.
National Historic Preservation Act 1966	Full compliance	By letter dated Nov. 12, 2013, SHPO stated no objections to the proposed project from a Section 106 compliance standpoint.
RCRA, CERCLA, Toxic Substances Control Act of 1976	Full compliance	An HTRW assessment has been performed to identify sites of concern in the project area and vicinity.
Farmland Protection Policy Act of 1981	Not applicable	No prime and unique farmlands are present at the project site.
EO 11988 Floodplain Management	Not applicable	This project would not affect floodplains.
EO 11990 Protection of Wetlands	Full compliance	The Recommended Plan would result in the loss of about 14 acres of brackish marsh. Use of dredged material to restore/create about 50 acres of marsh and estuarine habitat would more than offset losses in project area.
EO 12898 Environmental Justice	Not applicable	No minority or low-income communities would be affected by the project.
EO 13089 Coral Reef Protection	Not applicable	This project would not adversely impact coral reefs or coral reef resources.
EO 13112 Invasive Species	Full compliance	Project is not expected to lead to propagation of invasive species.

Source: USACE.

10.0. STUDY TEAM MEMBERS AND REPORT PREPARERS

Table 40. DMMP/SEIS List of Preparers

Name	Discipline/ Expertise	Organization	Role
Jeffrey Varisco	Project Management	USACE	Feasibility Preparation
Marshall Plumley	Plan Formulation	USACE	Feasibility Preparation
Karen Vance	Real Estate	USACE	Feasibility Preparation
Pamela Deloach	Engineering	USACE	Engineering Documents
Paul Bellocq	Hydrology & Hydraulics	USACE	Engineering Documents
Benjamin Salamone	Structures	USACE	Engineering Documents
Craig Waugaman	Cost	USACE	Engineering Documents
Mathew Napolitano	Economics	USACE	Feasibility/EIS Preparation
Timothy George	Environmental	USACE	Feasibility/EIS Preparation
Teri Allen	Environmental	USACE	Feasibility/EIS Preparation
Kenneth Cook	Environmental	USACE	Feasibility/EIS Preparation
Ronald Deiss	Cultural	USACE	Feasibility/EIS Preparation
Michael Henry	HTRW	USACE	Feasibility/EIS Preparation
Diane Karnish	Economics	USACE	Feasibility/EIS Preparation
David Canstellanos	Biologist	USFWS	Feasibility/EIS Preparation
Virgil Langdon	Economist	USACE	Navigation Analysis
Beth Cade	Economist	USACE	Navigation Analysis
Mark Haab	Economist	USACE	Reviewer
Camie Knollenberg	Planning	USACE	Reviewer
Ken Barr	Environmental	USACE	Reviewer
David Vigh	Biologist	USACE	Reviewer
Clara Bergeron	Real Estate	USACE	Reviewer
Judith Gutierrez	Real Estate	USACE	Reviewer
Phillip Brouillette	Construction	USACE	Reviewer
Eddie Leblanc, III	Construction	USACE	Reviewer
Cherie Price	Hydrology & Hydraulics	USACE	Reviewer
Brian Bonanno	Geotechnical	USACE	Reviewer
Michael Swanda	Cultural Resources	USACE	Reviewer
Gary DeMarcay	Cultural Resources	USACE	Reviewer
Mathew Napolitano	Economics	USACE	Reviewer
Geanette Kelley	Real Estate Appraisals	USACE	Reviewer
Yojna Calix	Operations & Maintenance	USACE	Reviewer
Robert Morgan	Operations & Maintenance	USACE	Reviewer
Brian Leaumont	Engineering	USACE	Reviewer

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