US Army Corps
Of Engineers
New Orleans District

FINAL

CALCASIEU RIVER AND PASS, LOUISIANA DREDGED MATERIAL MANAGEMENT PLAN AND SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Volume I

November 22, 2010

Final

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U.S. Army Corps of Engineers
New Orleans District
New Orleans, Louisiana

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ORGANIZATION OF REPORT

This Final Report, *Calcasieu River and Pass, Louisiana, Dredged Material Management Plan and Supplemental Environmental Impact Statement*, contains the following sections and is published in three volumes:

Volume I

Volume II

Volume III

FINAL DREDGED MATERIAL MANAGEMENT PLAN AND SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DMMP/SEIS) CALCASIEU RIVER AND PASS, LOUISIANA

LEAD AGENCY: U.S. Army Corps of Engineers - Mississippi Valley, New Orleans District (CEMVN).

ABSTRACT: The U.S. Army Corps of Engineers, New Orleans District (CEMVN), proposes to develop a plan for the management and disposal of dredged material for the Calcasieu River and Pass, Louisiana project (Calcasieu Ship Channel). The actions and strategies set forth in the DMMP/SEIS would provide for the management of materials dredged through operations and maintenance of the ship channel and berthing areas for a minimum period of 20 years while updating and redefining the base plan/Federal standard for the project. Preparation of the DMMP/SEIS would enable the CEMVN to comply with the requirement of ER 1105-2-100 to prepare a DMMP for each federally authorized navigation channel.

Currently, the project does not have the adequate dredged material disposal capacity needed to maintain the channel to authorized depths. The gross 20-year dredging capacity required to maintain the channel is approximately 97 million cubic yards, while the existing confined disposal capacity is only five million cubic yards. Existing discharge sites are at or near capacity, and past maintenance deficiencies have resulted in substantial erosion of discharge facilities into adjacent water bodies. As a result, it has become necessary for CEMVN to reduce channel widths in some reaches.

The Calcasieu Ship Channel supports a thriving commercial navigation industry. The tonnage of commodities handled at the ship channel's docks makes the Lake Charles Harbor and Terminal District (Port of Lake Charles) the 11th largest seaport in the U.S. and the second largest Strategic Petroleum Reserve facility. Without action, navigation on the channel may be restricted as a result of reduced channel depths.

Four alternative plans, with various combinations of dredged material management and disposal options, were developed and evaluated. Screening criteria were developed to select an alternative plan that would best meet planning goals and objectives. Alternative A is the future-without-project plan to which alternatives B, C, and D were compared. Alternative D, "Disposal of material from the channel at the Ocean Dredged Material Disposal Site," was eliminated from further consideration because it did not adequately meet the planning goals and objectives. Alternatives B and C were examined in detail. These two plans differed between channel miles 12 and 22 in that Alternative B would maximize the use of confined disposal of material, while Alternative C would maximize the use of dredged material for wetland nourishment. Alternative B would create 5,840 acres of marsh (1,183 AAHUs), while Alternative C would create 10,030 acres of marsh (2,035 AAHUs).

Alternative B, with a total estimated cost of $788,840,000 inclusive of associated investigation, environmental, engineering and design, construction, and supervision, is the Recommended Plan. It is the least-cost alternative that meets Federal environmental requirements and is consistent with sound engineering practices.

Comments: Please send comments or questions on this DMMP/SEIS to the U.S. Army Corps of Engineers, New Orleans District, Attention: Sandra Stiles, P.O. Box 60267, New Orleans, Louisiana 70160-0267. Telephone: (504) 862-1583; FAX: (504) 862-2088.

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EXECUTIVE SUMMARY

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INTRODUCTION

A key mission of the U.S. Army Corps of Engineers (USACE) is to provide safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for movement of commerce, national security needs, and recreation. Successfully accomplishing this mission requires dredging channels and managing dredged material. Engineering Regulation (ER) 1105-2-100 provides the requirement for the preparation of dredged material management plans (DMMPs), as follows:

> *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, potential for beneficial use of dredged material, and indicators of continued economic justification. The Dredged Material Management Plan shall be updated periodically to identify any potentially changed conditions.*

The National Environmental Policy Act of 1969 (NEPA) requires the Federal Government to prepare an environmental impact statement (EIS) for any major Federal action that has the potential to significantly affect the environment. The USACE, Mississippi Valley Division, New Orleans District (CEMVN) has prepared this DMMP/Supplemental EIS for the disposal of dredged material from the routine maintenance of the Calcasieu River and Pass, Louisiana, Federal project (Calcasieu Ship Channel) for at least a 20-year period. Dredged material management alternatives have been identified, evaluated, and screened so that recommended dredged material placement operations are conducted in a timely, environmentally sensitive, and cost-effective manner.

The local sponsor for the Calcasieu River and Pass DMMP/SEIS is the Lake Charles Harbor and Terminal District, also known as the Port of Lake Charles.

PURPOSE AND NEED

The purpose of this study is for CEMVN to develop a management plan for the placement of material dredged for the maintenance and operation of the Calcasieu Ship Channel. The actions and strategies set forth in the DMMP/SEIS would provide for the management of dredged material for a minimum period of 20 years while updating and redefining the base plan/Federal standard for the project.

Currently, the project does not have the adequate dredged material disposal capacity needed to maintain the channel to authorized depths. The gross 20-year dredging capacity required to maintain the channel is approximately 97 million cubic yards, while the existing confined disposal capacity is only five million cubic yards. Existing discharge sites are at or near capacity, and past maintenance deficiencies have resulted in substantial erosion of discharge facilities into adjacent water bodies. As a result, it has become necessary for CEMVN to reduce channel widths in some reaches.

The Calcasieu Ship Channel supports a thriving commercial navigation industry. The tonnage of commodities handled at the ship channel's docks makes the Lake Charles Harbor & Terminal District (Port of Lake Charles) the 11th largest seaport in the U.S. and the second largest Strategic Petroleum Reserve facility. In 2006, more than 58,000 jobs in Louisiana were related to business activity at the port's terminals. The marine cargo and vessel activity at the port generated $7.9 billion of total economic activity in Louisiana in the same year. Without action, navigation on the channel may be restricted as a result of reduced channel dimensions.

STUDY AUTHORITY

The River and Harbor Act of 1946, Public Law 79-525, July 24, 1946, authorized the *Lake Charles Deep Water Channel and Calcasieu River and Pass* in accordance with Senate Document No. 190. This document provided for:

- A channel 35 feet deep by 250 feet wide (from the Port of Lake Charles to the Gulf of Mexico) and including the loop around Clooney Island
- A channel 35 to 37 feet deep and 250 feet wide (between the jetties)
- An approach channel 37 feet deep and 400 feet wide (seaward of the jetties in the Gulf of Mexico
- The reconstruction and extension of existing jetties to the 15-foot depth contour, if and when it becomes necessary
- Improvement of the river from Lake Charles to Phillips Bluff by dredging, as well as removing logs, snags, and overhanging trees. Total length of improvement is approximately 102.1 miles

The River and Harbor Act of 1960, Public Law 86-645, July 14, 1960, authorized modifications to the Federal project in accordance with House Document No. 436, which authorized the following revised dimensions and improvements:

- A channel 40 feet deep by 400 feet wide (from the Port of Lake Charles to the shoreline, mile 0)
- A channel 40 to 42 feet deep and 400 feet wide (between the jetties)
- An approach channel 42 feet deep and 800 feet wide (seaward of the jetties in the Gulf of Mexico)
- A new turning basin at channel mile 36.0 with a depth of 35 feet, a width of 750 feet, and a length of 1,000 feet
- Northern extension of the ship channel from the Port of Lake Charles (mile 34.1) to the bridge on U.S. Highway 90 (mile 36.0) 35 feet deep and 250 feet wide
- A mooring basin near mile 3.0 with a depth of 40 feet, a width of 350 feet, and a length of 2,000 feet
- Enlargement of the turning based at mile 29.6 to a depth of 40 feet
- The existing channel from the ship channel to Cameron would be maintained at a depth of 12 feet and a width of 200 feet

The River and Harbor Act of October, 23 1962, House Document 582 provided for:

- A salt water barrier structure with five 40-foot tainter gates in a new bypass channel

- A parallel channel with navigation structures and a single sector-type gate
- An earthen closure dam
- A woven lumber-type revetment

The Senate Public Works Committee on December 27, 1970 and the House Public Works Committee on December 15, 1970 adopted resolutions approving the project at Devil's Elbow under the provisions of Section 201 of the Flood Control Act of 1965 (Public Law 89-298; S.D. 91-111). The plan of improvement consisted of:

- Enlarging 2.3 miles of the existing industrial channel to a depth of 40 feet over a bottom width of 400 feet
- Extending the enlarged channel one-half-mile eastward
- Constructing a 1,200-foot by 1,400-foot turning basin south of the extended channel at its landward end

The Calcasieu River at Coon Island project was authorized by the Secretary of the Army under Section 107 of the River and Harbor Act of 1960, as amended by Section 310 and Section 112 of the River and Harbor Acts of 1965 and 1970, respectively. The project consisted of:

- Deepening and widening a channel adjacent to Coon Island to 40 feet deep by 200 feet wide over a distance of 6,943 feet.
- Enlarging an existing turning basin at the end of the channel to 40 feet deep by 750 feet wide by 1,000 feet long.

STUDY AREA

The Calcasieu Ship Channel is located in Calcasieu and Cameron parishes, Louisiana. The project area is bounded on the north by Interstate 10 and on the south by the Gulf of Mexico; it reaches from channel mile 36.0 in Lake Charles, Louisiana south to mile -32 of the Bar (Entrance) Channel in the Gulf of Mexico. The project area extends into the coastal marshes west of the ship channel and into Calcasieu Lake east of the channel. Portions of Lake Charles, Prien Lake, Moss Lake, Browns Lake, Black Lake, and Calcasieu Lake are present in the project area.

PUBLIC INVOLVEMENT

In compliance with USACE policies and the National Environmental Policy Act, input on projects is solicited from the public and other government agencies. A Notice of Intent (NOI) to prepare a Draft Supplemental Environmental Impact Statement for the Dredged Material Management Plan for the Calcasieu River and Pass, Louisiana project was published in the Federal Register on July 14, 2005. Scoping is the process for determining the scope of alternatives and significant issues to be addressed in the DSEIS. Comments were solicited for this document during the scoping comment period of July 14-29, 2005. The Notice of Intent and the scoping report are included in Appendix Q, Scoping.

During the scoping phase of the project, three public and interagency meetings were held to receive suggestions for the management and placement of material dredged from the Calcasieu River and Pass. Two public scoping meetings were held on July 18, 2005, at the Calcasieu Parish Police Jury Building, and on July 19, 2005, at the Cameron Parish Courthouse. An interagency meeting was held with state and Federal agency personnel on April 5, 2005, in

Lafayette, Louisiana. The input from the public and agency personnel resulted in a wide array of suggestions, ideas, and prospective sites for the placement and management of dredged material.

A Notice of Availability for the Draft DMMP/SEIS was published in the Federal Register on May 22, 2009. The 45-day public comment period for the draft report began on May 22 and ended on July 6, 2009. Two public meetings were held to receive comments on July 8 and 9, 2009. The first was held in Hackberry, Louisiana, and the second was held in Lake Charles, Louisiana. Both meetings were well attended. Commenting letters, a summary of verbal comments given at the public meetings, and written responses provided by the CEMVN can be found in Appendix N.

Periodic interagency meetings have been held throughout the planning phase of the project. These meetings have involved participation by the U.S. Fish and Wildlife Service (both the Lafayette Ecological Services Field office and the Sabine National Wildlife Refuge), Environmental Protection Agency, National Marine Fisheries Service, Louisiana Department of Natural Resources, Louisiana Department of Wildlife and Fisheries, Louisiana Office of Coastal Protection and Restoration, and Louisiana Department of Environmental Quality (LDEQ). Topics discussed included criteria for screening alternatives and options, regulatory agency requirements, and recommendations for beneficial use of dredged material, fishery and oyster resources, requirements for the design of restored marsh, endangered species, and the development of a proposed plan.

AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

The major issue associated with this project is expected to involve different opinions regarding the selection of the Recommended Plan. Environmental interests are likely to favor Alternative C because it provides a greater amount of coastal wetland restoration. CEMVN and the local sponsor favor Alternative B. Although this alternative provides a lesser amount of coastal restoration benefits than Alternative C, it is the lowest cost alternative, and it meets engineering standards and Federal environmental requirements.

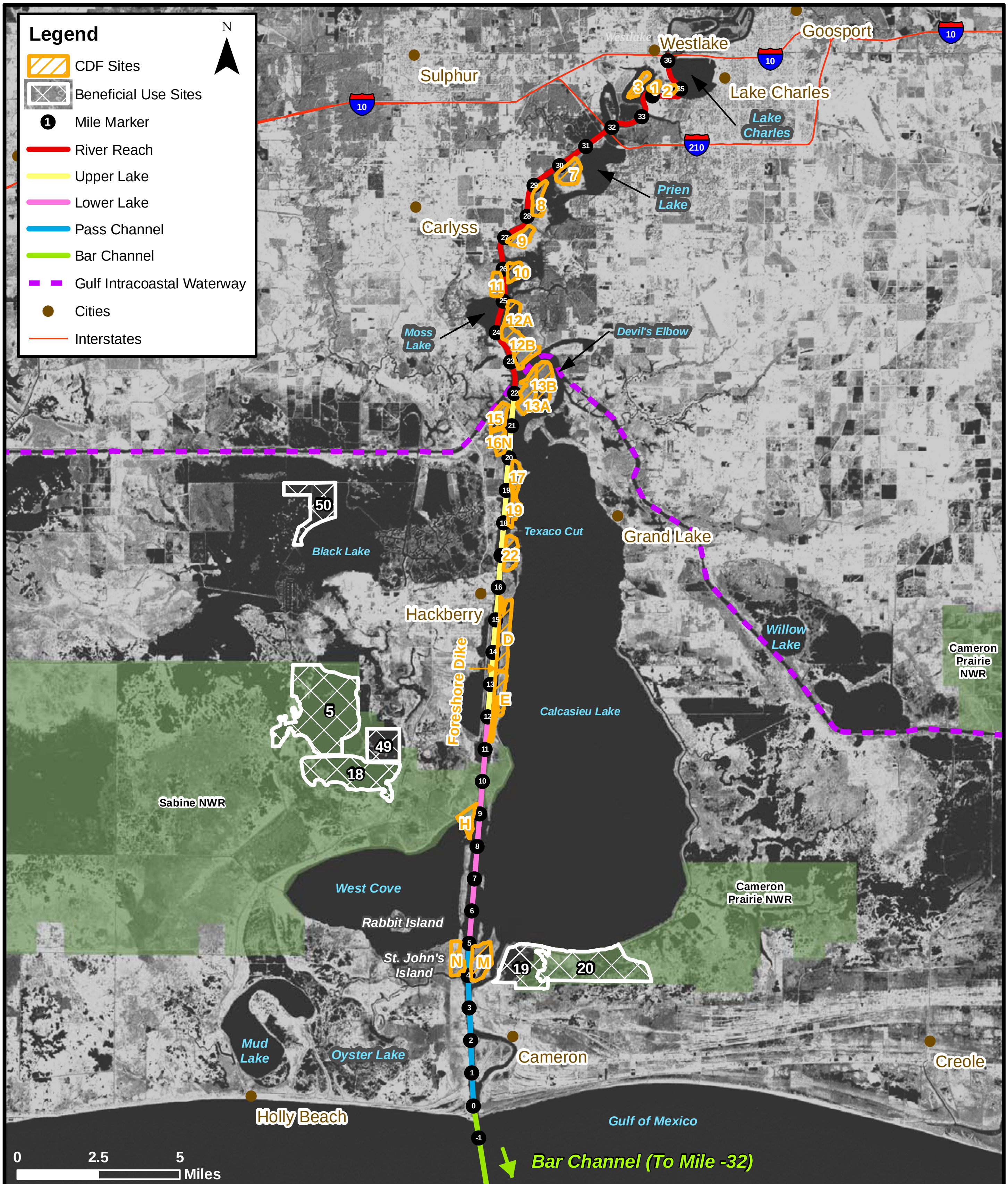
ALTERNATIVES

Four alternatives were evaluated.

Alternative A. Alternative A, the No Action Alternative, also known as the future-without-project condition, is a requirement of the Council on Environmental Quality regulations to implement the National Environmental Policy Act (40 CFR Part 1500 *et seq*.). This alternative assumes the continuation of current operation and maintenance practices, which includes the use of only the existing confined disposal facility (CDF) sites without expansion or rehabilitation. Because existing placement sites are near full capacity, this alternative would not allow for the channel to be maintained to authorized dimensions.

Alternative B. Alternative B places material in CDFs and beneficial use sites and emphasizes the rehabilitation and maximum use of CDFs between channel miles 12 and 22. Figure ES-1 is a map of the disposal sites for Alternative (Plan) B. Table ES-1 lists the placement areas by reach and channel mile.

Alternative B includes capacity for both Federal and non-Federal permitted dredging in the project area. Non-Federal dredging accounted for in this plan includes dredging undertaken by



PLAN B
DISPOSAL SITES FOR DREDGED MATERIAL

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: ES-1
Date: September 2010
Scale:1:260,000
Source: LDEQ/GEC/USACE
Map ID: 27585107-1241

Table ES-1. Alternative B Placement Sites

Reach	Section	Placement Sites	Type
River	34 to 36, Coon Island, Port	1	CDF
		2	CDF
	30 to 34, Turning Basin, Clooney Isl. Loop	3	CDF
		7 (1/2)	CDF
	26 to 30	7 (1/2)	CDF
		8	CDF
		9	CDF
	22 to 26	10	CDF
		11	CDF
		12A	CDF
		12B	CDF
Upper Lake	21 to 22	15	CDF
		16 N	CDF
	Devil's Elbow	13	CDF
	16 to 21	17	CDF
		19	CDF
		22	CDF
		Existing Foreshore Dike	CDF
		West of Black Lake (50)	Beneficial Use Site
	12 to 16	D/E	CDF
		Existing Foreshore Dike	CDF
		Sabine National Wildlife Refuge (NWR) (5)	Beneficial Use Site
Lower Lake	9.5 to 12	Cameron Parish School Board (49)	Beneficial Use Site
		Sabine NWR (18)	Beneficial Use Site
	5 to 9.5	H	CDF
		M	CDF
		N	CDF
		Cameron Prairie NWR (19)	Beneficial Use Site
		Cameron Prairie NWR (20)	Beneficial Use Site

the Port of Lake Charles and CITGO. This complies with ER 1105-2-100 and EP 1165-2-1, which states, “Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of disposal areas required for the Federal project(s).”

This alternative designates 9,550 acres of eroded and subsided coastal wetlands for the beneficial use of material, mostly on public lands. Based on preliminary estimates, 5,840 acres of marsh and estuarine habitat would be created and nourished by the placement of dredged material in the designated sites. Dredged material slurry would be discharged into the shallow open water areas shown in Figure ES-1 to an elevation conducive to the development of wetlands habitat. Following dewatering and compaction of the material, it is anticipated that the final result would be a combination of wetlands, mud flat, and shallow open water habitat.

Rock foreshore dikes were constructed by the USACE near 17, 19, and 22 along the left descending bank of the channel. These dikes are anticipated to reduce erosion resulting from ship wakes. Plan B includes expanding CDFs 17, 19, and 22 into the open-water area impounded by the prior construction of the foreshore dikes. Short-term effects would include the placement of dredged material into this area, thereby converting 99 acres of impounded brackish water to uplands and 25 acres of terrestrial habitat to uplands.

Advantages*:*

- Provides enough disposal capacity for the maintenance of the navigation channel to authorized dimensions over the life of the 20-year plan.
- Is the least-cost alternative.
- Is implementable and environmentally acceptable.
- Complies with sound economic and environmental principles Identifies beneficial use sites that would be available during the 20-year plan with a majority of the beneficial use sites on public lands.
- Includes beneficial use for the 20-year plan by designating approximately 30 percent of material dredged between channel miles 5 and 36 for the creation and nourishment of marsh and estuarine habitat.
- Operates and maintains CDFs in a manner that would maximize CDF capacity.
- Provides capacity for the placement of material dredged by private parties, within certain parameters.
- Maximizes previous engineering and construction investments in CDFs

Disadvantages.

- Provides less dredged material for beneficial use purposes than Alternative C.

The total 20-year cost of Alternative B is estimated to be $788,840,000.

Alternative C. Like Alternative B, Alternative C places material in CDFs and beneficial use sites. However, this alternative differs from Alternative B by placing most of the material dredged between channel miles 12 and 22 in designated beneficial use sites west of the channel. Dredged material disposal in the other reaches would be as described for Alternative B. Placement areas are depicted in Figure ES-2. Table ES-2 lists the placement areas by reach and channel mile.

Like Alternative B, Alternative C includes capacity for both Federal and non-Federal permitted dredging in the project area. Non-Federal dredging accounted for in this plan includes dredging undertaken by the Port of Lake Charles and CITGO. This complies with ER 1105-2-100 and EP 1165-2-1, which both state, "Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of disposal areas required for the Federal project(s)."

This alternative designates 17,901 acres for the beneficial use of material on public and private lands. Based on preliminary estimates, 10,030 acres of marsh and estuarine habitat would be created and nourished by the placement of dredged material in the designated sites.

Advantages.

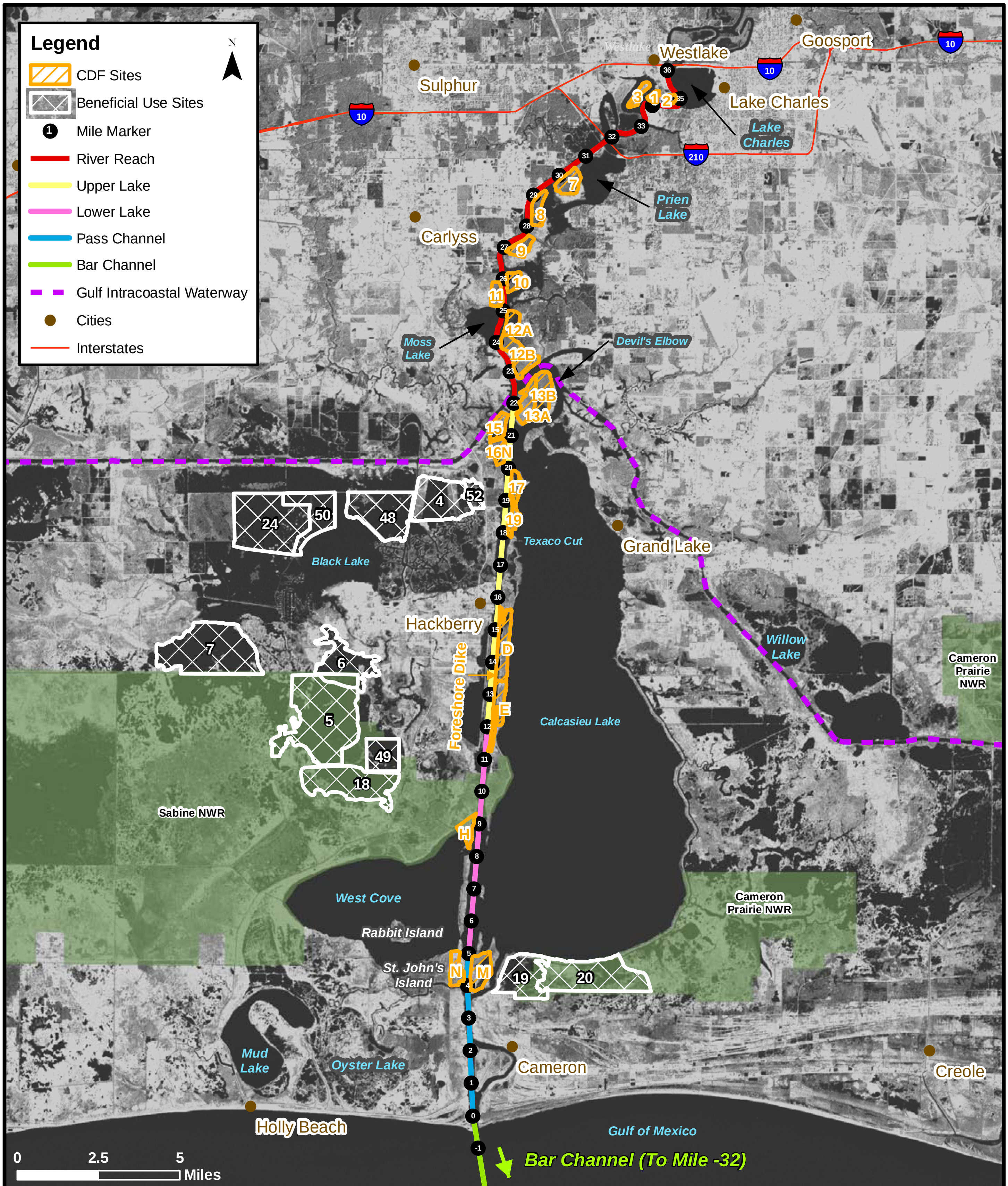
- Provides enough disposal capacity for the maintenance of the navigation channel to authorized dimensions over the life of the 20-year plan.
- Is cost effective due to minimal long-term maintenance costs.
- Optimizes the beneficial use of dredged materials through the placement of approximately 44 percent of the material dredged between channel miles 5 and 36 at 12 beneficial use sites.
- Allows for flexibility for future disposal.
- Operates and maintains CDFs in a manner that would maximize CDF capacity.
- Complies with sound economic and environmental principles.
- Provides disposal capacity for material dredged by private parties, within certain parameters.

Disadvantages.

- Is not the lowest cost alternative.
- Has a slightly higher risk of uncertainty than Alternative B with regards to technical risks. Little geotechnical and engineering and design information is available for beneficial use sites not located near existing CWPPRA coastal restoration sites.
- Some beneficial use sites are not sufficiently large for multiple placement cycles, and their use would involve a one-time investment.
- CDFs in the Lake reaches would no longer be used or maintained. In this way, Plan C would not optimize previous investments in engineering, real estate, and construction for these CDFs. If in the future it is decided that these sites are needed, significant costs could be required for their accessibility and reconstruction/rehabilitation.

The total 20-year cost of Alternative C is estimated to be $800,600,000.

Alternative D. Alternative D places material dredged from south of channel mile 22 into the Ocean Dredged Material Disposal Site (ODMDS). For the northern portion of the ship channel, the River Reach, the handling and placement of material dredged under Alternative D would remain identical to the procedures described for alternatives B and C. However, material dredged from the channel in the Upper Lake and Lower Lake reaches would be placed in hopper barges or bottom-dump scows and transported to the ODMDS for placement.



PLAN C
DISPOSAL SITES FOR DREDGED MATERIAL

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: ES-2	
Date: September 2010	
Scale: 1:260,000	
Source: USGS/GEC/USACE	
Map ID: 27585107-1243	

Table ES-2. Alternative C Placement Sites

Reach	Section	Placement Sites	Type
River	34 to 36, Coon Isl. Port	1	CDF
		2	CDF
	30 to 34, Turning Basin, Clooney Isl. Loop	3	CDF
		7 (1/2)	CDF
	26 to 30	7 (1/2)	CDF
		8	CDF
		9	CDF
	22 to 26	10	CDF
		11	CDF
		12A	CDF
		12B	CDF
Upper Lake	21 to 22	15	CDF
		16N	CDF
	Devil's Elbow	13	CDF
		West of Black Lake (50)	Beneficial Use Site
	16 to 21	Palermo (4)	Beneficial Use Site
		West of Black Lake (24)	Beneficial Use Site
		West of Black Lake (50)	Beneficial Use Site
		E. Palermo (52)	Beneficial Use Site
		BU (48)	Beneficial Use Site
		17	CDF
	12 to 16	Sabine National Wildlife Refuge NWR (5)	Beneficial Use Site
		Bel (6)	Beneficial Use Site
		Bel (7)	Beneficial Use Site
		Existing Foreshore Dike	CDF
Lower Lake	9.5 to 12	Sabine NWR (18)	Beneficial Use Site
		Cameron Parish School Board (49)	Beneficial Use Site
	5 to 9.5	H	CDF
		M	CDF
		N	CDF
		Cameron Prairie NWR (19)	Beneficial Use Site
		Cameron Prairie NWR (20)	Beneficial Use Site

Advantages

- The navigation channel would be maintained to authorized dimensions.
- Provides flexibility for future placement of dredged materials as it minimizes disposal site maintenance.
- Provides for the maintenance of dredge material disposal sites in a manner to optimize capacities.
- Provides for additional capacity should it be needed under emergency purposes to clear the navigation channel after a natural disaster.
- Provides for the disposal of material dredged by private parties.

Disadvantages

- Alternative D is the most costly plan.
- Is the least environmentally acceptable plan as it removes sediment from the eroding and subsiding coastal environment, and thus is not compatible with national and state priorities for using dredged material for coastal restoration projects in Louisiana.
- Does not optimize beneficial use of dredged materials.
- CDFs in the Lake reaches would no longer be used, maintained, or protected, and would be subject to loss through erosion; if in the future it is decided that these sites are needed, significant costs would be required for their reconstruction/rehabilitation.
- Does not maximize retention of the Federal and local sponsor's engineering, real estate, and construction investments in CDFs.

Questionable physical sediment quality for ocean disposal, the importance of dredged material to be used beneficially (particularly with respect to national ecological and economic interests and storm damage reduction), lack of consistency with Louisiana's Coastal Use Guidelines, and the likelihood of litigation delaying the project undermine the viability of this alternative and threaten its ability to maintain navigation. Therefore, Alternative D was eliminated from detailed evaluation.

Preliminary cost estimates indicate that the cost of Alternative D would exceed the costs of alternatives B and C by over $190,000,000 for the 20-year life of the DMMP.

COMPARISON OF IMPACTS

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 A, B, or C is presented in Table ES-3. A full explanation of environmental impacts of the alternatives can be found in Section 4.0 of this report.

Placement Areas. Alternatives differ in the amount of material placed at beneficial use sites and CDFs. Table ES-4 summarizes the percentages of material placed in CDFs and beneficial use by alternative and reach. Plan B would devote approximately 30 percent of material dredged from the River, Upper Lake, and Lower Lake reaches to beneficial use, whereas Plan C would devote 44 percent of material dredged from the same reaches to beneficial use.

Table ES-3. Summary of Environmental Consequences

Resource	Alternatives		
	Alternative A (No Action)	Alternative B	Alternative C
Physical Conditions	Increased erosion	Reduced erosion/minimal circulation changes	Reduced erosion/minimal circulation changes
Geology	No effect	No effect	No effect
Soils	No effect	Soils formed from the placement of dredged material would likely be denser and less subject to erosion than naturally occurring soils.	Soils formed from the placement of dredged material would likely be denser and less subject to erosion than naturally occurring soils.
Water Quality	No effect	Expanding existing CDFs and placing dredged material for beneficial use could result in short-term elevated levels of suspended solids and nutrients.	Expanding existing CDFs and placing dredged material for beneficial use could result in short-term elevated levels of salinity, suspended solids and nutrients.
HTRW	No effect	No effect	No effect
Air Quality	No effect	Minor short-term wind erosion of expanded CDFs or restoration sites is expected. There would be minor increases of emissions from construction equipment during CDF expansion/maintenance.	Minor short-term wind erosion of expanded CDFs or restoration sites is expected. There would be minor increases of emissions from construction equipment during CDF expansion/maintenance.
Wetlands	No effect	No wetlands would be converted to uplands. Beneficial use of dredged material may potentially restore and nourish 5,840 acres of subsided and existing coastal marsh. This plan would result in a net increase of 1183 AAHUs.	No wetlands would be converted to uplands. Beneficial use of dredged material may potentially restore and nourish 10,030 acres of subsided and existing coastal marsh. This plan would result in a net increase of 2035 AAHUs.
Essential Fish Habitat	No effect	No adverse impacts. No wetland would be lost. Beneficial use of dredged material may potentially restore and nourish 5,840 acres of subsided and existing coastal marsh and estuarine habitat.	No adverse impacts. No wetland would be lost. Beneficial use of dredged material may potentially restore and nourish 10,030 acres of subsided and existing coastal marsh and estuarine habitat.
Oyster Grounds	Secondary adverse impacts could occur as existing CDFs erode. Sediment and suspended solids would inhibit the establishment of oyster production near the Ship Channel.	No adverse impacts	No adverse impacts

Resource	Alternatives		
	Alternative A (No Action)	**Alternative B**	**Alternative C**
Threatened and Endangered Species	Possible reductions in channel dimensions would reduce traffic on the waterway, thereby reducing the chance of a collision with a Kemp's ridley sea turtle. However, reduced channel dimensions would also provide less room for a sea turtle to maneuver away from vessels and potentially increase chances for a collision.	No adverse impacts.	No adverse impacts.
Recreation	No effect	Recreational fishing is expected to improve as a result of the marsh restoration/enhancement	Recreational fishing expected to improve as a result of the marsh restoration/ enhancement
Cultural Resources	No effect	No effect	No effect
Noise	No effect	Temporary, minor increases in noise during periods of construction.	Temporary, minor increases in noise during periods of construction.

Table ES-4. Dredged Material Placement Capacity: Beneficial Use (BU) vs. Placement in CDFs, by Reach

Channel Location	Existing Conditions[1]		Alternative A[2]		Alternative B		Alternative C		Alternative D	
	BU	**CDF**	**BU**	**CDF**	**BU**	**CDF**	**BU**	**CDF**	**BU**	**CDF**
River Reach	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%
Upper Lake	23%	77%	0%	100%	31%	69%	55%	45%	0%	0%
Lower Lake	23%	77%	0%	100%	63%	37%	63%	37%	0%	0%
Pass Channel[3]	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Entrance (Bar) Channel[4]	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

[1] Existing Conditions represents historical data.
[2] Alternative A, the no action plan, would not include beneficial use. However, dredged material could be beneficially used through third party participation for costs beyond the Federal Standard.
[3] Strong tidal currents in the Pass Channel prevent the accumulation of sediments. Dredging in this reach is not required.
[4] Sediment accumulating in the Entrance (Bar) Channel would continue to be placed into the ODMDS.

Aquatic Consequences. Alternative B calls for the expansion of CDFs 17, 19, and 22 to the west as dredged material is placed into the area that was impounded by prior construction of the foreshore dikes. An assessment of the impacts of the foreshore dike was completed in a previous NEPA document, Environmental Assessment, Calcasieu River And Pass Foreshore

Rock Dikes and Bank Armoring, Cameron Parish, Louisiana, EA #485 (FONSI dated 08/19/2009).

Wetlands (marsh) are semiaquatic lands, flooded or saturated by water for varying periods of time. The need to reduce the loss of Louisiana coastal wetlands is of major importance and has been recognized by the U.S. Congress. Wetlands restore and maintain water quality, provide critical habitat for a diversity of plants and animals, and provide flood control by retaining water that would otherwise flood nearby residential and agricultural areas. Wetlands also provide protection to the Louisiana coastal zone from storm-induced wave erosion. As Table ES-4 shows, both alternatives B and C would restore thousands of acres of marsh habitat that has been eroded in the past.

Table ES-5. Comparison of Environmental Effects of Alternatives B and C (Acres)

Environmental Effect	Alternative B	Alternative C
Marsh Converted to Uplands	0	0
Open Water/Estuarine Habitat[1] Converted to Uplands	0	0
Open Water/Estuarine Habitat Converted to Wetlands	0	0
Potentially Productive Oyster Grounds Impacted	0	0
Marsh Created or Nourished	5,840	10,030

Differences between alternatives B and C for other environmental resources and conditions were found to be generally minor. Neither was determined to cause significant adverse environmental impacts.

Protected Species. The project is not likely to adversely affect any threatened or endangered species.

ALTERNATIVE C: RECENT CONSIDERATIONS

The CEMVN Project Delivery Team (PDT) has recently learned that subsequent to the formulation of Alternative C, the environmental impact analysis of Alternative C (Section 4), and the release of the Draft DMMP/SEIS to the public, BU sites 4, 48, and 52 (components of Plan C) BU sites 4, 48, and 52 are in the final stages of the permit application process as private mitigation banks. (See Table 2-8). As a result, it is necessary to eliminate these sites as viable placement options. To reformulate Alternative C to incorporate additional beneficial use sites would require the selection of sites located farther from the ship channel than BU sites 4, 48, and 52. The selection of more distant sites would require greater pumping distances involving additional booster pumps, longer pipelines, increased mobilization and de-mobilization costs, longer access and pipeline channels, etc., resulting in costs greater than those for pumping to BU Sites 4, 48, and 52. Therefore, a reformulated Alternative C would be more costly than the analyses included in this DMMP. Reformulating Alternative C to include additional sites would not change the status of Alternative B as the least-cost, environmentally acceptable, engineeringly feasible plan.

THE RECOMMENDED PLAN

The CEMVN PDT made detailed comparisons of alternatives B and C with respect to and C with respect to environmental consequences, established planning criteria, and costs. Of the two alternative plans carried forward for detailed analysis, the PDT determined that Alternative B would best meet the screening criteria and would accomplish the planning objectives and goals, and therefore chose it as the Recommended Plan. Alternative B would best meet the Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (P&G) criteria of completeness, effectiveness, efficiency, and acceptability. Alternative B provides the lowest level of risk and uncertainty in maintaining the navigation channel to its authorized dimensions for a minimum of 20 years while providing sound environmental practices from both a Federal and non-Federal perspective. Alternative B is the lowest cost alternative.

Alternative B is consistent with the “Federal standard”, defined in 33 C.F.R. § 335.7 as the least costly dredged material disposal alternative with sound engineering practices and meeting acceptable environmental standards. This alternative is also consistent with the “base plan” for navigation purposes, which is defined in ER 1105-2-100 as the least costly alternative with sound engineering practices and meeting all Federal environmental requirements.

Environmentally Preferred Plan

Alternative C is the environmentally preferred plan. Alternative C would restore 10,030 acres of eroded/subsided wetlands, while Alternative B would restore 5,840 acres. No significant adverse impacts would result from Alternative B or C.

The cost for creating an acre of marsh is similar between alternatives B and C. It would cost an estimated $32,000 to create each acre of marsh under Alternative B and $34,000 for each acre of marsh created under Alternative C.

Although not the environmentally preferable plan, Alternative B was selected as the Recommended Plan because it is the lowest cost, environmentally acceptable plan. According to ER 1105-2-100, "It is the Corps of Engineers policy to accomplish the disposal of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner. Disposal is to be consistent with sound engineering practice and meet all Federal environmental standards including the environmental standards established by Section 404 of the Clean Water Act of 1972 or Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. This constitutes the base disposal plan for the navigation purpose."

CONCLUSIONS

Based on the comparisons and the scoring of the alternatives, the PDT has determined that Alternative B is the Recommended Plan. It is the lowest cost alternative and is consistent with environmental and engineering requirements. It provides for the placement of material dredged from the Navigation Channel of the Calcasieu River and Pass for a minimum of 20 years. Even minor reductions in sailing draft would result in substantially higher transportation costs relative to the costs of the Recommended Plan.

Planning Objectives. The Recommended Plan would comply with each of the planning objectives:

- Maintain the navigation channel to authorized dimensions.
- Place the dredged material in the most cost-effective location consistent with environmental and engineering requirements.
- Includes beneficial use of dredged material.
- Provide flexibility for future placement of dredged material.
- Maintain dredged material disposal sites in a manner to optimize capacities and comply with sound economic and environmental principles.
- Provide for the placement of material dredged by private parties, within certain parameters.

Screening Criteria. The Recommended Plan would be compatible with Constraints, Considerations, and Opportunities identified in the plan formulation process.

Constraints:

- Contaminated materials. The Recommended Plan would avoid areas with potentially contaminated materials.
- Public oyster grounds. Public oyster grounds would not be affected.
- Impingement on public access. The Recommended Plan would not impinge on access by the public to any location.

Considerations:

- Costs. The Recommended Plan is economically sound.
- Real estate acquisitions. The Recommended Plan would account for all necessary real estate acquisitions.
- Public Use Enhancement. The Recommended Plan would enhance public use through the beneficial use of dredge material for habitat restoration and enhancement in the Sabine and Cameron Prairie NWRs.
- Long-term facilities operation and maintenance costs. The Recommended Plan accounts for long term operations and maintenance (O&M) costs.
- Mitigation requirements. Compensatory mitigation in the form of compensation would not be required.

Opportunities:

- Use of dredged material for habitat restoration and improvement. The Recommended Plan would provide for habitat restoration and improvement.
- Provide Opportunities for Mining of CDFs by Third Parties for Construction, Fill, Beneficial Use, or Other Actions. Although mining of CDFs is not an integral component of the Recommended Plan, the plan would provide opportunities for the excavation and use of dredged material for construction, fill, beneficial use, or other actions.
- Placement of material from private dredging. The Recommended Plan would provide the placement capacity for material dredged by private parties, within certain parameters.
- Recreation. The Recommended Plan is expected to enhance recreation through the creation of marsh and estuarine habitat amenable to hunting, fishing, and wildlife viewing.
- Storm damage abatement. The Recommended Plan would result in the restoration of subsided marsh, thereby assisting in the abatement of damage from storms.

Planning Criteria. The Recommended Plan would comply with each of the planning criteria:

Acceptability. The Recommended Plan is anticipated to be workable and viable with respect to acceptance by state and local entities and the public, and compatibility with existing laws, regulations, and public policies. The Recommended Plan is feasible and achievable in the context of technical, environmental, economic, and social considerations.

Completeness. The Recommended Plan would include and account for all necessary financial investments, long-term operation and maintenance costs, or other actions.

Effectiveness. The Recommended Plan provides attainment of the planning objectives.

Efficiency. The Recommended Plan provides for the continued operation of the Calcasieu Ship Channel. It is technically and environmentally sound and provides both monetary and non-monetary cost effectiveness. It provides for the realization of opportunities and considers constraints and other considerations.

RECOMMENDATIONS

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 provide for the disposal of dredged material during maintenance of the Calcasieu River and Pass protect for a minimum of the next 20 years, this is the recommended Dredged Material Management Plan for the Calcasieu River and Pass, Louisiana project.

The total estimated cost for the project is $788,840,000 inclusive of associated investigation, environmental, engineering and design, construction, and supervision. Costs for the project would be shared by the Federal Government and the Local Sponsor in accordance with the cost sharing provisions of the Water Resources Development Act of 1986, as amended.

The recommendation contained herein reflects the information available at this time, January 2008 price levels, and current Departmental 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 it is transmitted to the Congress as proposals for authorization and/or implementation funding.

UNCERTAINTIES

It must be emphasized that this DMMP is a plan. While the CEMVN has every intention of implementing the DMMP in its entirety, the DMMP is subject to the uncertainties that are inherent in the planning process when unknown conditions must be considered. Potential items that could affect the implementation of the DMMP include physical conditions that were modeled or inferred based on currently existing information, but the exact nature of which must await detailed surveys and engineering. Examples of physical uncertainties include forecasted dredging quantities, erosion rates, hydrodynamics, and geotechnical characteristics. Sociopolitical uncertainties include such examples as availability of Congressional, state, or local funding and the possibility for legal actions taken by third parties. In addition, there are catastrophic uncertainties that could affect the DMMP; these include hurricanes, chemical contamination from spills, and vessel accidents.

Such unforeseen events or conditions may result in the shifting of priorities for the placement of dredged material for beneficial use or the rehabilitation of CDFs, but it is not expected that these actions would affect the overall DMMP. In the event that it becomes necessary for the CEMVN to alter the DMMP, the alterations would be fully coordinated with state and Federal agencies, and the public would be advised of the changes.

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*Elements marked with an asterisk (*) are required for NEPA compliance according to CEQ Regulations

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CALCASIEU RIVER AND PASS, LOUISIANA DREDGED MATERIAL MANAGEMENT PLAN and SUPPLEMENTAL EIS

1.0 INTRODUCTION

1.1 PURPOSE AND NEED

1.1.1 Purpose

The purpose of this study is for the U.S. Army Corps of Engineers, New Orleans District (CEMVN) to develop a management plan for the placement of material dredged for the maintenance and operation of the Calcasieu River and Pass, Louisiana, project (Calcasieu Ship Channel). The actions and strategies set forth in the Dredged Material Management Plan/Supplemental Environmental Impact Statement (DMMP/SEIS) would provide for the management of dredged materials for a minimum of 20 years while updating and redefining the base plan/Federal standard for the project. Preparation of the DMMP/SEIS would enable the CEMVN to comply with the requirement of ER 1105-2-100 to prepare a DMMP for each federally authorized navigation channel. Section 3-2 (b)(8) states:

> *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, potential for beneficial use of dredged material, and indicators of continued economic justification. The Dredged Material Management Plan shall be updated periodically to identify any potentially changed conditions.*

The National Environmental Policy Act of 1969 (NEPA) requires the Federal Government to provide an EIS for any major Federal action that has the potential to significantly affect the environment. In accordance with the Council for Environmental Quality (CEQ) regulations, Section 1502.1, the EIS *shall provide full and fair discussion of significant environmental impacts and shall inform decision makers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment.*

This report represents an integrated DMMP and SEIS. Dredged material management alternatives have been identified, evaluated, and screened so that recommended dredged material placement operations are conducted in a timely, environmentally sensitive, and cost-effective manner.

1.1.2 Planning Objectives

Given the requirements of ER 1105-2-100, the goal of this project is to:

> *Develop an implementable plan that is engineering, economically, and environmentally sound, for the placement of material dredged from the federally Authorized Navigation Channel of the Calcasieu River and Pass, Louisiana, project for a minimum of 20 years*.

Planning objectives were developed to ensure compliance with the requirements of this regulation. The objectives are:

1. **Maintain the navigation channel to authorized dimensions**. The plan should ensure that the channel remains available for continued shipping and vessel traffic.

2. **Place the dredged material in the most cost-effective location consistent with environmental and engineering requirements.** The plan should comply with environmental and economic requirements.

3. **Optimize the beneficial use of dredged material.** Dredged material is an important resource for coastal wetland restoration in the project vicinity. Increased cost may be a factor in transporting dredged material to relatively distant sites for beneficial use, but other governmental agencies and/or programs may offer assistance in offsetting the potentially increased costs outside of the plan.

4. **Maintain dredged material disposal sites in a manner to optimize capacities and comply with sound economic and environmental principles.** Maintaining confined disposal facilities and beneficial use areas can maximize their capacity for the receipt of dredged material, minimize risk to environmentally sensitive areas by minimizing erosion, and protect the real estate investment of the Federal and local sponsors.

5. **Provide for the disposal of material dredged by private parties.** Commercial and industrial users of the Calcasieu Ship Channel are responsible for activities such as berthing development and maintenance. ER 1105-2-100 and EP 1165-2-1 both state, "Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of disposal areas required for the Federal project(s)."

1.1.3 Proposed Action

The proposed action is the development of a plan for the management and disposal of dredged material to enable the Calcasieu Ship Channel to be maintained at its authorized dimensions for at least the next 20 years. The proposed action would maximize the use of disposal sites through site development, expansion, and management, as well as optimize the beneficial use of dredged material.

1.1.4 Need for the Action

When the velocity of water slows in a navigation channel its sediment-carrying capacity decreases. Sediment drops out and settles on the channel bottom. In addition, as waves generated by wind or by vessel passage reach the shoreline, the shoreline material erodes and falls to the channel bottom, or is suspended within the water and deposited farther downstream. Other factors such as heavy rainstorms or hurricanes may cause additional sediment to enter the channel. Periodic dredging is required to remove accumulated sediments and thus maintain the channel at its authorized depth.

The Calcasieu Ship Channel does not currently have adequate dredged material disposal capacity to maintain the channel to authorized depths. Existing disposal sites are at or near capacity, and past maintenance deficiencies have resulted in substantial erosion of disposal facilities into adjacent water bodies. Other disposal sites have been lost to commercial development. Previous real estate agreements, which have enabled landowners to opt out of agreements for disposal, have resulted in some landowners rescinding permissions for their property to be used for the placement of dredged material. As a result, the remaining disposal areas cannot accommodate the volume of dredged material needed to maintain the ship channel to project-authorized dimensions. It has become necessary for CEMVN to reduce channel widths in some reaches.

1.2 STUDY AREA/PROJECT AREA

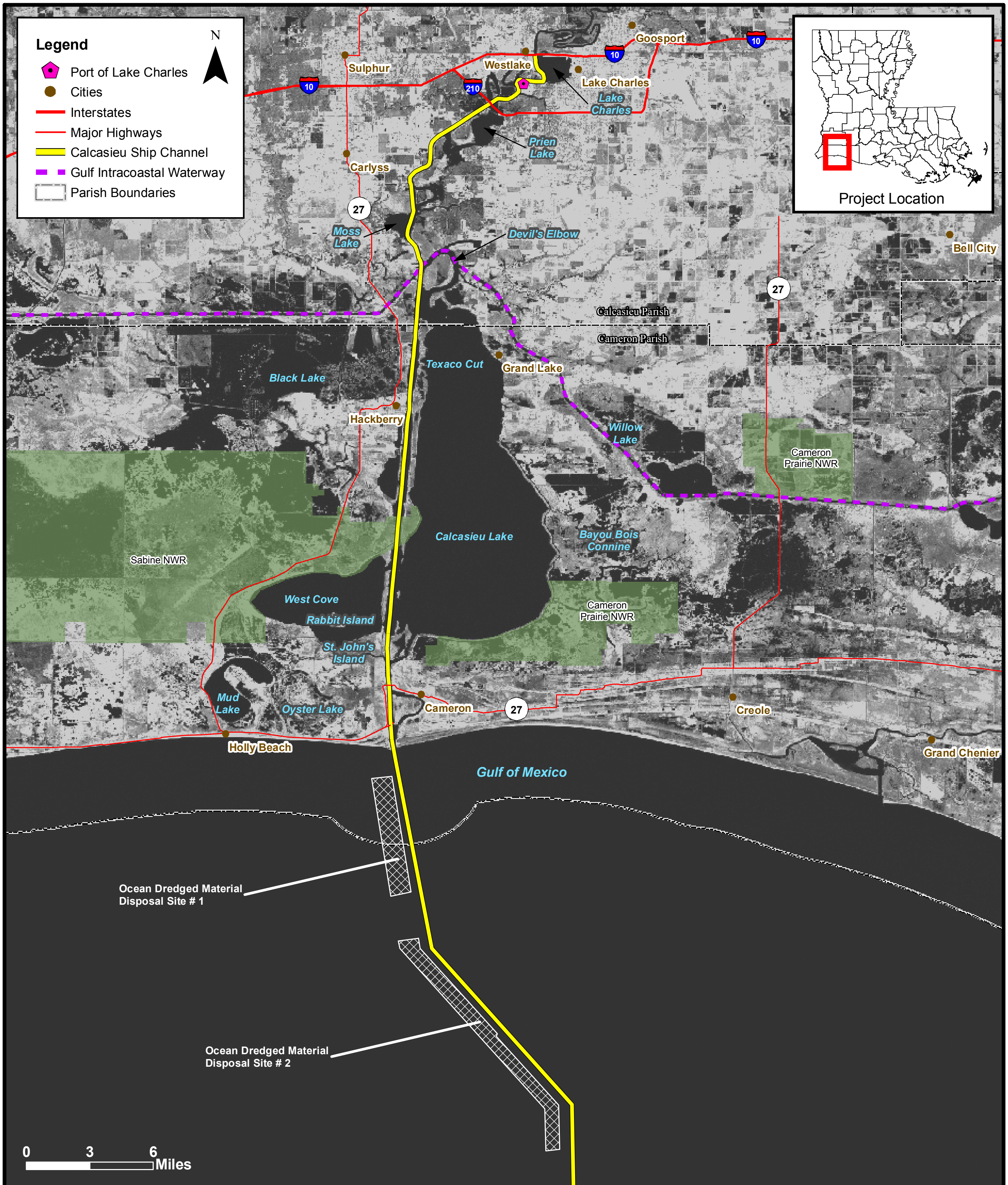
The Calcasieu Ship Channel is located in Calcasieu and Cameron parishes, Louisiana (Figure 1-1). The project area is bounded on the north by Interstate 10 and on the south by the Gulf of Mexico (channel mile 36.0 to channel mile -32.0). The project area extends into the coastal marshes west of the ship channel and into Calcasieu Lake east of the ship channel. Portions of Lake Charles, Prien Lake, Moss Lake, Browns Lake, Black Lake, and Calcasieu Lake are present in the project area.

To effectively evaluate the project area, channel mile 36.0 to channel mile -32.0 was divided into five reaches based upon differences in sedimentation rates, geomorphic characteristics, capacities for dredged material disposal, dredging frequencies, and problems and opportunities. The reaches were named the River Reach (mile 22 to mile 36), the Upper Lake (mile 12 to mile 22), the Lower Lake (mile 5 to mile 12), the Pass Channel (mile 0 to mile 5), and the Bar (Entrance) Channel (mile 0 to mile -32) (Figure 1-2). A brief description of each channel follows.

- The River Reach extends from channel mile 22 through channel mile 36. This reach is divided into three sections with dredging cycles that range from four to five years to every seven to 10 years. It requires the disposal of approximately two million cubic yards of dredged material each dredging cycle. This reach is located in the most highly developed and highly industrialized region of the channel.

- The Upper Lake is located between channel mile 12 and 22. The channel in this segment has the greatest rate of sedimentation. Some portions of this reach require dredging every year with the quantities varying. This reach currently has insufficient capacity for dredged material disposal, resulting in width and depth constraints to an already congested channel and a history of emergency dredging to keep the constrained channel open.

- The Lower Lake is located from channel mile 5 to channel mile 12. It is dredged approximately every two to three years with the quantities of dredged material varying. The Lower Lake offers the greatest opportunity for the beneficial use of dredged material, but may also have the greatest environmental concerns and mitigation costs with regards to specific marsh habitats and oysters.



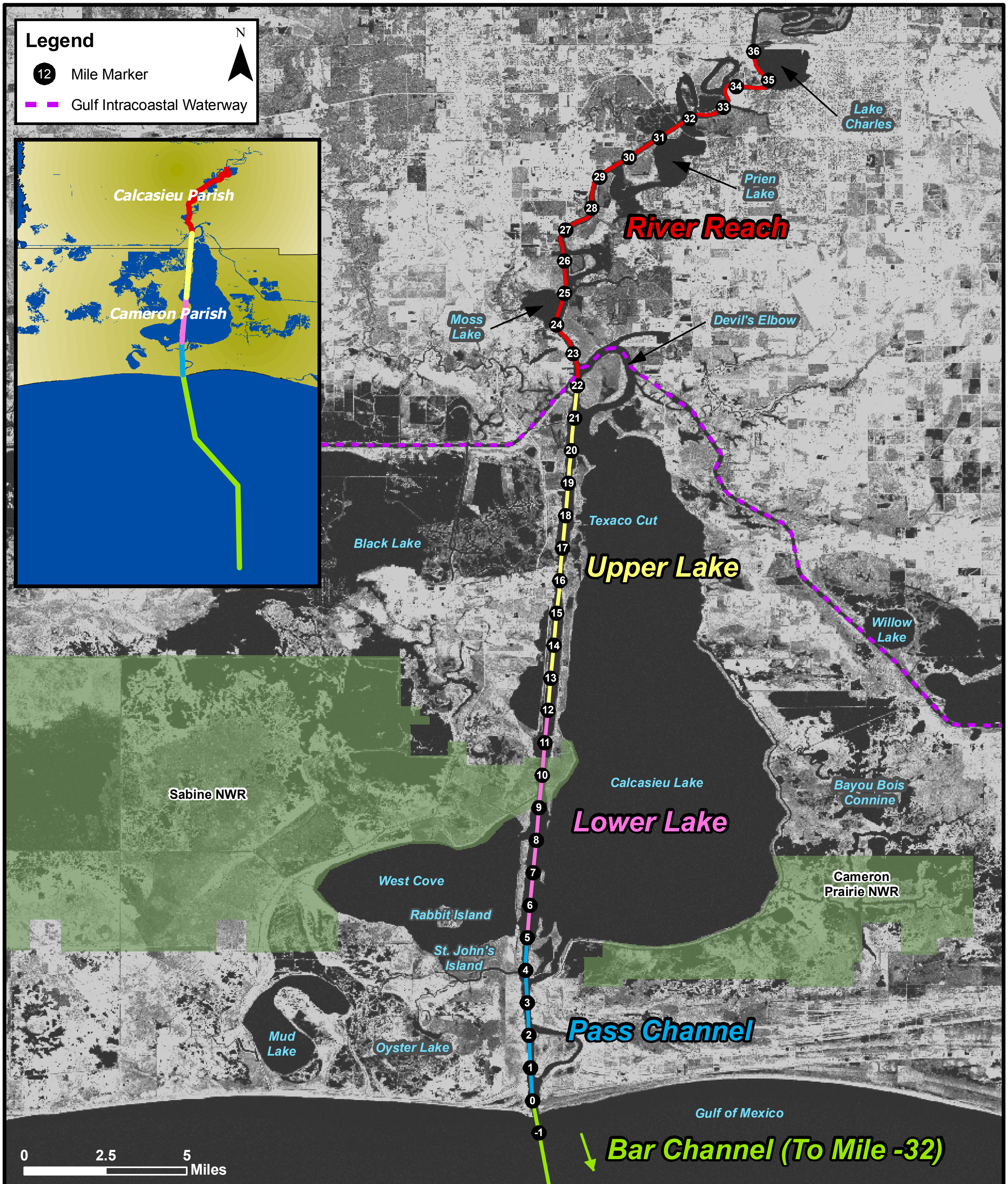
PHYSICAL AND GEOGRAPHICAL FEATURES OF THE CALCASIEU BASIN

Calcasieu River & Pass
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 1-1	
Date: March 2009	
Scale: 1:400,000	
Source: LDEQ/GEC/USACE	
Map ID: 27585107-1246	



REACH LOCATIONS

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

Figure: 1-2
Date: March 2009
Scale:1:260,000
Source: LDEQ/GEC/USACE
Map ID: 27585107-1244

- The Pass Channel is the portion of the project located between mile 0 and mile 5. The Pass Channel requires no dredging because strong tidal currents passing thorough this narrow inlet prevent the settling and accumulation of sediments. Located approximately at mile 2 of the Pass Channel, the 1.1-mile-long channel leading from the ship channel to Cameron has not required maintenance dredging for approximately 30 years; additional dredging is not anticipated during the 20-year life of this DMMP.

- The Bar Channel, also known as the Entrance Channel, extends offshore into the Gulf of Mexico from mile 0 to mile -32.0. Dredging is performed annually with material placed in the Ocean Dredged Material Disposal Site (ODMDS) located adjacent to the channel. Longshore currents within the Gulf sweep the ODMDS and disperse the dredged material, thereby renewing the placement site. This process results in providing adequate capacity for the placement of material dredged from the Bar Channel for at least the next 20 years, and no change in the current operations and maintenance (O&M) practices are anticipated. Disposal of dredged material from the Bar Channel at the ODMDS has been addressed by the USEPA in an existing NEPA document, *Final Environmental Impact Statement for Calcasieu River and Pass Ocean Dredged Material Disposal Site Designation*.

Because no additional measures or requirements are needed for the disposal of material from either the Pass Channel or the Bar Channel, there is not a need for a detailed analysis for managing the disposal of material dredged from these reaches. Therefore, this DMMP focuses on the needs for dredged material placement capacity at the three inland reaches of the Calcasieu Ship Channel.

1.3 AUTHORIZATION

The River and Harbor Act of 1946, Public Law 79-525, July 24, 1946, authorized the *Lake Charles Deep Water Channel and Calcasieu River and Pass* in accordance with Senate Document No. 190. This document provided for:

- A channel 35 feet deep by 250 feet wide (from the Port of Lake Charles to the Gulf of Mexico) and including the loop around Clooney Island

- A channel 35 to 37 feet deep and 250 feet wide (between the jetties)

- An approach channel 37 feet deep and 400 feet wide (seaward of the jetties in the Gulf of Mexico

- The reconstruction and extension of existing jetties to a 15-foot depth contour, if and when it becomes necessary

- Improvement of the river from Lake Charles to Phillips Bluff by dredging, as well as removing logs, snags, and overhanging trees. Total length of improvement is approximately 102.1 miles

The River and Harbor Act of 1960, Public Law 86-645, July 14, 1960, authorized modifications to the Federal project in accordance with House Document No. 436, which authorized the following revised dimensions and improvements:

- A channel 40 feet deep by 400 feet wide (from the Port of Lake Charles to the shoreline, mile 0)
- A channel 40 to 42 feet deep and 400 feet wide (between the jetties)
- An approach channel 42 feet deep and 800 feet wide (seaward of the jetties in the Gulf of Mexico)
- A new turning basin at channel mile 36.0 with a depth of 35 feet, a width of 750 feet, and a length of 1,000 feet
- A northern extension of the ship channel from the Port of Lake Charles (mile 34.1) to the bridge on U.S. Highway 90 (mile 36.0) 35 feet deep and 250 feet wide
- A mooring basin near mile 3.0 with a depth of 40 feet, a width of 350 feet, and a length of 2,000 feet
- Enlargement of the turning based at mile 29.6 to a depth of 40 feet
- The existing channel from the ship channel to Cameron would be maintained at a depth of 12 feet and a width of 200 feet

The River and Harbor Act of October, 23 1962, House Document 582 provided for:

- A salt water barrier structure with five 40-foot tainter gates in a new bypass channel
- A parallel channel with navigation structures and a single sector-type gate
- An earthen closure dam
- A woven lumber-type revetment

The Senate Public Works Committee on December 27, 1970 and the House Public Works Committee on December 15, 1970 adopted resolutions approving the project at Devil's Elbow under the provisions of Section 201 of the Flood Control Act of 1965 (Public Law 89-298; S.D. 91-111). The plan of improvement consisted of:

- Enlarging 2.3 miles of the existing industrial channel to a depth of 40 feet over a bottom width of 400 feet
- Extending the enlarged channel one-half-mile eastward
- Constructing a 1,200 by 1,400-foot turning basin south of the extended channel at its landward end

The Calcasieu River at Coon Island project was authorized by the Secretary of the Army under Section 107 of the River and Harbor Act of 1960, as amended by Section 310 and Section 112 of the River and Harbor Acts of 1965 and 1970, respectively. The project consists of:

- Deepening and widening a channel adjacent to Coon Island to 40 feet deep by 200 feet wide over a distance of 6,943 feet.
- Enlarging an existing turning basin at the end of the channel to 40 feet deep by 750 feet wide by 1,000 feet long.

1.4 CONSTRUCTION AND MAINTENANCE OF THE CHANNEL

The Calcasieu River and Pass, Louisiana, project has been constructed according to the authorizations described in Section 1.3. The three reaches of the main navigation channel addressed in this DMMP/SEIS, along with the side channels at Devil's Elbow and Coon Island and the turning basins, must be periodically dredged to maintain the authorized channel depth. Maintenance is accomplished with hydraulic cutterhead dredges that pumps dredged material through pipelines to the discharge points. Other types of dredges, such as dustpan dredges or hopper dredges, could be used but historically have not been. Contracts for dredging the channel typically require that the contractor excavate the channel to authorized dimensions plus two feet of advanced maintenance. Advanced maintenance is the practice of deepening a channel reach in anticipation of shoaling in order to allow for reasonable intervals between maintenance dredging events. Advanced maintenance is a standard USACE practice for maintaining channels that shoal and that must be periodically dredged. This practice minimizes the high costs of maintenance dredging, including the costs associated with dredge mobilization and demobilization and high costs per volume of material when only a thin layer of shoal material is removed from the channel bottom.

In addition to advanced maintenance, the term "allowable overdepth" is used to identify a vertical zone extending deeper than the advanced maintenance depth that may be disturbed or dredged so that the channel dimensions specified in the dredging contract are achieved. Due to inherent inaccuracies in the dredging process, contractors normally excavate somewhat deeper than the specified depth so that post-construction channel surveys confirm that minimal dimensions required in the dredging contract have been achieved. For some USACE projects, the zone of allowable overdepth is specified, and the contractor is paid for material removed from this zone. The practice of paying for excavation in the zone of allowable overdepth tends to encourage contractors to excavate within the zone and tends to increase total contract costs to the Government. For the Calcasieu Ship Channel project, allowable overdepth is not specified, and no payment is made for material dredged below the advanced maintenance depth. Channel surveys taken after dredging in the Calcasieu Ship Channel indicate that the channel may be dredged up to 2-3 feet deeper than the advanced maintenance depth specified in the dredging contract.

1.5 LOCAL SPONSOR

The local sponsor for the Calcasieu River and Pass, Louisiana, project is the Lake Charles Harbor & Terminal District, also known as the Port of Lake Charles. The port encompasses 203 square miles in Calcasieu Parish and accommodates five million tons of cargo annually at its public facilities. It owns and operates two marine terminals (the City Docks and Bulk Terminal No. 1) and two industrial parks (Industrial Canal and Industrial Park East). In calendar year 2006, 58,219 jobs in the State of Louisiana were related to business activity at the Port of Lake

Charles' public and private terminals. The marine cargo and vessel activity at the port generated $7.9 billion of total economic activity in Louisiana in the same year. The Port of Lake Charles is the 11th largest seaport in the U.S. based on tonnage.

In terms of energy importance, the port is the second largest Strategic Petroleum Reserve facility in the U.S. (219 million barrels of oil or 33 percent of the U.S. total). Refineries and manufacturers within the Port District and located on the Calcasieu Ship Channel include:

- CITGO
- Conoco/Phillips
- PPG Industries
- Westlake Petrochemicals
- Trunkline LNG
- Sempra LNG (under construction)
- Cheniere Creole Trail LNG (proposed)

The Port of Lake Charles is the current home of the largest liquefied natural gas (LNG) storage and regasification plant (Trunkline) in the U.S. By 2011, it is expected to handle over 60 million tons of LNG annually, equaling 20 percent of U.S. consumption. According to an economic impact study undertaken for the port, 4.5 percent of all U.S. motor fuel is supplied by producers on the Calcasieu Ship Channel. A nine-day closure of the channel in 2006 cost U.S. gasoline consumers $710 million and natural gas consumers $313 million for a total burden of over $1 billion to the nation (Martin Associates, 2007). (Please note: these are not NED benefits as defined by USACE regulations). Future plans call for the construction of the largest synthetic natural gas (SNG) plant in the U.S. to be built by Lake Charles Cogeneration. The Port District on the Calcasieu Ship Channel is a vital element of the U.S. energy infrastructure. It is a Strategic Energy Waterway.

1.6 FEDERAL STANDARD

The Federal standard is the dredged material placement alternative required by USACE in the DMMP that represents the least costly, environmentally sound alternative consistent with sound engineering practices and compliant with Federal environmental requirements (33 C.F.R. § 335.7).

There are three purposes for establishing the Federal standard. First, the Federal standard prescribes the limit of Federal investment consistent with the basis for project authorization. Second, it serves as a basis for cost-sharing the construction, operations, and maintenance costs for the project. Finally, the Federal standard establishes baseline costs to be used for economic analyses. Any cost in excess of the Federal standard is either borne by the non-Federal sponsor or shared with USACE under other authorities if the preferred placement site is considered to be in the Federal interest. For example, Section 204 of the WRDA of 1992, later amended by Section 207 of WRDA 1996, provides authority for USACE to implement projects for the protection, restoration, and creation of aquatic and ecologically-related habitats in connection with construction, operation, or maintenance dredging of an authorized Federal navigation project.

1.7 STUDY LIMITATIONS

This integrated DMMP/SEIS has been developed to evaluate potential alternatives for the placement of dredged material associated with operation and maintenance of the Calcasieu Ship Channel. Alternatives were evaluated on a planning level. Therefore, the descriptions of the alternatives include technical assumptions regarding the size, configuration, material requirements, volume requirements and other parameters used to estimate quantities for cost estimating and site capacity determinations. More precise details will be determined in follow-up studies, including geotechnical and engineering analyses and current-day cost estimates when engineering plans and specifications are prepared. Additional requirements under NEPA or other statutes and regulations may be required in the future, as well.

Potential impacts of other activities related to the continued operation of the ship channel, including possible future modifications to the authorized channel or its dimensions, have not been evaluated in this DMMP. Actions to develop and evaluate plans for such activities would be considered in future studies and NEPA documents.

1.8 HISTORY OF THE AREA

Sailing vessels first navigated the shallow Calcasieu River in 1865, when cargoes of lumber were needed for rebuilding the South at the end of the Civil War. On May 18, 1879, the New Orleans *Picayune*, in an article titled “Lake Charles Proposed as Port of Entry,” wrote of plans for the Lake Charles area to become a port for ocean-going vessels. Shortly thereafter, cuts were made in the sand bars in Calcasieu Lake, resulting in a dredged channel 70 feet wide and 7,500 feet long. However, because of sand bars in the river, Lake Charles remained inaccessible to all but shallow-draft schooners.

By the turn of the century, the rapidly growing rice industry increased the demand for water-borne transportation from Lake Charles to the Gulf of Mexico. In response, the Intracoastal Canal was built in 1915 to connect the Calcasieu and Sabine rivers. The Canal was 20.5 miles long and 12 feet deep, and had a 90-foot bottom width. Southwest Louisiana business leaders saw this as an opportunity to open Calcasieu Parish for commerce.

In 1921, the Louisiana Legislature authorized the Calcasieu Parish Police Jury to call a bond election to dredge and widen the Calcasieu River and Lake and procure rights of way. The formal opening of the Port of Lake Charles occurred on November 30, 1926. At that time, Calcasieu Parish produced two-thirds of all rice grown in the United States, all within 75 miles of Lake Charles. Oil, cotton, and lumber also contributed to the regional economy.

The River and Harbor Act of 1938 provided for dredging the channel from Lake Charles to the Gulf of Mexico, a distance of 34 miles, to a depth of 33 feet and a bottom width of 250 feet. The newly dredged channel and the outbreak of World War II in Europe sparked a second growth of industry in the Lake Charles area. The Mathieson Alkali Plant, Continental Oil, Firestone, Pittsburg Plate Glass, Davison Chemical, Dresser Minerals, Citcon, Hercules, Conalco, and others built plants along the Calcasieu River in Lake Charles. In the 1940s, the Port handled a diverse cargo, including tires and raw rubber from the Firestone plant. The Port also contracted with the U.S. War Department for the storage and handling of military cargo of all types.

1.9 PRIOR STUDIES AND RELATED REPORTS

This DMMP/SEIS builds upon three previous documents listed below. These documents are incorporated into the DMMP/SEIS by reference.

1.9.1 General Design, Calcasieu River and Pass, Louisiana, 1961

The basic concept of the authorized project in the 1961 General Design report was to build on this project by forming nearly continuous disposal areas on both sides of the channel to reduce the sedimentation in the channel originating from the adjacent lake bottom. The disposal sites set forth in 1961 General Design plan were generally satisfactory on the west bank, but significant erosion occurred along the lake and channel because of failure of the lake-side retaining dikes. These failures resulted in excessive shoaling and maintenance requirements, and environmental damage to adjacent lake areas. In 1972, local fish and wildlife interests requested that disposal of dredged material on the east bank be discontinued and that the authorized plan be modified.

1.9.2 Interim Plan, Calcasieu River and Pass, Louisiana, 1972

This plan was basically the same as the authorized plan above except that the planned disposal areas on the east side of the channel from mile 5.0 to mile 8.2 were not used. This is where the channel crosses what was formerly open lake area. The sediments from this reach are all placed in the authorized west bank disposal areas. The west bank disposal areas from mile 5.0 to mile 8.2 contained about 434 acres, all of which were formerly open lake area, and all of which are a part of the authorized plan. The east bank disposal areas, which are not presently being used, total about 355 acres.

1.9.3 Final Environmental Statement, Calcasieu River and Pass (including Salt Water Barrier); Coon Island; Devil's Elbow; Calcasieu River Basin, Louisiana, Continued Operation and Maintenance (CEMVN, 1976)

The purpose of this FEIS was to continue operation and maintenance of the Calcasieu River and Pass, Coon Island, and Devil's Elbow, Louisiana projects. This FEIS also proposed to widen portions of the channel around Clooney Island to facilitate ship movement.

Building upon the previous two documents, in this plan, the west bank disposal area remained the same as the authorized plan except for an additional freshwater gap at mile 5.4. Also, the channel-side retention dike was moved toward the channel and strengthened. The east bank disposal areas were modified in configuration between miles 5.0 and 9.8. The east bank retaining dikes and the west bank channel-side retaining dikes were strengthened by raising them to a higher elevation and by protecting the lake side and channel side with riprap. The gaps provided in the east bank disposal areas corresponded to existing gaps which formed naturally and served to maintain existing access and water circulation. The modified disposal area (east bank), between miles 5.0 and 9.8, contained about 1,158 acres, of which 1,037 acres were former lake area and 121 acres were marsh area. The modified area replaced 607 acres provided in the authorized plan, which consisted of 486 acres of lake and 121 acres of marsh. Operation and Maintenance (O&M) practices for the proposed plan were similar to those in use at the time, i.e., use of a cutterhead dredge. A new O&M feature was the use of rock and riprap retaining dikes to prevent erosion, reduce dredging costs, and prevent environmental damage. However, no rock or riprap was placed between miles 5.0 and 9.8.

1.9.4 Final Environmental Impact Statement for Calcasieu River and Pass Ocean Dredged Material Disposal Site Designation (USEPA, 1987).

The proposed action was the designation of the existing Calcasieu River and Pass ODMDS. The recommended action was the final designation of two sites for the disposal of dredged material.

Alternatives to the proposed action included no action, the relocation of the ODMDS to alternative ocean areas, land disposal, and beach nourishment. Ocean disposal of dredged material at the existing sites was considered the most acceptable action for several reasons: the existing ODMDS had been used for more than 30 years with no detected degradation of water or sediment quality or adverse effects on the biota in adjacent control stations.

Alternative ocean disposal in mid-shelf or deep water areas was eliminated because no previous disposal had taken place at those locations, and the impacts of disposal were unknown; monitoring and surveillance of these sites would have been difficult and expensive because of the deeper water. Adverse environmental effects of ocean disposal include possible temporary increases in turbidity, short-term changes in grain size of ODMDS surficial sediments, burial of benthic organisms, and temporary mounding. Further, increased transportation costs would have resulted from transporting dredged material for greater distances.

Upland disposal (disposal in confined disposal facilities) was determined to be unacceptable because the sites could not accommodate the dredged material. A floating pipeline was considered not feasible because it could not be used in the surf zone; submerged pipelines could pose a hazard to navigation. In addition, the cost of pumping the dredged material to an inland site was determined to triple those of existing dredging operations in the Bar Channel.

The use of dredged material for beach nourishment at locations such as Holly Beach was considered to be impractical due to the high costs of transporting the material. In addition, dredged material from the Bar Channel was often found to contain more silt than sand, making the material less suitable for beach nourishment projects.

Based on the evaluations discussed in the FEIS, the USEPA's preferred alternative was the final designation of the interim designated Calcasieu ODMDS for disposal of dredged material. Because there have been no changes to the Bar Channel since the preparation of the 1987 FEIS, and because the capacity of the ODMDS is sufficient for disposal for well beyond the next 20 years, the 1987 FEIS is incorporated by reference. This location was the least costly, environmentally-sound alternative consistent with sound engineering practices and compliant with Federal environmental laws. Therefore, the ODMDS is consistent with the Federal Standard as discussed in Section 1.6, *Federal Standard*.

1.9.5 Related Studies and Reports

Environmental Assessments

A number of environmental assessments (EAs) have been conducted for Federal actions in the project area. The EA for Olin Tailing Ponds is on-hold and the rest have been found to have no significant impact on the environment. These EAs include:

(a) Calcasieu River and Pass, Cameron and Calcasieu Parishes, Anchorage Feasibility Report and Environmental Assessment (in process).
(b) Calcasieu River and Pass, Access Corridors for the Marcantel O&M Beneficial Use Marsh Creation Disposal Area, Cameron Parish, Louisiana. Final Supplemental Environmental Assessments. Finding of No Significant Impact. Signed November 7, 2008.
(c) Calcasieu River and Pass, Marcantel O&M Beneficial Use of Disposal Areas, Cameron Parish, Louisiana. Environmental Assessment. Finding of No Significant Impact. Signed February 12, 2008.
(d) Sabine Refuge O&M Beneficial Use Marsh Creation Disposal Area Environmental Assessment. Finding of No Significant Impact. Signed August 15, 2006.
(e) Calcasieu River at GIWW Revetment Environmental Assessment. Finding of No Significant Impact. Signed October 31, 2002.
(f) Sabine Refuge Marsh Creation, Cameron Parish Environmental Assessment. Finding of No Significant Impact. Signed December 28, 2000.
(g) Moss Lake Disposal Dike Repairs, Calcasieu Parish Environmental Assessment. Finding of No Significant Impact. Signed Sept 8, 2000.
(h) East Fork, Calcasieu Pass – Assumption of Maintenance Environmental Assessment. Finding of No Significant Impact. Signed October 12, 1999.
(i) Calcasieu River and Pass, Louisiana, Turner Bay Disposal Area Environmental Assessment. Finding of No Significant Impact. Signed March 6, 2001.
(j) Calcasieu Ship Channel Bayou Black Remediation Dredging Environmental Assessment. Finding of No Significant Impact. Signed January 24, 1996.
(k) Lake Charles Ship Channel, Cameron and Calcasieu Parishes, LA, Marsh Creation Environmental Assessment. Finding of No Significant Impact. Signed January 29, 1992.
(l) Calcasieu River and Pass, Foreshore Rock Dikes and Bank Armoring, Cameron Parish, Louisiana, Environmental Assessment. Finding of No Significant Impact. Signed August 19, 2009.

Comprehensive Planning Studies

Coast 2050, 1999: In 1998, Federal and state agencies, local governments, academia, numerous non-governmental groups, and private citizens reached consensus on the Coast 2050 Plan, a conceptual plan for restoration of the Louisiana coast. The Coast 2050 Plan was a direct outgrowth of lessons learned from implementation of restoration projects through CWPPRA, reflected a growing recognition that a more comprehensive “systemic” approach was needed, and was the basis for the May 1999 905(b) reconnaissance report. The reconnaissance report was the precursor to the LCA Ecosystem Restoration Study.

Louisiana Coastal Area (LCA), 2004: The LCA Study focused on “lessons learned” from previous Louisiana coastal restoration efforts, the Coast 2050 restoration strategies, and the best available science and technology to develop a plan addressing the most critical ecological needs of the coastal area. The LCA Plan includes five near-term critical restoration features, recommended for specific authorization for implementation subject to approval of feasibility-level decision documents by the Secretary (conditional authorization). The LCA Beneficial Use Dredge Material (BUDMAT) Program is a feature of the Near-term Ecosystem Restoration Plan for the LCA, Louisiana, Ecosystem Restoration Feasibility Study. The plan was authorized by the Water Resources Development Act (WRDA) of 2007.

Louisiana Coastal Protection and Restoration (LACPR), 2010: The Louisiana Coastal Protection and Restoration (LACPR) technical report is authorized to include the analysis and design of hurricane risk reduction, coastal restoration, and flood control measures. A Final Technical Report prepared by the USACE was submitted to Congress in June 2010. The Draft Final Technical Report includes different alignments of structural measures, such as floodgates, floodwalls, and levees, to compare relative reduction of risk of flooding and storm surge. The Draft Final Technical Report also includes nonstructural measures, such as elevating homes. In addition, it investigates various wetland restoration projects and highlights the role of wetlands in coastal risk reduction.

Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2007: The Louisiana Legislature, through Act 8 of the First Extraordinary Session of the 2005 Louisiana Legislature, established the Coastal Protection and Restoration Authority (CPRA) to develop, implement, make reports on, and provide oversight for a comprehensive coastal protection master plan and annual coastal protection plans.

***Legislation and Programs**:*

Over the past three decades, both the Federal government and the State of Louisiana have established policies and programs that are intended to halt and reverse the loss of coastal wetlands and to restore and enhance their functionality. Coastal resource management in Louisiana accelerated once Louisiana adopted and began participating in the Federal Coastal Zone Management program in 1978. Shortly thereafter, the state developed its first coastal zone management plan. One of the primary objectives of this plan was to ensure that future development activities within the coastal area would be accomplished with the greatest benefit and the least amount of environmental damage.

In 1989, the constitution of the State of Louisiana was amended with enactment and voter approval of Act 6, LA. R.S. 49:213 *et seq*., also known as the Louisiana Coastal Wetlands Conservation, Restoration and Management Act. Act 6 empowered the Louisiana Department of Natural Resources (LDNR) as the lead state agency for the development, implementation, operation, maintenance, and monitoring of coastal restoration projects. Chief among its many functions, LDNR had the lead for the development and implementation of state-sponsored coastal restoration projects.

Act 6 also created the Wetlands Conservation and Restoration Fund (WCRF), which dedicates a portion of the state's revenues from severance taxes on mineral production (e.g., oil and gas) to finance coastal restoration activities and projects. Currently, the WCRF provides approximately $25 million per year to support coastal restoration activities and projects. Act 6 requires the State to prepare and annually update a "Coastal Wetlands Conservation and Restoration Plan." This plan provides location-specific authorizations for the funding of coastal restoration projects from the WCRF.

In November 2005, Act 8 of the First Extraordinary Session of 2005 created the Coastal Protection and Restoration Authority (CPRA) and charged it with coordinating the efforts of local, state, and Federal agencies to achieve long-term and comprehensive coastal protection and restoration. The CPRA created a Master Plan to integrate what had previously been discrete areas of activity: flood control and wetland restoration.

The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA): The Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) of 1990 was the first Federal statutory mandate for restoration of Louisiana's coastal wetlands. The CWPPRA Task Force is composed of five Federal agencies: U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), and National Resources Conservation Service (NRCS), and the State of Louisiana. The initial priority of the task force was to prepare a comprehensive restoration plan that would coordinate and integrate coastal wetlands restoration projects to ensure the long-term conservation of coastal wetlands of Louisiana. The plan was adopted in 1993.

The task force was also required to prepare and adopt an annual Project Priority List. CWPPRA provides funds annually for coastal restoration planning and the construction of coastal protection and restoration projects. As of July 2008, 145 active CWPPRA projects have been approved, 74 have been constructed, 17 are under construction, and 26 have been de-authorized or transferred to other programs. Many of these projects have occurred in the Calcasieu River and Pass project area (see Section 4.15 for a list of CWPPRA projects in the study area). The CWPPRA program anticipates receiving $84M in Federal funds for Fiscal Year 2009.

The Coastal Impact Assistance Program (CIAP): The Coastal Impact Assistance Program (CIAP) was originally authorized by Congress in 2001 in the Outer Continental Shelf (OCS) Lands Act, as amended (31 U.S.C. 6301-6305). Section 384 of the Energy Policy Act of 2005 (Public Law 109-58) authorized CIAP funds to be distributed to OCS oil and gas producing states to mitigate the impacts of OCS oil and gas activities for fiscal years 2007 through 2010. The state liaisons for this program are LDNR in Louisiana. The CIAP allocations have been used to fund various state and local coastal activities and projects including: monitoring, assessment, research, and planning; habitat, water quality, and wetland restoration; coastline erosion control; and control of invasive non-native plant and animal species.

USACE Continuing Authorities Program, 1996: Section 204 of the Water Resources Development Act (WRDA) 1992, as amended in WRDA 2007 Section 2037, is a "continuing authority" that authorizes the Secretary of the Army to plan, design, and implement certain ecosystem restoration measures, subject to specified cost sharing, cooperation, and positive Secretarial findings without additional project specific Congressional authorization. Section 204 as amended authorizes the beneficial use of sediments in connection with construction, operation, or maintenance dredging of an authorized Federal water resources project.

In addition to coastal restoration efforts undertaken through the efforts discussed above, other Federal and state coastal restoration efforts over the years have resulted in the construction of state projects, Federal projects, and state vegetative plantings (LDNR 2003). One of the more significant contributions to the restoration of coastal wetlands has been a result of the North American Wetlands Conservation Act (NAWCA), administered by the USFWS. The 1999 and 2001 biennial NAWCA report presented to Congress cites 30,558 acres (1,2372 ha) of restoration and 40,348 acres (16,335 ha) where ecosystem function has been improved in coastal Louisiana wetlands.

1.10 DECISION TO BE MADE

This DMMP identifies, evaluates, screens and recommends dredged material placement sites and operations for the Calcasieu River and Pass, Louisiana project for the next 20 years. The decision to be made is the selection of a plan to provide for continued commercial and recreational use of the waterway while maximizing efficiency, environmental sensitivity, and cost-effectiveness.

1.11 SCOPING AND INTERAGENCY COORDINATION

In compliance with USACE policies and NEPA, input on projects is solicited from the public and other government agencies. A Notice of Intent (NOI) to prepare a Draft Supplemental Environmental Impact Statement for the Dredged Material Management Plan for the Calcasieu River and Pass, Louisiana project was published in the Federal Register (Vol. 70, No. 134) on July 14, 2005. The NOI invited the public to comment during the scoping process and during public meetings. Comments were solicited for this document during the public comment period of July 14-29, 2005. The NOI and the scoping report are included in Appendix Q, *Scoping*.

During the scoping process, three public and interagency meetings were held to receive suggestions for the management and placement of material dredged from the Calcasieu River and Pass. Two public scoping meetings were held on July 18, 2005, at the Calcasieu Parish Police Jury Building, and on July 19, 2005, at the Cameron Parish Courthouse. An interagency meeting was held with state and Federal agency personnel on April 5, 2005, in Lafayette, Louisiana. The vast majority of comments regarded the proposed Cheniere LNG facility in Cameron Parish. A number of comments were also received concerning the beneficial use of dredged material along the channel, primarily the restoration of degraded wetlands. Other comments involved the non-beneficial use of dredged material, and the need for additional studies. A number of documents were received following the scoping meetings. The U.S. Fish and Wildlife Service resubmitted a letter dated February 14, 2003, containing several recommendations and strategies for the beneficial use of dredged material removed from the Calcasieu River and Pass. A letter dated July 11, 2005 was submitted by the National Marine Fisheries Service (NMFS). In the letter, NMFS recommended that the EIS evaluate the potential impacts and benefits of each alternative on essential fish habitat, and on marine fishery utilization of wetlands, water bottoms and water column within the project area. A letter dated July 22, 2005 was submitted by Cheniere Energy, Inc. In the letter, Cheniere recommended that the DMMP focus on: using maintenance dredged material for beneficial uses such as marsh restoration, restoring existing dredged placement areas, and updating easement agreements along the ship channel. All materials, including the presentation and comments, are shown in Appendix Q.

The plan formulation process involved several additional meetings. Outcomes of these meetings and how they relate to the plan formulation process can be found in Section 2.4. On May 23, 2006, representatives of the project team met with representatives of the U.S. Fish and Wildlife Service (USFWS), Louisiana Department of Natural Resources (LDNR), and Louisiana Department of Environmental Quality (LDEQ). Discussions involved criteria to be used to screen alternatives and options, regulatory agency requirements, and recommendations for beneficial use of dredged material. Follow-up meetings were held with the representatives of the National Marine Fisheries Service (NMFS) (May 26, 2006) and the Louisiana Department of Wildlife and Fisheries (LDWF) (June 8, 2006), to discuss fisheries and oyster resources of the area, requirements for the design of restored marsh, and other aspects of the project.

Another interagency meeting was held on October 16, 2006. Attendees were representatives of the USFWS, NMFS, U.S. Environmental Protection Agency (teleconference), LDWF, and LDNR. The main topic of discussion was the calculation of material to be dredged from the Calcasieu Ship Channel over the 20-year life of the project and the preliminary determinations of disposal actions. An additional meeting was held with the LDWF on October 5, 2006, to discuss oyster grounds, mitigation requirements, and survey techniques.

1.11.1 Public Comments on the Draft DMMP/SEIS

The draft EIS was released to the public on May 22, 2009. A Notice of Availability for the Draft DMMP/SEIS was transmitted to the EPA and published in the *Federal Register* on May 22, 2009. The 45-day public comment period for the draft report started May 22 and ended July 6, 2009. Public meetings to present the proposed project and hear comments were hosted on July 8 and 9, 2009. The public meeting on July 8 was conducted in Hackberry, Louisiana, and the meeting on July 9 was held in Lake Charles, Louisiana. A total of 14 individual comments were heard at the public meetings.

During the 45-day review period, a total of 11 comment letters were received which contained 50 individual comments. Public comments primarily focused on beneficial use of dredged material; design of beneficial use sites and shore stabilization for fisheries benefits; avoidance of CDF expansions if possible; real estate disposal easements; Hazardous, Toxic, and Radioactive Waste (HTRW) analysis; and flexibility of the recommended plan during period updates. The New Orleans District prepared responses to all of the public and agency comments. Changes made to the DMMP/SEIS included an expanded HTRW assessment and minor revisions to the Existing Environment section of the report with regard to biological resources. Commenting letters, a summary of oral comments received at the public meetings, and written responses provided by the CEMVN may be found in Appendix N.

Refer to Appendices N and Q for correspondence and additional details of public and agency involvement for this project.

1.12 PERMITS

The proposed dredging and disposal operations are subject to Section 401 of the Clean Water Act and a Water Quality Certification from the LDEQ. A National Pollution Discharge Elimination System (NPDES) permit must be obtained by construction contractors from LDEQ for disturbances to sites greater than one acre. Dredging and disposal operations must be consistent to the maximum extent possible with the Louisiana Coastal Resources Program. A Federal consistency determination was approved by the Louisiana Department of Natural Resources (LDNR) on April 14, 2009 (Appendix K).

1.13 COMPLIANCE WITH LAWS AND EXECUTIVE ORDERS

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. Appendix O documents compliance with all applicable Federal statutes, executive orders, and policies; Table 1-1 summarizes the level of compliance with those statutes, orders, and policies.

1.13.1 Fish and Wildlife Coordination Act of 1958

In accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq*.), the USFWS has provided recommendations on the Recommended Plan in a July 29, 2009, Fish and Wildlife Coordination Act Report (FWCAR) (Appendix M). In the report, the FWS gave the following comments and recommendations:

Table 1-1. Compliance with Environmental Laws, Regulations and Executive Orders, Tentatively Selected Plan (TSP)

Law, Regulation or Policy	Status	Comments
Clean Air Act of 1970	Complies fully	**Sec. 309:** Draft SEIS has been coordinated with the public and agencies. EPA rated the document as "Lack of Objections ". **Sec. 176:** No permanent sources of air emissions are part of the TSP.
Clean Water Act of 1977	Complies fully	404(b)(1) Evaluation signed by USACE September, 2009 is located in Appendix J; water quality certification was granted by LDEQ on June 24, 2009 (App. U); public notice comment period was held Feb 9 to March 9, 2009; NPDES non-point source permit will be required and obtained before construction commences.
National Environmental Policy Act of 1969	Complies fully	Draft SEIS has been coordinated with the public and agencies. The public comment period ended 45 days after the Notice of Availability of the Draft SEIS appeared in the Federal Register on May 22, 2009. EPA rated the document as "Lack of Objections ".
Fish and Wildlife Coordination Act of 1958	Complies fully	USFWS and DOI are active team participants and have provided input on fish and wildlife resources in the project area. A Final CAR was received on July 29, 2009.
Endangered Species Act of 1973	Complies fully	A Biological Assessment (BA) was submitted to NMFS and USFWS on July 2, 2007 with a "may affect, but not likely to adversely affect" opinion. USFWS concurred by letter dated Nov 13, 2007 and NMFS advised no further action was required in a letter dated Oct 11, 2007.
Magnuson-Stevens Fishery Conservation and Management Act of 1976	Complies fully	An EFH assessment is incorporated into the DMMP/SEIS in Section 4.7. By comment letter dated June 5, 2009, NMFS stated that the DMMP/SEIS adequately evaluates potential project impacts to EFH and related marine fishery resources. See Appendix N.
Fishery Conservation and Management Act	Complies fully	The project has been coordinated with NMFS
Coastal Zone Management Act of 1972	Complies fully	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 April 14, 2009 (App. K).
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	Complies fully	West Indian Manatee not likely to be adversely affected. Reference Appendix L--Biological assessment and Biological Opinion
Marine Protection, Research and Sanctuaries Act	Complies fully	Disposal of dredged material must comply with the Act.
Estuary Protection Act of 1968	Complies fully	It is anticipated that estuaries would be benefited by this project.
Anadromous Fish Conservation Act	Complies fully	Anadromous fish species would not be affected. The project has been coordinated with NMFS.
Migratory Bird Treaty Act and Migratory Bird Conservation Act	Complies fully	No migratory birds would be affected by project activities.
Wild and Scenic River Act of 1968	Not applicable	No designated Wild and Scenic river reaches would be affected by project related activities.

Law, Regulation or Policy	Status	Comments
Federal Water Project Recreation Act	Complies fully	The principles of this Act (PL 89-72) have been fulfilled.
Submerged Lands Act of 1953	Complies fully	Coordination with LDNR and LDWF has been ongoing.
Rivers and Harbors Act of 1899	Complies fully	The proposed work would not obstruct navigable waters of the United States.
National Historic Preservation Act of 1966	Complies fully	By letter dated Oct 5, 2007, SHPO stated no objections to the proposed project from a Section 106 compliance standpoint.
RCRA, CERCLA, Toxic Substances Control Act of 1976	Complies fully	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.
E.O. 11988 Floodplain Management	Not applicable	This project would not affect floodplains
E.O. 11990 Protection of Wetlands	Complies fully	Expanding CDFs would result in the loss of about 511 acres of marsh and estuarine/open water habitat. Beneficial use of dredged material may re-store, nourish, or create 6,306 acres of marsh and estuarine habitat, including the creation of 466 acres of wetland habitat in Calcasieu Lake.
E.O. 12898 Environmental Justice	Not applicable	No minority or low-income com-munities would be affected by the project.
E.O. 13089 Coral Reef Protection	Not applicable	This project would not adversely impact coral reefs or coral reef resources.
E.O. 13112 Invasive Species	Complies fully	Project is not expected to lead to propagation of invasive species.

Source: USACE.

"The Service would not object to further detailed planning and implementation of the TSP provided that the project incorporates the following recommendations to avoid unnecessary impacts to fish and wildlife resources, to quantify indirect project impacts, to achieve the anticipated wetland creation benefits, and to mitigate for unavoidable project-related wetland impacts:

1. To the greatest extent practicable, beneficial use sites should be considered the primary disposal option over CDFs and should be used prior to disposing in CDFs.

   Response: The USACE does not concur that beneficial use should be the "primary disposal option over CDFs," but rather that both CDFs and beneficial use sites should be evaluated based on the needs, capacities, and characteristics of each reach of the channel.

2. According to the Corps, the DMMP will be updated every five years. The Service, the NMFS, the LDNR, and the LDWF should be involved early on in this planning effort to identify any potential change in conditions including additional beneficial use disposal options and the overall placement capacity needed for maintaining the channel.

Response: The Corps will continue to work closely with the resource agencies in coordinating and planning disposal options for the Calcasieu Ship Channel. Annually, the Corps will host a planning meeting of future dredging cycles and disposal options.

3. Detailed design documents (e.g., design reports, plans and specifications, etc.) of the waterway and disposal sites should be prepared in consultation with the Service, the NMFS, the LDNR, and the LDWF to avoid unnecessary wetland impacts and to achieve the anticipated wetland creation benefits. At that time, WVA calculations should be updated to more accurately reflect project impacts and/or benefits. The following are some beneficial use disposal area design features that have been implemented for marsh creation projects in the Calcasieu-Sabine Basin and should be considered in all future sites:

    a. beneficial use disposal areas should have constructed bayous and openings to existing bayous (e.g., fish dips) to facilitate water exchange and aquatic organism access, openings should be constructed after dredged material has stabilized and vegetation has colonized;

    b. initial marsh elevations should be designed to + 4.5' MLG with a target elevation of+ 2.5' MLG (1.1 NAVD 88);

    c. beneficial use disposal area containment dikes should be breached or degraded to the settled elevations of the disposal area. Such breaches should be undertaken after consolidation of the dredged sediments and vegetative colonization of the exposed soil surface;

    d. for beneficial use disposal areas along Calcasieu Lake, fish dips or gaps should be located approximately every 1,000 feet to allow for some aquatic organism access and hydraulic exchange with those marsh creation areas; and,

    e. fish dips should have a minimum bottom width of 20 feet, a minimum depth of at least 1 foot below target marsh elevations (0.0 NAVD 88), and rock armoring on the sides and bottom to minimize scour.

    Response: The Corps will coordinate closely with the resource agencies in designing disposal facilities and marsh restoration sites

4. Shoreline protection features along the right descending bank between RM 16.5 and RM 18.7 should avoid obstructing Black Lake Bayou and Crab Gully.

    Response: The Corps will coordinate shoreline protection features with resource agencies.

5. To allow for some hydraulic exchange and aquatic organism access and to avoid impoundment of shallow open water areas, erosion control/shoreline protection features along the ship channel and waterward of interspersed marsh and shallow open water habitat should also include fish dips or gaps approximately every 1,000

feet. Design of those features should be prepared in consultation with the Service, the NMFS, the LDNR, and the LDWF to avoid unnecessary impacts to fish and wildlife resources.

Response: The Corps will coordinate design of features with resource agencies.

6. Monitoring of shoreline erosion should be conducted in conjunction with the scheduled 5-year DMMP review. Should shoreline erosion rates increase along natural marsh shorelines relative to the proposed shoreline protection features, efforts should be made to provide protection to those riparian marsh habitats.

   Response: The Corps will evaluate the need for erosion protection during periodic review and update of the DMMP.

7. Fee title or an equivalent easement should be acquired for any mitigation lands to preclude incompatible development and to ensure that the recommended mitigation

   Response: The Corps does not anticipate the need to acquire mitigation lands for this project. If it becomes apparent that mitigation is required, the Corps will coordinate all plans and designs with the resource agencies.

BLANK

2.0 ALTERNATIVES

2.1 INTRODUCTION

The dredged material disposal capacity for the Calcasieu Ship Channel has diminished over the years due to the loss of available lands, easements, and rights-of-way and limited funding to operate, maintain, and retrofit existing disposal areas. The volume of material needed to be dredged over the next 20 years to maintain authorized dimensions is estimated at 97 million cubic yards, while the existing capacity of disposal sites is estimated at only five million cubic yards. Currently, the ship channel is operating under reduced dimensions because of these constraints. Therefore, under the guidance of ER 1105-2-100, a new management plan must be established for the ongoing operation and maintenance of the ship channel. This section explains the existing Federal project, the need to identify additional dredged material placement capacity, and the process for choosing a Recommended Plan to meet the dredged material management needs over the next 20 years.

In developing the alternative plans from which the Recommended Plan was chosen, 78 dredged material placement options were screened and evaluated through a coordinated, interagency process. The various options were rated according to planning goals, objectives, and performance measures. Four final alternatives resulted from this process:

- Alternative A, the No Action Alternative,
- Alternative B, Placement in confined disposal facilities (CDFs) and beneficial use, with CDF capacity maximized from channel mile 12 to 22
- Alternative C, Placement in CDFs and beneficial use, with beneficial use capacity maximized from channel mile 12 to 22
- Alternative D, Placement of material in the Ocean Dredged Material Disposal Site (ODMDS).

This chapter is divided into seven sections. Figures are located in Section 2.8:

- 2.1 Introduction (including a description of placement types)
- 2.2 Existing Federal Project
- 2.3 Dredged Material Placement Capacity Need
- 2.4 Plan Formulation
- 2.5 Description of Alternatives
- 2.6 Comparison of Alternatives
- 2.7 Selection of the Recommended Plan
- 2.8 Figures

2.1.1 Placement Types

Three types of dredged material placement sites were analyzed in this DMMP/SEIS. They include: confined disposal facilities, beneficial use sites, and ocean disposal. A general description of each type of placement site is provided below.

Confined Disposal Facility (CDF): A CDF is an engineered structure for the containment of dredged material. CDFs are bound by confinement dikes or structures to enclose the placement area, thereby isolating the dredged material from its surrounding environment. The material is placed into the CDF either hydraulically or mechanically. Placing the material directly into the CDF hydraulically via pipeline connected to the dredge is the most economical method in this region. Material may also be dredged mechanically and then transferred to the CDF via barge and placed into the facility using a hydraulic unloader.

Dredged material placement within a CDF has several benefits. CDFs can:

- Prevent or substantially reduce the amount of sediment material re-entering the environment when properly designed, operated, and maintained;
- Provide a permanent storage location for dredged material that would naturally vegetate when left undisturbed;
- Be mined or processed for construction materials for beneficial use.

Hydraulically placed dredged material contains a large amount of additional water when it is introduced into the facility, causing it to occupy several times its original volume. In order to maximize the CDF capacity, management measures for dewatering the sites must be followed, including ditching, drying, and draining of materials to allow for consolidation and increased capacity (see Section 5.0, Implementation, for more details). Following these measures allows the dredged material to consolidate to 70–80 percent of its gross volume. The estimates of needed capacity in this DMMP/SEIS are based on *gross* dredging quantities and do not assume capacity gains from active site management and fill consolidation.

Beneficial Use: Since 1932, Louisiana has lost 1.2 million acres (1,900 square miles) of coastal wetlands from the combined impact of natural processes and human intervention. Louisiana currently loses approximately 10 square miles per year. Without action to reduce the loss of wetlands, Louisiana could lose an additional 500 square miles of land by the year 2050 (Coalition to Restore Coastal Louisiana, 2007).

The need to reduce the loss of Louisiana coastal wetlands has been recognized by the U.S. Congress. Title VII of the 2007 Water Resources Development Act (WRDA 2007) authorized the Louisiana Coastal Area (LCA) program, confirming the nation's commitment to coastal restoration in Louisiana. Section 7006(d) of the act specifically addresses the beneficial use of dredged material. Other recent congressional acts have included the Coastal Wetlands Planning, Protection and Restoration Act program (CWPPRA or Breaux Act), which provides for targeted funds through 2019 to be used for planning and implementing projects that create, protect, restore and enhance wetlands in coastal Louisiana. The Coastal Impact Assistance Program (CIAP) was authorized by Section 384 of the Energy Policy Act of 2005, to assist coastal producing states and their political subdivisions (parishes, counties, and boroughs) in mitigating the impacts from Outer Continental Shelf (OCS) oil and gas production. Louisiana is one of the seven coastal states selected to receive funds under this appropriation to implement this program.

In southwestern Louisiana, a primary resource for restoring coastal wetlands is dredged material. In the Calcasieu estuary, the Calcasieu Ship Channel is the main source of material for reclaiming subsided and eroded coastal marshes. Dredged material is placed in areas of open water that were once uplands and/or wetlands to provide the capability for wetland vegetation to become reestablished. Restoration of lost uplands and wetlands would help to reduce further loss of additional lands and wetlands and would serve to create a buffer and storm surge protection to surrounding areas during storms and tropical events.

Potential sites for the placement of dredged material for beneficial use for this project include both public and private tracts. The acquisition of real estate interests on public land for the beneficial placement of dredged material for this DMMP would be coordinated with state and Federal agencies. In order to ensure disposal area capacity needs are met, it would also be necessary to acquire real estate interests from private landowners. Details on how beneficial use sites would be constructed and maintained can be found in Section 5.0.

Ocean Dredged Material Disposal Sites (ODMDS): Ocean disposal is the discharge of dredged material in a designated ocean disposal site. The discharged material settles through the water column and deposits on the bottom of the placement site. Dredged material may be placed in an open water placement site hydraulically or mechanically. Hydraulically dredged material is transported to the placement site and deposited from a hopper. Mechanically dredged material is placed in a bottom-dump barge or scow and towed to the placement site for discharge. In the Bar Channel, typical dredging operations involve a hopper dredge agitating shoal material, which is allowed to overflow the hopper bin. The heavier sediments remain in the hopper bin. The lighter sediments remain suspended in the water overflowing the hopper bin and are transported away from the navigation channel by littoral drift. When enough of the heavier sediments have accumulated in the hopper bin, the hopper dredge hauls the material to the ODMDS. This occurs on average about twice within a 24-hour dredging period.

Two Ocean Dredged Material Disposal Sites (ODMDS) are being used by the CEMVN for the disposal of maintenance materials from the Bar Channel of the Calcasieu Ship Channel (Figure 1-1). Disposal of dredged material at the ODMDS is regulated by the EPA.

2.2 EXISTING FEDERAL PROJECT/BASE PLAN

2.2.1 Authorized Channel Dimensions

Authorization for the existing Federal project provides for the following. Currently, the ship channel is operating under reduced dimensions because of a shortage of placement capacity.

- A Gulf Entrance Channel (Bar Channel) 42 feet deep and 800 feet wide from a point 32 miles in the Gulf of Mexico to the jetties at the mouth of the Calcasieu River.

- Between the jetties, a channel 40 to 42 feet deep and 400 feet wide.

- A channel 40 feet deep and 400 feet wide extending from the jetties at the mouth of the Calcasieu River (mile 0) to Lake Charles (mile 34.1) including Clooney Island Loop.

- A northern extension of the channel 35 feet deep and 250 feet wide from mile 34.1 to the bridge at U.S. Highway 90 (mile 36.0) with a turning basin at the upper end.
- A mooring basin 40 feet deep and 350 feet wide at mile 3.
- A turning basin at mile 29.6.
- A channel 12 feet deep and 200 feet wide extending approximately 1.1 miles from the ship channel to Cameron, Louisiana, via the old channel of the Calcasieu River.
- An industrial channel at Devil's Elbow 40 feet deep and 400 feet wide extending 2.3 miles with a turning basin with dimensions of 1,200 by 1,400 feet and 40 feet deep.
- A channel 40 feet deep and 200 feet wide with a turning basin 40 feet deep with dimensions of 75 by 1000 feet at Coon Island.

2.2.2 Existing Dredged Material Disposal Sites

Currently, material dredged from the inland portions of the Calcasieu Ship Channel generally is placed in CDFs, while the majority of the material dredged from the bar channel is disposed by agitation dredging. Table 2-1 lists existing CDFs and their capacities. For purposes of this report, gross yardages have been used in determining the disposal capacity needs. Figure 2-1 shows the locations of these CDFs.

2.2.3 Existing Operations

Under existing procedures, dredging contractors are provided with the authority to decide which CDF would receive material dredged from the channel and the amount of material placed there. Contractors are also provided with the responsibility to prepare each CDF for receipt of dredged material and to manage each CDF during placement. No interim management is conducted by the Federal Government.

Site investigations of all the CDFs during July 2006 revealed that the CDF dikes typically have higher elevations along the edge adjacent to the ship channel and less substantial and weaker dikes on the opposite side. This condition has resulted from repeated discharges of dredged material in the same location. Little or no maintenance of the CDFs has been performed between dredging events to promote drying and consolidation of the dredged material or to stockpile materials against the interior slope of the dike for future dike construction. This has allowed weak, unconsolidated material to erode, resulting in deterioration of the dikes between dredging events. Some sites have little or no drainage. Further, contractors have no responsibility for managing the disposal areas upon completion of the contract.

Beneficial Use. Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 *et seq.* requires that "each federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs." Coastal Use Guidelines were written to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. The existing project provides no specific provisions for the placement of dredged material for beneficial use.

Table 2-1. Existing CDF Capacity, Calcasieu Ship Channel

CDF	Existing Capacity (CY)
1	80,700
2	97,000
3	364,600
7	414,600
8	0
9	0
10	0
11	217,800
12A	0
12B	2,095,800
13	0
15	584,000
16N	0
17	309,700
19	0
22	214,500
D	398,500
E	0
H	458,000
M	0
N	0
Total:	**5,235,200**

[1] All CDFs are estimated with 2 feet of freeboard and 1 foot for ponding or full capacity at 3 feet of total freeboard on dikes.

However, through such programs as the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), dredged material from the Calcasieu Ship Channel has been used beneficially. Under CWPPRA, the state and the Federal Government have shared in the cost of beneficial use disposal at the Sabine NWR.

ODMDS. Although the majority of material dredged from the Bar (Entrance) Channel is disposed of by agitation dredging, thousands of cubic yards are placed in the ODMDS sites each year. In Fiscal Year 2007, a total of 5,382,806 CY of material was removed from the Bar Channel: 5,185,188 CY by the agitation method, and 197,618 CY placed into the ODMDS sites (Figure 1-1) by the dredge-and-haul method. The Bar Channel extends from mile 0 to the Gulf of Mexico to approximate mile -32. The majority of shoaling occurs from approximately mile - 0.2 to mile -9. Typical Bar Channel dredging operations involve a hopper dredge agitating shoal material, which is allowed to overflow the hopper bin. Only about 8 to 10 percent of the material that is dredged in the Bar Channel is actually placed into the ODMDS.

Disposal of dredged material from the Bar Channel at the ODMDS has been evaluated by EPA in an existing NEPA document (see Section 1.9.4, *Final Environmental Impact Statement for Calcasieu River and Pass Ocean Dredged Material Disposal Site Designation (USEPA, 1987).* As an ongoing condition of the EPA permit, pre- and post-dredging surveys of the ODMDS are provided to EPA on an annual basis to demonstrate dispersal of dredged material at the site.

2.3 DREDGED MATERIAL PLACEMENT CAPACITY NEED

2.3.1 Forecast of 20-Year Federal and Non-Federal Dredge Quantities

To forecast the amount of material to be dredged in order to maintain the authorized dimensions of the ship channel for the next 20 years, data from the CEMVN and private companies were reviewed. The estimates were not intended to be of an engineering design level, but were developed to support the planning of placement areas for this DMMP. To forecast the quantity, historical data from CEMVN dredging contracts from 1994 to 2005 were reviewed and dredging contractors were interviewed. The estimated dredge quantities included assessments of channel dimensions, advanced maintenance, and allowable overdepth. A more detailed description of the analysis is included in Appendix A, *Shoaling*.

To assess the capacity needed for the 20-year DMMP, forecasts for not only Federal dredging, but also non-Federal dredging, were used. This complies with ER 1105-2-100 and EP 1165-2-1, both of which state, “Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of disposal areas required for the Federal project(s).”

The Port of Lake Charles, Trunkline Liquefied Natural Gas (LNG), Sempra LNG, Cheniere LNG, CITGO, and Conoco were the only private dredging parties identified during this study. Sempra and Cheniere LNG have established their own dredging disposal areas. Annual disposal needs were provided by the port and CITGO. No responses were received from Trunkline LNG and Conoco in response to requests for information; therefore, their requirements were estimated. Additional information is included in Appendix A, *Shoaling*. The non-Federal quantity of material is estimated to be 1.5 MCY and would require approximately 6.2 percent of the total capacity needed to be placed over multiple CDFs between Miles 22 and 36. Fees would be assessed by the non-Federal sponsor for using this capacity and are further defined in Section 5.4.1 of the DMMP.

An estimate of the total volume of material that would be dredged over the next 20 years by the CEMVN and private parties is summarized in Table 2-2.

2.3.2 Existing CDF Capacity and Expansion Evaluation

Existing CDFs along the Calcasieu Ship Channel would be able to accommodate only about five million cubic yards of material (Table 2-1), whereas approximately 97 million cubic yards of material is expected to be dredged over the next 20 years. Expanding CDFs vertically would increase their capacities for the placement of dredged material to 63 million cubic yards (Table 2-3). To expand CDF capacities, the CDFs would require the following rehabilitation:

Table 2-2. Estimated Gross Dredged Material Quantities, Calcasieu Ship Channel

Mile/Section	20-Year Gross Quantity (CY)
34 to 36	844,800
Coon Island	400,000
Port	352,000
Turning Basin	653,600
Clooney Isl. Loop	1,111,600
30 to 34	924,600
26 to 30	5,877,200
22 to 26	12,706,400
21 to 22	4,458,800
Devil's Elbow	10,310,400
16 to 21	19,885,400
12 to 16	19,475,000
9.5 to 12	9,261,800
5 to 9.5	10,853,000
Total:	**97,114,600**

Table 2-3. Existing and Expanded CDF Capacity, Calcasieu Ship Channel

CDF	Existing Capacity (CY)	Expanded Capacity (CY)
1	80,700	807,000
2	97,000	710,000
3	364,600	1,823,000
7	414,600	3,316,800
8	0	2,478,400
9	0	2,194,400
10	0	1,742,400
11	217,800	1,742,400
12A	0	2,064,800
12B	2,095,800	5,588,800
13	0	11,455,000
15	584,000	2,920,000
16N	0	2,710,000
17	309,700	1,347,300

<table>
<tr><th>CDF</th><th>Existing Capacity (CY)</th><th>Expanded Capacity (CY)</th></tr>
<tr><td>19</td><td>0</td><td>2,507,000</td></tr>
<tr><td>22</td><td>214,500</td><td>4,360,500</td></tr>
<tr><td>D</td><td>398,500</td><td rowspan="2">6,486,000</td></tr>
<tr><td>E</td><td>0</td></tr>
<tr><td>H</td><td>458,000</td><td>916,400</td></tr>
<tr><td>M</td><td>0</td><td>5,059,200</td></tr>
<tr><td>N</td><td>0</td><td>2,826,400</td></tr>
<tr><td>Total:</td><td>5,235,200</td><td>63,055,800</td></tr>
</table>

- Reduce erosion along both the channel and lake side of the facility,

- Reengineer the dikes to include evaluations of dike stability for retaining dredged material;

- Improve management practices to protect the integrity of the facility, to maximize the capacity of the facility, and to minimize environmental impacts to the surrounding area.

Unfortunately, even with expanded capacity, existing CDFs would not be capable of receiving all the material that would be dredged from the Calcasieu Ship Channel over the 20-year period. Additional disposal areas for dredged material must be identified.

2.4 PLAN FORMULATION

2.4.1 Development of Dredged Material Placement Options

Federal and state agency personnel held a meeting on April 5, 2005, in Lafayette, Louisiana, to discuss ideas for the management and placement of dredged material. Additionally, two public scoping meetings were held to discuss placement options: the first in Lake Charles, Louisiana, on July 18, 2005, and the second in Cameron, Louisiana, on July 19, 2005. The meetings involved the CEMVN Project Delivery Team (PDT) and representatives from the USFWS, NMFS, LDNR, LDEQ, and LDWF.

The input from agency personnel and the public resulted in a list of 78 prospective options for the placement and management of dredged material. Table 2-4 provides a summary and final disposition of each option as a result of screening by the PDT and agencies. The "Results of Screening" column explains which options were retained for further consideration and which were eliminated. The table also includes, where applicable, information regarding the reasons for dismissal during screening, the reach and sub-reach of each option, and distance from channel of each option.

Table 2-4 Management and Placement Options for Dredged Material

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
1	Closure of CITGO surge pond by capping with dredged material.	Eliminated because of potential contamination. This site is a potential Super Fund site and its use would not comply with USACE standards and regulations. Timing of remediation of the site is unknown.	River	Mile 26 - 30	0
2	Narrow washout area gaps to mid-1970s size.	Eliminated because the high-energy environment would create erosion and possibly impact nearby public oyster reefs. This measure would not provide placement capacity for dredged material.	Lower Lake	Mile 5 - 9.5	0
3	Wetland restoration – Garrison Pond.	Eliminated because the site has been permitted to be used as a private mitigation site.	Upper Lake	Mile 21 - 22	5,800/ 1.1
4	Wetland restoration – Palermo property.	Retained for further screening	Upper Lake	Mile 16 - 21	6,600/ 1.2
5	Wetland restoration – SNWR, west of CWPPRA Cycle I site.	Retained for further screening	Upper Lake	Mile 12 - 16	21,300/ 4
6	Wetland restoration - Bel property, north of CWPPRA Cycle I site.	Retained for further screening	Upper Lake	Mile 12 - 16	19,000/ 3.6
7	Wetland restoration - Bel property, northwest of CWPPRA Cycle I site.	Retained for further screening	Upper Lake	Mile 12 - 16	37,880/ 7.2
8	Use dredged material for capping EPA remediation site and create wetlands at Lockport Marsh.	Eliminated because of potential contamination. This site is a potential Super Fund site and its use would not comply with USACE standards and regulations. Timing of remediation of the site is unknown.	River	Mile 30-34	0
9	Create marsh within old right-of-way footprints along Calcasieu Lake.	Retained for further screening	Upper and Lower Lake	Mile 5 - 21	Varies
10	Reclaim/expand CDF F.	Eliminated. Most of the area is located on the SNWR. SNWR has withdrawn the previous easement for use of this site.	Lower Lake	Mile 9.5 - 12	0
11	Use dredged material to construct foreshore erosion protection along channel, Choupique Island to Long Point.	Eliminated – Not practical or cost effective because erosion from frequent high-energy ship-generated waves would require the material to be re-dredged on a regular basis.	Upper Lake	Mile 21 - 22	0
12	Construct foreshore erosion protection along channel north of Dugas Landing (near Mile 14).	Eliminated. Armoring along the right-descending bank of the channel will be implemented between Miles 16.5 and 18.7. This is not ARRA., but HQ advised not to include shore protection in the DMMP except along placement sites.	Upper Lake	Mile 12 - 16	0
13	Expand existing confined disposal facilities along the length of the channel.	Retained for further screening	Lower Lake, Upper Lake, River	Mile 5 - 36	0

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
14	Flatten channel side slopes and/or provide armoring of the channel sides to reduce shoaling.	Eliminated. Placing rock along the side slopes of the channel is not practical—rock would not stay in place, but would fall into channel and need to be re-dredged. Flattening the channel side slopes would increase the amount of dredging required and increase costs.	Lower Lake, Upper Lake, River	Mile 5 - 36	0
15	Construct plastic or steel bulkheads along eastern side of channel and lake sides of CDFs.	Eliminated. Armoring along the channel and lake sides of CDFs will be constructed with rock material and is more cost effective.	Lower Lake, Upper Lake, River Reach	Mile 5 - 36	0
16	Raise dike height on existing CDFs.	Retained for further screening. CDFs include 1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16N, 17, 19, 22, D, E, Foreshore Dike, H, M, N (see options 79 to 99), 4, 16C, 16S, 20, 21, 23, A, B, C, G, J, and K.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
17	Re-establish SNWR boundary at western edge of Calcasieu Lake.	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds, requiring mitigation. Not cost effective.	Lower Lake	Mile 5 - 9.5	28,905/ 5.5
18	Wetland restoration - Impoundment 1A, SNWR.	Retained for further screening.	Lower Lake	Mile 9.5 - 12	14,100/ 2.7
19	Wetland restoration – CPNWR, south end of Calcasieu Lake.	Retained for further screening.	Lower Lake	Mile 5 - 9.5	5,800/ 1.1
20	Restore marsh in levee borrow ditches and open water areas on CPNWR and Miami Corp. site	Retained for further screening.	Lower Lake	Mile 5 - 9.5	12,242/ 2.3
21	Reshape and plant banks.	Incorporated as a consideration for the design and stability of all CDF dikes in the DMMP.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
22	Perform hydrologic modeling of the lake to help in determining best locations for marsh restoration efforts.	Performed as a study accompanying the DMMP.	All	All	Does not apply
23	Wetland restoration - Prien Lake.	Eliminated –not needed because sufficient disposal capacity exists in River Reach.	River	Mile 26 - 30	3,138/ .6
24	Wetland restoration - west of Black Lake.	Retained for further screening.	Upper Lake	Mile 16 - 21	32,764/ 6.2
25	Use dredged material to fill geotubes and create islands edged by marsh in Calcasieu Lake.	Eliminated –impacts to oyster grounds would require mitigation costs. This option is also not cost effective because it would require periodic replacement and increase O&M costs.	Upper Lake, Lower Lake	Mile 5 - 22	Unknown

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
26	Wetlands restoration - Miami Corp. property.	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds, which would also require significant mitigation costs.	Lower Lake	Mile 5 - 9.5	35,083/ 6.6
27	Reestablish Turner's Island.	Eliminated – previously attempted and failed due to geotechnical issues that did not provide for the containment of materials.	Upper Lake	Mile 16 - 21	5,000/ 1
28	Wetlands restoration - west of Black Lake.	Eliminated – ample capacity is nearer the channel. Because of the distance from the channel, would incur significant additional pumping costs.	Upper Lake	Mile 16 - 21	28,600/ 5.4
29	Construct erosion control features along GIWW and use dredged material to restore bank lines.	Eliminated – work on the GIWW is under separate authorization. Erosion on GIWW may affect Calcasieu dredging frequency but current authorization for the ship channel would not allow for construction on a project under separate authorization. This option should be explored under a regional sediment management program.	Upper Lake	Mile 21 - 22	Varies
30	Marsh restoration - Hilcorp's Oil Fields.	Eliminated – site is already receiving dredged material form Sempra facility.	Upper Lake	Mile 16 - 21	7,693/ 1.4
31	Wetlands restoration - east of Calcasieu Lake.	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds, which would also require significant mitigation costs.	Lower Lake	Mile 9.5 - 12	32,639/ 6.2
32	Beach nourishment from Bar Channel. Location: Holly Beach.	Eliminated - outside the area identified for the DMMP/EIS; and because of insufficient beach quality material.	Bar Channel	Does not apply	10,849/ 2.0
33	Rock the channel to reclaim original dimensions and reduce erosion/shoaling.	Armoring the channel and the construction of a foreshore dike were undertaken as separate projects from the DMMP.	Upper Lake	Mile 12 - 21	0
34	Mine CDFs for material for beneficial use efforts.	Included as allowable action in all action alternatives.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
35	Perform wind/wave analysis of Calcasieu Lake and wake analysis in the channel.	Performed as a study accompanying the DMMP.	All	All	Does not apply
36	Flatten channel side slopes and/or provide armoring of the channel sides to reduce shoaling.	Eliminated. Placing rock along the side slopes of the channel is not practical—rock would not stay in place, but would fall into channel and need to be re-dredged. Flattening the channel side slopes would increase the amount of dredging required and increase costs.	Lower Lake, Upper Lake, River	Mile 5 - 36	0
37	Use dredged material to fill geotubes and create islands edged by marsh in Calcasieu Lake.	Eliminated –impacts to oyster grounds would require mitigation costs. This option is also not cost effective because it would require periodic replacement and increase O&M costs.	Upper Lake, Lower Lake	Mile Mile 5 - 22	Unknown

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
38	Mine CDFs for material for beneficial use efforts.	Eliminated. Same as Option 34.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
39	Wetland restoration between rock dikes and bank line.	Eliminated. The area is needed for upland disposal between the rock dike and shoreline.	Upper Lake	Mile 12 - 16	0
40	Restore shoreline of Rabbit Island.	Eliminated – Not cost effective because of its one-time use, and impacts on adjacent oyster reefs would incur mitigation costs.	Lower Lake	Mile 5 - 9.5	8,980/ 1.7
41	Allow commercial mining of CDFs.	Included as allowable action in all action alternatives.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
42	Construct foreshore dune/dike parallel to and south of HWY 82 west of the Bar Channel.	Eliminated - outside the area identified for the DMMP/EIS; and because of insufficient beach-quality material.	Bar Channel	Does not apply	31,663/ 6
43	Restore marsh and/or enhance bird habitat at Chenier mitigation bank site, Mud Lake.	Eliminated – placement of material at a private mitigation bank is not an appropriate use according to USACE policy.	Pass Channel	Does not apply	31,236/ 5.9
44	Construct nearshore feeder berm for beach nourishment, and/or construct geotubes to aid dune development along Gulf shoreline.	Eliminated – outside the area identified for the DMMP/SEIS and because of insufficient beach-quality material.	Bar Channel	Does not apply	23,196/ 4.4
45	Place dredged material in salt domes at Hackberry.	Eliminated – conveyance to off-site for non-beneficial use would not be cost effective due to the long pumping distances and the unknown capacity of the domes.	Upper Lake	Mile 12 - 16	16,484/ 3.1
46	Reclaim/expand CDF F.	Eliminated – most of the area is located on the SNWR and is not available for the disposal of dredged material.	Lower Lake	Mile 9.5 - 12	0
47	Restore eroded marsh east of Highway 27, north of SNWR, east of Brown's Lake.	Eliminated – pipeline access to this site would be detrimental to the natural marsh surrounding the site. The potential for mitigation costs in addition to construction costs for a one-time use would not make this option cost effective.	Lower Lake	Mile 9.5 - 12	6,527/ 1.2
48	Wetland restoration – west of Alkali Ditch	Retained for further screening.	Upper Lake	Mile 16 - 21	16,090/ 3.0
49	Wetland restoration – School Board property (Section 16).	Retained for further screening.	Lower Lake	Mile 9.5 - 12	13,287/ 2.5
50	Wetland restoration near Black Lake (Hinton/Marcantel property)	Retained for further screening.	Upper Lake	Mile 16 - 21; Devil's Elbow	27,390/ 5.2

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
51	Construct new CDF at Olin Tailings Pond.	Eliminated – not needed because sufficient capacity exists in the River Reach and because HTRW issues would need to be resolved before being used for placement capacity.	River	Mile 30 - 34	0
52	Wetland restoration –eastern portion of Palermo property.	Retained for further screening.	Upper Lake	Mile 16 - 21	4,081/ .8
53	Wetland restoration – Oyster Bayou/Lake at Chenier mitigation bank site, east of Mud Lake.	Eliminated – placement of material at a private mitigation bank is not an appropriate use according to USACE policy.	Pass Channel	Does not apply	14,920/ 2.8
54	Refill sand pit borrow areas throughout the channel	Eliminated - not cost effective or practical because erosion from frequent high-energy, ship-generated waves would not allow fine sediments to remain in place, requiring frequent re-dredging in other areas of the channel.	All	All	0
55	Construct island in Lake Charles.	Eliminated – not needed because sufficient capacity exists in the River Reach adjacent to the channel. Constructing a new facility farther from the channel would not be cost effective.	River	Mile 34 - 36, Coon Island, Port	1,000/ .2
56	Mine CDFs to fill geotubes and cap with hard material to create oyster habitat.	Eliminated - it would not provide placement capacity. Also, it is not cost effective or practical because of potential failure and high replacement cost of geotubes.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
57	Wetlands restoration - ponds east of Calcasieu Lake.	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds which would incur mitigation costs. Not cost effective.	Upper Lake	Mile 16 - 21	21,100/ 4.0
58	Investigate geotube use for foreshore protection.	Eliminated - impractical because of potential failure and high replacement cost of geotubes.	Upper Lake	Mile 12 - 16	0
59	Plant Vermilion Bay with *Spartina alterniflora* to reduce erosion.	Eliminated. The channel is a high-energy location that would not be conducive to successful plantings.	All	All	0
60	Form Beneficial Use Group with agency personnel.	Eliminated. Although potentially very useful, this is a policy issue and not an option for the management of dredged material.	Does not apply	Does not apply	Does not apply
61	Restore marsh east of Calcasieu River, north of and adjacent to I-10 Bridge.	Eliminated because sufficient capacity in CDFs exists adjacent to the channel. Therefore, constructing a new facility farther from the channel would not be cost effective.	River	Mile 34 - 36, coon Island, Port	0
62	Restore marsh south of Calcasieu River Saltwater Barrier near I-10.	Eliminated because sufficient capacity in CDFs exists adjacent to the channel, therefore, constructing a new facility farther from the channel would not be cost effective.	River	Mile 34 - 36, coon Island, Port	0
63	Restore marsh west of Calcasieu River Saltwater Barrier near I-10.	Eliminated because sufficient capacity in CDFs exists adjacent to the channel, therefore, constructing a new facility farther from the channel would not be cost effective.	River	Mile 34 - 36, coon Island, Port	0

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
64	Restore marsh north of Calcasieu River Saltwater Barrier near I-10.	Eliminated because sufficient capacity in CDFs exists adjacent to the channel, therefore, constructing a new facility farther from the channel would not be cost effective.	River	Mile 34 - 36, coon Island, Port	0
65	Seek Congressional authority to modify the Federal standard for maximum use of dredged material for beneficial use.	Eliminated. Although potentially very useful, this is a policy issue and not an option for the management of dredged material.	Does not apply	Does not apply	Does not apply
66	Manage CDFs to obtain maximum capacity.	Incorporated into all action alternatives. DMMP includes CDF rehabilitation and maintenance to maximize capacities.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
67	Establish a mitigation bank for incremental costs of beneficial use of dredged material.	Eliminated – potential for long-term incremental costs; beyond the authorization for a DMMP.	Does not apply	Does not apply	Does not apply
68	Recreate historic hydrology by filling levee borrow areas (recreate natural ridges).	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds.	Lower Lake	Mile 5 - 9.5	28,000/ 5.3
69	Use existing CDF at Monkey Island.	Eliminated – located in an area that would not require dredging.	Pass Channel	Does not apply	0
70	Nourish area north of the beach beyond the dunes west of channel.	Eliminated - outside the area identified for the DMMP; and because of insufficient beach-quality material.	Pass Channel	Does not apply	21,260/ 4.0
71	Beach habitat nourishment beyond dunes east of jetties east of channel.	Eliminated - outside the area identified for the DMMP; and because of insufficient beach-quality material.	Pass Channel	Does not apply	12,360/ 2.3
72	Convert CDF material into bank protection armor blocks on site.	Eliminated - not technically feasible or cost effective.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
73	Wetland restoration - Town of Grand Lake.	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds, which would also require significant mitigation costs.	Upper Lake	Mile 16 - 21	18,722/ 3.5
74	Wetland restoration - Geer/Tolbert properties.	Eliminated - significant additional pumping costs; pipeline placement could damage public oyster grounds, which would also require significant mitigation costs.	Upper Lake	Mile 16 - 21	16,600/ 3.1
75	Restore marsh in levee borrow ditches and open water areas on CPNWR and Miami Corp. site	Eliminated. Same as Option 20, which is retained as a component of the action alternatives.	Lower Lake	Mile 5 - 9.5	12,242/ 2.3

Placement and Management Options	Description	Results of Screening	Reach	Sub-each	Distance from Channel (ft./mile)
76	Evaluate bank reshaping and planting to reduce erosion/shoaling.	Incorporated as a consideration for the design and stability of CDF dikes.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
77	Install permanent pipeline for placing dredged material on SNWR.	Eliminated. Placement of a permanent pipeline is underway but not a part of this DMMP.	Lower Lake	Mile 9.5 - 12	Varies
78	Use hopper dredges to place material from Bar (Entrance) channel in ODMDS.	Retained for further screening.	Bar Channel	Does not apply	0

Some of the options (for example, options 23, 24, 31, and 39) are not actually placement locations, but are methods to manage material or to reduce the dredging quantity. For that reason, "Distance from Channel" and "Volume/Capacity" descriptions were not applicable.

2.4.2 Screening

Objectives and screening criteria to evaluate and narrow the list of 78 placement options were developed through interagency meetings and coordination with the CEMVN PDT. USACE engineering regulations were also considered. The objectives developed for the project included:

- Maintain the navigation channel to authorized dimensions.
- Place the dredged material in the most cost-effective location consistent with environmental and engineering requirements.
- Optimize beneficial use of dredged material.
- Maintain dredged material disposal sites in a manner to optimize capacities and comply with economic and environmental principles.
- Provide for the disposal of material dredged by private parties if private use will not reduce the availability of the facility for project purposes, and subject to payment from private users, as appropriate." (see PGL No. 47)

In conjunction with the initial screening criteria discussed above, four planning evaluation criteria were used in order to meet the requirements of ER 1105-2-100: acceptability, completeness, effectiveness, and efficiency.

Screening criteria were also developed in multiple meetings with resource agencies, the Port, and the PDT. The following screening criteria were developed:

Constraints
- Contaminated materials
- Public oyster grounds
- Impingement on public access

Considerations
- Costs
- Public use enhancement
- Long-term facilities operation and maintenance costs
- Mitigation requirements
- Real estate acquisitions, including administrative costs

Opportunities
- Use of dredged material for habitat restoration and enhancement
- Opportunities provided for mining of CDFs by third parties for construction, fill, beneficial use, or other actions
- Armoring of channel sides to reduce erosion and shoaling
- Placement of material from private dredging
- Recreation
- Storm damage abatement

Beneficial Use Screening Criteria: Each beneficial use (BU) site was evaluated to determine:

- The size and depth of the property to estimate placement capacity
- The distance from dredging operations
- Real estate considerations
- The feasibility of the proposed action relating to the engineering, environmental cost, and practicality
- Long-term placement

CDF Screening Criteria: Please note that Option 16 of the original 78 options did not break out all of the CDFs individually. Instead, it made the general recommendation to "raise dike heights on existing CDFs." The screening of existing CDFs is shown separately in Table 2-5, "CDF screening." Each CDF was evaluated to determine:

- The potential capacity of the facility.
- Reconstruction/retrofit actions of the facility necessary to optimize facility viability
- Actions necessary to reduce erosion along both the channel and lake side of the facility.
- Evaluations of dike stability and the possible need to reengineer the dikes over the life of the DMMP.
- Management practices, including long-term costs, to protect the integrity of the facility, to maximize the capacity of the facility, and minimize environmental impacts on the surrounding area.
- Continued availability of the site. Landowners at some sites have withdrawn permission for dredged material placement.
- Mitigation requirements.
- Opportunities for the use of dredged material for ecosystem restoration and marsh creation, and enhancement.

Results of Screening: The initial list of 78 options (Table 2-4) was screened using the above screening criteria, and many options were eliminated. Options were eliminated for the following reasons:

- Methods of Analysis: The following options did not constitute actual plans for placement, but instead were methods of analysis: options 22 and 35;

- Located in Potentially Contaminated Areas: options 1 and 8;

- Lacking Engineering/Cost Feasibility: options 2, 11, 15, 17, 27, 40, 54, 56, 58, 59, and 72 (Table 2-4);

- Inability to Meet Beneficial Use Criteria: options 3, 26, 28, 47 and 74;

- Located on the East Side of Calcasieu Lake: There were concerns that transporting dredged material to sites on the eastern side of Calcasieu Lake would have significant additional pumping costs and would limit the ability of the dredging industry to respond with more than one bidder. In addition, the placement of the pipeline could damage productive public oyster grounds located in the Lake. Options screened from consideration for these reasons included 31, 57, 68, and 73;

Table 2-5. Option 16 (Raise dike heights of existing CDFs) Screened

CDF	Results of Screening
1	Retained as a final placement option
2	Retained as a final placement option
3	Retained as a final placement option
4	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
7	Retained as a final placement option
8	Retained as a final placement option
9	Retained as a final placement option
10	Retained as a final placement option
11	Retained as a final placement option
12	Retained as a final placement option
13	Retained as a final placement option
15	Retained as a final placement option
16C	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
16N	Retained as a final placement option
16S	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
17	Retained as a final placement option
19	Retained as a final placement option
20	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
21	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
22	Retained as a final placement option
23	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
A	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
B	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
C	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
D	Retained as a final placement option
E	Retained as a final placement option
G	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
H	Retained as a final placement option
J	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
K	Eliminated from further consideration. This CDF is full, near capacity, or significant rehabilitation is needed that would not be cost effective compared to available capacity.
M	Retained as a final placement option
N	Retained as a final placement option
Foreshore Dike, Mile 11.2-15.6 (place material behind)	Retained as a final placement option

- Involved Beach/Dune Nourishment: Beach restoration options were eliminated because of a shortage of material with sufficient quality for beach renourishment: options 32, 42, 44, 70, and 71;

- Located in the River Reach: Some options concerned various actions that would be taken in the River Reach. Because sufficient CDF capacity exists in that reach, additional placement areas would not be required during the life of the DMMP. The following were eliminated: options 51, 55, 61, 62, 63, and 64;

- Miscellaneous reasons: Other options were screened for a variety of reasons, including 12, 14, 23, 25, 29, 30, 34, 37, 38, 39, 43, 45, 46, 53, 60, 65, 67, 69, 75 and 77. Table 2-4 contains a brief summary of why each of these options was eliminated.

2.4.3 Retained Management Measures and Placement Options

The management measures and placement options that were retained for further consideration are shown in Table 2-6. The placement options shown in this table are all environmentally acceptable and feasible to construct from an engineering standpoint, irrespective of costs.

A final list of placement sites that remained viable for consideration in the development of alternatives is provided in Table 2-7. The retained management measures (options 21, 66, and 76) shown in Table 2-6 were incorporated into the plan as well, as explained in Section 5 of this report. The final placement sites, along with the capacity of each site, the total cost of each site, and the unit cost/cubic yard for each site are listed in Table 2-7. All of these sites are shown in Figure 2-2. A map for each site is provided at the end of this section. Figure numbers for each map are listed in Table 2-7.

The total costs shown in Table 2-7 include all O & M and construction costs associated with pumping to, constructing, and maintaining each site. More specifically, the total cost (from which the unit costs are derived) include the costs of (1) dredging the amount of material shown, based on dredging need and cycles (Table 2-2), (2) pumping this material to each site, (3) installing pipelines to each site, (4) rehabilitating each site, (5) managing (dewatering) each site, (6) constructing dikes, (7) mobilizing and demobilizing equipment, (8) real estate acquisition costs, (9) the required contingency, and (10) engineering, design, supervision, and administration.

The sub-reach that includes Miles 12 to 21 is the only sub-reach in the project that has more placement options than are needed to meet the 20-year dredging and placement projections. As shown in Table 2-8, these options were evaluated and compared not only for their cost, but also for logistical factors that may incur additional costs and delays not reflected in costs shown in Table 2-6 above. As Table 2-8 shows, some of the least-cost sites, based on total O & M and construction unit costs (Table 2-7), have implementation considerations that may incur additional costs and delays. Although feasible from an engineering standpoint and environmentally beneficial, the placement sites with considerations may not be compatible with the objective of providing placement capacity for unimpeded maintenance of the channel.

Table 2-6. Management and Placement Options Retained

Option	Description	Results of Screening	Reach	Sub-Reach	Distance from Channel (ft./mile)
4	Wetland restoration – Palermo property.	Placement Option Retained	Upper Lake	Mile 16 - 21	6,600/ 1.2
5	Wetland restoration – SNWR, west of CWPPRA Cycle I site.	Placement Option Retained	Upper Lake	Mile 12 - 16	21,300/ 4
6	Wetland restoration - Bel property, north of CWPPRA Cycle I site.	Placement Option Retained	Upper Lake	Mile 12 - 16	19,000/ 3.6
7	Wetland restoration - Bel property, northwest of CWPPRA Cycle I site.	Placement Option Retained	Upper Lake	Mile 12 - 16	37,880/ 7.2
9	Create marsh within old right-of-way footprints along Calcasieu Lake.	Placement Option Retained	Upper and Lower Lake	Mile 5 - 21	Varies
13	Expand existing confined disposal facilities along the length of the channel.	Placement Option Retained	Lower Lake, Upper Lake, River	Mile 5 - 36	0
16	Raise dike height on existing CDFs.	Retained as a placement option. CDFs retained include 1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16N, 17, 19, 22, D, E, Foreshore Dike, H, M, N (see options 79 to 99).	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
18	Wetland restoration - Impoundment 1A, SNWR.	Placement Option Retained	Lower Lake	Mile 9.5 - 12	14,100/ 2.7
19	Wetland restoration – CPNWR, south end of Calcasieu Lake.	Placement Option Retained	Lower Lake	Mile 5 - 9.5	5,800/ 1.1
20	Restore marsh in levee borrow ditches and open water areas on CPNWR and Miami Corp. site	Placement Option Retained	Lower Lake	Mile 5 - 9.5	12,242/ 2.3
21	Reshape and plant banks.	Incorporated as a consideration for the design and stability of all CDF dikes in the DMMP.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
22	Perform hydrologic modeling of the lake to help in determining best locations for marsh restoration efforts.	Performed as a study accompanying the DMMP.	All	All	Does not apply
24	Wetland restoration - west of Black Lake.	Placement Option Retained	Upper Lake	Mile 16 - 21	32,764/ 6.2
34	Mine CDFs for material for beneficial use efforts.	Included as allowable action in all action alternatives.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
35	Perform wind/wave analysis of Calcasieu Lake and wake analysis in the channel.	Performed as a study accompanying the DMMP.	All	All	Does not apply
41	Allow commercial mining of CDFs.	Included as allowable action in all action alternatives.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
48	Wetland restoration – west of Alkali Ditch	Placement Option Retained	Upper Lake	Mile 16 - 21	16,090/ 3.0
49	Wetland restoration – School Board property (Section 16).	Placement Option Retained	Lower Lake	Mile 9.5 - 12	13,287/ 2.5
50	Wetland restoration near Black Lake (Hinton/Marcantel property)	Placement Option Retained	Upper Lake	Mile 16 - 21; Devil's Elbow	27,390/ 5.2
52	Wetland restoration –eastern portion of Palermo property.	Placement Option Retained	Upper Lake	Mile 16 - 21	4,081/ .8
66	Manage CDFs to obtain maximum capacity.	Incorporated into all action alternatives. DMMP includes CDF rehabilitation and maintenance to maximize capacities.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
76	Evaluate bank reshaping and planting to reduce erosion/shoaling.	Incorporated as a consideration for the design and stability of CDF dikes.	Lower Lake, Upper Lake, River	Mile 9.5 - 36	0
78	Use hopper dredges to place material from Bar (Entrance) channel in ODMDS.	Placement Option Retained	Bar Channel	Does not apply	0

Table 2-7. Final Placement Sites

Name	Description	Reach	Sub-Reach	Figure # in Report	Capacity (CY)	Cost	Cost/CY
CDF 1	Raise dike height on existing CDF 1.	River	Mile 34 - 36, Coon Island, Port	2-3	887,700	$4,269,000	$4.81
CDF 2	Raise dike height on existing CDF 2.	River	Mile 34 - 36, Coon Island, Port	2-3	807,000	$4,035,000	$5.00
CDF 3	Raise dike height on existing CDF3.	River	Mile 30 - 34, Turning Basin, Clooney Island Loop	2-3	2,187,600	$10,679,000	$4.88
CDF 7	Raise dike height on existing CDF 7.	River	Mile 26 - 34, Turning Basin, Clooney Island Loop	2-4	3,731,400	$13,683,000	$3.67
CDF 8	Raise dike height on existing CDF 8.	River	Mile 26 - 30	2-5	2,478,400	$9,124,000	$3.68
CDF 9	Raise dike height on existing CDF 9.	River	Mile 26 - 30	2-6	2,194,000	$9,306,000	$4.24
CDF 10	Raise dike height on existing CDF 10.	River	Mile 22 - 26	2-7	1,742,400	$7,215,000	$4.14
CDF 11	Raise dike height on existing CDF 11.	River	Mile 22 - 26	2-8	1,960,200	$8,653,000	$4.41
CDF 12	Raise dike height on existing CDF 12.	River	Mile 22 - 26	2-9	9,749,400	$45,354,000	$4.65
CDF 15	Raise dike height on existing CDF 15.	Upper Lake	Mile 21 - 22	2-11	3,504,000	$16,678,000	$4.76
CDF 16N	Raise dike height on existing CDF 16N.	Upper Lake	Mile 21 - 22	2-11	2,710,000	$14,875,000	$5.49
CDF 13	Raise dike height on existing CDF 13.	Upper Lake	Devil's Elbow	2-10	11,455,000	46,035,000	$4.02
BU 50	Wetland restoration near Black Lake (Hinton/Marcantel property)	Upper Lake	Mile 16 - 21; Devil's Elbow	2-12	7,158,000	$43,500,000	$6.08
BU 4	Wetland restoration – Palermo property.	Upper Lake	Mile 16 - 21	2-16	1,864,000	$11,400,000	$6.12
BU 24	Wetland restoration - west of Black Lake.	Upper Lake	Mile 16 - 21	2-12	4,356,000	$30,225,000	$6.94
BU 48	Wetland restoration – west of Alkali Ditch	Upper Lake	Mile 16 - 21	2-17	6,214,000	$38,747,000	$6.24
BU 52	Wetland restoration –eastern portion of Palermo property.	Upper Lake	Mile 16 - 21	2-16	621,000	$4,100,000	$6.60
CDF 17	Raise dike height on existing CDF 17.	Upper Lake	Mile 16 - 21	2-13	2,336,100	$8,342,000	$3.57
CDF 17	Raise dike height minimally on existing CDF 17 and expand into new FSD. Site will be combined with 19 in future	Upper Lake	Mile 16 - 21	2-18	1,657,000	$12,600,000	$7.60
19	Expands the old CDF 19 to all the available land mass remaining including the new FSD	Upper Lake	Mile 16 - 21	2-18	2,507,000	$19,400,000	$7.74
CDF 22	Raise dike height on existing CDF 22.	Upper Lake	Mile 16 - 21	2-15	1,931,300	$5,917,000	$3.06
CDF 22	Raise dike height on existing CDF 22, expand to all available land mass to include new FSD.	Upper Lake	Mile 16 - 21	2-15	4,575,000	$27,900,000	$6.10
Foreshore Dike	Place material behind existing Foreshore Dike	Upper Lake	Mile 12 - 21	2-14	8,390,000	$42,300,000	$5.04
BU 5	Wetland restoration – SNWR, West of CWPPRA Cycle I site.	Upper Lake	Mile 12 - 16	2-19	8,873,000	$50,800,000	$5.73
BU 6	Wetland restoration - Bel property, north of CWPPRA Cycle I site.	Upper Lake	Mile 12 - 16	2-20	2,191,000	$13,029,000	$5.95
BU 7	Wetland restoration - Bel property, northwest of CWPPRA Cycle I site.	Upper Lake	Mile 12 - 16	2-21	3,895,000	$24,376,000	$6.26
CDF D/E	Raise dike height on existing foot prints of D & E and utilize as one site.	Upper Lake	Mile 12 - 16	2-14	6,884,500	$41,400,000	$6.01
BU 18	Wetland restoration - Impoundment 1A, SNWR.	Lower Lake	Mile 9.5 - 12	2-22	6,946,000	$43,884,000	$6.32
BU 49	Wetland restoration – School Board property (Section 16).	Lower Lake	Mile 9.5 - 12	2-22	2,315,000	$16,045,000	$6.93
BU 19	Wetland restoration – CPNWR, south end of Calcasieu Lake.	Lower Lake	Mile 5 - 9.5	2-23	1,551,000	$9,452,000	$6.09
BU 20	Restore marsh in levee borrow ditches and open water areas on CPNWR and Miami Corp. site	Lower Lake	Mile 5 - 9.5	2-23	775,000	$5,071,000	$6.54
CDF H	Raise dike height on existing CDF H.	Lower Lake	Mile 5 - 9.5	2-24	1,374,400	$5,594,000	$4.07
CDF M	Raise dike height on existing CDF M.	Lower Lake	Mile 5 - 9.5	2-25	5,059,200	$22,978,000	$4.54
CDF N	Raise dike height on existing CDF N.	Lower Lake	Mile 5 - 9.5	2-25	2,826,400	$11,848,000	$4.19

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Table 2-8. Final Placement Options, Mile 12 to 22: Implementation Considerations

Name	Mile	Considerations
BU 50	16 - 21; Devil's Elbow	None
Foreshore Dike	16 - 21	None
Expanded CDF 22	16 - 21	None
BU 4	16 - 21	This site is in the final stages of being permitted as a private mitigation bank. Permits are anticipated to be issued soon.
BU 48	16 - 21	This site is in the final stages of being permitted as a private mitigation bank. Permits are anticipated to be issued soon.
BU 52	16 - 21	Only large enough for one dredging cycle. This site is in the final stages of being permitted as a private mitigation bank. Permits are anticipated to be issued soon.
BU 24	16 - 21	Located more than 5 miles from the channel. There would be high pumping costs and a limited availability of dredging equipment to allow for unimpeded maintenance of the channel.
CDF 17	16 - 21	This CDF is available for the receipt of material. However, not expanding its western dikes to the existing foreshore dike wastes prior investments and capacity directly adjacent to the channel.
CDF 17 expanded	16 - 21	None
CDF 19 expanded	16 - 21	None
BU 5	12 - 16	None
BU 6	12 - 16	None
BU 7	12 - 16	Located more than 5 miles from the channel. There would be high pumping costs and a limited availability of dredging equipment to allow for unimpeded maintenance of the channel.
CDF D/E	12 - 16	None

2.5 DESCRIPTION OF ALTERNATIVES

The objective of the plan formulation process was to identify a final list of dredged material placement options and arrange them into plan alternatives that would provide capacity for the unimpeded maintenance of the channel for at least the next 20 years. Location, costs, and implementation considerations shown in the tables above were taken into consideration in formulating the alternatives. Three action alternatives were developed in addition to the No Action Alternative:

- **Alternative A,** the No Action Alternative, includes only the use of existing CDF sites without expansion or rehabilitation

- **Alternative B** places material in CDFs and beneficial use sites with CDF capacity maximized from channel mile 16 to 21

- **Alternative C** places material in CDFs and beneficial use sites with beneficial use site capacity maximized from channel mile 16 to 21

- **Alternative D** places material dredged from south of channel mile 22 in the Ocean Dredged Material Disposal Site (ODMDS)

Below is a description of each alternative, including the specific components of each channel reach and sub-reach. Concerns related to Alternative D are also presented. Site-specific recommendations are provided for each alternative but would require the collection of additional data to prepare final design and plans and specifications.

For beneficial use sites, the acreage available may be greater than the area needed for construction of dikes to contain the dredging need. Only the capacity needed to contain the dredged materials would be constructed. In order to accommodate efficient and cost effective dike construction on the CDFs, dikes are raised initially on a five-foot increment. In order to contain the expected dredging need, the second lift would be constructed in either a three or five-foot increment to contain the dredging need over the remaining 20-year period in a manner that allows for minimal ponding and freeboard capacity within the sites. Therefore, the amount of materials to be dredged would be slightly lower than the amount of capacity created.

2.5.1 Alternative A: No-Action

Evaluation of the No-Action Alternative, also known as the future-without-project condition, is a requirement of the National Environmental Policy Act (NEPA) regulations (40 CFR Part 1500 *et seq*.) and the USACE Guidance for Conducting Civil Works Planning Studies (ER 1105-2-100, Appendix E, Table E-14).

The No-Action Alternative assumes that no further construction of disposal areas or modification of existing disposal areas would occur. The No Action Alternative would not provide for the continued maintenance of the Calcasieu Ship Channel to authorized dimensions. Once existing capacity of CDFs is used, dredging would cease. The gross 20-year dredging capacity requirement is approximately 97 million cubic yards, while the existing CDF capacity is only five million cubic yards.

Without-project shoaling rates for the Calcasieu River are not available; however, past experience indicates that the limiting segment of the channel is River Mile 14-17, which shoals at a rate of less than two feet a year over the long-term, with draft reductions most likely occurring at a rate of approximately one foot per year (starting two years after a dredging event). For this analysis, two average annual shoaling rates (draft reduction rates) were assumed: (1) one foot of draft reduction every two years (one-half foot a year), and (2) one foot of draft reduction per year. Under both assumptions, for with-project conditions, there would be no draft reductions for the first two years after a dredging event. Assuming one foot of draft reduction every two years results in a maximum draft reduction of 9 feet by year 19 of the project. Assuming one foot of draft reduction per year, the maximum draft reduction of 10 feet occurs in year 12 of the project; this reduction was assumed to remain constant for the remainder of the project.

2.5.2 Alternative B: Placement in CDFs and Beneficial Use Sites, with CDF Capacity Maximized from Channel Mile 12 to 22

The placement sites included in this alternative are shown in Table 2-9 and in Figure 2-26. Alternative B was formulated to minimize O & M costs over the 20-year plan by maximizing placement capacity directly adjacent to the channel. The potential for long-term placement capacity directly adjacent to the channel is captured by extending the horizontal boundaries of CDFs 17, 19, and 22 to foreshore rock dikes that have already been constructed along the channel (Figures 2-15 and 2-18). By expanding the CDF boundaries, long-term placement capacity adjacent to the channel would be available beyond the 20-year plan by providing a large area around which dikes can be incrementally raised in the future. In doing so, this alternative also optimizes the Federal and local sponsor's previous engineering, real estate, and construction investments in CDFs.

Under this plan, approximately 30 percent of material dredged between channel miles 5 to 36 to maintain navigation would be placed in beneficial use sites for the restoration of subsided and eroded coastal wetlands.

Alternative B includes only placement sites free of the implementation considerations shown earlier in Table 2-8. All of the sites either have real estate easements in place (although some may need to be perfected by the local sponsor) or are located on Federal property, with interagency agreements in place for the beneficial use of material. This plan holds the highest level of confidence in providing placement options for the unimpeded maintenance of the channel for the 20-year plan.

Table 2-9 lists the placement areas of Alternative B by reach and mile. The estimated capacity need is shown in gross yards. Additional capacity is provided for the CDFs to allow for bulking, freeboard and ponding between dredging cycles and drying times.

River Reach

Mile 34 to Mile 36 and the Port of Lake Charles Terminals: The 20-year dredging need in this area can be met by rehabilitation of CDFs 1 and 2 and increasing the dike heights an additional 10 feet (Figure 2-3). The maintenance dredging material in this channel segment is predominantly sand with a low bulking factor. The dredging cycle is approximately 10 years for the channel and every five years for the Port facilities, thus allowing ample time for site management.

Mile 30 to 34, the Turning Basin, Coon Island, and Clooney Island: The 20-year dredging need for this reach could be achieved by raising the dikes at CDF 3 by 10 feet, raising the dikes at CDF 7 by 8 feet, and utilizing half of the capacity of CDF 7 (figures 2-3 and 2-4, respectively). The channel is maintained on an approximately 10-year dredging frequency and the turning basin, Clooney Island Loop, and Coon Island are maintained approximately every seven years.

Mile 26 to 30: The 20-year dredging need can be met by raising the existing dikes 8 feet at CDFs 7, 8 and 9 (figures 2-4, 2-5, and 2-6, respectively). Half of the CDF 7 capacity would be used for River Reach Mile 30 to 34, leaving the remainder of its existing capacity available for Mile 26 to 30. This area is dredged approximately every six years.

Mile 22 to 26: The 20-year dredging demand can be met by raising the existing dikes at CDFs 10, 11, 12A and 12B an additional 8 feet (figures 2-7, 2-8, and 2-9). This area is dredged approximately every two to three years.

Upper Lake

Devil's Elbow: The 20-year dredging capacity requirement can be met by raising the dikes at CDF 13 by 10 feet (Figure 2-10). This reach is dredged every one-and-one-half to two years.

Mile 21 to 22: Rehabilitating the sites and raising the dikes at CDFs 15 and 16N approximately 10 feet would meet the 20-year dredging demand for material dredged from Mile 21 to 22 (Figure 2-11). Dredging at miles 21 to 22 takes place approximately every two years.

Mile 16 to 21:

- Beneficial Use West of Black Lake (BU Site 50). Approximately 887 acres are available for beneficial use to create a diversity of habitats at this site (Figure 2-12). Containment features would be required to control the placement within the property boundaries unless adjacent landowners become part of the coastal restoration initiatives in this reach. The northern portion of this site has been assessed under a separate NEPA document (see Section 1.9.5 (c)) and may be used for the placement of dredged material as needed prior to the finalization of this DMMP/SEIS. This is in accordance with WRDA 2007, Section 5081, which states, "The Secretary shall expedite completion of a dredged material management plan for the Calcasieu Ship Channel, Louisiana, and may take interim measures to increase the capacity of existing disposal areas, or to construct new confined or beneficial use disposal areas, for the channel."

- Recovering the eroded channel-side capacity by pumping behind the foreshore dike adjacent to CDF D/E. The CEMVN has constructed a foreshore rock dike from approximate mile 11.2 to 15.6 (Figure 2-14). The dike has been placed along the historic shoreline of the channel, providing dredged material placement from -3 to +20 feet for an average width of 500 feet. Approximately eight million cubic yards of capacity can be placed here. The majority of this site would be used in this reach but shared with Mile 12 to 16.

- Recovering the eroded channel-side capacity through expansion of CDFs 17, 19, and 22 to existing foreshore dikes. CDFs 17, 19, and 22 have eroded significantly over the years. Additional capacity would be gained by expanding CDFs 17, 19, and 22 into the open-water area impounded by the prior construction of new foreshore dikes along the left descending bank of the ship channel. (Figures 2-15 and 2-18).

Dredging in this reach is performed every two to 2.5 years.

Table 2-9. Alternative B: Placement Sites and Capacity

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Reach	Section	Placement Sites	Type	Beneficial Use (CY)	Existing Capacity (CY)	Vertical Expansion (CY)	Horizontal Expansion: Upland Creation (CY)	Total Site Capacity (CY)	Total Site Capacity by Sub-Reach (CY)	20-Year Dredge Quantity (CY)
River	34 to 36, Coon Island, Port	1	CDF	0	80,700	807,000	0	887,700		
		2	CDF	0	97,000	710,000	0	807,000	1,694,700	1,596,800
	30 to 34, Turning Basin, Clooney Isl. Loop	3	CDF	0	364,600	1,823,000	0	2,187,600		
		7 (1/2)	CDF	0	207,300	1,658,400	0	1,865,700	4,053,300	2,689,800
	26 to 30	7 (1/2)	CDF	0	207,300	1,658,400	0	1,865,700		
		8	CDF	0	0	2,478,400	0	2,478,400		
		9	CDF	0	0	2,194,400	0	2,194,400	6,538,500	5,877,200
	22 to 26	10	CDF	0	0	1,742,400	0	1,742,400		
		11	CDF	0	217,800	1,742,400	0	1,960,200		
		12A	CDF	0	0	2,064,800	0	2,064,800		
		12B	CDF	0	2,095,800	5,588,800	0	7,684,600	13,452,000	12,706,400
Upper Lake	21 to 22	15	CDF	0	584,000	2,920,000	0	3,504,000		
		16 N	CDF	0	0	2,710,000	0	2,710,000	6,214,000	4,458,800
	Devil's Elbow	13	CDF	0	0	11,455,000	0	11,455,000	11,455,000	10,310,400
	16 to 21	17	CDF	0	309,700	1,347,300	0	1,657,000		
		19	CDF	0	0	2,507,000	0	2,507,000		
		22	CDF	0	214,500	4,360,500	0	4,575,000		
		Existing Foreshore Dike	CDF	0	0	0	4,549,000	4,549,000		
		West of Black Lake (50)	BU Site	7,158,000	0	0	0	7,158,000	20,446,000	19,885,400
	12 to 16	D/E	CDF	0	398,500	6,486,000	0	6,884,500		
		Existing Foreshore Dike	CDF	0	0	0	3,841,000	3,841,000		
		Sabine NWR (5)	BU Site	8,873,500	0	0	0	8,873,500	19,599,000	19,475,000
Lower Lake	9.5 to 12	Cameron Par. School Bd (49)	BU Site	2,315,000	0	0	0	2,315,000		
		Sabine NWR (18)	BU Site	6,946,000	0	0	0	6,946,000	9,261,000	9,261,800
	5 to 9.5	H	CDF	0	458,000	916,400	0	1,374,400		
		M	CDF	0	0	5,059,200	0	5,059,200		
		N	CDF	0	0	2826400	0	2,826,400		
		Cameron Prairie NWR (19)	BU Site	1,551,000	0	0	0	1,551,000		
		Cameron Prairie NWR (20)	BU Site	775,000	0	0	0	775,000	11,586,000	10,853,000
Total				**27,618,500**	**5,235,200**	**63,055,800**	**8,390,000**	**104,299,500**	**104,299,500**	**97,114,600**

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Mile 12 to 16: Rehabilitation and vertical expansion of CDFs D and E do not provide sufficient capacity. The proposed placement areas are:

- Recovering the eroded channel-side capacity through construction of a Foreshore Dike. The CEMVN has constructed a foreshore rock dike from approximate mile 11.2 to 15.6 (Figure 2-14). The dike is placed along the historic shoreline of the channel, providing dredged material placement from -3 to +20 feet for an average width of 500 feet. Approximately 8 million cubic yards of capacity can be realized with proper placement and management.

- Beneficial Use in the Sabine National Wildlife Refuge (BU Site 5). Approximately 3,083 acres are available for placement to restore marsh habitat (Figure 2-19). The ratio of open water to marsh would be approximately 1:1 to allow for water circulation, terracing and other restoration features. Although the Sabine NWR includes more than 5,000 acres of potential disposal area, refuge officials have indicated preference for the disposal area shown in Figure 2-19. Portions of this site have been assessed or are currently being analyzed under separate NEPA documents (see Section 1.9.5) and may be used for the placement of dredged material as needed prior to the finalization of this DMMP/SEIS in accordance with WRDA 2007, Section 5081.

Dredging between miles 12 and 16 is accomplished approximately every 2.5 years.

Lower Lake

Mile 9.5 to 12: The CDFs in this area do not have sufficient capacity or acreage for expansion. CDF F was withdrawn from use by the Sabine NWR, which has indicated that upland placement of dredged material is not consistent with the refuge's approved management policy. Proposed actions to meet the 20-year dredging capacity need are as follows:

- Beneficial use in the Sabine NWR (BU Site 18). Approximately 1,572 acres are available for unconfined placement for beneficial use to restore marsh habitat (Figure 2-22).

- Beneficial use on submerged lands owned by the Cameron Parish School Board (BU Site 49). Approximately 639 acres are available for placement of dredged material to restore marsh habitat or create uplands habitat (Figure 2-22).

This reach is dredged approximately every three years.

Mile 5 to 9.5: CDFs H, M and N could provide the 20-year dredged material capacity requirement with a 10-foot dike raise and proper dewatering and site management (figures 2-24 and 2-25). CDFs J and K were considered not to be viable disposal sites due to their limited capacity and dike stability issues and were eliminated. Supplemental actions to meet the 20-year dredging capacity need are:

- Beneficial use of dredged materials on the Cameron Prairie NWR (BU Site 19). Approximately 1,026 acres are available for potential beneficial use in the Cameron Prairie NWR (Figure 2-23). With limited containment, the side-cast borrow ditches along the storm surge dikes could be refilled and the shallow open water areas used for marsh and habitat restoration.

- Beneficial use of dredged materials on the Cameron Prairie NWR (BU Site 20). Approximately 1,867 acres are available for beneficial use in the Cameron Prairie NWR for marsh restoration (Figure 2-23).

The dredging frequency for miles 5 to 9.5 is approximately every three years.

Pass Channel

Mile 0 to 5: The presence of strong tidal currents in this reach prevents the accumulation of sediments. Dredging in this reach is not required.

Bar Channel

Mile 0 to -32: The practice of agitating and placing material dredged from this reach into the ODMDS would be continued. The ODMDS provides sufficient capacity for disposal of material dredged from the Bar (Entrance) Channel for at least the next 20 years.

2.5.3 Alternative C: Placement in CDFs and Beneficial Use, with Beneficial Use Capacity Maximized from Channel Mile 12 to 22

Alternative C includes all of the beneficial use sites included in Alternative B plus additional beneficial use sites. Whereas Alternative B emphasizes the rehabilitation and expansion of CDFs in the upper lake reach, Alternative C emphasizes the beneficial use of dredged materials in this reach. Unfortunately, the sites that are part of this plan include those with implementation considerations, as shown in Table 2-8. Under this plan, approximately 44 percent of material dredged between miles 5 and 36 to maintain navigation would be placed in beneficial use sites for the restoration of subsided and eroded coastal wetlands.

Figure 2-27 is a map of the disposal sites for Plan C. Table 2-10 lists the placement areas of Alternative C by reach and mile section. The estimated capacity is shown in gross yards.

River Reach

The River Reach for Plan C is identical to the River Reach in Plan B.

Upper Lake

For the placement of material for beneficial use, the available placement quantity was divided in half to allow for a ratio of open water to marsh of approximately 1:1 to allow for water circulation, terracing and other restoration features. The actual amounts could depend upon engineering design, resource agency coordination, and landowner agreements.

Mile 21 to 22: Rehabilitating the sites and raising the dikes at CDFs 15 and 16N approximately 10 feet would meet the 20-year dredging need (Figure 2-11). Beneficial use in this reach is not

Table 2-10. Alternative C: Placement Sites and Capacity

Reach	Section	Placement Sites	Placement Site Type	Beneficial Use (CY)	Existing Capacity (CY)	Vertical Expansion (CY)	Horizontal Expansion: Upland Creation (CY)	Total Site Capacity (CY)	Total Site Capacity by Sub-Reach (CY)	20-Year Dredge Quantity (CY)
River Reach	34 to 36, Coon Island, Port	1	CDF	0	80,700	807,000	0	887,700		
		2	CDF	0	97,000	710,000	0	807,000	1,694,700	1,596,800
	30 to 34, Turning Basin, Clooney Isl. Loop	3	CDF	0	364,600	1,823,000	0	2,187,600		
		7 (1/2)	CDF	0	207,300	1,658,400	0	1,865,700	4,053,300	2,689,800
	26 to 30	7 (1/2)	CDF	0	207,300	1,658,400	0	1,865,700		
		8	CDF	0	0	2,478,400	0	2,478,400		
		9	CDF	0	0	2,194,400	0	2,194,400	6,538,500	5,877,200
	22 to 26	10	CDF	0	0	1,742,400	0	1,742,400		
		11	CDF	0	217,800	1,742,400	0	1,960,200		
		12A	CDF	0	0	2,064,800	0	2,064,800		
		12B	CDF	0	2,095,800	5,588,800	0	7,684,600	13,452,000	12,706,400
Upper Lake	21 to 22	15	CDF	0	584,000	2,920,000	0	3,504,000		
		16 N	CDF	0	0	2,710,000	0	2,710,000	6,214,000	4,458,800
	Devil's Elbow	13	CDF	0	0	11,455,000	0	11,455,000		
		West of Black Lake (50)	BU Site	2,062,000		0	0	2,062,000	13,517,000	10,310,400
	16 to 21	Palermo (4)	BU Site	1,864,000	0	0	0	1,864,000		
		West of Black Lake (24)	BU Site	4,356,000	0	0	0	4,356,000		
		West of Black Lake (50)	BU Site	5,096,000	0	0	0	5,096,000		
		E. Palermo (52)	BU Site	621,000	0	0	0	621,000		
		BU (48)	BU Site	6,214,000	0	0	0	6,214,000		
		17	CDF	0	309,700	2,026,400	0	2,336,100	20,487,100	19,885,400
	12 to 16	Sabine NWR (5)	BU Site	8,873,000	0	0	0	8,873,000		
		Bel (6)	BU Site	2,191,000	0	0	0	2,191,000		
		Bel (7)	BU Site	3,895,000	0	0	0	3,895,000		
		Existing Foreshore Dike	CDF	0	0	0	8,390,000	8,390,000	23,349,000	19,475,000
Lower Lake	9.5 to 12	Sabine NWR (18)	BU Site	6,946,000	0	0	0	6,946,000		
		Cameron Par School Bd (49)	BU Site	2,315,000	0	0	0	2,315,000	9,261,000	9,261,800
	5 to 9.5	H	CDF	0	458,000	916,400	0	1,374,400		
		M	CDF	0	0	5,059,200	0	5,059,200		
		N	CDF	0	0	2,826,400	0	2,826,400		
		Cameron Prairie NWR (19)	BU Site	1,551,000	0	0	0	1,551,000		
		Cameron Prairie NWR (20)	BU Site	775,000	0	0	0	775,000	11,586,000	10,853,000
Total				**46,759,000**	**4,622,200**	**49,574,400**	**8,390,000**	**110,152,600**	**110,152,600**	**97,114,600**

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necessary but could be used if dredging in this reach were concurrent with dredging in lower reaches.

Devil's Elbow: The 20-year dredging capacity requirement can be met by raising the dikes at CDF 13 by 10 feet (Figure 2-10). Due to the level of shoaling and the frequency of dredging in this reach, CDF 13 would be needed throughout the term of the DMMP and may need to be taken off-line for a period of time to allow for rehabilitation and consolidation. Proposed actions to meet or supplement the 20-year dredging capacity requirement are:

Beneficial Use in Black Lake at the Black Lake Site (BU Site 50). Approximately 887 acres would be available for the beneficial use of material (Figure 2-12). Geotechnical and engineering studies as well as surveys have been completed at this site. This site is also shared with the following reach. This area is dredged approximately every two to three years.

Mile 16 to 21: This section would include the use of CDFs 16N and 17 (figures 2-11 and 2-13). Unlike Alternative B, CDF 22 would not be used for Alternative C; nor would the upland expansion of CDF 17 into Calcasieu Lake take place. The use of dredged material for beneficial use would be increased from that described in Alternative B. The recommended additional placement areas are as follows:

- Beneficial Use for Wetland Restoration on the Western Portion of the Palermo Property (BU Site 4). Approximately 1,279 acres of subsided marsh would be available for beneficial use of material at this site (Figure 2-16). Wetland restoration through the beneficial use of dredged materials from the ship channel has been previously implemented on this property.

- Beneficial Use for Wetland Restoration West of Black Lake (BU Site 24). Approximately 2,327 acres of subsided marsh would be available for the placement of material (Figure 2-12). This is a Marcantel property that could be made available upon the completion and filling of BU Site 50.

- Beneficial Use West of Black Lake (BU Site 50). Approximately 887 acres would be used for coastal restoration for this section of the channel (Figure 2-12). At the time of preparation of the DMMP, the owner of this property had requested that dredged material be used to restore the property. The northern portion of this site has been cleared under a separate NEPA document (see Section 1.9.5 (c)) and may be used for the placement of dredged material as needed prior to the finalization of this DMMP/SEIS. This is in accordance with WRDA 2007, Section 5081: "The Secretary shall expedite completion of a dredged material management plan for the Calcasieu Ship Channel, Louisiana, and may take interim measures to increase the capacity of existing disposal areas, or to construct new confined or beneficial use disposal areas, for the channel."

- Beneficial Use for Wetland Restoration on the Eastern Portion of the Palermo Property (BU Site 52). Dredged material would be placed in approximately 258 acres of subsided marsh (Figure 2-16).

- Beneficial Use to Restore Shallow Open Water Area West of the Alkali Ditch (BU Site 48). Approximately 1,475 acres of subsided marsh would be available for the beneficial use of material (Figure 2-17). Lakes of Gum Cove Lane, LLC (the Palermo family) is the landowner of this property.

Mile 12 to 16: Alternative C does not include the placement of material on CDFs in this section; all material would be placed in beneficial use sites and behind the existing foreshore dike. The proposed beneficial use placement areas in this area in Alternative C are as follows:

- Beneficial Use in the Sabine NWR West of the CWPPRA Cycle 1 Site (BU Site 5). Approximately 3,083 acres would be available for semi-confined placement to restore marsh habitat (Figure 2-19). Portions of this site have been cleared or are currently being analyzed under separate NEPA documents (see Section 1.9.5) and may be used for the placement of dredged material as needed prior to the finalization of this DMMP/SEIS. This is in accordance with WRDA 2007, Section 5081.

- Beneficial Use to Restore Wetlands on the Bel Property North of CWPPRA Cycle I (BU Site 6). Approximately 990 acres would be available for placement of dredged materials (Figure 2-20).

- Beneficial Use to Restore Additional Wetlands on Bel Property North of CWPRRA Cycle I Site (BU Site 7). Approximately 2,498 acres would be available for placement of dredged materials (Figure 2-21).

- Recovering the channel side capacity lost from erosion (Foreshore Dike). The CEMVN has constructed a foreshore rock dike from approximate mile 11.2 to 15.6 (Figure 2-14). The dike is placed along the historic shoreline of the channel, providing dredged material placement from -3 to +20 feet for an average width of 500 feet. Approximately 8 million cubic yards of capacity can be realized.

Lower Lake

Mile 9.5 to 12: The Sabine NWR has indicated that upland placement of dredged material on CDF F is not consistent with the agency's approved management plan and has withdrawn the easement for placement. All dredged material placement from Mile 9.5 to 12 would be used for beneficial use. Proposed actions to meet the 20-year dredging capacity need are:

- Beneficial Use in the Sabine NWR at Impoundment 1 (BU Site 18). Approximately 1,572 acres are available for unconfined placement for beneficial use to restore marsh habitat (Figure 2-22). This number was also halved to allow for marsh-to-open-water requirements requested by the refuge.

- Beneficial-use on submerged lands owned by the Cameron Parish School Board (BU Site 49). Approximately 639 acres are available for placement of dredged material to restore marsh habitat or create uplands habitat (Figure 2-22).

Mile 5 to 9.5: Dredged material placement in this reach would be as described for Alternative B, with CDFs H, M, and N providing the 20-year dredged material capacity. As mentioned for Alternative B, it is proposed that dredged material be beneficially used in the Cameron Prairie NWR to restore marsh.

- Beneficial use of dredged materials on the Cameron Prairie NWR (BU Site 19). Approximately 1,026 acres are available for potential beneficial use in the Cameron Prairie NWR (Figure 2-23). With limited containment, the side-cast borrow ditches along the storm surge dikes could be refilled and the open water areas used for marsh and habitat restoration.

- Beneficial use of dredged materials on the Cameron Prairie NWR (BU Site20). Approximately 1,867 acres are available for beneficial use in the Cameron Prairie NWR for marsh restoration (Figure 2-23).

Pass Channel

Mile 0 to 5: The presence of strong tidal currents in this reach prevents the accumulation of sediments. Dredging in this reach is not required.

Bar Channel

Mile 0 to -32: The practice of agitating and placing material dredged from this reach into the ODMDS would be continued. The ODMDS provides sufficient capacity for disposal of material dredged from the Bar Channel for at least the next 20 years.

2.5.4 Alternative D: Placement of Material in the Ocean Dredged Material Disposal Site (ODMDS)

Alternative D places material dredged from the River Reach to Devil's Elbow in rehabilitated CDFs, as described in both alternatives B and C above. Material dredged from south of mile 22 would be placed in the Ocean Dredged Material Disposal Site (ODMDS). See Figure 2-28. A description of this alternative is provided below, followed by an explanation for its dismissal.

River Reach

The River Reach sites in Plan D are identical to those in plans B and C.

Upper Lake

Mile 21 to 22: Rehabilitating the sites and raising the dikes at CDFs 15 and 16N approximately 10 feet would meet the 20-year dredging need. Beneficial use in this reach is not necessary but could be used if dredging in this reach were concurrent with dredging in lower reaches.

Devil's Elbow*:* The 20-year dredging capacity requirement can be met by raising the dikes at CDF 13 by 10 feet (Figure 2-12). This area is dredged approximately every two to three years.

Material dredged from the channel in the remainder of the Upper Lake would be placed in hopper barges or bottom-dump scows and transported to the ODMDS for placement.

Lower Lake

Material dredged from the channel in Lower Lake would be placed in hopper barges or bottom-dump scows and transported to the ODMDS for placement.

Pass Channel

Mile 0 to 5: The presence of strong tidal currents in this reach prevents the accumulation of sediments. Dredging in this reach is not required.

Bar Channel

Mile 0 to -32: The practice of agitating and placing material dredged from this reach into the ODMDS would be continued. The ODMDS provides sufficient capacity for disposal of material dredged from the Bar (Entrance) Channel for at least the next 20 years.

Reasons for Concern

There are several concerns regarding the use of the ODMDS for disposal of material from the inland portion of the Calcasieu Ship Channel:

Uncertainty of Dredge Availability. According to the USACE National Deep Draft Navigation Planning Center of Expertise:

> *There are a limited number of dredging companies with large equipment. An improvement project that changes the maintenance dredge type can impact the ability of industry to respond. For instance, currently the east coast turtle window typically absorbs the entire commercial hopper fleet from December through March every year. Any project that would require additional hopper work during this time frame should consider that the additional requirement could result in no bids or higher than normal bids due to lack of dredge availability. Also, the bucket dredge fleet is extremely limited especially due to the small number of medium to large scows. A large project that would need this type of equipment either during initial construction or maintenance phase should be presented as early as possible at annual dredging meetings*.
> (http://www.sam.usace.army.mil/ddncx/reviewguide.asp)

Uncertainty of ODMDS Availability. There are two ODMDS sites utilized by the CEMVN for the disposal of maintenance materials from the Bar Channel. The USEPA restricts placement at the sites to two feet of fill. The area of the first ODMDS site is estimated at 3,000 acres with an available capacity of approximately 9.7 million cubic yards. The area of the second ODMDS site is approximately 4,700 acres with an available capacity of 15.2 million cubic yards. The combined estimated capacity at one time is 24.9 million cubic yards. The required 20-year capacity need from Mile 5 to 22 is approximately 74 million yards. This is three times the available capacity of the ODMDS. While all the material would not be placed in the ODMDS at one time and would not remain in place over time, a formal study to determine the retention factors has not been conducted. Therefore, the viability of the long term use of the site is questionable.

Additionally, the use of the ODMDS for disposal of material dredged from the interior channel would require the sampling and analysis of sediments to determine their compatibility with the criteria established in the USEPA Testing Manual, *Evaluation of Dredged Material Proposed for Ocean Disposal*. The Marine Protection, Research, and Sanctuaries Act of 1972 prohibits the dumping of material into the ocean that would unreasonably degrade the marine environment. Physical differences exist between sediment from the inland portion of the Calcasieu Ship Channel and the sediments of the ODMDS. There is some doubt that the clayey sediments dredged from the Upper Lake reach and the northern portion of the Lower Lake would be compatible with the benthic community of the sandy substrate of the ODMDS.

Federal Emphasis Placed on Beneficial Use. The use of the ODMDS would eliminate the potential for using dredged material in a beneficial manner. The Federal Government has placed considerable emphasis on the desirability of using dredged material in a beneficial manner, particularly with regard to improved environmental quality. Statutes such as the Water Resources Development Acts of 1992, 1996, 2000, and 2007 demonstrate that beneficial use has been a Congressional priority. The USACE has emphasized the use of dredged material for beneficial use through such regulations as 33 CFR Part 335, ER 1105-2-100, and ER 1130-2-520 and by Policy Guidance Letter No 56. The use of the ODMDS for disposal of sediments, while not necessarily a violation, would not be compatible with the promotion of beneficial use by these laws and regulations.

Coastal Erosion in Louisiana. Current wetland losses in coastal Louisiana are estimated to average 10 square miles (6,400 acres) per year (Coalition to Restore Coastal Louisiana, 2007). From 1932 to 1990, southwestern Louisiana lost about 226,000 acres or about 25 percent of the original 893,300 acres that existed in 1932. The western portion of the Calcasieu-Sabine Basin is estimated to have lost 15,950 acres from 1978-90 or 18 percent of the 1978 marsh. The Calcasieu-Sabine Basin is projected to lose an additional 50,000 by 2050 without restoration. In 1990, Congress enacted the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), which mandated restoration of Louisiana's coastal wetlands and provided Federal funds dedicated exclusively to the long-term restoration of coastal wetlands. Since then, Louisiana has received an average of approximately $50 million each year for coastal restoration projects through CWPPRA. Dredged material placed in the ODMDS would remove the material from the Calcasieu estuarine system. This would eliminate the possibility of using the dredged material to restore eroded and subsided wetlands

Economic Importance of Coastal Wetlands. Coastal Louisiana is important to the local and national economies through oil and gas production and international seafood and recreation industries. The disappearance of Louisiana's wetlands threatens the enormous productivity of its coastal ecosystems, the economic viability of its industries, and the safety of its residents. The wetlands support various functions and values, including commercial fisheries; harvesting of furbearers and alligators; recreational fishing and hunting; ecotourism; critical migratory butterfly, songbird and waterfowl habitat; endangered and threatened species habitat; water quality improvement; navigation and waterborne commerce; flood control; buffering protection from storms; and the perpetuation of a unique culture that has developed in this beautiful and bountiful area of the country (Coast 2050: Toward a Sustainable Coastal Louisiana).

Importance of Coastal Wetlands for Storm Surge Protection. It is recognized that coastal wetlands reduce the magnitude of hurricane storm surges and related flooding. While wetlands cannot prevent the devastating effects of major hurricanes such as the recent hurricanes Katrina, Rita, and Gustav, wetlands are known to significantly reduce the storm surges associated with the more frequent tropical storms and smaller hurricanes. Data gathered after Hurricane Andrew in 1993 provided estimates that every 3.8 to 4.3 miles of wetlands reduces storm surge by an average of one foot (*Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA): A Response to Louisiana's Land Loss*).

Importance of Dredged Material. Sediment dredged from the Calcasieu Ship Channel is vital to the coastal restoration program of southwestern Louisiana. It is a major component of the plans for coastal protection and restoration in Louisiana, and the sole source of material for wetland restoration in the vicinity of the ship channel. Sediment placed in the ODMDS would adversely impact efforts for restoring wetland tracts in the Calcasieu Estuary.

Consistency with Louisiana Coastal Management Program. Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 *et seq.* requires that *each federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with approved state management programs*. Coastal Use Guidelines were written to implement the policies and goals of the Louisiana Coastal Resources Program, and serve as a set of performance standards for evaluating projects. Consistency with the Louisiana Coastal Use Guidelines would not be achieved with the use of the ODMDS for dredged material disposal.

Cost. Preliminary estimates indicate that the cost of Alternative D exceeds the costs of alternatives B and C by over $190,000,000 for the 20-year life of the DMMP.

Elimination of ODMDS Alternative

Excessive costs, questionable physical sediment quality, the importance of dredged material to be used beneficially (particularly with respect to national ecological and economic interests and storm damage reduction), lack of consistency with Louisiana's Coastal Use Guidelines, the likelihood of litigation delaying the project, and high operating costs undermine the viability of this alternative and threaten its ability to sustain navigation within the channel.

It is concluded that placing material dredged from the inland reaches of the Calcasieu Ship Channel in the ODMDS is not a viable option. Therefore, this alternative is eliminated from further consideration and detailed analysis.

2.6 COMPARISON OF ALTERNATIVES

2.6.1 Methodology

The final alternatives A, B, and C were compared against one another on the basis of:

- Quantitative criteria: cost, capacity, environmental benefit;
- Qualitative risk criteria: technical, acceptability, and logistical risks;
- A trade off analysis to assess the three final alternatives against the planning objectives; and
- A comparison of environmental impacts.

Table 2-11 provides a summary of the results of the evaluation of alternatives. In the table, yellow shading represents the highest ranking alternative. The quantitative, qualitative, trade off, and environmental impact evaluations summarized in the table are explained in detail below, sections 2.6.2 – 2.6.5.

2.6.2 Quantitative Criteria

Quantitative criteria include environmental benefit, capacity, and cost. Based on environmental, engineering, and geotechnical analyses and professional judgment, each alternative was given a score of 1 to 3, with 3 being the best.

Table 2-11. Summary of Alternative Evaluations

Evaluations	Alternatives		
	A	B	C
Quantitative Criteria			
Environmental Benefits (Nourishment or creation of marsh and estuarine habitat)	0	5,840 acres	10,030 acres
Capacity	Insufficient capacity	Sufficient capacity	Sufficient capacity
Cost	N/A	$788,840,000	$800,600,000
Benefit-to-Cost Ratios[2]	N/A	1.43-4.44	N/A
Qualitative Risk Criteria			
Technical Risk	No technical risk	Minimal technical risk	Slight technical risk
Acceptability	Not acceptable	Most Acceptable	Acceptable
Logistical Risk	Navigation and safety hazards	Minimal logistical risk	Moderate logistical risk
Planning Objectives			
Maintain the navigation channel to authorized dimensions	Does not meet objective	Meets objective	Meets objective
Place the dredged material in the most cost effective location consistent with environmental and engineering requirements.	Does not meet objective	Meets objective	Meets objective
Optimize beneficial use	Does not meet objective	Meets objective	Meets objective
Optimize capacities and comply with sound economic and environmental principles	Does not meet objective	Meets objective	Meets objective
Provide for material dredged by private parties, within certain parameters.	Does not meet objective	Meets objective	Meets objective
Uncertainty			
Availability of Sites	Insufficient availability	Available	Available
Acceptability of Material	N/A	Acceptable	Acceptable

[1] Restored marsh habitat would be a combination of marsh, mudflats, and shallow open water habitat. Additional details regarding restoration goals can be found in Appendix P, *Wetland Value Assessment.*
[2]Benefit-to-Cost ratios were only developed for the Recommended Plan, and were developed for two shoaling rates: (1) one foot of draft reduction per year, and (2) one foot of draft reduction every two years (one-half foot a year); and three alternative LNG facility operation scenarios: (1) Scenario 1 which excludes tonnages associated with the approved Cheniere LNG facility, (2) Scenario 2 which assumes all three LNG facilities operate at 50 percent of their baseline capacity, and (3) Scenario 3 which assumes that the Trunkline and Sempra LNG facilities operate at 50 percent of capacity and the Cheniere facility is not developed.

Environmental Benefit Evaluation. The alternatives were weighed against each other based upon the number of acres of eroded marsh and estuarine habitat that may be restored or nourished based on wetland value assessments (WVAs) (Appendix P) and the acreage of marsh and estuarine habitat that would be converted to uplands (Table 2-12). In addition to acreage impacts, the *quality* of marsh being created or impacted by each plan was also evaluated using the WVA process (Appendix P) and quantified in Average Annual Habitat Units.

Based on this comparison, Alternative C was given the highest score--3, Alternative B was given a 2, and Alternative A was given the lowest score--1.

Table 2-12. Acres of Coastal Marsh Restored: Alternatives A, B, and C

Criterion	Alternative A	Alternative B	Alternative C
Estimated acres of marsh/estuarine habitat created or restored	0	5,840	10,030
Estimated acres of marsh and open water/estuarine habitat converted to uplands	0	0	0
Average Annual Habitat Units (AAHUs) Created	0	1,183	2,035

Sustainable Capacity Evaluation. According to ER 1105-2-100, all federally maintained navigation projects must have sufficient dredged material disposal for a minimum of 20 years. In addition, sustainability of disposal capacity beyond the specified 20-year period is considered a factor. Estimated capacities are shown in Table 2-13 with further details explained below.

Table 2-13. 20-Year Capacity (Gross Cubic Yards): Plans A, B, and C

Alternative A	Alternative B	Alternative C
5,235,200	104,299,500	110,152,600

- Alternative A – has minimal remaining capacity and does not provide capacity for the 20-year dredging need. Therefore, this alternative was given a score of 1.

- Alternative B – has adequate capacity for the 20-year dredging need. Significant gains in capacity could be realized through active site management, which would shrink and consolidate the existing and future placement of dredged materials. This alternative would require active management of the upland CDFs, which historically has not taken place. Because of the abundance of sites available for beneficial use, Alternative B provides dredged material disposal capacity well beyond the 20-year life of the DMMP. This alternative was given a score of 2.

- Alternative C – has adequate capacity for the 20-year dredging need. With fewer CDFs, it would require less site management than Alternative B. As with Alternative B, the abundance of sites available for beneficial use provides Alternative C with sufficient disposal capacity to last well beyond the 20-year life of the DMMP. Therefore this alternative was given a score of 3.

Cost Evaluation. Cost estimates (based on the current market) were developed for each of the DMMP alternatives and presented in Table 2-14. Alternative A would not allow for the continued operation and maintenance of the Calcasieu Ship Channel. A nine-day closure of the channel in 2006 cost U.S. gasoline consumers $710 million and natural gas consumers $313 million with a total burden of $1 billion to the nation in nine days. The resulting costs to the region and the nation to supply alternate energy resources to replace those provided by this channel are considered to be significantly greater than the costs of the other alternatives resulting in a score of 1 for this alternative. Alternatives B and C were given scores of 3 and 2, respectively.

Table 2-14. Costs for Placement of Dredged Materials

Location	Alternative A	Alternative B	Alternative C
Mile 5-36	--	$628,387,000	$640,147,000
ODMDS	--	$160,453,000	$160,453,000
Total Cost	--	$788,840,000	$800,600,000

Cost estimates were calculated using the engineering assumptions described in Appendix D, *Cost Estimation*. Cost spreadsheets for each alternative and its respective dredging area or section are also located in Appendix D. Each spreadsheet provides an overview of factors affecting project cost. Individual cost components of the estimate include, where applicable, contingency, initial costs (preliminary study and design, permitting), site development costs (mobilization/demobilization, containment dike construction), dredging costs (mobilization/ demobilization, dredging, transportation, placement), and O&M costs (O&M monitoring and reporting, dredged material management).

2.6.3 Qualitative Risk Criteria

Three types of risk criteria used to compare alternatives were: technical risk, acceptability risk, and logistical risk.

Technical Risk. Technical risk is the uncertainty of cost and capacity estimates for each alternative. Uncertainty is derived from a lack of site-specific data during the planning phase of the project, such as geotechnical data, bathymetry, real estate, or design parameters. Contingency factors for each alternative take into consideration potential unknowns in areas such as engineering and constructability but may not adequately address cost and capacity uncertainties. Alternatives with minimal technical risk were given a score of 3. Alternatives with little information with regards to geotechnical data, bathymetry, real estate, or required design parameters were scored lower.

- Alternative A – would place material on existing CDFs until capacity is reached and dredging is ceased. This alternative has very little if any technical risk and was given a ranking of 3.

- Alternative B – has some technical risk. Although there are existing reliable data to estimate the costs and conceptual design parameters for CDFs, a determination of CDF capacity is dependent upon the proper maintenance and dewatering of sites that historically have not been funded. Furthermore, under this alternative, approximately 30 percent of the needed capacity is based upon beneficial use, which has risks associated with a lack of site-specific information; however, most of the beneficial use capacity of this alternative is located close to existing CWPPRA coastal restoration sites, which have geotechnical and engineering data, which minimizes technical uncertainty. This alternative was given a score of 2.

- Alternative C – has more technical risk than Alternative B. As with Alternative B, although there are existing reliable data to estimate the costs and conceptual design parameters for CDFs, a determination of CDF capacity is dependent upon the proper maintenance and dewatering of sites that historically have not been funded. However, many of the CDFs in the Lake reaches would no longer be used or maintained. If in the future it becomes necessary to restore these CDFs, their engineering and construction would require significant cost expenditures. For the additional reason that a greater proportion of dredged material would be placed in beneficial use areas (sites 4, 6, 7, 24, 48, and 52) lacking site-specific water depth and geotechnical information, this alternative was deemed to involve slightly greater technical uncertainty/risk than Alternative B. Therefore, this alternative was given a score of 1.

Acceptability Risk. Acceptability risk is the likelihood that legal and political challenges would adversely affect project implementation. Acceptability involves several factors, including potential legal constraints, as well as acceptance by the public and governmental agencies. The alternatives were scored based upon information gathered in public meetings, interagency coordination, and professional judgment. The alternative that has the least opposition that allows for the continued use of the ship channel, and that is in line with national and state goals for restoring the Louisiana Coast, was given a score of 3.

- Alternative A – This alternative does not ensure that the ship channel would remain open to allow for commerce that is in the national and state interest, nor does this alternative promote the national and state priorities to restore coastal wetlands of Louisiana. This alternative could have significant local opposition. This alternative was given a score of 1.

- Alternative B – This alternative remains in line with existing practices and has additional beneficial use. It would likely have minimal opposition. It is consistent with coastal restoration priorities for both the Federal government and the State of Louisiana. Most of the beneficial use acreage would occur on public lands (8,187 acres of subsided marsh on public lands would be designated for the beneficial use of dredged material; 86% of beneficial use disposal would occur on public lands). The remaining beneficial use acreage would be located on property owned by a landowner with an agreement to receive material for beneficial use. This alternative was given a score of 3.

- Alternative C – Because of the coastal restoration benefits that would result from this alternative, it would be favored by environmental resource agencies and likely by much of the general public. However, this plan includes eight privately owned beneficial use sites. It was given a score of 2.

Logistical Risk. Alternatives B and C are feasible from an engineering standpoint and would allow for the continued operation and maintenance of the ship channel. However, each alternative poses some potential risks in placing material in designated areas depending on the dredging method proposed, pumping and transportation methods, distance of the area from the channel, and navigational safety.

- Alternative A – would result in navigational safety hazards and does not allow for the continued maintenance and operation of the ship channel. This alternative was given a score of 1.

- Alternative B – Most of the placement areas have existing access routes or proposed routes that would be shorter than those of Alternative C. This alternative allows for the majority of the dredging industry to respond to the dredging needs of the area efficiently. This alternative was given a score of 3.

- Alternative C – Because many of the placement areas in this alternative have long pumping distances, this alternative would require coordination with numerous landowners, considerable pipeline lengths, and additional booster pumps to transport the materials to the placement areas. These requirements may reduce the number of contractors capable of performing the work and the ability of the dredging industry to respond to the dredging needs of the area in a reliable and cost effective manner. Consequently, this alternative was given a score of 2.

Table 2-15 provides a summary of the quantitative and qualitative risk scores for each plan.

Table 2-15. Evaluation Scores for Plans A, B, and C

Alternative	Quantitative Screening Criteria (1-3)			Risk Screening Criteria (1-3)			Total
	Environmental Benefit	Capacity	Cost	Technical Risk	Acceptability Risk	Logistical Risk	
A	1	1	1	3	1	1	8
B	2	2	3	2	3	3	15
C	3	3	2	1	2	2	13

2.6.4 Trade-Off Analysis

A trade-off analysis was conducted to assess the three final alternatives against the planning objectives that were defined during plan formulation:

- Maintain the navigation channel to authorized dimensions

- Place the dredged material in the most cost-effective location consistent with environmental and engineering requirements.

- Optimize beneficial use of dredged materials.

- Maintain dredged material disposal sites in a manner to optimize capacities and comply with sound economic and environmental principles

- Provide for the placement of material dredged by private parties, within certain parameters.

Alternative A (No-Action)

Advantages: None.

Disadvantages: Does not allow for the maintenance of the navigation channel to authorized dimensions. The backlog of maintenance dredging would continue to accrue, which would continue to limit full use of the channel, resulting in increased transportation costs to the region and the nation. The plan does not allow for the placement of dredged material in the most cost-effective location consistent with environmental and engineering requirements. The plan does not optimize the beneficial use of dredged material. The plan does not allow for the maintenance of dredged material disposal sites in a manner to optimize capacities and comply with sound economic and environmental principles. The plan does not provide for placement of material dredged by private parties.

Alternative B

Advantages:

- Is the least costly

- Provides for the maintenance of the navigation channel to authorized dimensions.

- Is implementable and environmentally acceptable.

- Places approximately 30 percent of the material dredged between miles 5 and 36 for beneficial use to nourish and restore existing and eroded wetlands.

- Identifies beneficial use sites that would be available during the 20-year plan with a majority being on public lands.

- Would operate and maintain dredged material disposal sites in a manner that would optimize capacities of the majority of the existing CDFs.

- Maximizes the use and protection of the Federal Government's and local sponsor's existing engineering, real estate, and construction investments but requires the local sponsor to perfect the disposal easements over certain CDF sites and to acquire LERRs for beneficial use sites.

- Complies with sound economic and environmental principles.

- Allows for the placement of material dredged by private parties, within certain parameters (capacity is accounted for in this DMMP/SEIS. Please see Appendix A, *Shoaling*).

Disadvantages: Alternative B does not provide the greatest environmental benefit. The perfection of easements over CDFs and the acquisition of LERRs for beneficial use sites would be necessary to ensure their availability. The acquisition of improved easements may meet with landowner and local resistance.

Alternative C

Advantages:

- Provides for the maintenance of the navigation channel to authorized dimensions.
- Is cost-effective due to minimal long-term maintenance costs.
- Is the most environmentally beneficial plan. Approximately 44% of material dredged between miles 5 and 36 would be used to nourish or restore existing and eroded wetlands.
- Would operate and maintain CDFs in a manner to optimize capacities in the River Reach.
- Complies with sound economic and environmental principles.
- Provides for the placement of material dredged by private parties, within certain parameters (capacity is accounted for in this DMMP/SEIS. Please see Appendix A, *Shoaling*).

Disadvantages: Alternative C is not the least costly and has a slightly higher risk of uncertainty with regards to technical risks. Little geotechnical, engineering and design information is available for beneficial use sites not located near existing CWPPRA coastal restoration sites, making it difficult to precisely estimate cost and capacity. Many of the CDFs in the lake reaches would no longer be used or maintained under Alternative C. In this way, Alternative C would not optimize previous investments in CDFs.

2.6.5 Comparison of Environmental Consequences of Alternatives

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 A, B, or C is presented in Table 2-16. A full explanation of environmental impacts of the alternatives can be found in Section 4.0 of this report.

Table 2-16. Summary of Environmental Consequences

Resource	Alternatives		
	Alternative A (No Action)	Alternative B	Alternative C
Physical Conditions	Increased erosion	Reduced erosion/minimal circulation changes:	Reduced erosion/minimal circulation changes:
Geology	No effect	No effect	No effect

Resource	Alternatives		
	Alternative A (No Action)	**Alternative B**	**Alternative C**
Soils	No effect	Soils formed from the placement of dredged material would likely be denser and less subject to erosion than naturally occurring soils.	Soils formed from the placement of dredged material would likely be denser and less subject to erosion than naturally occurring soils.
Water Quality	No effect	Expanding existing CDFs and placing dredged material for beneficial use could result in short-term elevated levels of suspended solids and nutrients.	Expanding existing CDFs and placing dredged material for beneficial use could result in short-term elevated levels of salinity, suspended solids and nutrients.
HTRW	No effect	No effect	No effect
Air Quality	No effect	Minor short-term wind erosion of expanded CDFs or restoration sites is expected. There would be minor increases of emissions from construction equipment during CDF expansion/maintenance.	Minor short-term wind erosion of expanded CDFs or restoration sites is expected. There would be minor increases of emissions from construction equipment during CDF expansion/maintenance.
Wetlands	No effect	Beneficial use of dredged material may potentially restore and nourish 5,840 acres of subsided and existing coastal marsh. This plan would result in a net increase of 1183 AAHUs.	No wetlands would be converted to uplands. Beneficial use of dredged material may potentially restore and nourish 10,030 acres of subsided and existing coastal marsh. This plan would result in a net increase of 2035 AAHUs.
Essential Fish Habitat	No effect	No wetland would be lost. Beneficial use of dredged material may potentially restore and nourish 5,840 acres of subsided and existing coastal marsh and estuarine habitat.	No wetland would be lost. Beneficial use of dredged material may potentially restore and nourish 10,030 acres of subsided and existing coastal marsh and estuarine habitat.
Oyster Grounds	Secondary adverse impacts could occur as existing CDFs erode. Sediment and suspended solids would inhibit the establishment of oyster production near the Ship Channel.	No adverse impacts	No adverse impacts

Resource	Alternatives		
	Alternative A (No Action)	Alternative B	Alternative C
Threatened and Endangered Species	Possible reductions in channel dimensions would reduce traffic on the waterway, thereby reducing the chance of a collision with a Kemp's ridley sea turtle. However, reduced channel dimensions would also provide less room for a sea turtle to maneuver away from vessels and potentially increase chances for a collision.	No adverse impacts.	No adverse impacts.
Recreation	No effect	Recreational fishing is expected to improve as a result of the marsh restoration/enhancement	Recreational fishing expected to improve as a result of the marsh restoration/ enhancement
Cultural Resources	No effect	No effect	No effect
Noise	No effect	Temporary, minor increases in noise during periods of construction.	Temporary, minor increases in noise during periods of construction.

2.6.6 Alternative C Considerations

As shown in Table 2-4, BU site 3 was screened out because it had been permitted as a private wetland mitigation bank. The PDT has recently learned that subsequent to the formulation of Alternative C, the environmental impact analysis of Alternative C (Section 4), and the release of the Draft DMMP/SEIS to the public, BU sites 4, 48, and 52 (components of Plan C) are in the final stages of the permit application process as private mitigation banks. (See Table 2-8). As a result, it is necessary to eliminate these sites as viable placement options. To reformulate Alternative C to incorporate additional beneficial use sites would require the selection of sites located farther from the ship channel than BU sites 4, 48, and 52. The selection of more distant sites would require greater pumping distances involving longer pipelines, increased mobilization and de-mobilization costs, longer access and pipeline channels, etc., resulting in costs greater than those for pumping to BU Sites 4, 48, and 52. Therefore, a reformulated Alternative C would be more costly than the analyses included in this DMMP. Reformulating Alternative C to include additional sites would not change the status of Alternative B as the least-cost, environmentally acceptable, engineeringly feasible plan.

2.7 SELECTION OF THE RECOMMENDED PLAN

Based on the comparisons and the scoring of the alternatives, the PDT has determined that Alternative B is the Recommended Plan. Alternative B provides the lowest level of risk and uncertainty in maintaining the navigation channel while providing sound environmental practices from both a Federal and non-Federal perspective. Alternative B is the lowest cost alternative. The beneficial use components of the Recommended Plan are considered general navigation features and the cost sharing is determined by WRDA 86, as amended.

Alternative B is the “Federal standard” per the requirements of 33 C.F.R. § 335.7: “Federal standard means the dredged material disposal alternative or alternatives identified by the Corps which represent the least costly alternatives consistent with sound engineering practices and meeting the environmental standards established by the 404(b)(1) evaluation process or ocean dumping criteria.”

Alternative B is the “base plan” per ER 1105-2-100, Appendix F: “Disposal of dredged material associated with construction or maintenance dredging of navigation projects should be accomplished in the least costly manner consistent with sound engineering practice and meeting all Federal environmental requirements. This constitutes the base plan for navigation purpose.”

2.7.1 Benefit/Cost Ratio of the Recommended Plan

To address the uncertainty associated with forecasting future shoaling rates and the operating capacity of the three LNG plants, transportation cost savings associated with the Recommended Plan were developed for two shoaling rates and three alternative LNG facility operating scenarios. The two shoaling rates (draft reduction rates) assumed: (1) one foot of draft reduction every two years (one-half foot a year), and (2) one foot of draft reduction per year. The three LNG operating scenarios consisted of: (1) Scenario 1, which excluded tonnages associated with the approved Cheniere LNG facility, (2) Scenario 2, which assumed all three LNG facilities operate at 50 percent of their baseline capacity, and (3) Scenario 3, which assumed that the Trunkline and Sempra LNG facilities operate at 50 percent of capacity and the Cheniere facility is not developed. Crude petroleum movements were assumed to remain constant at 19.95 million tonnes for all scenarios.

The benefit-to-cost ratios for the Recommended Plan, assuming 1-foot of draft reduction every two years, were 2.56 for Scenario 1, 2.04 for Scenario 2, and 1.43 for Scenario 3. The benefit-to-cost ratios, assuming 1-foot of draft reduction every year, were 4.44 for Scenario 1, 3.54 for Scenario 2, and 2.49 for Scenario 3. The benefit-to-cost ratios for the three LNG development scenarios under the two assumed shoaling rates indicate that there are substantial increased costs resulting from slight reductions in sailing drafts relative to a cessation of dredging and commercial navigation. The benefit-to-cost ratios indicate that very slight draft reductions in the range of one to two feet per year for the Calcasieu River (river miles -32 through 36) under “no action” dredge alternative would result in substantially higher transportation costs relative to the costs of the DMMP Recommended Plan. Details on development of the benefit-to-cost ratios are in Appendix E, *Economics*.

2.7.2 Compliance of Recommended Plan with Planning Goals, Objectives, and Evaluation Criteria

Planning Goals

The Recommended Plan complies with the Project Goal. It is the lowest cost alternative and is consistent with environmental and engineering requirements. It provides for the placement of material dredged from Calcasieu River and Pass for a minimum of 20 years.

Planning Objectives

The Recommended Plan would comply with each of the planning objectives developed during the plan formulation process.

- Maintain the Navigation Channel to Authorized Dimensions. The Recommended Plan would ensure that the channel remains available for continued shipping and vessel traffic.

- Place the dredged material in the most cost-effective location consistent with environmental and engineering requirements**.** The plan would comply with environmental and engineering requirements in a cost-effective manner.

- Beneficially Use of Dredged Material. Approximately 30 percent of the material dredged from the inland portions of the channel would be used for beneficial use.

- Maintain Dredged Material Disposal Sites in a Manner to Optimize Capacities and Comply With Sound Economic and Environmental Principles. The Recommended Plan would include maintenance to ensure the integrity of CDFs and beneficial use sites, provide for long-term availability for dredged material placement, protect the real estate investment of the Federal Government and the local sponsor, and minimize risk to environmentally sensitive areas.

- Provide for the Placement of Material Dredged by Private Parties. The Recommended Plan would provide for the placement of material dredged by commercial and industrial users of the Calcasieu River and Pass, Louisiana, Navigation Channel, within certain parameters.

Screening Criteria

The Recommended Plan would be compatible with the screening criteria discussed in Section 2.4.

Constraints:

- Contaminated materials. The Recommended Plan would avoid areas with potentially contaminated materials

- Public oyster grounds. The Recommended Plan would not impact oyster grounds

- Impingement on public access. The Recommended Plan would not impinge on access by the public to any location.

Considerations:

- Costs. The Recommended Plan is economically sound.

- Real estate acquisitions. The Recommended Plan would account for all necessary real estate acquisitions.

- Public use enhancement. The Recommended Plan would enhance public use through the beneficial use of dredge material for habitat restoration and enhancement in the Sabine and Cameron Prairie NWRs.

- Long-term facilities operation and maintenance costs. The Recommended Plan accounts for long-term operations and maintenance (O&M) costs.

Opportunities:

- Use of dredged material for habitat restoration and improvement. The Recommended Plan would provide for habitat restoration and improvement.

- Provide Opportunities for Mining of CDFs by Third Parties for Construction, Fill, Beneficial Use, or Other Actions. Although mining of CDFs is not an integral component of the Recommended Plan, the plan would provide opportunities for the excavation and use of dredged material for construction, fill, beneficial use, or other actions.

- Placement of material from private dredging. The Recommended Plan would provide the placement capacity for material dredged by private parties, within certain parameters.

- Recreation. The Recommended Plan is expected to enhance recreation through the creation of marsh and estuarine habitat amenable to hunting, fishing, and wildlife viewing.

- Storm damage abatement. The Recommended Plan would result in the restoration of subsided marsh, thereby assisting in the abatement of damage from storms.

Planning Criteria

Acceptability. The Recommended Plan is anticipated to be workable and viable with respect to acceptance by state and local entities and the public, and compatibility with existing laws, regulations, and public policies. The Recommended Plan is feasible and achievable in the context of technical, environmental, economic, and social considerations.

Completeness. The Recommended Plan would include and account for all necessary financial investments, long-term operation and maintenance costs, or other actions.

Effectiveness. The Recommended Plan provides attainment of the planning objectives.

Efficiency. The Recommended Plan provides for the continued operation of the Calcasieu River and Pass project. It is technically and environmentally sound and provides both monetary and non-monetary cost-effectiveness. It provides for the realization of opportunities and considers constraints and other considerations.

2.7.3 Future DMMP Updates

General

ER 1105-2-100 states that DMMPs shall be updated periodically to identify potentially changed conditions. Conditions that shall be addressed include dredging needs, disposal capabilities, capacities of disposal areas, environmental compliance requirements, potential for beneficial use, and indicators of continued economic justification. This DMMP would be updated when changes occur that would require new approvals.

Beneficial Use and the Base Plan/Federal Standard

As provided in ER 1105-2-100, when determining an acceptable method of dredged material placement, USACE districts are encouraged to consider options that provide opportunities for aquatic ecosystem restoration. Beneficial use sites included in the Recommended Plan of this DMMP are components of the least-cost, environmentally-acceptable alternative for disposing dredged material from the Calcasieu Ship Channel, and are therefore part of the base plan/Federal standard.

Beneficial use sites not included as components of the Recommended Plan may be reevaluated during future updating of the DMMP. If it is determined that placing dredged material at these beneficial use sites is a least-cost, environmentally acceptable method of placement, the sites may become part of the base plan/Federal standard for the project and the dredged material could be placed in accordance with the prescribed navigation cost share.

Section 204 of the Water Resources Development Act of 1992 provides programmatic authority for the selection of a placement method that provides beneficial use when it is not the least cost method of placement. In this situation, the incremental cost of the placement could be provided by a non-Federal sponsor or cost-shared with a non-Federal sponsor pursuant to Section 204 and/or other applicable authority.

Ongoing Interagency Coordination

The CEMVN plans to conduct annual coordination meetings with interested Federal and state agencies. The meetings are anticipated to provide an opportunity for the CEMVN to present dredging plans for the upcoming year and provide a forum for discussion. Through these meetings, CEMVN will keep agencies involved and notified of the project's ongoing compliance with environmental laws and requirements related to future dredging operations. Other considerations for discussion may include proposed changes to the DMMP, newly identified beneficial use opportunities, changed environmental conditions, anticipated problems, and other topics related to dredging and dredged material disposal.

2.7.4 Comparison of Recommended Plan and Existing Conditions

The Recommended Plan would differ from existing conditions in the way the project is managed. The existing project is managed largely through the use of contracts with dredging companies who are tasked to provide not only dredging of the ship channel, but also decisions on where dredged material would be placed and the management of the placement areas (Table 2-17). Under the Recommended Plan, the CEMVN would provide more centralized management to maximize capacity through scheduled placement of dredged material and subsequent ditching and draining. Dredging contractors would be provided directions regarding the locations for placement of material.

Table 2-17. Comparison of Elements and Features of Existing Conditions and the Recommended Plan

Feature	Existing Conditions	Recommended Plan
Dredged Material Placement Sites: Inland Portions of Channel	Contractor Decides	Prescribed in Plan
Dredged Material Placement Sites: Bar Channel	Agitation and ODMDS	Agitation and ODMDS
CDF Vertical Expansion	Managed by Dredging Contractors	Designed and Managed by CEMVN
CDF Lateral Expansion	None	Lateral Expansion of CDFs in Upper Lake Reach
CDF Dike Engineering	None	Engineered by CEMVN
CDF Dike Construction	Managed by Dredging Contractors	Managed by CEMVN
Dredged Material Consolidation/Dewatering	Managed by Dredging Contractors	Managed by CEMVN
Armoring of Placement Facilities in Calcasieu Lake	None	Rock Dikes for CDFs and Wetland Creation Site
Schedule for Dredged Material Placement Locations	None	Prescribed in Plan
Beneficial Use	Third Party Cost Sharing	General Navigation Feature

A second main difference between the two plans involves the use of dredged material for beneficial use. Under existing conditions, beneficial use is a function of outside agencies, which provide the incremental funding over the Federal standard to enable the dredged material to be placed at selected sites. Environmental studies and NEPA documentation are currently required for this beneficial use. Under the Recommended Plan, a major portion of the dredged material would be placed at beneficial use sites over the next 20 years as a general navigation feature of the project. NEPA documentation and other environmental clearances for the sites are provided by this DMMP.

A comparison of selected features of the Recommended Plan to those of the existing Federal Project is presented in Table 2-17.

2.7.5. Compliance with the Water Resources Development Act of 2007 (WRDA 2007) Regional Sediment Management Plans

Section 2037 of WRDA 2007 amends Section 204 of the Water Development Act of 1992 and requires the Secretary of the Army to develop, at Federal expense, a Regional Sediment Management Plan. The introduction to Section 2037 states:

> *(a) IN GENERAL.—*
> *(1) SEDIMENT USE.—For sediment obtained through the construction, operation, or maintenance of an authorized Federal water resources project, the Secretary shall develop, at Federal expense, regional sediment management plans and carry out projects at locations identified in plans developed under this section, or identified jointly by the non-Federal interest and the Secretary, for use in the construction, repair, modification, or rehabilitation of projects associated with Federal water resources projects for purposes listed in paragraph (3).*
> *(2) COOPERATION.—The Secretary shall develop plans under this subsection in cooperation with the appropriate Federal, State, regional, and local agencies.*
> *(3) PURPOSES FOR SEDIMENT USE IN PROJECTS.—The purposes of using sediment for the construction, repair, modification, or rehabilitation of Federal water resources projects are—*
> *(A) to reduce storm damage to property;*
> *(B) to protect, restore, and create aquatic and ecologically related habitats, including wetlands; and*
> *(C) to transport and place suitable sediment.*

Paragraph (d) of Section 2037 involves the beneficial use of dredged material and states:

> *(1) IN GENERAL.—In developing and carrying out a Federal water resources project involving the disposal of dredged material, the Secretary may select, with the consent of the non-Federal interest, a disposal method that is not the least cost option if the Secretary determines that the incremental costs of the disposal method are reasonable in relation to the environmental benefits, including the benefits to the aquatic environment to be derived from the creation of wetlands and control of shoreline erosion.*

Paragraph (f)(4) of Section 2037 designates the Calcasieu Ship Channel as one of 11 priority areas in the United States for the development of a Regional Management Plan. The Recommended Plan falls within the purview of Section 2037.

Louisiana Coastal Area. Title VII of WRDA 2007 addresses the Louisiana Coastal Area (LCA). Section 7002 directs the Secretary of the Army to coordinate with the State of Louisiana in the development of a plan for "protecting, preserving, and restoring the coastal Louisiana ecosystem." Section 7006(d) addresses the beneficial use of dredged material and states:

> *(1) IN GENERAL.—The Secretary, substantially in accordance with the restoration plan, shall implement in the coastal Louisiana ecosystem a program for the beneficial use of material dredged from federally maintained waterways at a total cost of $100,000,000.*

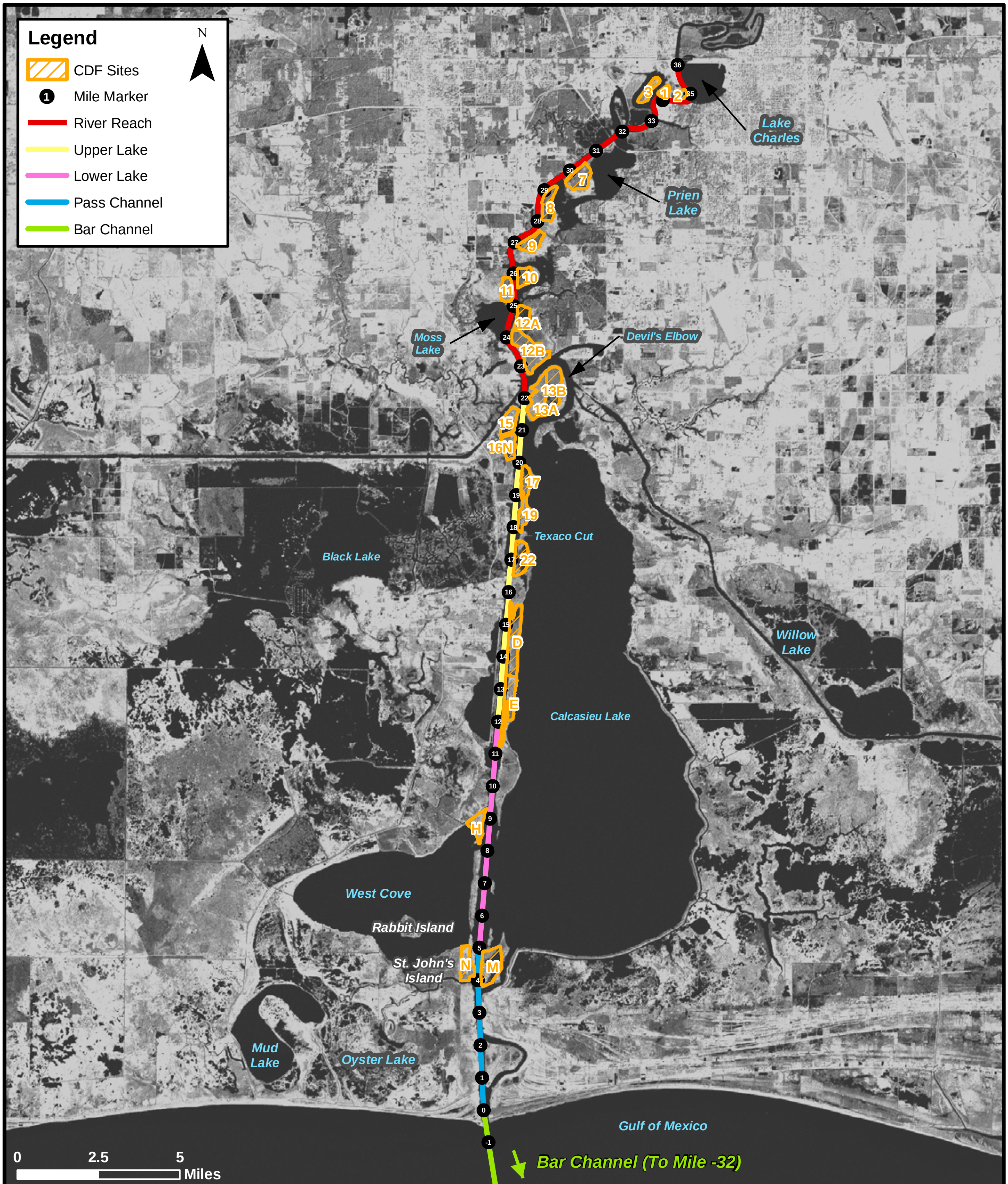
The Recommended Plan would provide dredged material for the restoration of coastal ecosystems. It is anticipated that the Recommended Plan would be compatible with an LCA plan.

2.7.6 Environmentally Preferred Plan

Alternative C is the environmentally preferred plan. Alternative C would restore 10,030 acres of eroded/subsided wetlands, while Alternative B would restore 5,840 acres. No significant adverse impacts would result from either alternative action. The cost for creating an acre of marsh is similar between alternatives B and C. It would cost an estimated $32,000 to create each acre of marsh under Alternative B and $34,000 for each acre of marsh created under Alternative C.

Although not the environmentally preferable plan, Alternative B was selected as the Recommended Plan because it is the lowest cost, environmentally acceptable plan. According to ER 1105-2-100, "It is the Corps of Engineers policy to accomplish the disposal of dredged material associated with the construction or maintenance dredging of navigation projects in the least costly manner. Disposal is to be consistent with sound engineering practice and meet all Federal environmental standards including the environmental standards established by Section 404 of the Clean Water Act of 1972 or Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended. This constitutes the base disposal plan for the navigation purpose."

2.8 FIGURES

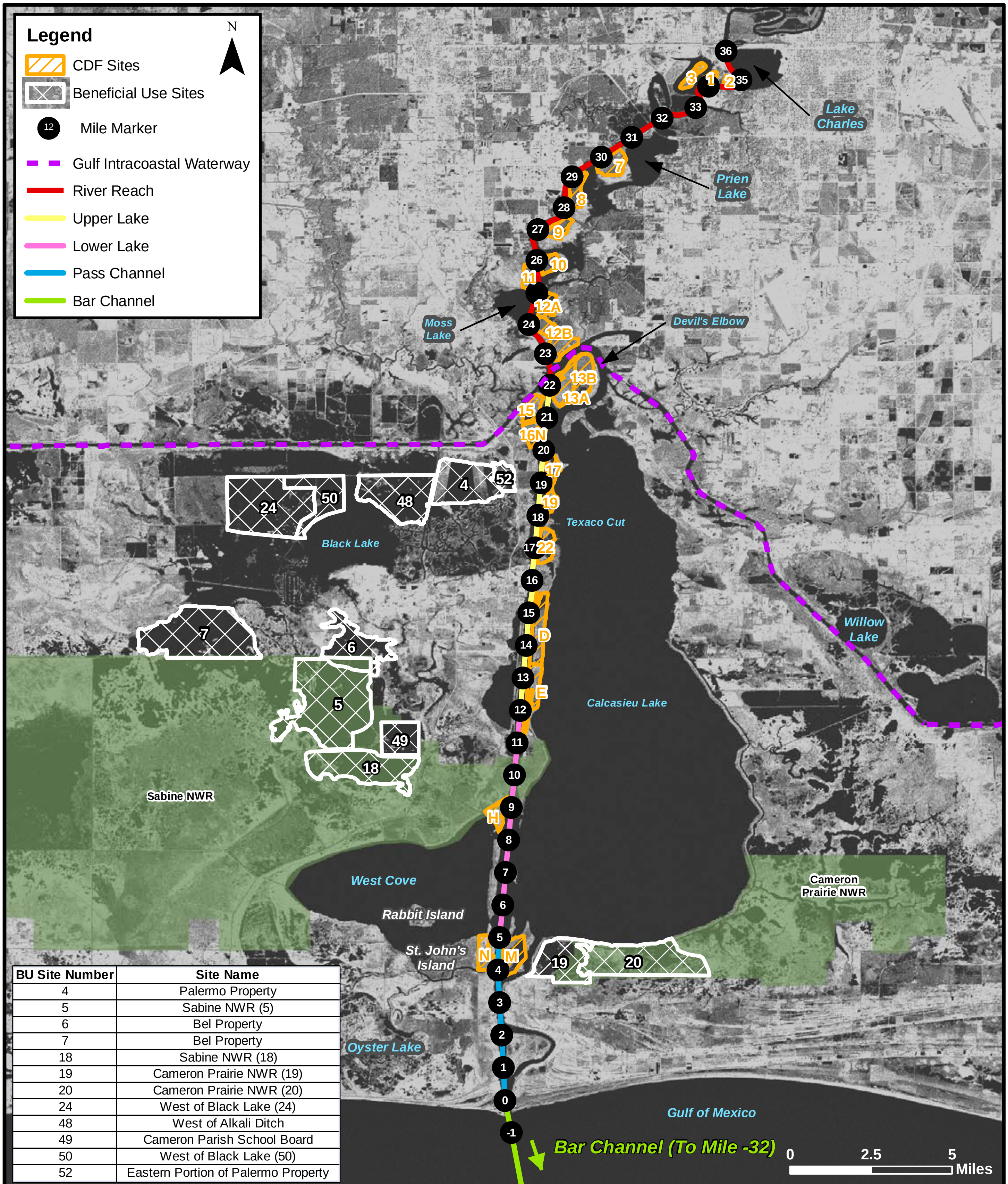


EXISTING CDF SITES

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC
Figure: 2-1
Date: September 2010
Scale:1:260,000
Source: LDEQ/GEC/USACE
Map ID: 27585107-1245



BU Site Number	Site Name
4	Palermo Property
5	Sabine NWR (5)
6	Bel Property
7	Bel Property
18	Sabine NWR (18)
19	Cameron Prairie NWR (19)
20	Cameron Prairie NWR (20)
24	West of Black Lake (24)
48	West of Alkali Ditch
49	Cameron Parish School Board
50	West of Black Lake (50)
52	Eastern Portion of Palermo Property

FINAL PLACEMENT OPTIONS

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 2-2
Date: September 2010
Scale:1:260,000
Source: LDEQ/GEC/USACE
Map ID: 27585107-1247

CDFs 1, 2, & 3

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

Figure: 2-3
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1249

CDF 7

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

Figure: 2-4
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1250

CDF 8

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-5
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1251

CDF 9

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

Figure: 2-6
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1252

CDF 10

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-7	
Date: September 2010	
Scale:1:15,000	
Source: GEC/USACE	
Map ID: 27585107-1254	

CDF 11

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-8
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1255

CDFs 12A & 12B

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-9
Date: September 2010
Scale:1:20,000
Source: GEC/USACE
Map ID: 27585107-1256

CDFs 13A & 13B

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-10
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1257

CDFs 15 & 16N

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-11
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1258

BENEFICIAL USE SITES 24 & 50

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

USGS 2005 DOQQ: Black Lake

GEC

Figure: 2-12
Date: September 2010
Scale:1:30,000
Source: USGS/GEC/USACE
Map ID: 27585107-1260

CDF 17

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-13
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1304

CDFs D & E AND FORESHORE DIKE FOR PLAN B

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

USGS 2005 DOQQ: Hackberry

GEC
Figure: 2-14
Date: September 2010
Scale:1:36,000
Source: USGS/GEC/USACE
Map ID: 27585107-1261

CDF 22

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-15	
Date: September 2010	
Scale:1:15,000	
Source: GEC/USACE	
Map ID: 27585107-1259	

GEC

BENEFICIAL USE SITES 4 & 52

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

Figure: 2-16
Date: September 2010
Scale:1:30,000
Source: USDA/GEC/USACE
Map ID: 27585107-1269

BENEFICIAL USE SITE 48

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

Figure: 2-17
Date: September 2010
Scale:1:30,000
Source: USDA/GEC/USACE
Map ID: 27585107-1270

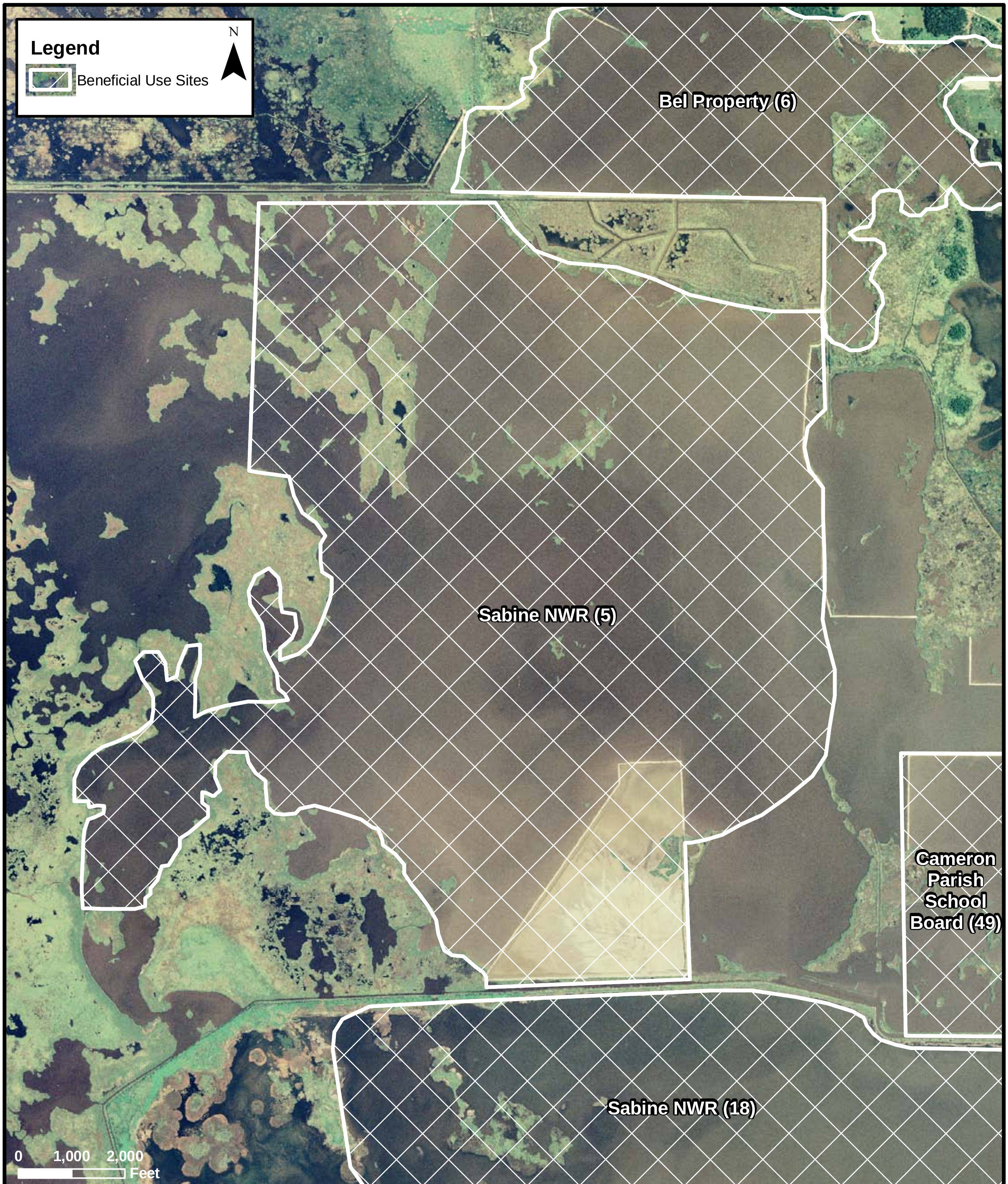
CDFs 17 & 19
PROPOSED EXPANSION FOR PLAN B

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2008 USACE 6 inch High Resolution Aerial Photography

GEC

Figure: 2-18
Date: September 2010
Scale:1:15,000
Source: GEC/USACE
Map ID: 27585107-1262



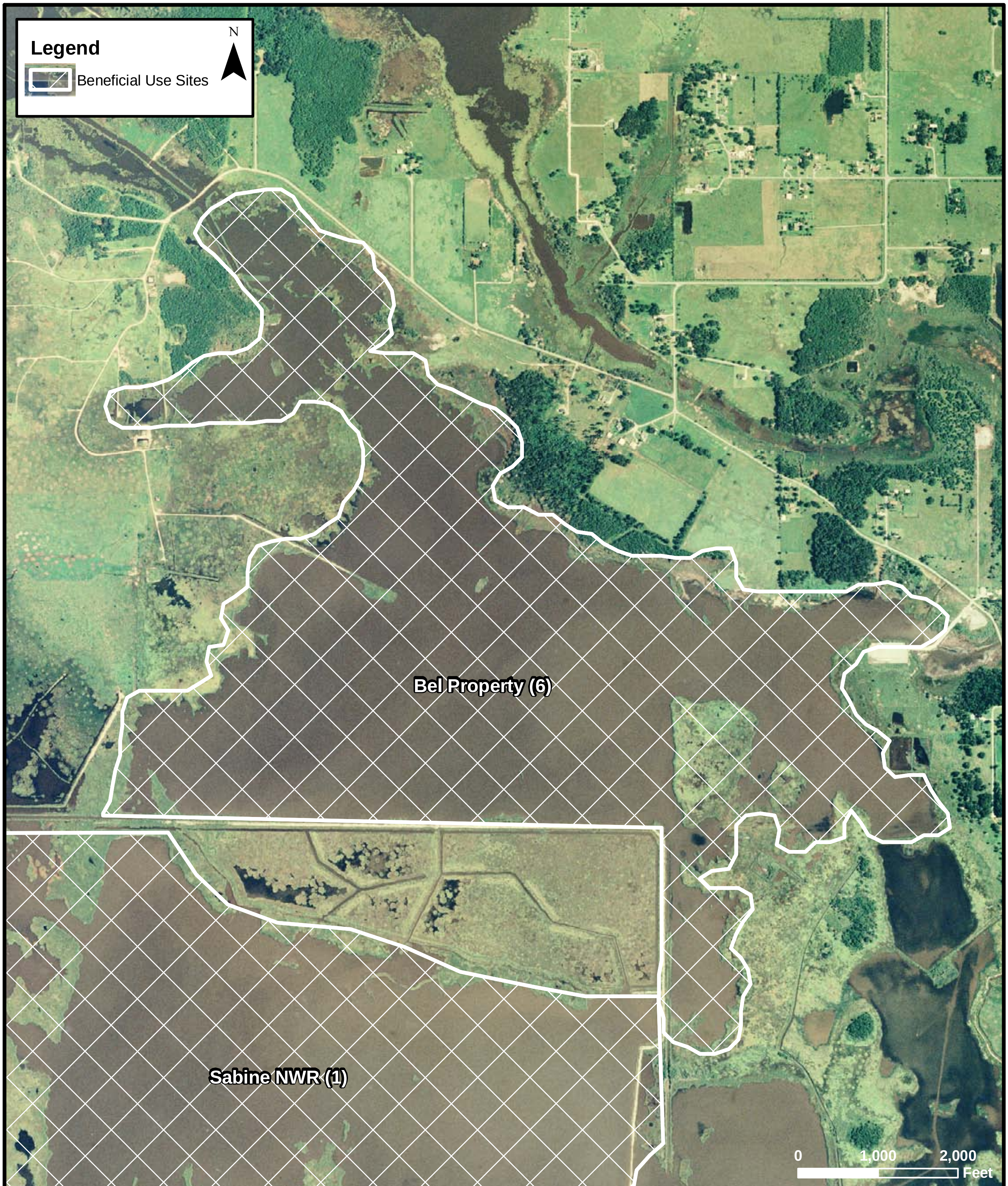
BENEFICIAL USE SITE 5

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

GEC

Figure: 2-19
Date: September 2010
Scale:1:30,000
Source: USDA/GEC/USACE
Map ID: 27585107-1263



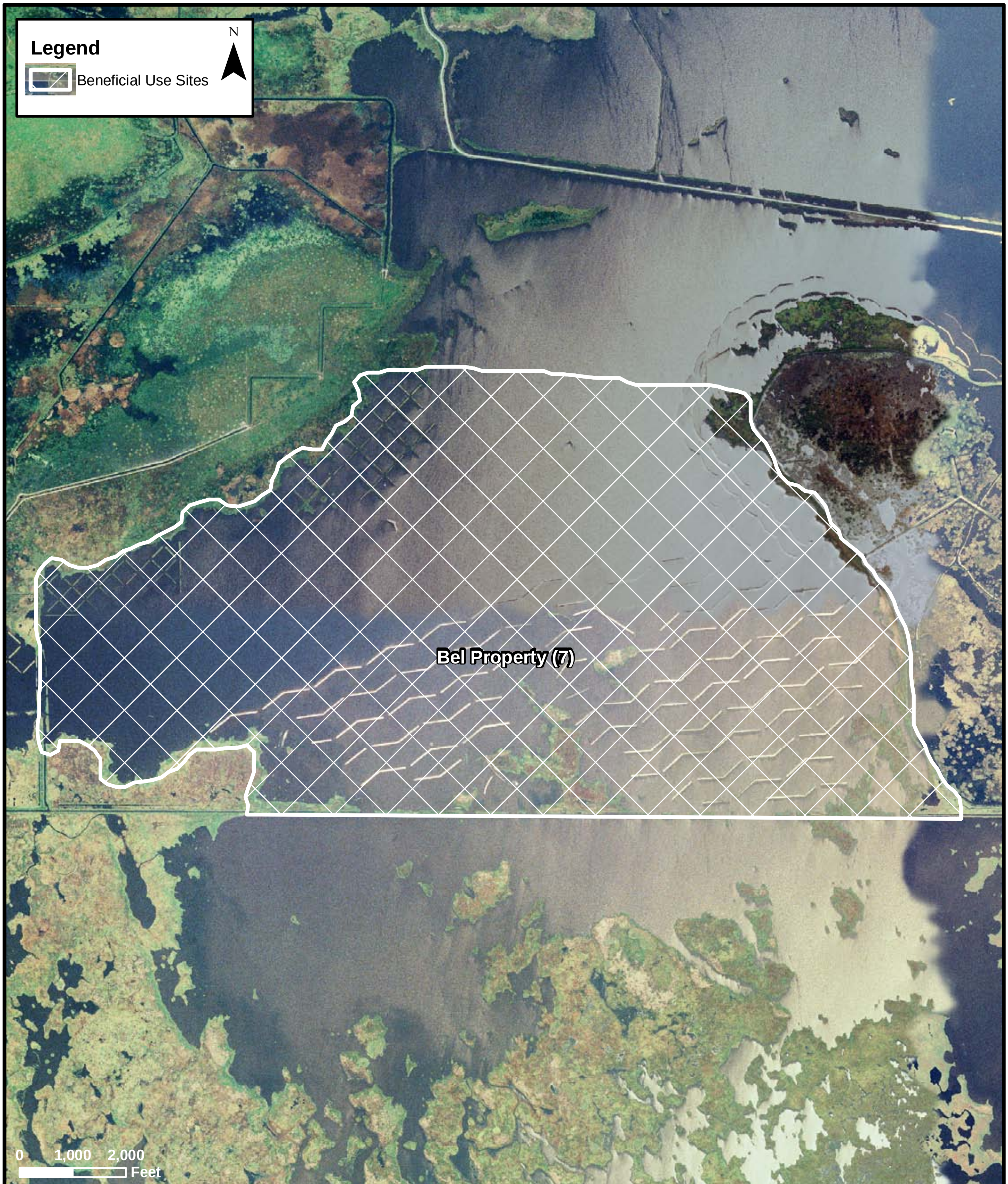
BENEFICIAL USE SITE 6

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

GEC

Figure: 2-20
Date: September 2010
Scale:1:20,000
Source: USDA/GEC/USACE
Map ID: 27585107-1271

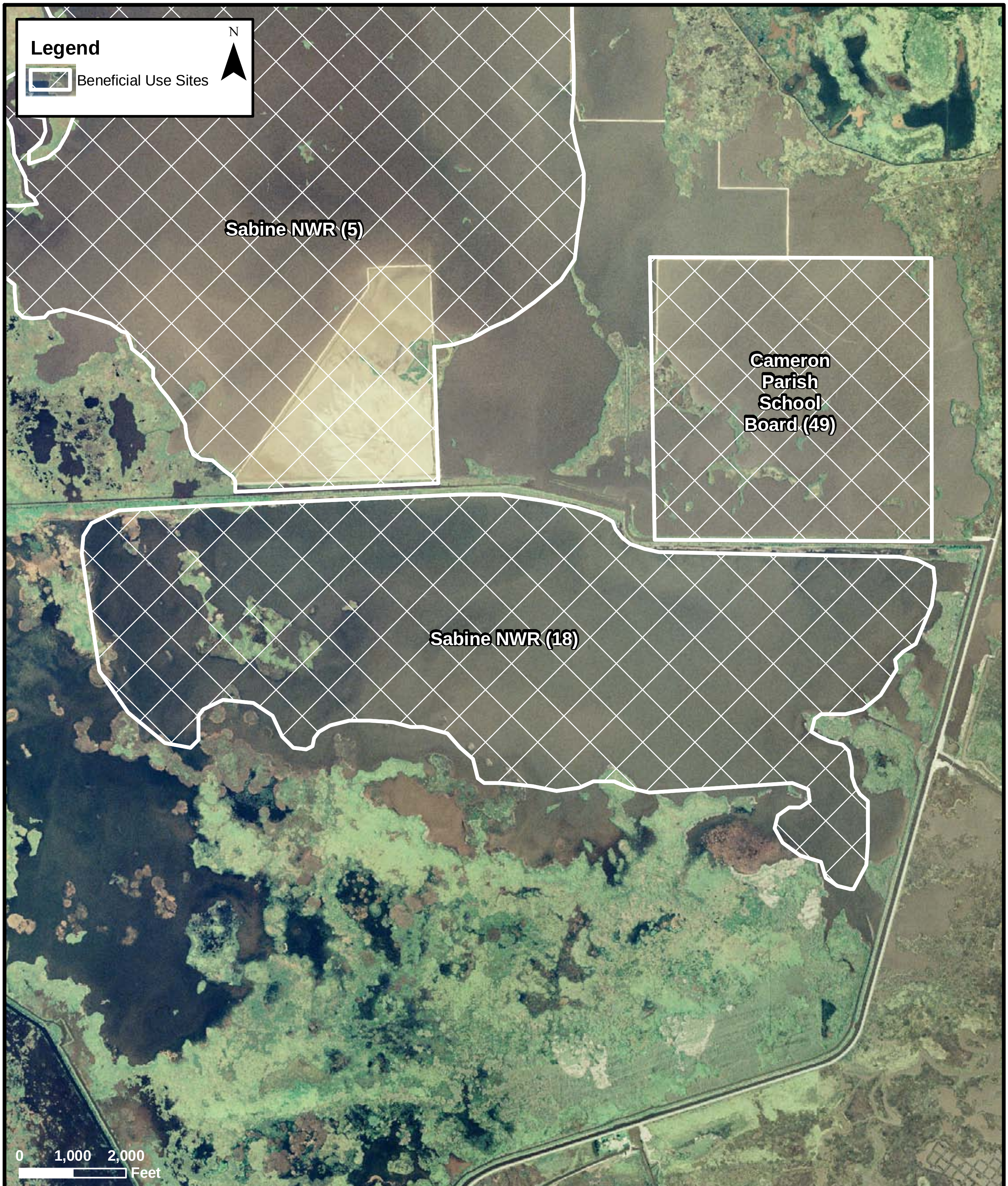


BENEFICIAL USE SITE 7

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

Figure: 2-21
Date: September 2010
Scale:1:30,000
Source: USDA/GEC/USACE
Map ID: 27585107-1272



BENEFICIAL USE SITES 18 & 49

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

GEC

Figure: 2-22
Date: September 2010
Scale:1:30,000
Source: USDA/GEC/USACE
Map ID: 27585107-1264

BENEFICIAL USE SITES 19 & 20

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

GEC

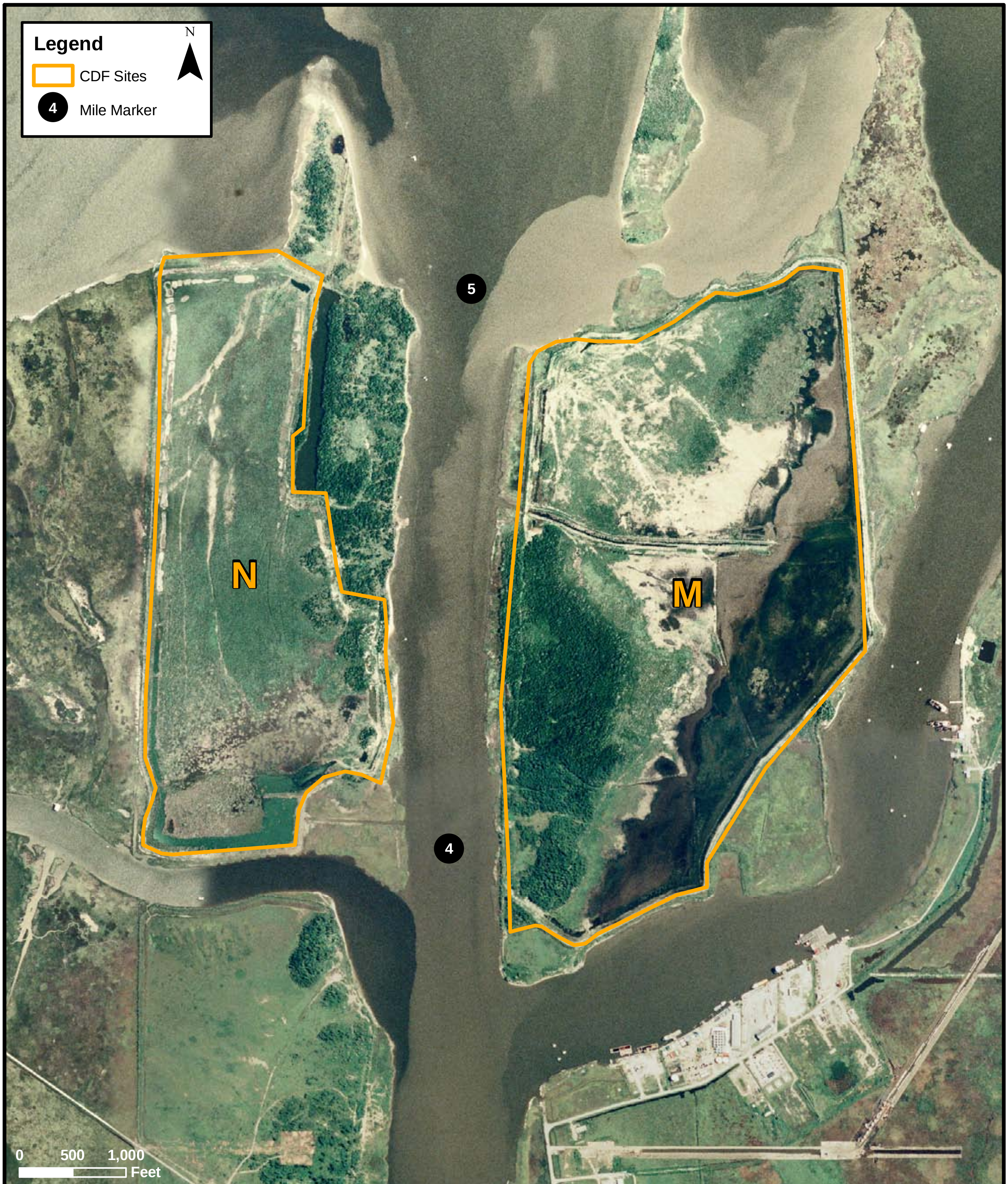
Figure: 2-23	
Date: September 2010	
Scale:1:45,000	
Source: USDA/GEC/USACE	
Map ID: 27585107-1267	

CDF H

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

GEC
Figure: 2-24
Date: September 2010
Scale:1:15,000
Source: USDA/GEC/USACE
Map ID: 27585107-1265



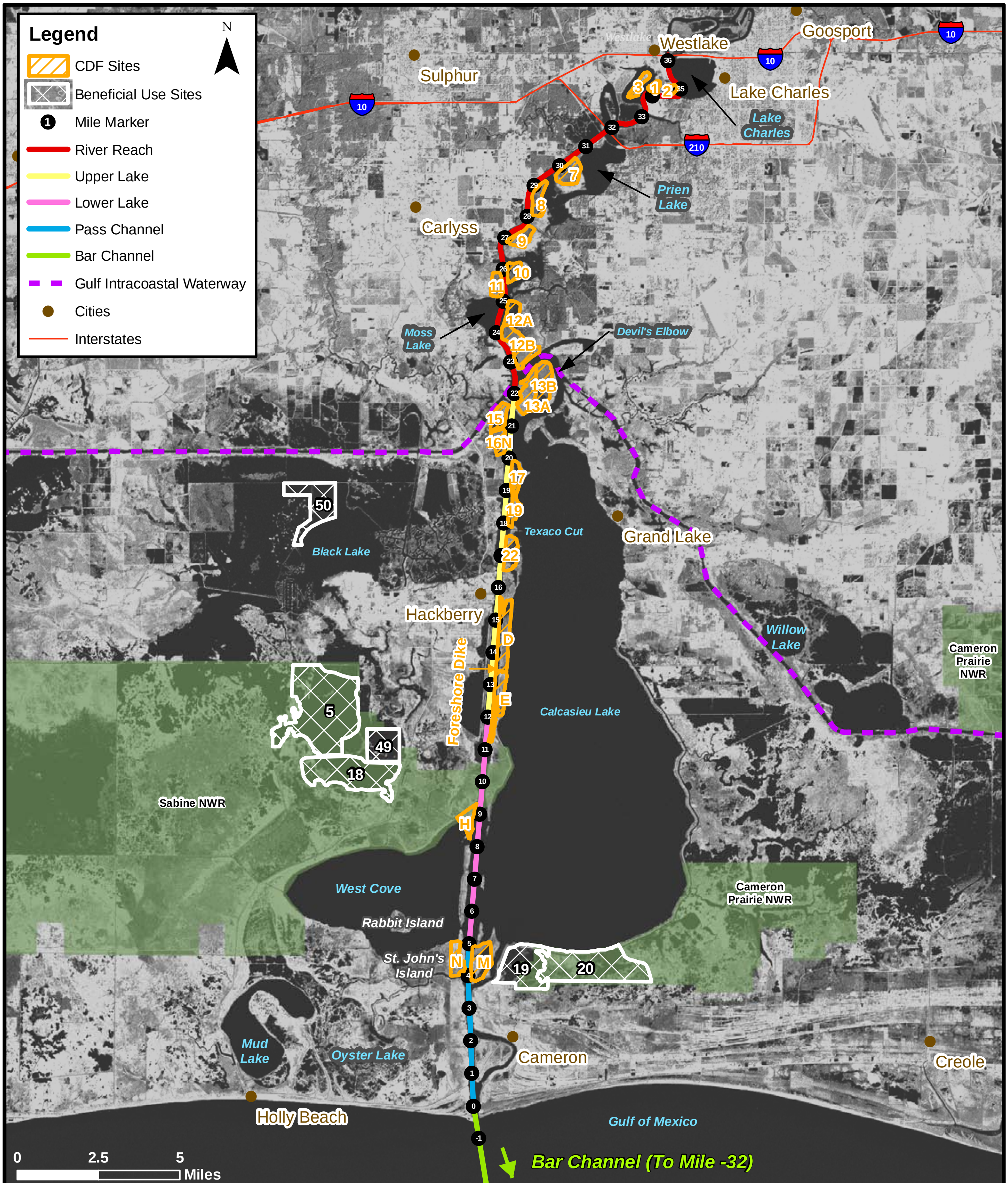
CDFs M & N

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

2007 NAIP Aerial Photography: USDA/FSA Aerial Photography Field Office

GEC

Figure: 2-25
Date: September 2010
Scale:1:15,000
Source: USDA/GEC/USACE
Map ID: 27585107-1266



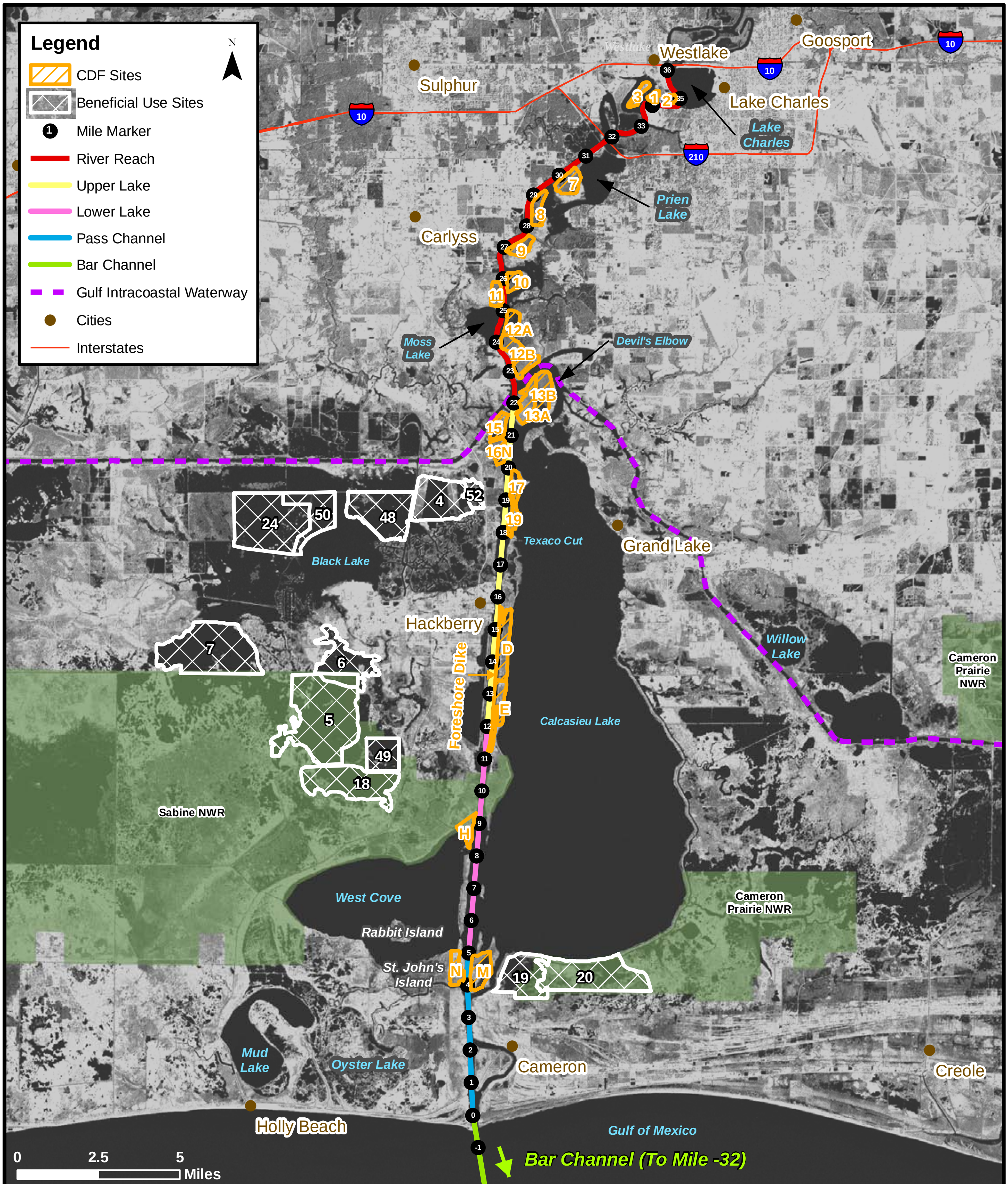
PLAN B
DISPOSAL SITES FOR DREDGED MATERIAL

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 2-26
Date: September 2010
Scale:1:260,000
Source: LDEQ/GEC/USACE
Map ID: 27585107-1241



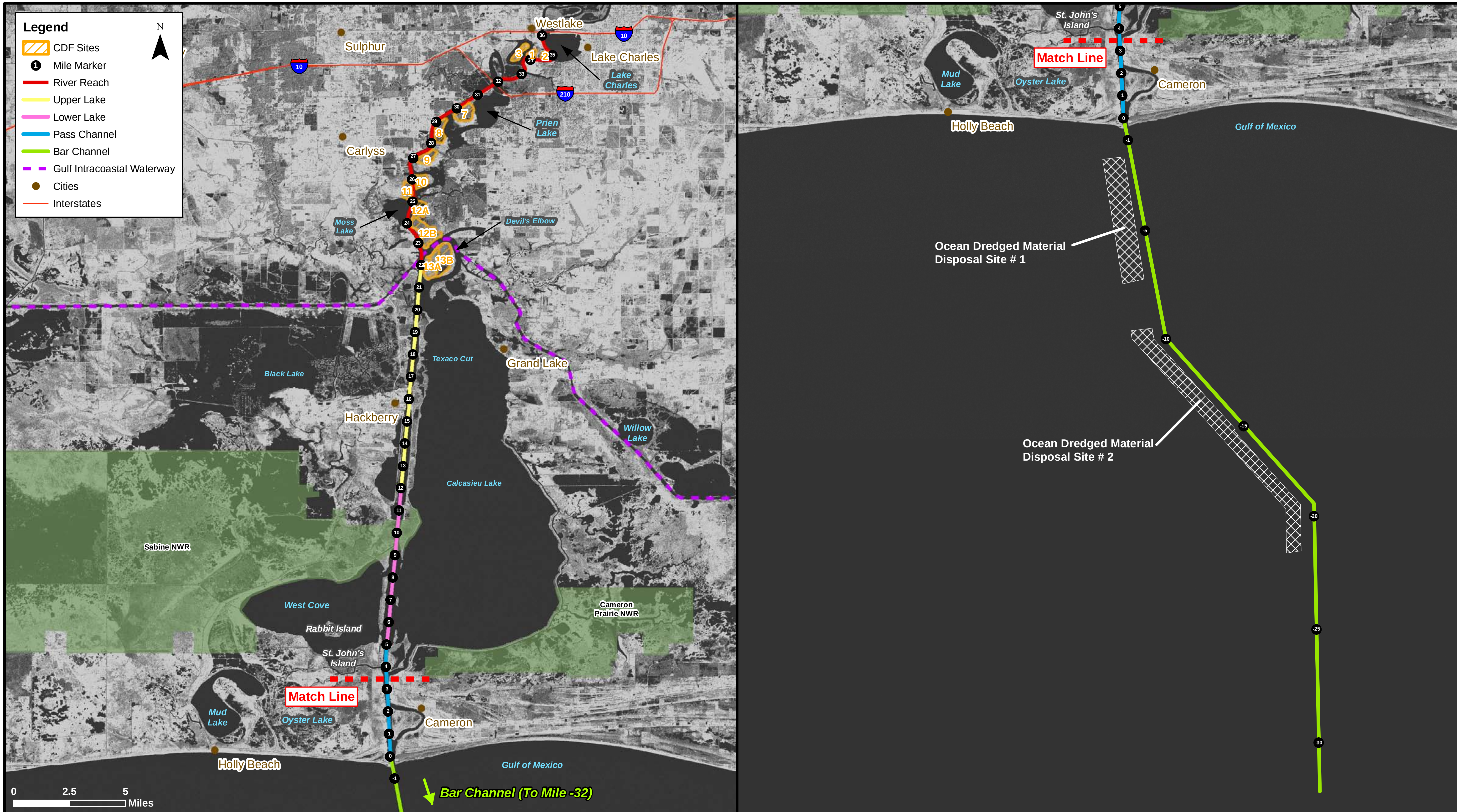
PLAN C
DISPOSAL SITES FOR DREDGED MATERIAL

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 2-27
Date: September 2010
Scale: 1:260,000
Source: USGS/GEC/USACE
Map ID: 27585107-1243



PLAN D
DISPOSAL SITES FOR DREDGED MATERIAL

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Panmerge, LDEQ (2002)

GEC

Figure: 2-28	
Date: September 2010	
Scale: 1:260,000	
Source: LDEQ/GEC/USACE	
Map ID: 27585107-1273	

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The Federal Council on Environmental Quality (CEQ) regulations (40 CFR Part 1500 *et seq*.), promulgated to implement the National Environmental Quality Act, provides guidance for the preparation of environmental impact statements. Section 1502.15 of the CEQ regulations provides direction for preparing the Affected Environment section and states that this section shall contain data and analysis “commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced.”

This section of the DMMP/SEIS places emphasis on two areas: water/sediment quality and biological resources, including wetlands. Because of the long history of water quality problems associated with the petrochemical industrial corridor along the Calcasieu River, it has been suspected by individuals within government agencies and the general public that chemical contamination could be an important issue. In association with the preparation of the DMMP/SEIS, the USACE conducted a comprehensive water and sediment sampling program to evaluate the quality of these materials. The water and sediment quality discussions in this section are somewhat detailed, but they include summaries of the extensive background information on the Calcasieu system and discussions of the results of the sampling program.

The second major environmental issue pertaining to the project area and described in this section is biological resources. Louisiana’s coastal areas, including the Calcasieu estuary, are economically, recreationally, and ecologically important to the region and the entire country. The loss and restoration of coastal wetlands have been issues of major importance for years. In addition, the Calcasieu area is the home of protected species and is within a major flyway for migratory birds. Emphasis is placed on those existing biological resources potentially affected by the alternative actions.

3.2 PHYSICAL CONDITIONS OF THE CALCASIEU ESTUARY

The Calcasieu Ship Channel can be separated into two separate components that together comprise an estuary system. The upper section consists of the historical Calcasieu River, and the lower portion consists of the Calcasieu Lake; the ship channel was constructed through the western edge of the lake. The ship channel is 36 miles long, spanning from the Gulf of Mexico to Lake Charles, and traverses Calcasieu and Cameron parishes (Figure 1-1).

Calcasieu Lake is a drowned river valley that acted as a sink for material deposited by riverine discharge from the Calcasieu River prior to the construction of the ship channel. The lake is 16 miles long from north to south, varying in width from five miles at the north end to seven miles in the southern region.

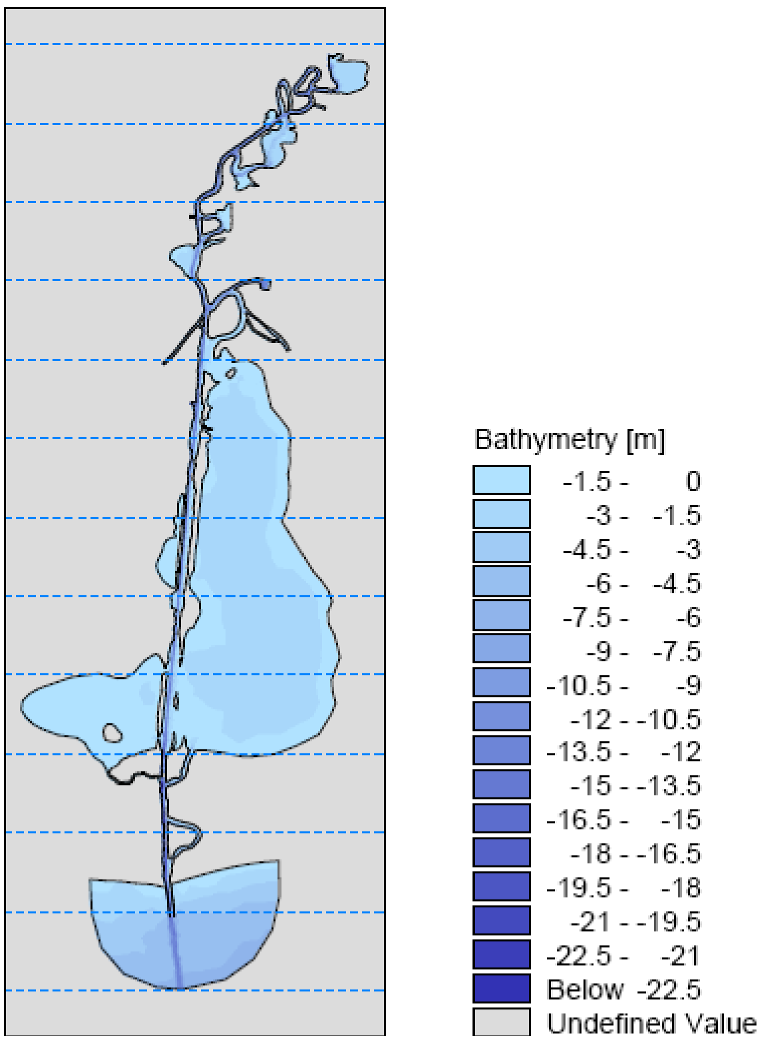
The climate of the project area is classified as humid subtropical. Little change occurs in the day-to-day weather of the summer months, except for an occasional rain shower or a tropical storm traversing near the area. Based on a 30-year data set from the National Weather Service, the average total annual precipitation is approximately 54.5 inches, with a monthly average of 4.54 inches.

The physical conditions of particular concern in the study area primarily affect the lake portion. They include bathymetry, water levels, wind conditions, wave conditions, and tidal currents.

3.2.1 Bathymetry

The National Oceanic and Atmospheric Association (NOAA) Chart 11347, 28th Edition, April 27, 1996, depicts a unique bathymetric depression in the center of Calcasieu Lake. The results of the wind and wave study of the area indicate that the depression is a result of circulation generated by dominant strong wind patterns characteristic of this area. Strong south to southeast winds create persistent flow patterns that scour the region, which has resulted in the formation of a depression approximately seven feet deep. The average depth of Calcasieu Lake is six feet; the scour feature runs the length of the lake, gradually sloping to shallow water environments along the banks. The shoreline adjacent to the Calcasieu Ship Channel consists of shallow shoals where active bank erosion has dispersed sediment on the nearshore.

The remaining bathymetry in the area is generally shallow with gradual depth transitions, except for areas near natural or dredged channels, where steeper gradients exist. Figure 3-1, reproduced from Appendix C, *Hydrodynamic Studies*, depicts the bathymetry of the Calcasieu system.



(Depth Contours are in Meters Referenced to MLG)

Figure 3-1. Bathymetry of the Lake Calcasieu System

The Calcasieu Ship Channel is a multi-use channel. Predominant uses include transportation of liquefied natural gas, bulk materials, chemicals, and raw fuels. Port, commercial and industrial berths are typically dredged to the adjacent Federally authorized channel depths and have bulkheads, low-level relieving platforms or other berthing structures. This results in abrupt changes in bathymetry from the berthing areas to adjacent port and industrial facilities and marinas.

The navigation channel consists of four main components:

- A 42-foot-deep by 800-foot-wide approach channel from the Gulf of Mexico to the seaward end of the jetties.
- A 40 to 42-foot-deep by 400-foot wide channel though the jetties.
- A 40-foot-deep by 400-foot-wide channel extending from the landward end of the jetties at channel mile 0 to channel mile 34.1 near Lake Charles, including the loop around Clooney Island.
- A 35-foot-deep by 250-foot-wide channel between channel miles 34.1 and 36.0 in Lake Charles.

Additionally, the project includes the following improvements:

- A 40-foot-deep by 350-foot by 2,000-foot mooring basin at channel mile 3 near Cameron.
- A 40-foot-deep turning basin at channel mile 29.6. Width and length not specified.
- A 35-foot-deep by 750-foot by 1,000-foot turning basin at channel mile 36.0.
- A 40-foot-deep by 400-foot-wide by approximately 2.8-mile-long channel at Devil's Elbow, with a 40-foot-deep by 1,200-foot by 1,400-foot turning basin at its terminus.
- A 40-foot-deep by 200-foot-wide by 6,953-foot-long channel at Coon Island, with a 40-foot-deep by 750-foot by 1,000-foot turning basin at its terminus.

The inland portion of the ship channel is maintained with contracted hydraulic cutterhead dredges. Other types of dredges, such as dustpan dredges or hopper dredges, could be used but have not been used historically. Contracts for dredging the channel typically require that the contractor excavate the channel to the authorized dimensions plus two feet of advanced maintenance. Advanced maintenance is the practice of deepening a channel reach in anticipation of shoaling in order to allow for reasonable intervals between maintenance dredging events. Advanced maintenance is a standard USACE practice for maintaining channels that shoal and must be periodically dredged. This practice minimizes the high costs of maintenance dredging, including the costs associated with dredge mobilization and demobilization and high costs per volume of material when only a thin layer of shoal material is removed from the channel bottom.

In addition to advanced maintenance, the term allowable overdepth is used to identify a vertical zone extending deeper than the advanced maintenance depth, which may be disturbed or dredged so that the channel dimensions specified in the dredging contact are achieved. Due to inherent inaccuracies in the dredging process, contractors normally excavate the channel somewhat deeper than the specified depth so that post-construction channel surveys confirm that minimal dimensions required in the dredging contract have been achieved. For some USACE projects, the zone of allowable overdepth is specified, and the contractor is paid for material removed from this zone. The practice of paying for excavation in the zone of allowable overdepth tends to encourage contractors to excavate within the zone and tends to increase total contract costs to the Government. For the Calcasieu Ship Channel project, allowable overdepth is not specified; therefore, no payment is made for material dredged below the advanced maintenance depth. Channel surveys taken after dredging indicates that the ship channel may be dredged up to two to three feet deeper than the advanced maintenance depth specified in the dredging contract.

3.2.2 Water Levels

The study area is dominated by wind-driven water levels, along with astronomical tidal signals and terrestrial runoff. Calcasieu Lake is aligned with the prevailing seasonal wind directions. Winds from the northeast decrease water levels and winds from the south periodically increase water levels. Direct short-term impacts to the study area are caused by localized wind events. The daily tides for the system have both diurnal and semidiurnal components but are primarily diurnal, resulting in a single high tide and single low tide per day. Spring tidal ranges vary by approximately 1.9 feet according to the Coastal Inlets Research Program and the National Oceanic and Atmospheric Administration (NOAA). Extreme changes in water levels sometimes occur as a result of storm surges from tropical systems and winter frontal passages. Additionally, water levels are elevated from surface runoff during intense rainfall events. The entrance channel to the system is a narrow (1,080 feet) five-mile-long channel. The Calcasieu Ship Channel is the only major connection between the Gulf of Mexico and Calcasieu Lake. Tidal exchange between these two water bodies is confined by the banks of the channel, creating strong tidal currents during conditions with large tidal fluctuations.

3.2.3 Wind Conditions

Winds in the study area have characteristic seasonal patterns. A predominant south-southeast wind is common throughout the year, but is most common during the spring to late summer months. During the fall months, winds are typically from the east; north winds dominate the winter months as frontal systems move across the area. Winter storm systems have a frequency of five to eight days, with durations from two to four days. Average wind speed in the area is 10 knots, with higher winds occurring along the lower Calcasieu Lake and lower wind speeds at the northern terminus near Lake Charles. During the passage of winter storms (late fall to early spring), sustained wind speeds of 15 knots are common, with gusts reaching 25 knots. These frontal systems can create erosive wind and wave conditions across the lake, elevating the rate of shoreline retreat. During the summer months, winds occur primarily from the southerly direction with speeds around five knots. Differential cooling and heating of the adjacent land masses can create afternoon wind conditions across the lake where wind speeds can exceed 10 knots.

3.2.4 Wave Conditions

Wave conditions impact primarily Calcasieu Lake. Short fetch lengths in the upper portion of the ship channel do not allow wave field development. The wave field for Calcasieu Lake has maximum seasonal wave heights less than or equal to 2.5 feet with a period of 3.5 to 4.0 seconds. Characteristic mean wave height produced from an average wind event is approximately 1.5 feet with a 2.0 second period. The shallow nature of the system and the limited fetch lengths across the bay are limiting factors for wave growth. Wave field development occurs within a narrow time frame and does not significantly increase with longer duration wind events. These wind events can produce high frequency wave conditions that are extremely erosive because of their short intervals, energy potential, and recurrence.

3.2.5 Tides and Currents

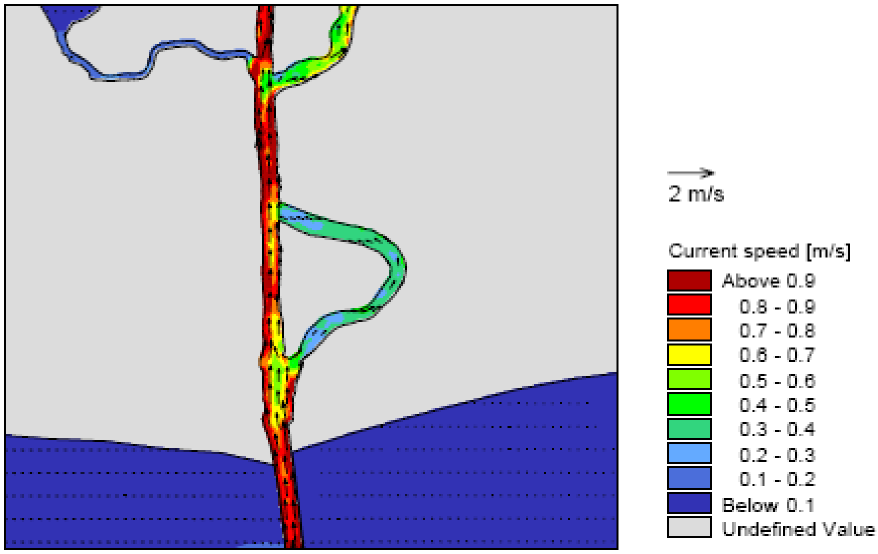
The hydrodynamic analysis of the Lake Calcasieu system (Appendix C) provides detailed model results of tide data, current velocities, and flow rates. When considering tides, ebb tides occur when the tide goes out, while flood tides occur when the tide comes in. The importance of ebb and flood tidal cycles is related to the velocity of the currents in the system. This, in turn, is of major importance in the erosion and deposition of sediments.

Because fresh water continually enters the system from the Calcasieu River and other sources, less water enters from the Gulf of Mexico during flood tides than is discharged into the Gulf of Mexico during ebb tides. Therefore, tidal currents tend to be stronger during ebb tides. Flow velocities are the strongest along the main channel between channel miles 1 to 5. This is due to the narrowed channel between the tip of the jetties and the southern end of the lake. Current velocities averaged over the depth of the water column in the inlet generally peak around 3.9 - 4.6 feet per second for outgoing tides and 3.3 - 3.9 feet per second for flood tides. A depiction of the hydrodynamic model output is presented in Figure 3-2, which shows the velocity, direction, and magnitude of flow when maximum flood tidal current velocities occur at the inlet.

Between channel miles 5 and 21 the flow is divided between the main channel and the main body of Lake Calcasieu. A portion of the ebbing flow bypasses the main channel just south of Devil's Elbow and enters into the lake. The secondary flow route through the main body of the lake creates relatively high velocity ebb currents returning flow to the ship channel in the area not constrained by disposal islands. Velocities are the greatest along the constrained sections of the main channel and at the flow constrictions at the north and south end of the lake, as shown in Figure 3-3. The flow velocities are often below the threshold for suspending sediment in this region, with peaks at maximum flood and ebb flows that likely suspend sediment for short periods of time.

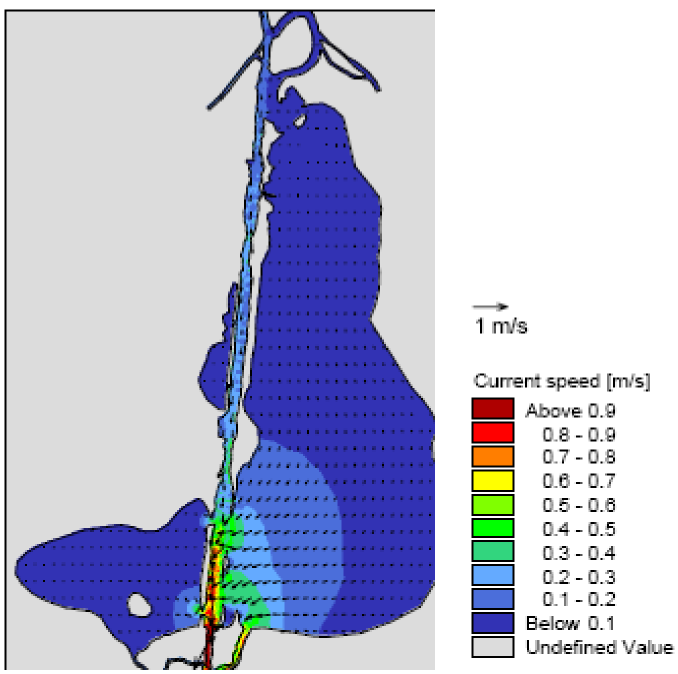
At the northern end of the lake the flow is generally constrained to the GIWW and the navigation channel to Lake Charles. The circulation patterns around Devil's Elbow are weak, with flow velocities remaining below 0.3 feet per second for all phases of the tide. Because of the channel configuration, the relatively low velocities promote the settling of suspended material, which is supported by the significant volume of historic dredging in this area.

The channel is constrained north of channel mile 23 until it reaches Lake Charles at mile 35. Flow magnitudes are generally between 0.1 and 1.0 feet per second along the main channel and lower in the fringing bays and marshes. Velocities decrease further towards the head of the system, as shown in Figure 3-4.



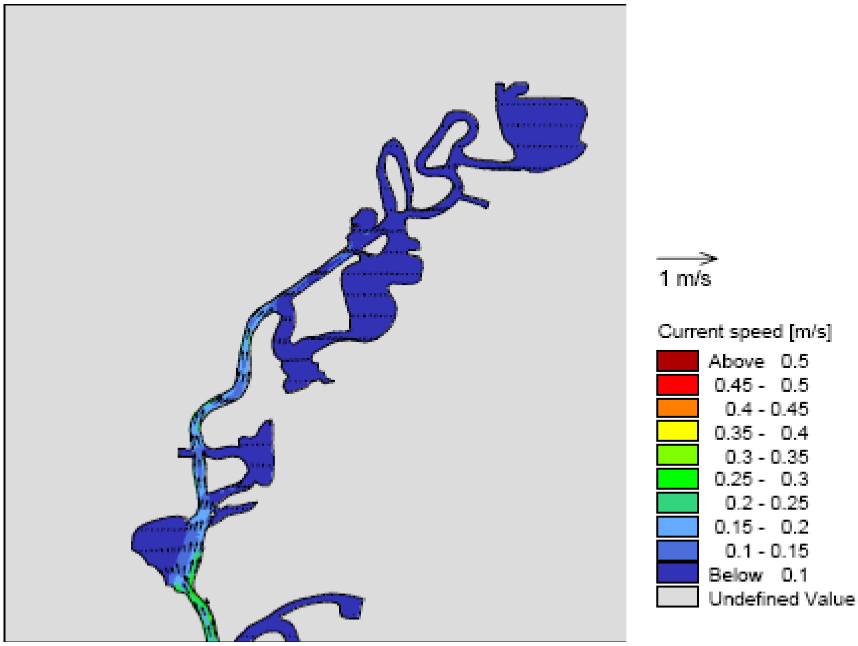
(Color contours indicate flow velocity, and arrows indicate the direction and magnitude of flow.)

Figure 3-2. Hydrodynamic Model Output in the Channel Between the Gulf of Mexico and Lake Calcasieu During Maximum Flood Tidal Velocities



(Color contours indicate flow velocity, and arrows indicate the direction and magnitude of flow.)

Figure 3-3. Hydrodynamic Model Output in Channel along Lake Calcasieu During Maximum Ebb Tidal Velocities



(Color contours indicate flow velocity, and arrows indicate the direction and magnitude of flow.)

Figure 3-4. Hydrodynamic Model Output along Calcasieu Ship Channel During Maximum Ebb Tidal Velocities

3.3 GEOLOGY AND SOILS

3.3.1 Geology

Surface sediments within the project site and the surrounding area consist largely of dredged material comprised of river alluvium deposited by the Calcasieu River. No significant naturally occurring geomorphologic features are present, and artificial levees composed of dredged material and riprap are the only significant topographic features within the project area. The surface, riverine, and lacustrine deposits are underlain by approximately 34,000 feet of sediment and sedimentary rock that consist almost entirely of sandstone, siltstone, and claystone. These sediments record the outward progression of the Gulf Coastal Plain over time as a result of natural erosion and sedimentation processes.

The project area is a deltaic-marine environment. The current morphology of the basin is primarily the result of deterioration of abandoned delta complexes through wave erosion and subsidence. Abandoned deltaic environments have received little attention in the past, but recent concern for coastal land loss in Louisiana has generated considerable interest in these environments and has resulted in the formulation of a model (the Penland and Boyd model) that provides an interpretation for some of the more distinctive features observed in these areas.

In the Penland and Boyd model, deltaic-marine environments form repeatedly over time in cyclic patterns. The model begins with the formation of delta lobes by sediment deposition from a river and its distributaries. Over time the course of the river changes, resulting in abandonment of the delta lobe. The abandoned lobe is rapidly destroyed by erosion and/or subsidence; winnowed sediments from the lobe accumulate offshore to form barrier islands. Wave erosion gradually destroys the barrier islands, leaving shallow shoals in their place. Eventually the river resumes its previous course, resulting in the rebuilding of the delta lobe and the beginning of a new cycle.

Deltaic-marine environments are transitional environments, combining the morphologic features of fluvial and deltaic environments with those of coastal settings. A wide variety of features may be found in deltaic-marine environments, depending in part upon the local climate and geologic setting. Some of the more prevalent morphologic features of these environments are discussed below.

Distributaries. Many of the smaller waterways in southern Louisiana are current or former distributaries of the Mississippi River or proto-Mississippi River, which has ranged over virtually the entire breadth of the state during its lifespan. The division of a river into multiple distributary channels is a common occurrence in coastal areas with a low gradient, as is the case in the Gulf Coast of Louisiana.

Distributaries commonly develop due to levee breaches (crevasses) caused by rivers in flood stage and can vary greatly in size and lifespan. Water flowing through a crevasse may have enough erosive force to incise a channel into the adjacent flood/delta plain. This channel may remain a water-bearing body after the river level drops, forming a distributary. Distributaries seldom carry more than a very small volumetric percentage of the river system's total discharge. Following river channel abandonment, distributaries may still function as active water conduits, transporting runoff to backswamps or coastal marshes. The abundant bayous of the Louisiana coastal plain generally function in this capacity.

Interdistributary Marshes. Interdistributary marshes comprise the most inland portion of a deltaic-marine environment. They form due to an interdependent relationship and favorable balance between sedimentation and vegetative growth. Sediments entering interdistributary bays accrete and form intratidal mudflats. Once these mudflats vertically accrete enough sediment at the surface to support vegetative growth, they are rapidly colonized by emergent plants (typically freshwater communities), which allow further sediment entrapment. Along the Louisiana coast, sedimentation rates are seldom high enough to convert the marsh into a more upland environment. In some instances, sedimentation rates have not kept pace with subsidence rates, resulting in land loss, and subsequently, marine encroachment. As subsidence continues, marsh vegetation typically changes from freshwater communities to brackish and saline plant communities and is prevalent during delta abandonment phases.

Cheniers. Cheniers are relic beach ridges that form following delta abandonment. Winnowing of sediments from deteriorated interdistributary marsh may concentrate coarser sediments along the marsh perimeter into beaches and spits. Subsequent mudflat formation may trap these beaches and spits, which are then considered to be linear ridges of high ground within the surrounding marsh. Such landforms are termed cheniers after the oak trees that frequently grow along them and are particularly abundant along the coast of southwest Louisiana.

Bays, Lakes, and Sounds. Shallow lakes, bays, and sounds are ubiquitous in all stages of a deltaic cycle. The abundance and size of these features increase during the abandonment stage, when land loss caused by wave erosion and subsidence is no longer compensated by sedimentary input from distributaries. Lakes, bays, and sounds first become abundant near the seaward margin of a delta lobe, increasing and ultimately coalescing inland. The waterbodies increase in depth and salinity as land loss continues, and may eventually give way to open marine waters.

Bottom sediments in these water bodies are highly variable, consisting of detrital material from deteriorated interdistributary marsh, as well as material from preexisting delta lobes that have been exposed by bottom current action. Sediments consist primarily of silt and sand, with sporadic occurrences of organic clay, and reef and shell deposits. Coarser sediments are generally deposited farther seaward, occasionally reaching a thickness of 10-15 feet.

Beaches and Barrier Islands. Fine-grained sediments typically dominate the outer portions of delta lobes and coastal complexes. During winnowing associated with deltaic deterioration, coarser sediments augmented by shell fragments of marine invertebrates (i.e., sand) are often concentrated by waves and currents and form beaches and barrier island deposits.

Two distinct stages of barrier island formation have been documented. Stage 1 is referred to as an erosional headland, and is characteristic of relatively young systems, such as those found in the Barataria Basin. Stage 2 is known as a transgressive barrier island arc and is typically characteristic of more mature systems, such as coastal southwest Louisiana.

During erosional headland formation, sediments transported by marine processes begin to accumulate along the headland of a deteriorating interdistributary marsh. The sedimentation rates eventually override the headland and, erosion and subsidence cause the area to migrate inland, leaving offshore accumulations of coarser sediment. These deposits are known as barrier islands. Barrier islands migrate inland due to sediment accumulation from distributaries and laterally due to sediment transport from longshore currents. Breaches in barrier islands from storm action result in the formation of tidal inlets and eventually transform a single island into a series of adjacent islets. Sediment supply decreases with continued headland erosion, resulting in rapid erosion of offshore barrier islands, eventually giving way to Stage 2 systems, or transgressive barrier island arcs.

A transgressive barrier island arc is completely detached from the headland. As in Stage 1, the barrier island system continues to migrate landward and laterally, while concurrently diminishing in size. In the most advanced stage of delta abandonment, a barrier island may be destroyed by erosion, leaving a shallow, submerged shoal in its place. The lack of barrier island deposits in the sedimentary record appears to support this theory.

Reefs. True reefs in Louisiana have been constructed only by oyster colonies. Oysters thrive in bays and sounds, where shallow, brackish to saline water is abundant. New generations often attach themselves to older living oysters or to dead shells. In favorable areas that experience subsidence, oyster colonies exhibit a vertical growth pattern in an attempt to remain within a specific photic zone, and these reefs may reach a thickness of many feet. Oyster reefs in offshore Louisiana are typically linear and appear to follow ancient distributary paths on the submerged continental shelf. This implies that submerged levee systems from a sea-level lowstand may be a preferred substrate for colonization.

Nearshore Gulf Environments. Nearshore gulf environments are often referred to as gulf-bottom, strand plain, or shelf deposits. They are directly associated with the postglacial rise in sea level (transgression) that began approximately 12,000 years B.P. This transgression caused sediments that had previously been deposited during the Pleistocene sea level lowstand on the then-exposed continental shelf to erode and become submerged. Nearshore Gulf deposits consist of accumulations of eroded and winnowed sediments from these deposits, as well as sediment transported by longshore currents. These deposits typically thicken in a seaward direction with the thickest deposits over incised channel features in the underlying seafloor (achieving a thickness of up to 40 feet) and thinnest over topographic highs on the seafloor (reaching a thickness of several feet). Nearshore Gulf deposits often represent a classic sedimentary sequence that reflects the transgression of the sea. The deposits closest to the shoreline are composed of a sand-shell hash substrate, and as water depths increase, finer-grained sediments are more prevalent and often culminate into layers of organic-rich clay.

3.3.2 Geomorphology

The project area is mainly comprised of a series of low-lying, semi-inundated marsh areas with interspatial salt dome formations, such as the formation which makes up the Hackberry Area on the western shoreline of the Calcasieu Lake. An estuary has been defined as “a semi-enclosed coastal body of water which has free connection with the open sea and within which sea water is measurably diluted with fresh water of river origin” (Pritchard, 1967). Calcasieu Lake is considered a partially-mixed estuary in which tidal inundation creates a salt wedge in the upper estuary, forcing a mixing zone with the upper freshwater discharge into the system. This boundary migrates up and down the estuary depending on the time of year and tidal cycles, and creates a null-point where sediment particles flocculate through various transport pathways into the salt wedge and settle into the deeper contours of the estuary. It is suspected that the null-point occurs immediately south of the intersection of the GIWW and the Calcasieu Ship Channel. The deeper contours of the existing ship channel act as a sediment sink. Riverine deposits are deposited within Lake Charles and other pooling lakes along the meandering path of the old Calcasieu River alignment. These fluvial deposits consist of dark brown to light grey silty and sandy clays. During high flow events these deposits are flushed in to the upper region of Calcasieu Lake where they are acted upon by the wind and wave environment.

3.3.3 Sediment Sources, Sinks, and Transport Processes

The currents and shoaling evaluation has primarily relied on historic dredging records to determine shoaling rates (see the full Shoaling Report, Appendix A). Identified sources of material include riverine deposits, lake and bay bottom erosion, and possible recycling of materials from eroding CDFs. A report by the USACE Engineering Research and Development Center Water Station (Phase 2 Study) compiled historical survey data from 1972-1998 to determine erosion rates along the banks of the Calcasieu Ship Channel. These data are summarized in Table 3-1. The study indicates that erosion occurs on the west bank between miles 8-11 and miles 18 to 23, and on the east bank between miles 11-19, encompassing a total of eight miles of the ship channel.

Visual examination of all existing CDFs in July 2006 indicated significant dike erosion, particularly from miles 7 to 21 on both the ship channel and lake sides of the CDFs. Active shoreline erosion, upland surface erosion, and fringe marsh loss could contribute to shoaling of the ship channel.

The hydrology of the marshes near of Calcasieu Lake has also been altered by numerous relatively small access canals. The GIWW and this network of canals have established hydrologic connections within the estuary. This interlinked system with fresh water drainage and tidal circulation in the northern and western portions of the basin allow for a multitude of sediment transport pathways.

Subsidence and sea level rise simultaneously contribute to wetland loss and increase the surface area of the estuary system through geologic time. The combination of the two processes results in a water level rise of more than 0.25 inches per year or two feet per century.

Shoreline erosion-related breaching of marsh systems near the GIWW results from water level rise and human activities including canal cutting, vessel traffic, and urbanization.

Table 3-1. Bank Erosion Rates (1972-1998) and Yearly Shoaling Rates (1995-2005)

Mile	West Bank Erosion			East Bank Erosion			Channel Width (ft)	Yearly Shoaling(CY/LF)
	Rate (ft/yr)	Total Distance (ft)	D/A Area	Rate (ft/yr)	Total Distance, (ft)	D/A Area		
5 – 8	No Data			No Data: Open to Lake			Wide	22.8
8 – 9	16.3	424	H	No Change: Open to Lake			wide	35.1
9 – 10	19.3	503		No Change: D/A's G & F			1,250	35.1
10 – 11	11.5	298		53	137	F	1,100	35.1
11 – 11.3	16.0	417		4.5	118	F	2,050	35.1
12 – 13	Little Change Due to Rock Revetment			8.4	218	E	1,800	46.1
13 – 16				3.9	100	D	1,500	46.1
16 – 17				5.8	150	23,22	1,000	37.7
18 – 19	6.4	167	Mil18	8.8	230	19	1500	37.7
	9.9	257	16S	6.6	171	17		
20 – 22	11.1	290	16N	Little Change: Open to Mud Lake			1,700	42.2
22 – 23	7.3	190	15				1,000	30.1
23 – 26	Little Erosion Between Mile 23 and 36						1,000	30.1
26 – 30							1,000	13.9
30 – 34				Little Erosion Between Mile 30 and 36			1,000	2.2
34 – 36							1,000	0.43

Source: USACE.

Appendix C, *Hydrodynamic and Sediment Transport Study*, provides details on the erosion and deposition of sediments in the Calcasieu Ship Channel. The Calcasieu estuary is complex, and sediment transport patterns are dominated by different mechanisms within each unique part of the overall system. The open-water area of Calcasieu Lake is dominated by wind-driven waves. Strong tidal currents are evident in the area between the Gulf of Mexico and Calcasieu Lake, but the long narrow channel prevents wave energy from entering the estuary from the Gulf.

North of mile 20, in the region of the confluence of the west and east sections of the GIWW, the confined portion of the Calcasieu Ship Channel, the northern reaches of Calcasieu Lake, and the Calcasieu River, the riverine morphology suggests that episodic freshwater inflow events are a major source of sediments that need to be dredged from the channel. The sediment transport model concluded that most of the western channel margins and a significant portion of the eastern margins of the channel experience net erosion. For areas where the entire channel width is relatively narrow, current velocities and associated bottom shear stress along the flanks of the channel increase, leading to higher erosion rates along these locations. For other portions of the Calcasieu Ship Channel, the navigation channel is near the west bank, causing larger tidal velocities and erosion in the shallows along the west edge of the channel.

The hydrodynamic response to vessel traffic in the channel includes strong shear stresses at the channel banks. Vessel traffic in the Calcasieu Ship Channel is a major cause of bank erosion and sediment re-suspension.

3.3.4 Soils

Soils are a dominant factor in substrate formation, which in turn influence the type of vegetation communities and land use that may be found within a given area. Of particular concern are prime farmland soils. The U.S. Department of Agriculture (USDA) defines prime farmland as land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. Table 3-2 provides information on soils that occur in the vicinity of the project corridor.

Table 3-2. Soils Occurring in the Project Corridor Vicinity

Name	Slope	Hydric	Taxonomic Class	Comments
Kinder-Messer silt loams	**0-5%**	**Yes**	**Typic Glossaqualfs/ Haplic Glossudalfs**	**Terrace uplands**
Guyton-Messer silt loams	**0-5%**	**Yes**	**Typic Glossaqualfs/ Haplic Glossudalfs**	**Terrace uplands**
Arat mucky silt loam	0-0.5%	Yes	Typic Hydraquents	Swamps
Clovelly muck	0-0.2%	Yes	Terric Medisaprists	Brackish marshes
Udifluvents	1-20%	No	---	Spoil banks
Crowley-Vidrine silt loams	**0-1%**	**No**	**Typic Albaqualfs/ Glossaquic Hapludalfs**	**Broad convex ridges on Gulf Coast prairies**
Acadia silt loam	1-3%	No	Aeric Ochraqualfs	Side slopes of terrace uplands
Basile and Guyton silt loams	---	Yes	Typic/Thermic Glossaqualfs	Frequently flooded
Aquents	0-1%	Yes	---	Frequently flooded
Gentilly muck	0-1%	Yes	Typic Hydraquents	Brackish marshes
Morey loam	**0-1%**	**No**	**Typic Argiaquolls**	**Broad flats on Gulf Coast prairies**
Mowata-Vidrine silt loams	**0-5%**	**Yes**	**Typic Glossaqualfs/ Glossaquic Hapludalfs**	**Broad mounded flats on Gulf Coast prairies**
Scatlake mucky clay	0-5%	Yes	Typic Hydraquents	Saline marshes
Crowley-Vidrine silt loams	**0-5%**	**No**	**Typic Hydraquents/ Glossaquic Hapludalfs**	**Broad ridges on Gulf Coast prairies**

Name	Slope	Hydric	Taxonomic Class	Comments
Creole mucky clay	0-1%	Yes	Typic Hydraquents	Brackish marsh
Mermentau clay	0-1%	Yes	Typic Haplaquepts	Brackish marsh
Hackberry loamy fine sand	0-1%	No	Aeric Haplaquepts	Toe slopes
Hackberry-Mermentau complex	0-3%	Yes	Aeric/Typic Haplaquepts	Gently undulating
Beaches, coastal	0-1%	Yes	---	Shoreline deposits

Note: Soils classified as prime farmland are denoted by bold font.

Source: NRCS, 1988, 1995.

The project corridor itself is comprised almost exclusively of the Calcasieu Ship Channel, which does not contain any soils, or adjacent spoil banks and is composed of frequently flooded aquents and udifluvents. Soils in the vicinity of the project corridor are typically hydric silt loams and mucks that generally experience a high degree of flooding. Six soil types occurring in the project corridor are classified as prime farmland (bolded text in Table 3-2). These prime soils make up a miniscule proportion of the project area.

3.4 SURFACE WATER AND SEDIMENT QUALITY

The Clean Water Act (CWA) of 1977 established a process for each state to monitor and report on its surface and groundwater quality. The USEPA compiles and summarizes the data from the state reports and transmits them to Congress along with an analysis of the status of nationwide water quality. Requirements for this process are found in Section 305(b) of the CWA. The National Water Quality Inventory 305(b) Report to Congress identifies widespread water quality problems of national significance and describes various programs to restore and protect water quality. The Section 305(b) Water Quality Report (2004) prepared by the LDEQ summarizes the monitoring data that characterizes the quality of waters in the Calcasieu Ship Channel (Table 3-3).

Table 3-3. Summary of Monitoring Data in the Project Area (2004)

LDEQ Subsegment Number	Subsegment Description	Type	Size	PCR	SCR	FWP	DWS	ONR	SFP	AGR	LAL	Suspected Causes of Impairment	Suspected Sources of Impairment
LA030301_00	Calcasieu River and Ship Channel-Saltwater Barrier to Moss Lake	R	21	F	F	N	--	--	--	--	--	Polychlorinated biphenyls (PCB)	Industrial Point Source Discharge
LA030301_00	Calcasieu River and Ship Channel-Saltwater Barrier to Moss Lake	R	21	F	F	N	--	--	--	--	--	Polycyclic Aromatic Hydrocarbons (PAHs)	Industrial Point Source Discharge

LDEQ Subsegment Number	Subsegment Description	Type	Size	PCR	SCR	FWP	DWS	ONR	SFP	AGR	LAL	Suspected Causes of Impairment	Suspected Sources of Impairment
LA030401_00	Calcasieu River-Calcasieu Ship Channel below Moss Lake to the Gulf of Mexico	R	26	F	F	F	--	--	F	--	--	--	--
LA030303_00	Prien Lake (Estuarine)	E	2	F	F	F	--	--	--	--	--	--	--
LA030402_00	Calcasieu Lake (Estuarine)	E	67	F	F	F	--	--	F	--	--	--	--

Header: R-River; E-Estuary; PCR-Primary Contact Recreation; SCR-Secondary Contact Recreation; FWP-Fish & Wildlife Propagation; DWS-Drinking Water Source; ONR -Outstanding Natural Resource; SFP-Oyster Production; AGR-Agriculture; LAL-Limited Aquatic & Wildlife
Use Support Status: F-fully supported; T-fully supported but threatened; P-partially supported; N-not supported
River Size in Miles; Estuary Size in Square Miles.

Section 303(d) of the CWA requires states to identify and list waterbody segments where water quality standards are not met and designated uses are not fully supported. Several segments of the Calcasieu River were placed on the Louisiana 2004 Section 303(d) list of water bodies that are monitored and evaluated for polychlorinated biphenyls and polycyclic aromatic hydrocarbons. These impairments typically affect waters designated for secondary contact recreation and aquatic life support. Overall, the waters in the project area fully support primary and secondary contact recreation, while aquatic life is fully supported in some areas and not supported in others. All waterbodies near the project area and suspected impairment causes are listed in Table 3-3.

According to Table 3-3, waterbody impairments, causes, and effects include:

a. Polycyclic aromatic hydrocarbons (PAHs): a group of organic contaminants that are a byproduct of incomplete burning of hydrocarbons in industrial processes. The introduction of PAHs to the Calcasieu Ship Channel is attributed to point source discharges from numerous industrial facilities in the area. PAHs can build up in the tissue of local fish through bioaccumulation, which can then be transferred by their consumption to humans or other aquatic life.

b. Polychlorinated biphenyls (PCBs): man-made chemicals of varying toxicity, some of which are considered carcinogenic. Their introduction to the Calcasieu Ship Channel is also attributed to point source discharges from industrial facilities in the area. PCBs commonly bioaccumulate in various fish species, which are then consumed by humans or other aquatic life, causing further contamination.

According to guidance provided by the USEPA, a waterbody may fall within one of three use support categories depending on the percent of measurements for any one physical or chemical parameter that exceeds the state's numerical water quality standards. These categories include

Fully Supporting, Partially Supporting, and Not Supporting. In the case where more than one parameter defines a designated use, support for each designated use is defined by the poorest performing parameter. General water quality criteria against which ambient concentrations are evaluated to make use support decisions are promulgated in the Louisiana Administrative Code, Title 33, Part XI, Chapter 11. General criteria include numeric values for temperature, pH, dissolved oxygen, turbidity, and total suspended solids. The general criteria concentrations applicable in the project area are: temperature less than 35° C, pH range 6.5 to 9 standard units, dissolved oxygen greater than 4 mg/L, turbidity less than 50 NTU, and total suspended solids less than 500 mg/L. A detailed breakdown of each category is given in Table 3-4.

Table 3-4. Summary of Use Support Categories

Designated Use	Measured Parameter	Support Classification for Measured Parameter		
		Fully Supporting	Partially	Not Supporting
Primary Contact Recreation (PCR) Designated swimming months of May - October Only.	Fecal coliform[1]	0-25% do not meet criteria	--	>25% do not meet criteria
	Temperature	0-30% do not meet criteria	>30-75% do not meet criteria	>75% do not meet criteria
Secondary Contact Recreation (SCR) (All months)	Fecal coliform[1]	0-25% do not meet criteria	--	>25 % do not meet criteria
Fish and Wildlife Propagation (FWP)	Dissolved oxygen[3]	0-10% do not meet minimum of 3.0 ppm and median > criteria of 5.0 ppm	--	>10% do not meet minimum of 3.0 ppm or median < criteria of 5.0 ppm
	Dissolved oxygen[4]	0-10% do not meet criteria	>10-25% do not meet criteria	>25% do not meet criteria
	Temperature, pH, chloride, sulfate, TDS, turbidity	0-30% do not meet criteria	>30-75% do not meet criteria	>75% do not meet criteria
	Metals[5] and Toxics	< 2 exceedances of chronic or acute criteria in most recent consecutive 3-year period, or 1-year period for newly tested waters	--	2 or more exceedances of chronic or acute criteria in most recent consecutive 3-year period, or 1-year period for newly tested waters

Designated Use	Measured Parameter	Support Classification for Measured Parameter		
		Fully Supporting	Partially	Not Supporting
Drinking Water Source (DWS)	Color, Fecal coliform	0-30% do not meet criteria	>30-75% do not meet criteria	>75% do not meet criteria
	Metals and Toxics	< 2 exceedances of drinking water criteria in most recent consecutive 3-year period, or 1-year period for newly tested waters	--	2 or more exceedances of drinking water criteria in the most recent consecutive 3-year period, or 1-year period for newly tested waters
Outstanding Natural Resource (ONR)	Turbidity	0-10% do not meet criteria	>10-25% do not meet criteria	>25% do not meet criteria
Agriculture (AGR)	None	--	--	--
Oyster Production (SFP)[6]	Fecal coliform[1]	Median fecal coliform < 14 MPN/100 mL; and < 10% of samples < 43 MPN/100 mL	--	Median fecal coliform > 14 MPN/100 mL; and > 10% of samples > 43 MPN/100 mL
Limited Aquatic and Wildlife (LAW)	Dissolved oxygen[4]	0-10% do not meet criteria	>10-25% do not meet criteria	>25% do not meet criteria

1. For most water bodies, criteria is as follows: PCR, 400 colonies/100 mL; SCR, 2,000 colonies/100 mL; DWS, 2,000 colonies/100 mL, SFP, 43 colonies/100 mL (see ERC 33:IX.1123).
2. While the assessment category of "Partially Supporting" is included in the SAS statistical assessment programming, any use support failures were recorded in ADB as "Not Supporting." This procedure was first adopted for the 2002 □305(b) cycle because "partially supported" uses receive the same TMDL treatment as "not supported" uses.
3. Water bodies with a D.O. criterion of 5.0 mg/L. This assessment method differs from USEPA guidance.
4. Estuarine waters with a D.O. criterion of 4.0 mg/L and water bodies for which a special study has been conducted to establish site specific criteria for D.O.
5. Marine metals criteria were used for all water bodies with an average salinity greater than or equal to 16.0 ppt. Freshwater metals criteria were used for all other water bodies.
6. Oyster propagation (SFP) was previously assessed using an assessment method of <25 percent of samples shall exceed 43 MPN/100 mL in order to be fully supporting. This method was not in accordance with ERC 33:IX.1113.C.5.iv. The assessment shown in Table 3-4 is the correct method. All subsegments previously assessed for oyster propagation were reassessed using the correct method, and the ADB system was updated as needed.

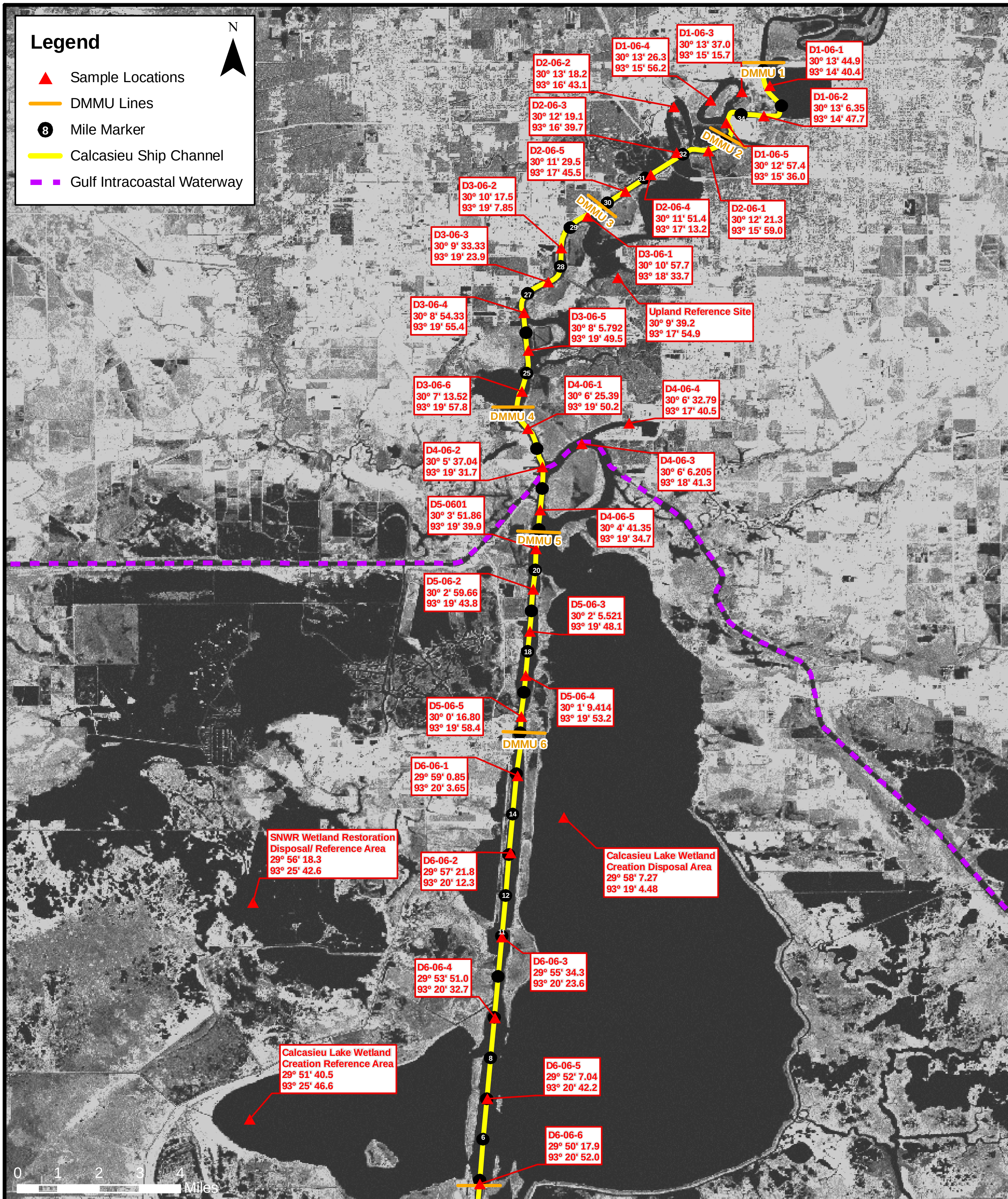
Source: LDEQ 2004 Water Quality Integrated Report.

LDEQ has also collected ambient water quality data from the ship channel for common field parameters, including pH, temperature, and dissolved oxygen, along with specific categories of constituents regulated by the USEPA. The results from LDEQ's studies within the project area are tabulated in Appendix S. These results indicate general compliance with water quality criteria, except copper and zinc, which were occasionally in concentrations in excess of applicable criteria.

Additional studies by LDEQ to ascertain the existing conditions in areas surrounding the Calcasieu Ship Channel, including Calcasieu Lake and the Sabine National Wildlife Refuge (SNWR) indicated levels of concern for some constituents. According to the Final 2006 Louisiana Water Quality Integrated Report prepared by LDEQ, Calcasieu Lake is considered impaired for oyster habitation due to elevated levels of fecal coliform from sewage spills in the area. Additionally, the USEPA surface water quality studies from 1999 to 2002 in the Calcasieu Lake detected levels of PAHs and various metals, primarily lead, copper, mercury, chromium, and zinc. More specifically, copper concentrations exceeded the ambient water quality criteria set for acute and chronic marine exposure and chronic freshwater exposure limits. Mercury concentrations exceeded the chronic ambient water quality criteria for freshwater systems. Additionally, sediment samples within the same study indicated levels of PAHs (HPAH and LPAH), PCBs, lead and zinc. Sediment contamination studies were conducted throughout the SNWR by the USFWS, as part of a Hurricane Rita Cleanup study. These studies indicated the presence of both diesel and oil range organics, along with various metals, including copper, lead, mercury, and zinc.

Water and sediment from thirty-two (32) stations within the ship channel and from two reference areas, the Calcasieu Lake Wetland Creation Reference Area (“Calcasieu Lake reference area”) and the SNWR Wetland Restoration Disposal/Reference Area (“SNWR reference area”) were collected in December 2006. Samples were analyzed in accordance with the protocols described in *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual* (ITM) (USEPA/USACE, 1998) and *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities - Testing Manual* (UTM) (USACE, 2003) as specified in the CEMVN’s Sampling and Analysis Plan (Figure 3-5).

Physical and chemical analyses were performed on sediment from each in-channel station and the two reference areas. Reference areas were selected to represent potential wetland development disposal areas in shallow open water within broken marsh or in shallow open water in Calcasieu Lake. Chemical analyses also were conducted on ambient water from six in-channel stations, from the SNWR reference area, from the Calcasieu Lake Wetland Creation Disposal Area (“Calcasieu Lake disposal site”), and on an elutriate from each in-channel station. Water at the SNWR reference area, at the Calcasieu Lake disposal area, and in the Calcasieu River represent receiving waters for wetland development sites within broken marsh, wetland development areas within Calcasieu Lake, and for effluent discharged from CDFs, respectively. Water column toxicity tests/suspended particulate phase bioassays used an elutriate dilution series from six Dredged Material Management Units (Figure 3-5). Benthic toxicity tests/solid phase bioassays and bioaccumulation tests used composited sediment from each Dredged Material Management Unit (DMMU) and both reference areas (Figure 3-5). DMMU 1 consisted of in-channel stations D1-06-1 through D1-06-5 (approximate channel mile 36 to channel mile 33 and Clooney Island Loop); DMMU 2 consisted of in-channel stations D2-06-1 through D2-06-5 (approximate channel mile 33 to channel mile 30 and Coon Island); and DMMU 3 consisted of in-channel stations D3-06-1 through D2-06-6 (approximate channel mile 30 to channel mile 24); DMMU 4 consisted of in-channel stations D4-06-1 through D4-06-5 (approximate channel mile 24 to channel mile 21 and Devil’s Elbow). DMMU 5 consisted of in-channel stations D5-06-1 through D5-06-5 (approximate channel mile 21 to channel mile 16); and DMMU 6 consisted of in-channel stations D6-06-1 through D6-06-6 (approximate channel mile 16 to channel mile 5. Copies of the Final Calcasieu River and Pass, Louisiana, Dredged Material Management Plan, Phase 2, Sampling and Analysis report which includes the MVN’s sampling and analysis plan, the scope of work, and the results of the analyses are available from the CEMVN upon request.



DMMUS AND SAMPLE LOCATIONS

Calcasieu River & Pass
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

Figure: 3-5
Date: March 2009
Scale: 1:210,000
Source: LCHTD/GEC/USACE/LDEQ
Map ID: 27585107-1312

Sediment Chemistry Summary. Results from chemical analyses of sediment from the six DMMUs within the Calcasieu River and Pass, Calcasieu Lake reference area, and the SNWR reference area revealed the presence of 13 metals, 14 PAHs, seven pesticides, three petroleum hydrocarbons, three PCBs, one volatile organic compound, and ammonia (Table 3-5).

Table 3-5. Analytes Detected in Sediment from Calcasieu River and Pass Dredged Material Management Units (DMMUs), and the Calcasieu Lake (CL) and Sabine National Wildlife Refuge (SNWR) Reference Areas

METALS	Channel Sediment						Reference Sediment		Units
	DMMU1	DMMU2	DMMU3	DMMU4	DMMU5	DMMU6	CL	SNWR	
Antimony	0.131	0.107	0.174	0.111	-	0.101	-	0.250	(ppm)
Arsenic	1.18	1.48	2.13	2.26	2.56	2.70	3.90	1.20	(ppm)
Barium	180	142	80.8	68.6	116	101	26.0	20.0	(ppm)
Beryllium	0.280	0.326	0.403	0.396	0.564	0.440	0.380	0.340	(ppm)
Chromium	6.26	7.68	6.97	7.04	8.58	8.03	6.90	5.80	(ppm)
Copper	6.16	9.36	6.95	6.44	6.90	5.97	5.00	4.50	(ppm)
Hexavalent Chromium	-	0.106	0.13	0.152	-	0.0957	-	-	(ppm)
Lead	8.22	9.48	8.68	8.32	8.42	7.60	6.60	6.50	(ppm)
Mercury	0.0466	0.114	0.0343	0.0362	0.0335	0.0501	-	-	(ppm)
Nickel	3.38	5.40	6.62	6.92	8.54	8.46	7.70	4.30	(ppm)
Selenium	-	-	-	0.253	0.502	0.335	-	-	(ppm)
Thallium	0.0880	-	-	-	-	-	-	-	(ppm)
Zinc	19.8	29.8	26.3	24.4	26.4	25.1	23.0	10.0	(ppm)

PAHs	Channel Sediment						Reference Sediment		Units
	DMMU1	DMMU2	DMMU3	DMMU4	DMMU5	DMMU6	CL	SNWR	
Anthracene	-	12.8	-	-	-	-	-	-	(ppb)
Benzo(a)anthracene	12.4	36.0	-	17.6	-	-	-	-	(ppb)
Benzo(a)pyrene	13.0	27.0	-	19.2	-	-	-	-	(ppb)
Benzo(b)fluoranthene	20.8	10.0	-	21.6	-	-	-	-	(ppb)
Benzo(ghi)perylene	12.4	27.2	-	19.0	-	-	-	-	(ppb)
Benzo(k)fluoranthene	-	-	-	12.2	-	-	-	-	(ppb)
bis(2-Ethylhexyl) phthalate	-	-	21.7	-	-	-	-	-	(ppb)
Chrysene	-	61.6	13.8	19.6	-	-	-	-	(ppb)
Fluoranthene	17.6	47.6	-	20.8	14.0	-	-	-	(ppb)
Fluorene	-	12.2	-	-	-	-	-	-	(ppb)
gamma-Chlordane	0.728	-	-	-	-	-	-	-	(ppb)
Indeno(1,2,3-cd) pyrene	-	15.0	-	14.8	-	-	-	-	(ppb)
Naphthalene	-	12.0	-	-	-	-	-	-	(ppb)
Phenanthrene	-	33.6	-	13.0	-	-	-	-	(ppb)
Sum PAH	76.9	295	35.5	158	14.0	-	-	-	(ppb)

PESTICIDES	Channel Sediment						Reference Sediment		Units
	DMMU1	DMMU2	DMMU3	DMMU4	DMMU5	DMMU6	CL	SNWR	
4,4'-DDT	2.67	1.16	2.26	2.08	-	1.85	2.30	2.00	(ppb)
beta-BHC	-	1.15	-	-	-	-	-	-	(ppb)
delta-BHC	1.56	0.667	-	-	-	-	1.20	1.30	(ppb)
Endosulfan Sulfate	2.98	-	-	-	-	-	-	-	(ppb)
PESTICIDES	**Channel Sediment**						**Reference Sediment**		**Units**
	DMMU1	**DMMU2**	**DMMU3**	**DMMU4**	**DMMU5**	**DMMU6**	**CL**	**SNWR**	
Endosulfan II	-	-	2.08	2.05	-	2.11	-	-	(ppb)
gamma-BHC	-	-	-	0.618	-	-	-	-	(ppb)
Heptachlor	-	0.585	-	0.574	-	-	-	-	(ppb)

OTHER	Channel Sediment						Reference Sediment		Units
	DMMU1	DMMU2	DMMU3	DMMU4	DMMU5	DMMU6	CL	SNWR	
Diesel Range Organics	41,800	55,600	43,500	43,600	34,200	18,157	6,900	7,300	(ppb)
Gasoline Range Organics	-	228	204	172	-	-	-	-	(ppb)
Motor Oil Range Organics	135,600	144,000	79,000	50,500	-	-	-	-	(ppb)
PCB-1016	-	-	-	1.99	-	0.744	-	-	(ppb)
PCB 1254	6.19	-	-	1.24	-	-	-	-	(ppb)
PCB 1260	3.60	5.92	1.68	0.927	-	-	-	-	(ppb)
Tetrachloroethylene	-	-	-	-	-	1.29	-	-	(ppb)
Ammonia	6023	48000	34833	27000	27000	24714	3500	-	(ppb)

Note: Analytes that were below laboratory detection limits for a DMMU or reference area are noted with a dash mark (-).

Concentrations of most metals detected in river sediments were similar and within the same order of magnitude as metals detected in the reference areas, including antimony, arsenic, beryllium, chromium, copper, lead, nickel, and zinc. Barium concentrations were consistently higher in the river (69 to 180 ppm) but within an order of magnitude of concentrations observed in reference sediments (20 to 26 ppm). Four metals were detected in river sediments, but not in either reference area. Mercury was detected at all six DMMUs (0.034 to 0.114 ppm); hexavalent chromium was detected at DMMUs 2, 3, 4, and 6 (0.096 to 0.152 ppm); selenium was detected at DMMUs 4, 5, and 6 (0.25 to 0.50 ppm); and thallium was detected at DMMU 1 only (0.088 ppm).

PAHs were detected in DMMUs 1 - 5, but not in DMMU 6 or either reference area. While PAHs were more prevalent in DMMUs 1, 2, and 4, the sum of all detected PAHs was relatively low and did not exceed a total of 295 ppb at any of the DMMUs. Benzo (a)anthracene, benzo(a)Pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, and phenanthrene occurred at two or more DMMUs. Anthracene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, fluorene, gamma-chlordane, and naphthalene were less common among the DMMUs.

Pesticides were detected in five DMMUs and the reference areas, but were more prevalent in DMMUs 1, 2, and 4. The concentration of 4,4'-DDT was comparable between DMMUs 1, 2, 3, 4 and 6 (1.2 to 2.7 ppb) and the reference areas (2.0 to 2.3 ppb). Delta-BHC was detected at DMMUs 1 and 2 (0.7 to 1.6 ppb) and the reference areas (1.2 to 1.3 ppb). All other pesticides were detected in river sediments only: endosulfan II (DMMUs 3, 4, and 6); heptachlor (DMMUs 2 and 4); endosulfan sulfate (DMMU 1); beta-BHC (DMMU 2); and gamma-BHC (DMMU 4).

Diesel range organics (DRO) and ammonia were common to river and reference area sediments, with concentrations nearly an order of magnitude greater in the river. DRO and ammonia tended to decrease from upper to lower reaches of the river. Gasoline and motor oil range organics (GRO and MRO) were detected in DMMUs above Calcasieu Lake, with a similar decrease in concentration from upper to lower reaches. PCB 1260 was common to DMMUs 1, 2, 3, and 4, while PCB 1016 and PCB 1254 occurred less frequently. A single volatile organic compound (tetrachloroethylene) was detected at DMMU 6.

Elutriate Chemistry Summary. Nineteen analytes were detected in elutriates prepared from ship channel sediments, including metals, PAHs, pesticides, petroleum hydrocarbons, and ammonia. While state and Federal water quality criteria (WQC) are not directly applicable to elutriate chemistry, analytes detected in an elutriate at concentrations below acute WQC are not expected to adversely impact receiving waters adjacent to dredged material disposal areas (Table 3-6). Twelve of the 19 analytes detected in elutriates were below WQC, including arsenic, mercury, nickel, selenium, zinc, gamma-chlordane, 4'4,-DDD, 4,4'-DDE, endrin, gamma-BHC, heptachlor, and heptachlor epoxide. Ammonia and copper were the only analytes to exceed acute WQC. An additional five analytes without WQC were detected in the elutriates, including barium and chromium (all DMMUs), antimony (DMMU 1 only), delta-BHC (DMMU 2 only), and GRO (DMMUs 5 and 6).

Table 3-6. Analytes Detected in Elutriates from Calcasieu River and Pass Dredged Material Management Units (DMMUs), and Background Water Chemistry from Calcasieu Lake (CL), Sabine National Wildlife Refuge (SNWR), and the Calcasieu River (miles 36-5)

Analyte	Elutriate Chemistry DMMU 1	Lowest Marine Acute WQC	Receiving Water - Background Chemistry			Units
			Calcasieu Lake	SNWR	River mi. 36-33	
Antimony	2.1	-	< 2.0	< 2.0	< 2.0	(ppb)
Arsenic	53	69[a,b]	34	< 2.0	43	(ppb)
Barium	710	-	89	2.05	72	(ppb)
Chromium	9.5	-	6.7	< 2.0	8.1	(ppb)
Mercury	0.37	1.8[a]	< 0.2	< 0.2	< 0.2	(ppb)
Nickel	15	74[a,b]	11	< 2.0	13	(ppb)
Selenium	190	290[b]	130	< 2.0	150	(ppb)
4,4'-DDD	0.0023	1.25[a,b]	< 0.0019	< 0.0019	< 0.0019	(ppb)
4,4'-DDE	0.0055	0.7[a,b]	< 0.0019	< 0.0019	< 0.0019	(ppb)
Endrin	0.0024	0.037[a,b]	< 0.0019	0.0020	0.0032	(ppb)
Gamma-chlordane	0.0019	0.09[a,b]	< 0.00094	< 0.00094	< 0.00094	(ppb)
Heptachlor epoxide	0.016	0.053[b]	0.0051	0.00095	< 0.0094	(ppb)
Ammonia	7300	Varies[c]	210	200	260	(ppb)

Analyte	Elutriate Chemistry DMMU 2	Lowest Acute Marine WQC	Receiving Water - Background Chemistry			Units
			Calcasieu Lake	SNWR	River mi. 33-30	
Arsenic	57	69[a,b]	34	< 2.0	44	(ppb)
Barium	270	-	89	4.1	62	(ppb)
Chromium	12	-	6.7	< 2.0	7.3	(ppb)
Copper	2.1	3.63[a]	6.0	< 2.0	7.2	(ppb)
Nickel	15	74[a,b]	11	< 2.0	13	(ppb)
Selenium	200	290[b]	130	< 2.0	170	(ppb)
delta-BHC	0.0016	-	< 0.00095	< 0.00094	< 0.00093	(ppb)
Endrin	0.0031	0.037[a,b]	< 0.0019	0.002	0.0036	(ppb)
Gamma-BHC	0.0017	0.16[a,b]	< 0.00095	< 0.00094	< 0.00093	(ppb)
Heptachlor	0.0019	0.053[a,b]	< 0.00095	< 0.00094	< 0.00093	(ppb)
Heptachlor epoxide	0.0034	0.053[b]	0.0051	0.00095	0.0170	(ppb)
Ammonia	9400	Varies[c]	210	200	71	(ppb)
Analyte	**Elutriate Chemistry DMMU 3**	**Lowest Acute Marine WQC**	**Receiving Water - Background Chemistry**			**Units**
			Calcasieu Lake	**SNWR**	**River mi. 30-24**	
Arsenic	50	69[a,b]	34	< 2.0	53	(ppb)
Barium	150	-	89	4.1	55	(ppb)
Chromium	12	-	6.7	< 2.0	7.5	(ppb)
Copper	6.1	3.63[a]	6.0	< 2.0	6.2	(ppb)
Mercury	0.4	1.8[a]	< 0.2	< 0.2	0.69	(ppb)
Nickel	14	74[a,b]	11	< 2.0	15	(ppb)
Selenium	180	290[b]	130	< 2.0	200	(ppb)
Ammonia	7300	Varies[c]	210	200	58	(ppb)
Analyte	**Elutriate Chemistry DMMU 4**	**Lowest Acute Marine WQC**	**Receiving Water - Background Chemistry**			**Units**
			Calcasieu Lake	**SNWR**	**River mi. 24-21**	
Arsenic	56	69[a,b]	34	< 2.0	44	(ppb)
Barium	200	-	89	4.1	54	(ppb)
Chromium	10	-	6.7	< 2.0	9.7	(ppb)
Copper	6.3	3.63[a]	6.0	< 2.0	7.4	(ppb)
Nickel	16	74[a,b]	11	< 2.0	15	(ppb)
Selenium	200	290[b]	130	< 2.0	180	(ppb)
Zinc	7.3	90[a,b]	3.4	3.6	4.9	(ppb)
Ammonia	9300	Varies[c]	210	200	35	(ppb)
Analyte	**Elutriate Chemistry DMMU 5**	**Lowest Acute Marine WQC**	**Receiving Water - Background Chemistry**			**Units**
			Calcasieu Lake	**SNWR**	**River mi. 21-16**	
Arsenic	56	69[a,b]	34	< 2.0	55	(ppb)
Barium	170	-	89	4.1	48	(ppb)
Chromium	8.4	-	6.7	< 2.0	8.9	(ppb)
Copper	6.8	3.63[a]	6.0	< 2.0	7.0	(ppb)
Nickel	17	74[a,b]	11	< 2.0	15	(ppb)
Selenium	210	290[b]	130	< 2.0	200	(ppb)
Zinc	5.4	90[a,b]	3.4	3.6	4.8	(ppb)
Gasoline Range Organics	52	-	< 50	< 50	< 50	(ppb)
Ammonia	7900	Varies[c]	210	200	< 30	(ppb)

Analyte	Elutriate Chemistry DMMU 6	Lowest Acute Marine WQC	Receiving Water - Background Chemistry			Units
			Calcasieu Lake	SNWR	River mi. 16-5	
Arsenic	56	69[a,b]	34	< 2.0	53	(ppb)
Barium	200	-	89	4.1	55	(ppb)
Chromium	8.3	-	6.7	< 2.0	7.5	(ppb)
Copper	6.8	3.63[a]	6.0	< 2.0	6.2	(ppb)
Nickel	15	74[a,b]	11	< 2.0	15	(ppb)
Selenium	200	290[b]	130	< 2.0	200	(ppb)
Gasoline Range Organics	57	-	< 50	< 50	< 50	(ppb)
Ammonia	3500	Varies[c]	210	200	58	(ppb)

Note: Comparison to state and Federal water quality criteria (WQC). Analytes that were below laboratory detection limits for a DMMU or reference area are noted with a dash mark (-).
a = LA DEQ acute water quality criteria for marine systems
b = EPA acute water quality criteria for marine systems
c = EPA acute WQC varies with temperature, salinity, and pH; acute criteria vary with site-specific variation.

The concentration of ammonia in elutriates from all DMMUs (3,500 to 9,400 ppb) consistently exceeded concentrations observed at disposal area receiving waters (< 0.03 to 1,100 ppb). The USEPA has established water quality criteria for both total ammonia ($NH_3 + NH_4^+$) and unionized ammonia, NH_3, in marine systems (USEPA, 1989a). However, the criteria are dependent on water temperature, pH, and salinity, and therefore vary with conditions of receiving waters. While elevated levels of ammonia are common in anaerobic sediments underlying Louisiana's estuaries and waterways, ammonia is rapidly oxidized when exposed to oxygenated surface waters. Special management of dredged material within disposal areas can further facilitate the oxidation of ammonia prior to the release of effluent into adjacent receiving waters. Special management practices include:

1. Attachment of a baffle plate to the end of the discharge pipeline to thoroughly expose slurry to oxygen prior to placement in a disposal area;

2. Increase 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 effluent across vegetated wetlands within the disposal area prior to discharge into adjacent receiving waters. Due to elevated levels of ammonia in elutriates from all DMMUs as compared to concentrations in receiving waters, as well as expected seasonal variation in acute WQC, special management practices similar to those described above would be employed during dredged material disposal operations to dissipate ammonia.

The concentration of copper in elutriates from DMMUs 3, 4, 5, and 6 (6.1 to 6.8 ppb) exceeded the LDEQ acute WQC for marine waters (3.63 ppb). Copper in elutriates from DMMUs 1 and 2 (< 2.0 ppb) were below WQC (2.1 ppb. Copper in receiving waters of Calcasieu Lake (6.0 ppb) and the Calcasieu River (6.2 to 7.4 ppb) also exceeded acute WQC and were similar to concentrations observed in the elutriates. Copper was not detected in waters of the SNWR (<2.0 ppb). Dilution factors determined for copper were within five percent of background levels observed in Calcasieu Lake and Calcasieu River, and to WQC in the SNWR (Table 3-7). The

CORMIX model was used to predict the size of mixing zones that would be required for the dilution of copper in effluent from DMMUs 3, 4, 5, and 6 to specified dilution endpoints. Mixing zones extending from disposal areas 7 to 60 feet into Calcasieu Lake, 7 to 33 feet into the Calcasieu River, and 7 to 39 feet into the SNWR would provide sufficient dilution of copper in effluent from the DMMUs.

Table 3-7. Concentration of Copper in Elutriates from DMMUs Requiring Dilution. Dilution Endpoints and Dilution Factors for Discharge into Calcasieu Lake, Calcasieu River, and Sabine National Wildlife Refuge (SNWR) Disposal Areas

DMMU	Elutriate Copper (ppb)	Required Endpoint for Dilution (ppb)			Dilution Factor[c]		
		Calcasieu Lake[a]	Calcasieu River[a]	SNWR[b]	Calcasieu Lake	Calcasieu River	SNWR
3	6.1	6.3	6.5	3.63	0	0	0.94
4	6.3	6.3	7.8	3.63	0	0	1.02
5	6.8	6.3	7.4	3.63	1.67	0	1.21
6	6.8	6.3	6.5	3.63	1.67	0.94	1.21

Note: Shaded dilution factors indicate where dilution is required for disposal of dredging elutriate into a given disposal area.
a = endpoint includes a five percent allowance above background levels.
b = acute water quality criteria; copper below detection in ambient water.
c = dilution factors were determined with the following equations:

(1a) Where background concentration exceeded WQC, $D = [C_{100\%\ Elutriate} - (1.05 \times C_{background})] / [(1.05 \times C_{background}) - C_{background}]$

(1b) Where background concentration were below WQC, $D = (C_{100\%\ Elutriate} - C_{WQC}) / (C_{WQC} - C_{background})$

At the SNWR, copper was below detection limit in ambient water but detected in sediments. A conservative estimate for copper of 1.0 ppb (1/2 of the laboratory reporting limit) was assumed to represent maximum background concentration expected at the SNWR, and was included in the denominator of equation 1b.

For coastal lakes and bays, including the open waters of Calcasieu Lake and the SNWR, LDEQ requires dilution of effluent to WQC or approximate background levels within 200 feet of a dredged material disposal area. For tidal channels with flows greater than 100 cubic feet per second, such as the Calcasieu River, mixing zones may not exceed one third of the channel's ambient flow. Considering an approximate width of 900', approximate depth of 42 feet, and a mean low tidal velocity of 0.79 feet/second, the regulatory mixing zone for the Calcasieu River is approximately 9,944 feet. Predicted mixing zones required for sufficient dilution of copper are no greater than 60 feet for Calcasieu Lake, 33 feet for Calcasieu River, and 39 feet for the SNWR.

Water Column Toxicity Test (Elutriate Bioassay). In water column toxicity tests, sensitive water column organisms are exposed for 96 hours to serial dilutions (100, 50, and 10 percent) of dredged material elutriate, a site water treatment, and a performance control treatment (reconstituted water, adjusted for salinity). If survival in the 100 percent dredged material elutriate treatment is at least 10 percent less than survival in the control, the results are evaluated statistically (t-test) to determine if the elutriate treatment is significantly more toxic than the control.
Water column toxicity tests were conducted with mysid shrimp (*Americamysis bahia*). Five replicates with 10 shrimp per test chamber were run for each elutriate treatment, site water, and

control group. Temperature, pH, salinity, dissolved oxygen, and salinity were measured in all test chambers at test initiation and termination; and in select chambers at 24, 48, and 72 hours. Ammonia was also measured prior to test initiation to determine if it was within tolerable limits reported for mysid shrimp. All water quality parameters were within acceptable ranges, and are summarized in Table 3-8.

Table 3-8. Water Quality Observations from Test Chambers During the Elutriate Bioassay

Site ID	Treatment	Temperature (°C)	Salinity (o/oo)	PH (SU)	D.O. (mg/l)	Initial Ammonia (mg/l)
Performance Control (30‰ Instant Ocean)	NA	19.7 ± 0.2 (19.2 - 19.9)	29 ± 1 (28 - 30)	7.86 ± 0.05 (7.73 - 7.89)	7.1 ± 0.6 (6.3 - 7.9)	< 1
Site Water	0%	19.9 ± 0.3 (19.6 - 20.7)	27 ± 0 (27 - 27)	8.13 ± 0.04 (8.03 - 8.17)	7.0 ± 0.9 (5.9 - 8.3)	< 1
DMMU 1	10%	19.9 ± 0.4 (19.5 - 20.8)	27 ± 0 (27 - 27)	7.98 ± 0.07 (7.92 – 8.20)	7.2 ± 1.0 (5.9 - 8.5)	NA
	50%	19.4 ± 0.8 (18.2 - 20.8)	27 ± 0 (27 - 27)	8.11 ± 0.07 (8.00 - 8.19)	7.3 ± 1.1 (5.6 - 8.8)	5
	100%	19.1 ± 1.2 (17.5 - 20.9)	27 ± 0 (26 - 27)	8.24 ± 0.010 (8.10 - 8.35)	7.3 ± 1.1 (5.8 - 8.8)	10 ‡
DMMU 2	10%	19.6 ± 0.5 (19.0 - 20.8)	28 ± 0 (27 - 29)	8.01 ± 0.02 (7.97 - 8.07)	7.3 ± 0.8 (6.3 - 8.3)	NA
	50%	19.5 ± 0.3 (18.8 - 20.6)	28 ± 1 (27 - 29)	8.25 ± 0.22 (8.11 - 8.95)	7.3 ± 1.0 (6.1 - 8.5)	5
	100%	19.4 ± 0.6 (18.8 - 20.6)	27 ± 1 (26 - 28)	8.31 ± 0.13 (8.15 - 8.44)	7.3 ± 0.9 (6.3 - 8.5)	10 ‡
DMMU 3	10%	19.4 ± 0.6 (18.8 - 20.6)	28 ± 1 (27 - 28)	7.94 ± 0.11 (7.61 - 8.02)	7.2 ± 0.8 (6.3 - 8.2)	NA
	50%	19.3 ± 0.9 (18.0 - 20.6)	28 ± 1 (27 - 29)	8.15 ± 0.12 (7.97 - 8.29)	7.4 ± 1.1 (6.3 - 8.5)	5
	100%	19.3 ± 0.9 (18.0 - 20.6)	28 ± 1 (27 - 29)	8.26 ± 0.16 (8.01 - 8.44)	7.2 ± 1.2 (6.3 - 9.2)	10 ‡
DMMU 4	10%	19.8 ± 0.2 (19.2 – 19.0)	28 ± 1 (27 - 29)	7.92 ± 0.05 (7.85 – 7.99)	7.1 ± 0.7 (6.2 – 7.9)	NA
	50%	19.7 ± 0.3 (18.9– 19.9)	27 ± 2 (25 - 29)	8.11 ± 0.14 (7.94 - 8.26)	7.1 ± 0.5 (6.5 – 7.7)	7
	100%	19.8 ± 0.2 (19.4 – 20.0)	28 ± 1 (27 - 28)	8.23 ± 0.19 (7.99 - 8.43)	6.9 ± 0.6 (6.1 – 7.5)	14‡
DMMU 5	10%	19.8 ± 0.2 (19.7 – 19.9)	28 ± 1 (27 - 28)	7.93 ± 0.09 (7.70 - 8.03)	7.2 ± 0.6 (6.4 – 7.9)	NA
	50%	19.9 ± 0.2 (19.2 – 20.1)	27 ± 2 (24 - 30)	8.08 ± 0.17 (7.88 - 8.26)	7.1 ± 0.5 (6.3 – 7.9)	8
	100%	19.9 ± 0.3 (19.1 – 20.0)	27 ± 1 (25 - 29)	8.17 ± 0.26 (7.87 - 8.43)	6.9 ± 0.4 (6.5 – 7.3)	16‡
DMMU 6	10%	19.8 ± 0.2 (19.4 – 20.0)	28 ± 1 (27 - 30)	7.97 ± 0.28 (7.86 - 8.13)	7.3 ± 0.4 (6.5 – 7.3)	1
	50%	19.8 ± 0.2 (19.4 – 20.0)	28 ± 2 (27 - 30)	8.12 ± 0.16 (7.80 - 8.29)	7.2 ± 0.5 (6.5 – 7.7)	5
	100%	19.7 ± 0.1 (19.5- 20.0)	28 ± 1 (27 - 29)	8.24 ± 0.19 (8.02 - 8.45)	6.9 ± 0.4 (6.5 – 7.6)	10

‡ Measurement > 8 mg/l. Extrapolated from lower concentrations.

NA = Not Available.

Mean survival was relatively high in most of the elutriate treatments (82 percent to 100 percent), site water treatment (96 percent), and control group (98 percent). There were no statistically significant differences between survival in the control compared to the 100 percent, 50 percent, and 10 percent elutriate treatments for DMMUs 1, 2, 4, and 5; 50 percent and 10 percent elutriate treatments for DMMUs 3 and 6; and the site water treatment (Table 3-9).

Table 3-9. Survival Mean, Standard Deviation, and Range of *Americamysis bahia* from the Elutriate Bioassay. Statistical Comparison (T-Test) of Survival in Treatments to the Performance Control

Site ID	Treatment	Mean Survival	Min	Max
Performance Control (30‰ Instant Ocean)	NA	98 ± 4%	90%	100%
Site Water	0%	95 ± 5%	90%	100%
DMMU 1	10%	100 ± 0%	100%	100%
	50%	98 ± 4%	90%	100%
	100%	96 ± 5%	90%	100%
DMMU 2	10%	94 ± 9%	80%	100%
	50%	86 ± 11%	70%	100%
	100%	86 ± 11%	70%	100%
DMMU 3	10%	98 ± 4%	90%	100%
	50%	100 ± 0%	100%	100%
	100%	86 ± 11% *	60%	80%
DMMU 4	10%	94 ± 5%	90%	100%
	50%	90 ± 12%	70%	100%
	100%	82 ± 13%	60%	90%
DMMU 5	10%	98 ± 4%	90%	100%
	50%	98 ± 4%	90%	100%
	100%	88 ± 4%	80%	90%
DMMU 6	10%	96 ± 5%	90%	100%
	50%	94 ± 5%	90%	100%
	100% #	65 ± 13% *	50%	80%

* Indicates treatments with significantly greater mortality than observed in the control.
\+ Statistically reduced survival compared to site water (0 percent treatment).
\# One replicate lost due to laboratory error. Four replicates used in data presentation and analysis.

Significant differences in mean survival were observed between the control group (98 percent) and the 100 percent elutriate treatment for DMMUs 3 (68 percent) and 6 (65 percent). It is unlikely that the observed mortality resulted from ammonia toxicity. According to Miller *et al.* (1990), ammonia toxicity in mysids was observed under similar water quality conditions (temperature, salinity, and pH) at concentrations above 25.5 ppm total ammonia. Total ammonia from the test chambers for the 100 percent elutriate treatments for both DMMU 3 and 6 was 10 ppm. Moreover, no significantly reduced survival was observed in elutriates with the highest ammonia levels (DMMUs 4 and 5).

Predicted Effluent Toxicity. When statistical analyses from water column toxicity tests indicate that survival in an elutriate treatment differs significantly from survival in the control, dredged material is predicted to be acutely toxic to water column organisms. Dilution of the dredging elutriate is therefore required within a proposed disposal area and across an allowable mixing zone prior to discharge of effluent into adjacent receiving waters. Mixing zone models are evaluated to determine if analytes detected in the dredged material would be diluted within the disposal area and mixing zone to concentrations at or below established benchmarks.

Benchmarks may include state or Federal WQC, other conservative screening values, background concentrations in receiving waters, or concentrations equivalent to a “no observable effects level” (NOEL) predicted from the elutriate treatments.

Mean survival differed significantly between the control group and the 100 percent elutriate treatment for DMMUs 3 and 6. A preliminary screening of analytes detected in elutriates was conducted to reduce the number of analytes carried forward for mixing zone calculations (Table 3-10). Screening values included available state and Federal WQC, USEPA maximum contaminant levels for drinking water (MCL), and background concentration in receiving waters. Analytes detected in the elutriate, but at concentrations below screening values included arsenic, barium, chromium, nickel, and selenium (DMMUs 3 and 6); and mercury (DMMU 3 only). Analytes carried forward for further analysis included ammonia and copper (DMMUs 3 and 6); and gasoline range organics (DMMU 6 only).

Analytes detected in the sediment of a DMMU but below detection limits in the elutriate cannot be assumed not to have contributed to observed mortality in the water column toxicity test. For any analyte that was quantified in the sediment, but below detection limit in the elutriate, the laboratory reporting limit was assumed to represent a maximum concentration expected in the elutriate. Laboratory detection limits with available WQC or MCL were initially compared to determine if any of the non-detected analytes should be carried forward for mixing zone calculations (Table 3-11). Reporting limits for antimony, beryllium, hexavalent chromium, lead, and zinc (DMMUs 3 and 6); PCB-1260 and bis(2-ethylhexyl) phthalate (DMMU 3 only); and mercury, PCB-1016, 4,4’-DDT, endosulfan II, and tetrachloroethylene (DMMU 6 only) were below screening values and were eliminated from further analysis. DRO and endosulfan II (DMMUs 3 and 6); and chrysene, 4,4’-DDT, GRO, and motor oil range organics (DMMU 3 only) were further analyzed.

Partitioning analysis was used to estimate concentrations of pesticides and PAHs in elutriates from DMMUs 3 and 6 that were below detection limit but carried forward from the screens described above (endosulfan II from DMMUs 3 and 6; chrysene and 4,4’-DDT from DMMU 3). Analytes in a sediment-water “system” distribute between the solid and aqueous phases proportionally. This distribution occurs as a function of the solubility and hydrophobicity of the analyte, the characteristics and content of carbon-bearing phases within the sediment, length of time the phases have been in contact with each other, and other characteristics of the system. Partitioning analysis uses the known properties of the analytes to predict this distribution, and arrives at estimated dissolved concentrations of analytes in the aqueous phase. Estimated concentrations from the partitioning analysis were compared to available acute WQC and MCL (Table 3-12). Estimates for 4,4’-DDT and endosulfan II were below acute WQC, and the analytes were eliminated from further analysis. Screening values were not available for chrysene, and the analyte was further analyzed.

Table 3-10. Analytes Detected in Elutriates From DMMUs 3 and 6. Comparison to Screening Values and Receiving Water Chemistry at Calcasieu Lake, Calcasieu River, and Sabine National Wildlife Refuge (SNWR)

	Analyte	Elutriate	Screening Values		Receiving Waters - Background Chemistry			Units
			Acute WQC[a]	EPA MCL[b]	Calcasieu Lake	Calcasieu River	SNWR	
DMMU 3	Arsenic	50	69	.	34	53	< 2.0	(ppb)
	Barium	150	.	2000	89	55	4.1	(ppb)
	Chromium	12	.	100	6.7	7.5	< 2.0	(ppb)
	Copper	6.1	3.63	.	6.0	6.2	< 2.0	(ppb)
	Mercury	0.4	1.8	.	< 0.2	0.69	< 0.2	(ppb)
	Nickel	14	74	.	11	15	< 2.0	(ppb)
	Selenium	180	290	.	130	200	< 2.0	(ppb)
	Ammonia	7300	Varies[c]	.	210	58	200	(ppb)
DMMU 6	Arsenic	56	69	.	34	53	< 2.0	(ppb)
	Barium	200	.	2000	89	55	4.1	(ppb)
	Chromium	8.3	.	100	6.7	7.5	< 2.0	(ppb)
	Copper	6.8	3.63	.	6.0	6.2	< 2.0	(ppb)
	Nickel	15	74	.	11	15	< 2.0	(ppb)
	Selenium	200	290	.	130	200	< 2.0	(ppb)
	Gasoline Range Organics	57	.	.	< 50	< 50	< 50	(ppb)
	Ammonia	3500	Varies[c]	.	210	58	200	(ppb)

Note: Analytes were first compared to available screening values. If screening values were exceeded or were not available, analytes were compared to background concentrations. Shaded analytes were carried forward for dilution calculations.
a = lowest marine acute WQC available from either state or Federal criteria.
b = USEPA Maximum Contaminant Levels (MCL) for drinking water.
c = EPA acute WQC varies with temperature, salinity, and pH; acute criteria therefore vary with site specific variation.

Table 3-11. Analytes Below Detection Limits in Elutriates, but Detected in Sediments, from DMMUs 3 and 6. Comparison of Reporting Limits to Screening Values and Receiving Water Chemistry at Calcasieu Lake, Calcasieu River, and Sabine National Wildlife Refuge (SNWR)

	Analyte	Elutriate Reporting Limit	Screening Values		Receiving Waters - Background Chemistry			Units
			Acute WQC[a]	EPA MCL[b]	Calcasieu Lake	Calcasieu River	SNWR	
DMMU 3	Antimony	< 2.0	.	6.0	< 2.0	< 2.0	< 2.0	(ppb)
	Beryllium	< 2.0	.	4.0	< 2.0	< 2.0	< 2.0	(ppb)
	Hexavalent Chromium	< 10	1100	.	< 10	< 10	< 10	(ppb)
	Lead	< 2.0	209	.	< 2.0	< 2.0	< 2.0	(ppb)
	Zinc	< 5.0	90	.	3.4	5.6	3.6	(ppb)
	4,4'-DDT	n/a	0.13	.	0.0046	0.011	0.0029	(ppb)
	Endosulfan II	< 0.04	0.034	.	< 0.0019	< 0.0019	< 0.0019	(ppb)
	Diesel Range Organics	< 100	.	.	< 100	< 100	< 100	(ppb)
	Gasoline Range Organics	< 50	.	.	< 50	< 50	< 50	(ppb)
	Motor Oil Range Organics	< 3000	.	.	< 3000	< 3000	< 3000	(ppb)
	PCB-1260	< 0.4	.	0.5	< 0.047	< 0.047	< 0.048	(ppb)
	Chrysene	< 0.2	.	.	< 0.2	< 0.2	< 0.2	(ppb)
	bis(2-Ethylhexyl) phthalate	< 2.0	.	6.0	< 2.1	< 2.0	< 2.0	(ppb)

DMMU 6	Antimony	< 2.0	.	6.0	< 2.0	< 2.0	< 2.0	(ppb)
	Beryllium	< 2.0	.	4.0	< 2.0	< 2.0	< 2.0	(ppb)
	Hexavalent Chromium	< 10	1100	.	< 10	< 10.0	< 10	(ppb)
	Lead	< 2.0	209	.	< 2.0	< 2.0	< 2.0	(ppb)
	Mercury	< 0.2	1.8	.	< 0.2	0.69	< 0.2	(ppb)
	Zinc	< 5.0	90	.	3.4	5.6	3.6	(ppb)
	Diesel Range Organics	< 100	.	.	< 100	< 100	< 100	(ppb)
	PCB-1016	< 0.4	.	0.5	< 0.047	< 0.047	< 0.048	(ppb)
	4,4'-DDT	< 0.002	0.13	.	0.0046	0.011	0.0029	(ppb)
	Endosulfan II	< 0.04	0.034	.	< 0.0019	< 0.0019	< 0.0019	(ppb)
	Tetrachloroethylene	< 1.0	1020	.	< 1.0	< 1.0	< 1.0	(ppb)

Note: Reporting limits were first compared to screening values. If screening values were exceeded or not available, analytes were compared to background concentrations. Shaded analytes were carried forward for partitioning analysis (where possible) or dilution calculations.
n/a = Not Available.
a = lowest marine acute WQC available from either state or Federal criteria.
b = USEPA Maximum Contaminant Levels (MCL) for drinking water.

Table 3-12. Predicted Analyte Concentration from Partioning Analysis for DMMUs 3 and 6. Comparison to Screening Values and Receiving Water Chemistry at Calcasieu Lake, Calcasieu River, and Sabine National Wildlife Refuge (SNWR)

	Analyte	Elutriate Predicted Conc.	Screening Values		Receiving Waters - Background Chemistry			Units
			Acute WQC[a]	EPA MCL[b]	Calcasieu Lake	Calcasieu River	SNWR	
DMMU 3	Chrysene	0.004	.	.	< 0.2	< 0.2	< 0.2	(ppb)
DMMU 3	4,4'-DDT	0.001	0.13	.	0.0046	0.011	0.0029	(ppb)
DMMU 3	Endosulfan II	0.006	0.034	.	< 0.0019	< 0.0019	< 0.0019	(ppb)
DMMU 6	Endosulfan II	0.02	0.034	.	< 0.0019	< 0.0019	< 0.0019	(ppb)

Note: Predicted concentrations for shaded analytes exceeded either screening values (when available), background analyte concentration, or water chemistry detection limits, and were carried forward for dilution calculations.
a = lowest marine acute WQC available from either state or Federal criteria.
b = USEPA Maximum Contaminant Levels (MCL) for drinking water.

Analytes further analyzed that required dilution included ammonia, copper, DRO, and GRO (DMMUs 3 and 6); and chrysene and MRO (DMMU 3 only). Considerations for the dilution of ammonia within disposal areas are detailed above in the *Elutriate Chemistry Summary*. Dilution factors were determined for the remaining analytes, with dilution to either WQC, within five percent of background levels in receiving waters, or the predicted NOEL (Table 3-13). Dilution factors were typically at or below 1.0 for most analytes in DMMU 3 for discharge into Calcasieu Lake, Calcasieu River, and SNWR receiving waters. Slightly greater dilution of chrysene would be required for discharge of DMMU 3 elutriate into the Calcasieu River. Dilution factors ranged between 0.94 and 1.67 for all analytes in DMMU 6, with maximum dilution factors of 1.67 (copper) for Calcasieu Lake; 1.0 (DRO and GRO) for Calcasieu River; and 1.21 (copper) for SNWR.

The CORMIX model was used to predict the size of mixing zones that would be required for the maximum dilution of analytes in effluent from DMMUs 3 and 6 necessary for discharge into Calcasieu Lake, Calcasieu River, and SNWR receiving waters. Mixing zones extending from disposal areas 13 to 60 feet into Calcasieu Lake, 7 to 33 feet into the Calcasieu River, and 10 to 39 feet into the SNWR would provide sufficient dilution of analytes in effluent from the DMMUs. For coastal lakes and bays, including the open waters of Calcasieu Lake and the SNWR, LDEQ requires that dilution of effluent to WQC or approximate background levels occurs within 200 feet of a dredged material disposal area. For tidal channels with flows greater than 100 cubic feet per second, such as the Calcasieu River, mixing zones may not exceed one third of the channels ambient flow. Considering an approximate width of 900 feet, approximate depth of 42 feet, and a mean low tidal velocity of 0.79 feet/second, the regulatory mixing zone for the Calcasieu River is approximately 9,944 feet. Predicted mixing zones required for sufficient dilution of analytes are no greater than 60 feet for Calcasieu Lake, 33 feet for Calcasieu River, and 39 feet for SNWR.

Table 3-13. Elutriates from DMMUs 3 and 6 Requiring Dilution. Dilution Endpoints and Dilution Factors for Discharge into Calcasieu Lake, Calcasieu River, and Sabine National Wildlife Refuge (SNWR) Disposal Areas

	Analyte	Elutriate (ppb)	Required Endpoint for Dilution (ppb)			Dilution Factor[g]		
			Calcasieu Lake	Calcasieu River	SNWR	Calcasieu Lake	Calcasieu River	SNWR
DMMU 3	Copper	6.1[a]	6.3[d]	6.5[d]	3.63[e]	0	0	0.94
DMMU 3	Chrysene	0.004[b]	0.002[f]	0.002[f]	0.002[f]	1.0[h]	2.0[h]	1.0[h]
DMMU 3	Diesel Range Organics	100[c]	50[f]	50[f]	50[f]	1.0	1.0	1.0
DMMU 3	Gasoline Range Organics	50[c]	25[f]	25[f]	25[f]	1.0	1.0	1.0
DMMU 3	Motor Oil Range Organics	3000[c]	1500[f]	1500[f]	1500[f]	1.0	1.0	1.0
DMMU 6	Copper	6.8[a]	6.3[d]	6.5[d]	3.63[e]	1.67	0.94	1.21
DMMU 6	Diesel Range Organics	100[c]	50[f]	50[f]	50[f]	1.0	1.0	1.0
DMMU 6	Gasoline Range Organics	57[a]	28.5[f]	28.5[f]	28.5[f]	1.0	1.0	1.0

Note: Positive dilution factors are shaded to indicate that dilution is required for disposal of an analyte into a given disposal area.
a = Observed Concentration
b = Predicted Concentration
c = Laboratory Reporting Limit; Analyte was not detected in the elutriate, but concentration assumed to be equivalent to the reporting limit.
d = Endpoint includes a five percent allowance above background levels.
e = Acute Water Quality Criteria; Copper below detection in ambient water.
f = No Observable Effects Level (NOEL); equivalent to expected analyte concentration in the 50 percent elutriate bioassay treatment.
g = Dilution factors were determined with the following equations:
(1a) Where background concentration exceeded WQC, $D = [C_{100\%\ Elutriate} - (1.05 \times C_{background})] / [(1.05 \times C_{background}) - C_{background}]$
(1c) Where NOEL served as a dilution endpoint (WQC not available), $D = (C_{100\%\ Elutriate} - C_{NOEL}) / (C_{NOEL} - C_{background})$
h = Background concentration of chrysene in reference area waters predicted from partitioning analysis (Calcasieu Lake 0 ppb; Calcasieu River 0.001 ppb; SNWR 0 ppb).

Note that for gasoline and motor oil range organics, background concentration in reference area waters was assumed to be zero because the analytes were not detected in water or sediment from the reference areas. Diesel range organics (DRO) were detected in reference area sediments, but below laboratory detection limits in ambient water. Partitioning coefficients were not available to predict surface water background concentrations - and a default assignment of 1/2 the laboratory reporting limit for DRO (equal to the NOEL dilution endpoint) would have resulted in a mathematical error (zero denominator) in dilution equation 1c. A value of zero was therefore assigned to background concentrations of DRO in ambient waters of the reference areas.

Benthic Toxicity Test/Solid Phase Bioassays. Dredged material is predicted to be acutely toxic to benthic organisms when the mortality of test organisms exposed to sediment from in-channel stations is statistically greater than the mortality of test organisms exposed to sediment from the reference area, *and* exceeds mortality of organisms exposed to sediment from the reference area by at least 10 percent (20 percent for amphipods).

Results from the 10-day benthic toxicity tests/solid phase bioassays using the amphipod, *Leptocheirus plumulosus*, indicated a high level of mortality for all sediments tested, i.e., in both sediments from each DMMU and from the two reference areas (Table 3-14). Survival in the control sediment indicated that test conditions and health of the organisms were acceptable. Furthermore, dissolved oxygen, temperature, ammonia, pH, and salinity within the test chambers were within the recommended tolerance limits for *L. plumulosus*.

Table 3-14. *Leptocheirus plumulosus* Survival in Benthic Toxicity Tests

Treatment	Percent Survival	
	Mean	STD
Control	98	2.7
DMMU 1	29	11.2
DMMU 2	60	7.9
DMMU3	14	10.2
DMMU 4	11	5.5
DMMU 5	23	20.8
DMMU 6	28	12.5
Calcasieu Lake Reference	11	10.8
SNWR Reference	21	11.9

Because sediment chemistry indicated no significant levels of contamination, the observed toxicity in *L. plumulosus* was likely a response to a non-contaminant confounding factor such as the grain size of the sediments. Physical characterization of the sediment from each DMMU and from the reference areas revealed that the sediments were comprised of silts and clay with high plasticity (Table 3-15). According to the Unified Soil Classification System, the clays in the Calcasieu Ship Channel and reference area sediments are classified as fat clays (inorganic clays with liquid limits >50 and high plasticity). Fat clays are cohesive and compressible, difficult to work when damp, but strong when dry. Amphipods such as *L. plumulosus* have limited tolerance to these grain size conditions (Emery *et al.,* 1997).

Other benthic species was tested to demonstrate that the toxicity response observed was the result of a non-contaminant effect specific to *L. plumulosus*. These tests were designed to determine the response of other sensitive species to the relatively uncontaminated ship channel sediment. Additional 10-day solid phase bioassays were conducted using three species of benthic invertebrates, *L. plumulosus*, *Eohaustorius estuarius* (amphipod), and *Neanthes arenaceodentata* (polychaete) and sediment from DMMU 5. A control sediment was included to evaluate test performance.

Table 3-15. Physical Characteristics of Sediment

Sample Identification	Moisture Content %	Total Organic Carbon %	Liquid Limit	Plasticity Limit	Plastic Limit	Specific Gravity	Sand %	Silt %	Clay %
D1-06-01	87.1	2.7	33	15	18	2.651	49.7	26.0	24.3
D1-06-02	154.2	4.8	91	62	29	2.677	15.7	29.0	55.4
D1-06-03	182.6	7.7	119	81	38	2.664	7.3	24.8	67.9
D1-06-04	182.3	6.6	110	76	34	2.668	15.1	29.9	55.0
D1-06-05	156.1	5.1	52	25	26	2.631	30.0	21.6	47.8
D2-06-01	182.9	4.2	118	81	37	2.222	16.4	44.3	39.2
D2-06-02	242.8	7.2	73	31	41	2.710	7.3	55.8	36.9
D2-06-03	161.6	4.2	101	70	32	2.656	19.9	46.8	33.3
D2-06-04	201.9	7.5	130	87	43	2.689	4.1	47.9	48.0
D2-06-05	220.3	6.9	142	92	50	2.519	7.7	41.0	51.3
D3-06-01	186.8	8.8	124	79	46	2.729	2.2	41.7	56.2
D3-06-02	169.3	11.4	129	85	44	2.726	8.0	41.3	50.6
D3-06-03	164.7	9.1	123	80	43	2.725	9.2	36.2	54.6
D3-06-04	163.8	8.8	122	77	46	2.736	2.6	36.7	60.7
D3-06-05	154.9	7.1	117	75	42	2.735	8.8	33.2	58.0
D3-06-06	170.1	6.9	113	74	39	2.731	12.6	33.7	53.7
D4-06-01	162.8	3.5	120	80	41	2.431	4.8	29.3	65.8
D4-06-02	173.6	5.5	126	79	47	2.716	0.8	26.3	73.0
D4-06-03	154.3	3.4	72	37	35	2.721	5.7	41.9	52.4
D4-06-04	125.7	4.2	57	30	27	2.653	26.3	29.3	44.4
D4-06-05	139.9	5.0	110	72	38	2.714	6.7	30.2	63.1
D5-06-01	132.7	4.4	61	29	39	2.723	14.6	33.7	51.7
D5-06-02	124.1	3.0	64	32	32	2.730	10.1	36.6	53.4
D5-06-03	164.7	3.7	71	35	35	2.728	3.4	38.6	58.0
D5-06-04	105.6	3.8	58	29	28	2.714	19.1	34.2	46.6
D5-06-05	104.0	2.6	63	32	31	2.757	10.7	34.5	54.8
D6-06-01	114.6	2.5	68	37	31	2.718	9.8	36.3	53.8
D6-06-02	108.9	3.7	63	37	26	2.740	9.5	39.7	50.8
D6-06-03	106.5	3.8	60	32	28	2.683	14.9	40.7	44.5
D6-06-04	95.6	2.2	57	32	25	2.724	20.1	39.3	40.6
D6-06-05	68.7	2.5	40	25	15	2.710	41.3	28.9	29.8
D6-06-06	41.5	1.1	0	NP	0	2.680	78.6	7.8	13.6
Calcasieu Lake Wetland Creation Reference Area	66.8	1.0	47	27	20	2.724	36.1	31.0	32.9
SNWR Wetland Restoration Ref/ Disposal Area	98.2	6.1	71	44	27	2.322	24.8	21.0	53.9
Upland Reference Area	24.4	5.0	28	10	19	2.665	13.9	52.3	33.8

Mortality of the amphipods exposed to sediment from DMMU 5 was statistically greater those organisms exposed to the control sediment; however, there was no statistical difference between survival of the polychaetes exposed to sediment from DMMU 5 and the control sediment (Table 3-16). Observed survival for *L. plumulosus* was 10 percent compared to 90 percent survival in the control sediment; survival for *E. estuarius* was 33 percent compared to 89 percent survival in the control sediment; and survival for *N. arenaceodentata* was 88 percent compared to 100 percent survival in the control sediment. *L. plumulosus* were observed to be unable to burrow into the sediment; *E. estuarius* were able to penetrate the sediment but the burrows were extremely shallow; and *N. arenaceodentata* were able to successfully burrow into the sediment. In summary, chemical analysis of sediment from DMMU 5 indicated a relatively low level or absence of chemical contaminants while the physical analysis of the sediment indicated a high percentage of clay (51.7 percent) with a liquid limit greater than 50 and high plasticity. The amphipods that rely on burrowing into the sediment had a low level of survival in the cohesive DMMU 5 sediments. The polychaete worm, which is tolerant of cohesive sediments, had a high level of survival in DMMU 5 sediment. The results of these tests and the behavioral observations indicate that the amphipods fail to burrow because they are unable to penetrate the sediment due to its cohesive nature and not because of a classic sediment avoidance response to contamination.

Table 3-16. Survival Results from Additional Benthic Toxicity Tests

Test Organism	Treatment	Mean	SD
Leptocheirus plumulosus	Control	90%	12%
	DMMU 5	10%	5%
Eohastorius estuarius	Control	89%	4%
	DMMU 5	33%	15%
Neanthes arenaceodentata	Control	100%	0%
	DMMU 5	88%	18%

Based on the results of the additional tests with other sensitive species, it is likely that the observed mortality in the 10-day benthic toxicity tests was a response to a physical effect produced by the cohesiveness and plasticity of the sediment in the navigation channel and at the two reference areas, rather than a response to the presence of contaminants.

Bioaccumulation Tests. According to the Inland Testing Manual, data from bioaccumulation tests are evaluated at two levels. First, the amount of bioaccumulation of a specific contaminant in tissues exposed to dredged material is compared to applicable Food and Drug Administration (FDA) Action or Tolerance Levels for Poisonous or Deleterious Substances in Fish and Shellfish for Human Food, when such levels have been set for the particular contaminant. If the tissue concentration of the contaminant is not less than the FDA levels, the dredged material is predicted to result in benthic bioaccumulation and there is a potential for the dredged material to have an "unacceptable adverse effect." If the tissue concentration of the contaminant is less than the FDA level, or if there is no FDA level for comparison, the contaminant concentration in tissues exposed to dredged material is compared to contaminant concentrations of tissues exposed to sediment from the reference area. If the tissue concentration of the contaminant in organisms exposed to dredged material does not statistically exceed the tissue concentration of the contaminant in organisms exposed to sediment from the reference area, the dredged material is not predicted to result in benthic bioaccumulation. If tissue concentrations of the contaminant in organisms exposed to dredged material statistically exceed those of organisms exposed to sediment from the reference area, the conclusion regarding benthic bioaccumulation is based on technical evaluations such as the following:

1. The toxicological importance of the contaminant;
2. The magnitude by which bioaccumulation in tissues of organisms exposed to dredged material exceed bioaccumulation in tissues of organisms exposed to sediment from the reference area;
3. The propensity for the contaminant to biomagnify within the aquatic food webs;

4. The magnitude by which the contaminant whose bioaccumulation from dredged material exceeds that from the reference area also exceeds the concentrations found in comparable species living in the vicinity of the proposed disposal area; and
5. The number of contaminants for which bioaccumulation from the dredged material is statistically greater than bioaccumulation from sediment from the reference area.

Chemical analysis of tissues of the clam, *Macoma nasuta*, exposed to in-channel sediment/dredged material from DMMUs 1 through 6 during the 28-day solid phase bioaccumulation tests revealed the presence of metals and PAHs (tables 3-17 and 3-18). Tissues exposed to sediment from the reference areas revealed the presence of metals only. PAHs did not bioaccumulate in the tissues of clams exposed to sediment from either reference area.

There are no applicable FDA Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food for any of the contaminants that bioaccumulated in tissues of organisms exposed to sediment from the 6 DMMUs.

Bioaccumulation of Metals. The concentration of heavy metals in tissues of exposed clams is reported in Table 3-19 and Figure 3-6. Concentrations of barium in tissues of clams exposed to sediments from the DMMUs (1, 2, 3, 5 & 6) were significantly higher than the concentrations in clams exposed to the Calcasieu Lake reference area. Highlighted concentrations of arsenic, barium, copper, lead, and selenium in the tissues of clams exposed to DMMU sediments from were significantly higher than concentrations in clams exposed to the SNWR reference area sediment.

The tissue concentrations of arsenic, copper, lead and selenium in clams exposed to channel sediments exceed the concentration of those metals in clams exposed to reference sediments by factors ranging from 0.8 to 1.5 (tables 3-19 and 3-20). Such low magnitude of difference in bioaccumulation levels suggests that the toxicological relevance of the measured statistical significant differences is negligible and does not warrant further examination of the ecological significance. The similarity of the tissue residues from all exposures rule out the metals arsenic, copper, lead and selenium as posing any potential detrimental ecological or human health effect to the disposal area.

The concentrations of barium in tissues of clams exposed to sediment from all six DMMUs were statistically greater than the concentrations of these compounds in tissues of clams exposed to sediment from the SNWR reference area. The magnitude of the difference for the significantly different bioaccumulation ranged from 3.8 to 15.6 (Table 3-19). Concentrations of barium in tissues of clams exposed to five of the DMMUs were statistically greater than the concentrations of these compounds in tissue of clams exposed to sediment from the Calcasieu Lake reference area with magnitudes ranging from 1.8 to 7.3 (Table 3-20). Such magnitudes of difference suggest that the presence of barium in the dredged material may pose detrimental ecological or human health effects at the disposal area, warranting ecological and human risk evaluations of barium bioaccumulation in sediment invertebrates at the disposal site.

Ecological Risk. Although no studies provide direct linkages between tissue residues of barium and adverse biological effects in aquatic organisms, an effect residue can be estimated from concentrations of barium in water producing specific biological effects. The EPA's Ecotox database (http://www/epa.gov/med/databases/databases.htmlaquire) was used to estimate the

Table 3-17. Tissue Concentrations (Average and Standard Deviation for 5 Replicates) of Metals In *Macoma Nasuta* Exposed to Sediment from DMMUs 1 through 6 and the Reference Areas

Sample	Tissue Concentration (mg/kg)																			
	Antimony		Arsenic		Barium		Chromium		Copper		Lead		Mercury		Nickel		Selenium		Zinc	
	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev	Avg	St Dev
Archive	BDL	BDL	2.64	0.11	0.15	0.02	0.20	0.08	1.42	0.08	0.15	0.02	0.06	0.01	0.38	0.02	0.65	0.06	14.00	0.45
SNWR	BDL	BDL	4.70	0.41	0.70	0.08	0.37	0.22	2.24	0.30	0.24	0.04	0.17	0.03	0.58	0.18	0.80	0.04	17.00	1.60
CLWCRA	0.13	N/A	5.50	0.17	1.50	0.58	0.38	0.10	2.40	0.30	0.31	0.03	0.19	0.08	0.79	0.09	0.93	0.05	19.00	1.30
DMMU1	BDL	BDL	4.60	0.23	10.90	3.37	0.32	0.07	2.72	0.19	0.36	0.07	0.23	0.10	0.54	0.16	0.92	0.05	17.00	0.71
DMMU2	BDL	BDL	4.50	0.38	4.38	1.90	0.29	0.09	2.64	0.32	0.27	0.05	0.17	0.10	0.41	0.13	0.95	0.05	16.00	0.55
DMMU3	BDL	BDL	5.50	0.77	3.08	0.77	0.62	0.61	2.50	0.42	0.32	0.11	0.24	0.16	0.55	0.19	0.97	0.14	19.00	2.70
DMMU4	BDL	BDL	5.48	0.30	1.90	0.95	0.30	0.06	2.66	0.33	0.34	0.11	0.15	0.07	0.77	0.34	0.94	0.06	19.00	2.70
DMMU5	0.16	N/A	5.28	0.48	2.68	1.40	0.26	0.09	2.40	0.20	0.28	0.07	0.16	0.09	0.51	0.18	0.93	0.04	16.00	1.60
DMMU6	BDL	BDL	5.68	0.36	2.96	1.20	0.32	0.15	2.50	0.15	0.23	0.05	0.23	0.10	0.53	0.23	0.94	0.08	18.00	1.10

Note: Concentrations in clams at the time of exposure initiation (Archive) are also reported. Shaded values are significantly higher than tissues exposed to reference areas.

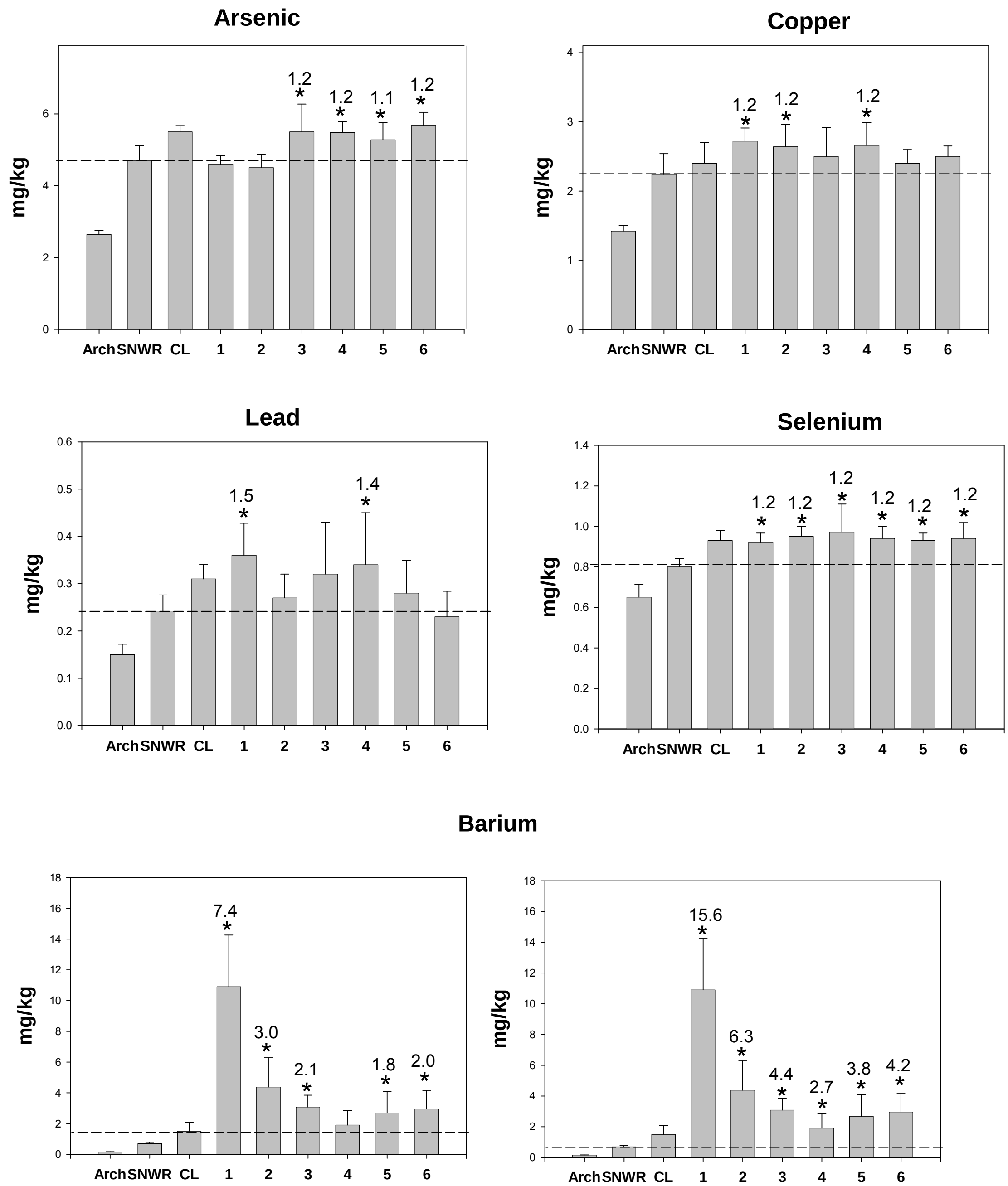
Table 3-18. Tissue Concentrations (Average and Standard Deviation of 5 Replicates) of PAHs in *Macoma nasuta* Exposed to DMMUs 1 through 6 and the Reference Areas

Sample	Tissue Concentration (mg/kg)					
	Chrysene		Fluoranthene		Pyrene	
	Avg	St Dev	Avg	St Dev	Avg	St Dev
Archive	BDL	BDL	BDL	BDL	BDL	BDL
SNWR	BDL	BDL	BDL	BDL	BDL	BDL
CLWCRA	BDL	BDL	BDL	BDL	BDL	BDL
DMMU1	BDL	BDL	21.2	N/A	15.0	6.9
DMMU2	24.4	9.1	BDL	BDL	27.8	3.6
DMMU3	BDL	BDL	BDL	BDL	18.4	8.1
DMMU4	BDL	BDL	BDL	BDL	23.6	8.7
DMMU5	BDL	BDL	BDL	BDL	BDL	BDL
DMMU6	BDL	BDL	BDL	BDL	BDL	BDL

Note: Concentrations in clams at the time of exposure initiation (Archive) area also reported. Shaded values are significantly higher than tissues exposed to reference areas.

Table 3-19. Magnitude of Difference of Metals Tissue Concentrations in Clams Exposed to DMMUs 1 through 6 Sediments to Clams Exposed to SNWR Reference Sediment

Site	Magnitude of Difference (DMMU ÷ SNWR)				
	Arsenic	Barium	Copper	Lead	Selenium
DMMU1	1.0	15.6	1.2	1.5	1.2
DMMU2	1.0	6.3	1.2	1.1	1.2
DMMU3	1.2	4.4	1.1	1.3	1.2
DMMU4	1.2	2.7	1.2	1.4	1.2
DMMU5	1.1	3.8	1.1	1.2	1.2
DMMU6	1.2	4.2	1.1	1.0	1.2



Notes: Concentrations in clams at the time of exposure initiation (Arch) are also reported. The dotted line is the average concentration for the SNWR samples (SNWR or CLWCRA for Barium); * denote significant difference from SNWR; the numbers over the bars denote the magnitude of difference of DMMU average relative to SNWR average (SNWR or CLWCRA for Barium). For simplicity, orders of magnitude have been rounded.

Figure 3-6. Tissue Concentrations (Average and Standard Deviation for 5 Replicates) of Metals in *Macoma nasuta* Exposed to Sediment from DMMUs 1 through 6 and the Reference Areas SNWR and CLWCRA

Table 3-20. Magnitude of difference of Metal Tissue Concentrations in Clams Exposed to DMMUs 1 through 6 Sediments to Clams Exposed to CLWCRA Sediment

Site	Magnitude of Difference (DMMU ÷ CLWCRA)				
	Arsenic	Barium	Copper	Lead	Selenium
DMMU1	0.8	7.3	1.1	1.2	1.0
DMMU2	0.8	2.9	1.1	0.9	1.0
DMMU3	1.0	2.1	1.0	1.0	1.0
DMMU4	1.0	1.3	1.1	1.1	1.0
DMMU5	1.0	1.8	1.0	0.9	1.0
DMMU6	1.0	2.0	1.0	0.7	1.0

concentrations of barium at which effects occur in aquatic organisms. The no observed effect concentrations (NOEC) of barium in water were 500 mg/l for mysid shrimp, *Americamysis bahia* (USEPA, 1978), and 68 mg/l for the water flea, *Daphnia magna* (Leblanc, 1980). The concentration of barium (ba) in tissues associated with this effect can be estimated using the bioconcentration factor (bcf) of 100 reported by Bowen (1966) and Schroeder (1970) as follows:
68mg/l NOEC ba x 100 (bcf) = 6,800 mg/kg ba estimated NOEC in tissue

The highest concentration of barium in the tissues of the clams exposed to sediment from the Calcasieu River and Pass, 10.9 mg/kg, is 624 times lower than the estimated NOEC; therefore, no effects would be expected to occur in organisms exposed to the sediment proposed for dredging and placement in proposed shallow open water disposal sites for wetland development.

Human Health Risk. Although concentrations of barium in the tissues of clams exposed to sediment from the Calcasieu River are statistically higher than concentrations of these metals in tissues of clams exposed to sediment from the reference areas, the levels do not appear to be of toxicological significance with respect to human consumption of contaminated shellfish.
Based on methodology in the EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1* (EPA, 2000), fish screening values are as follows: Barium – 280 mg/kg assuming average consumption for recreational fishermen (default national value 17.5 g/d).

The observed bioaccumulation of barium in clams exposed to sediment from the Calcasieu River and Pass channel are around 25 fold and 150 fold less than the EPA screening criteria, respectively.

The Oral Reference Dose (RfD) is an estimate of a daily exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime. According to the USEPA's Integrated Risk Information System (IRIS) database (www.epa.gov/iris), the RfD for barium is 0.2 mg/kg/day. The acceptable human exposure through consumption of mussels at the site can be determined using the following conservative default assumptions:

- Generic quantity of fish consumed daily (6.8 g/day)
- Weight of average human (70 kg)
- RfD for barium (0.2 mg/kg/day)

- 0.2 mg/kg/day RfD x 70 kg person / 6.8 g shellfish/day = 2.059 mg/g barium in shellfish or estimated maximum acceptable concentration in seafood is 2059 mg barium/kg.

The observed bioaccumulation of barium in clams exposed to sediment from the Calcasieu River is around 190 fold and 1,085 fold less than the calculated estimated maximum acceptable concentrations in seafood, respectively.

Bioaccumulation of PAHs. Evaluation of the potential ecological effects of the bioaccumulation of the PAHs, fluoranthene, pyrene, and chrysene, was done by direct comparison of total PAH tissue residues from clams exposed to sediment from each DMMU with the Critical Body Residue (CBR) as described by McCarty, *et al.* (1992) and Dillion and Gibson (1992). The CBR is the whole body concentration of a chemical that is associated with a given adverse biological response (Rand, 1995) and is represented as the ratio of the mass of the chemical/toxicant to the mass of the organism, *i.e.*, µmol/g. The acknowledged mode of toxicity for PAHs is narcosis, e.g., lethargy, unconsciousness, and death in extreme narcosis. According to McCarty, *et al.* (1992), CBRs of PAHs ranging from 2 to 8 *u*mol/g can produce acute narcotic response and CBRs of PAHs ranging from 0.2 to 0.8 *u*mol/g can produce chronic narcotic response.

CBRs were calculated as the sum of the concentrations of all PAHs in tissues of clams exposed to sediment from each of the DMMUs (tables 3-21 to 3-26). The total PAH level in tissues from clams in the DMMUs ranged from 0.00069539 *u*mol/g to 0.000779226 µmol/g. These values are 1,000 times less than the levels at which chronic narcotic effects might be expected and 10,000 times less than the levels at which acute narcotic effect might be expected.

Table 3-21. Comparison of Total PAH Tissue Residues for DMMU 1 to CBR

PAHs	MW	TSC µmol/g	Clam A µg/kg	Clam µmol/kg	Clam A µmol/g
Naph	128.2	0	10	0.07800312	7.80031E-05
Acena	152.2	0		0	0
Acena	154.2	0		0	0
Fluore	166.2	0	10	0.060168472	6.01685E-05
Phenan	178.2	0	10	0.056116723	5.61167E-05
Anthra	178.2	0	10	0.056116723	5.61167E-05
Fluora	202.3		21.2	0.104794859	0.000104795
Pyrene	202.3	0	15.5	0.076618883	7.66189E-05
Benzaan	228.3	0	10	0.043802015	4.3802E-05
Chryse	228.3	0	10	0.043802015	4.3802E-05
Benzobf	252.3	0	10	0.039635355	3.96354E-05
Benzokf	252.3	0	10	0.039635355	3.96354E-05
Benzoap	252.3	0	10	0.039635355	3.96354E-05
Indeno	276.3	0	10	0.036192544	3.61925E-05
Dibenzo	278.4	0		0	0
Benzoep	252	0		0	0
Perylene	252.3	0		0	0
Benzoghi	276.3	0	10	0.036192544	3.61925E-05
Total	**3910.6**	**0**			**0.000710714**

Acute CBR= 2-8 µmol/g; Chronic CBR= 0.2-0.8 µmol/g; COC in red are non-detects = 1/2 RL

Table 3-22. Comparison of Total PAH Tissue Residues for DMMU 2 to CBR

PAHs	MW	TSC µmol/g	Clam A µg/kg	Clam µmol/kg	Clam A µmol/g
Naph	128.2	0	10	0.07800312	7.80031E-05
Acena	152.2	0		0	0
Acena	154.2	0		0	0
Fluore	166.2	0	10	0.060168472	6.01685E-05
Phenan	178.2	0	10	0.056116723	5.61167E-05
Anthra	178.2	0	10	0.056116723	5.61167E-05
Fluora	202.3	0	10	0.049431537	4.94315E-05
Pyrene	202.3	0	27.8	0.137419674	0.00013742
Benzaan	228.3	0	10	0.043802015	4.3802E-05
Chryse	228.3	0	24.4	0.106876916	0.000106877
Benzobf	252.3	0	10	0.039635355	3.96354E-05
Benzokf	252.3	0	10	0.039635355	3.96354E-05
Benzoap	252.3	0	10	0.039635355	3.96354E-05
Indeno	276.3	0	10	0.036192544	3.61925E-05
Dibenzo	278.4	0		0	0
Benzoep	252	0		0	0
Perylene	252.3	0		0	0
Benzoghi	276.3	0	10	0.036192544	3.61925E-05
Total	**3910.6**	**0**			**0.000779226**

Acute CBR= 2-8 µmol/g; Chronic CBR= 0.2-0.8 µmol/g; COC in red are non-detects = 1/2 RL

Table 3-23. Comparison of Total PAH Tissue Residues for DMMU 3 to CBR

PAHs	MW	TSC µmol/g	Clam A µg/kg	Clam µmol/kg	Clam A µmol/g
Naph	128.2	0	10	0.07800312	7.80031E-05
Acena	152.2	0		0	0
Acena	154.2	0		0	0
Fluore	166.2	0	10	0.060168472	6.01685E-05
Phenan	178.2	0	10	0.056116723	5.61167E-05
Anthra	178.2	0	10	0.056116723	5.61167E-05
Fluora	202.3	0	10	0.049431537	4.94315E-05
Pyrene	202.3	0	18.4	0.090954029	9.0954E-05
Benzaan	228.3	0	10	0.043802015	4.3802E-05
Chryse	228.3	0	10	0.043802015	4.3802E-05
Benzobf	252.3	0	10	0.039635355	3.96354E-05
Benzokf	252.3	0	10	0.039635355	3.96354E-05
Benzoap	252.3	0	10	0.039635355	3.96354E-05
Indeno	276.3	0	10	0.036192544	3.61925E-05
Dibenzo	278.4	0		0	0
Benzoep	252	0		0	0
Perylene	252.3	0		0	0
Benzoghi	276.3	0	10	0.036192544	3.61925E-05
Total	**3910.6**	**0**			**0.000669686**

Acute CBR= 2-8 µmol/g; Chronic CBR= 0.2-0.8 µmol/g; COC in red are non-detects = 1/2 RL

Table 3-24. Comparison of Total PAH Tissue Residues for DMMU 4 to CBR

PAHs	MW	TSC µmol/g	Clam A µg/kg	Clam µmol/kg	Clam A µmol/g
Naph	128.2	0	10	0.07800312	7.80031E-05
Acena	152.2	0		0	0
Acena	154.2	0		0	0
Fluore	166.2	0	10	0.060168472	6.01685E-05
Phenan	178.2	0	10	0.056116723	5.61167E-05
Anthra	178.2	0	10	0.056116723	5.61167E-05
Fluora	202.3	0	10	0.049431537	4.94315E-05
Pyrene	202.3	0	23.6	0.116658428	0.000116658
Benzaan	228.3	0	10	0.043802015	4.3802E-05
Chryse	228.3	0	10	0.043802015	4.3802E-05
Benzobf	252.3	0	10	0.039635355	3.96354E-05
Benzokf	252.3	0	10	0.039635355	3.96354E-05
Benzoap	252.3	0	10	0.039635355	3.96354E-05
Indeno	276.3	0	10	0.036192544	3.61925E-05
Dibenzo	278.4	0		0	0
Benzoep	252	0		0	0
Perylene	252.3	0		0	0
Benzoghi	276.3	0	10	0.036192544	3.61925E-05
Total	**3910.6**	**0**			**0.00069539**

Acute CBR= 2-8 µmol/g; Chronic CBR= 0.2-0.8 µmol/g; COC in red are non-detects = 1/2 RL

Table 3-25. Comparison of Total PAH Tissue Residues for DMMU 5 to CBR

PAHs	MW	TSC µmol/g	Clam A µg/kg	Clam µmol/kg	Clam A µmol/g
Naph	128.2	0	10	0.07800312	7.80031E-05
Acena	152.2	0		0	0
Acena	154.2	0		0	0
Fluore	166.2	0	10	0.060168472	6.01685E-05
Phenan	178.2	0	10	0.056116723	5.61167E-05
Anthra	178.2	0	10	0.056116723	5.61167E-05
Fluora	202.3	0	10	0.049431537	4.94315E-05
Pyrene	202.3	0	10	0.049431537	4.94315E-05
Benzaan	228.3	0	10	0.043802015	4.3802E-05
Chryse	228.3	0	10	0.043802015	4.3802E-05
Benzobf	252.3	0	10	0.039635355	3.96354E-05
Benzokf	252.3	0	10	0.039635355	3.96354E-05
Benzoap	252.3	0	10	0.039635355	3.96354E-05
Indeno	276.3	0	10	0.036192544	3.61925E-05
Dibenzo	278.4	0		0	0
Benzoep	252	0		0	0
Perylene	252.3	0		0	0
Benzoghi	276.3	0	10	0.036192544	3.61925E-05
Total	**3910.6**	**0**			**0.000628163**

Acute CBR= 2-8 µmol/g; Chronic CBR= 0.2-0.8 µmol/g; COC in red are non-detects = 1/2 RL

Table 3-26. Comparison of Total PAH Tissue Residues for DMMU 6 to CBR

PAHs	MW	TSC µmol/g	Clam A µg/kg	Clam µmol/kg	Clam A µmol/g
Naph	128.2	0	10	0.07800312	7.80031E-05
Acena	152.2	0		0	0
Acena	154.2	0		0	0
Fluore	166.2	0	10	0.060168472	6.01685E-05
Phenan	178.2	0	10	0.056116723	5.61167E-05
Anthra	178.2	0	10	0.056116723	5.61167E-05
Fluora	202.3	0	10	0.049431537	4.94315E-05
Pyrene	202.3	0	10	0.049431537	4.94315E-05
Benzaan	228.3	0	10	0.043802015	4.3802E-05
Chryse	228.3	0	10	0.043802015	4.3802E-05
Benzobf	252.3	0	10	0.039635355	3.96354E-05
Benzokf	252.3	0	10	0.039635355	3.96354E-05
Benzoap	252.3	0	10	0.039635355	3.96354E-05
Indeno	276.3	0	10	0.036192544	3.61925E-05
Dibenzo	278.4	0		0	0
Benzoep	252	0		0	0
Perylene	252.3	0		0	0
Benzoghi	276.3	0	10	0.036192544	3.61925E-05
Total	**3910.6**	**0**			**0.000628163**

Acute CBR= 2-8 µmol/g; Chronic CBR= 0.2-0.8 µmol/g; COC in red are non-detects = 1/2 RL

Further evaluation of the potential ecological effects of the bioaccumulation of PAHs was done by comparing the total PAH level in tissues from clams exposed to sediment in the DMMUs to Narcosis Final Chronic Values (FCV) developed using the target lipid model (Stevens, 2001). This model uses extensive chemical and biological data in an approach to determine the concentration of a narcotic chemical in an organism's tissue that results in an adverse effect. In this approach the percent lipid in clams in each DMMU is multiplied by the FCV for PAHs (3.7g *u*mol/g) to determine the concentration that would result in an adverse effect. This FCV is then compared to the CBR in the tissues of the clams exposed to sediment from each DMMU. The calculated CBR for each DMMU is 1000 times less than the FCVs derived with the target lipid model (Table 3-27).

Table 3-27. Comparison of Calculated Total PAH Body Residues (BR) with Narcosis Final Chronic Values (FCV)

Site	Percent lipids[1]	f_lipids	Narcosis FCV (µmol/g tissue[2)])	Calculated BR (µmol/g)
DMMU 1	0.66	0.0066	0.025014	0.000710714
DMMU 2	0.67	0.0067	0.025393	0.000779226
DMMU 3	0.73	0.0073	0.027667	0.000669686
DMMU 4	0.69	0.0069	0.026151	0.00069539
DMMU 5	0.74	0.0074	0.028046	0.000628163
DMMU 6	0.836	0.00836	0.0316844	0.000628163

[1] Mean lipid concentration for all 5 replicates
[2] 3.79 µmoles/g octanol X f_lipids = Narcosis FCV

3.5 GROUNDWATER

Aquifers in the project area include a shallow, unconfined aquifer and the deeper, confined Chicot aquifer. These aquifers typically consist of sand and gravel units separated by clay aquitards [Louisiana Geological Survey (LGS), 1984].

The shallow aquifer is comprised of unconsolidated sand units referred to as the 10-, 20-, and 36-foot sands (LGS, 1984). Groundwater in this aquifer is unconfined and occurs as shallow as 0.3 - 1 meter below ground surface (bgs). Recharge to the shallow aquifer is from infiltration of precipitation, impoundment leakage and commingling of surface water. Groundwater flow, fluctuation, and quality are generally influenced by surface water that intercepts the shallow groundwater (PRC, 1994).

Water levels in the shallow aquifer are tidally influenced with up to several inches of daily fluctuation. Because of the local influences, groundwater flow directions are irregular and vary seasonally. The groundwater quality is typically poor and unsuitable for domestic use.

The major sources for potable water are the 200-, 500-, and 700-foot sands of the Chicot aquifer. These sands are locally named for their approximate depths. The Chicot aquifer is the primary source of groundwater for public supply, irrigation and industrial use in the area. Yields from wells completed in the 200-foot sand range from 25-450 gallons per minute (gpm); in the 500-foot sand from 19-3,800 gpm; and in the 700-foot sand from 27-2,200 gpm. Specific capacity of the Chicot aquifer ranges from 2-23 gpm per foot. The hydraulic conductivity ranges from 40-220 feet per day (LGS, 1984).

3.6 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

3.6.1 Introduction

Toxic chemicals are a major stressor for aquatic systems. Chemical contaminants harm plants, animals, fish, and humans, affecting reproduction, development, and the survival of organisms. Major contaminants found in sediments include bulk organics (such as oil and grease), halogenated hydrocarbons (chemicals highly resistant to decay such as DDT and PCBs), polycyclic aromatic hydrocarbons (such as petroleum), and metals (such as lead, cadmium, and mercury) (USEPA, 1999). Many metals occurring naturally in soil and sediments, such as zinc and copper, are essential for plant life, but can become toxic at high concentrations.

Chemical contaminants originate from point sources (e.g., industrial and municipal wastewater treatment plants) and nonpoint sources (e.g., urban and suburban stormwater runoff and agricultural runoff). Domestic activities such as home and lawn maintenance, driving, and discarding unused household chemicals are sources of airborne and waterborne contaminants. Persistent chemicals may reach harmful levels when they accumulate in the sediment.

A Hazardous, Toxic, and Radioactive Waste (HTRW) assessment was conducted for the project corridor in general accordance with guidelines set forth in USACE Regulation ER 1165-2-132, *Water Resources Policies and Authorities for Hazardous, Toxic, and Radioactive Waste Guidance for Civil Works Projects*, 26 June 1992, and the American Society for Testing and Materials (ASTM) Standard E 1527-05, *Standard Practice for Environmental Site Assessments: Phase I, Environmental Site Assessment Process*. The complete HTRW report is included in Appendix G. A summary of the results of the HTRW assessment is presented below.

The goal of the HTRW assessment was to identify recognized environmental condition (REC) sites or potential REC sites in connection with the project area and to provide an opinion based upon an investigation described in the ASTM Standard. This was accomplished through research and site observations to establish whether any of the following conditions exist:

1. Indications that hazardous substances or petroleum products exist, or have existed, on or adjacent to the subject property;

2. The possibility that violations of environmental regulations have occurred on the subject property;

3. The potential for spilled, leaked, disposed, or otherwise released hazardous substances or petroleum products to migrate to the subject property from nearby properties containing such materials; and

4. The existence of unsafe conditions in connection with the subject property.

REC sites were evaluated for their potential to pose constraints to the project engineering design process.

3.6.2 Methodology

The initial HTRW assessment consists of four major components:

1. A review of Federal, state and local environmental database records and a review of current and historical physical setting records;

2. A site reconnaissance to observe project corridor environmental conditions and indications of impacts or potential impacts to the environment;

3. Interviews with local government officials familiar with environmental conditions of the project corridor; and

4. Preparation of a written report documenting the findings of the HTRW assessment.

An environmental database report developed by Banks Information Solutions, Inc. reports the cause(s) for listing and the current status of each site. This information was used to determine which, if any, sites warrant further scrutiny for the potential presence of HTRW.

Seven Federal and four state databases, listed below, were reviewed in 2006 to assess the area along the Calcasieu Ship Channel between channel mile 36 and the Gulf of Mexico. The same databases were reviewed again in 2007 to assess the proposed beneficial use sites, and in January, 2009 to assess expanded areas of the proposed beneficial use sites. An additional Banks report of these databases was issued in June 2009 that specifically targeted a list of additional companies located within one mile of the ship channel. These additional facilities were recommended for investigation by the Port of Lake Charles and the U.S. Fish and Wildlife Service, Lafayette office. Appendix A provides summaries of the 2006, 2007, and 2009 Banks reports.

Federal Databases:

- NPL – National Priority List. The USEPA's list of confirmed or proposed Superfund sites (updated June 2006).
- CERCLIS – The USEPA's Comprehensive Environmental Response, Compensation and Liability Information System (updated June 2006).
- NFRAP – A CERCLIS designation indicating that to the best of the USEPA's knowledge, assessment of a site has been completed and the USEPA has determined no further remedial action is planned (updated June 2006).
- RCRA TSD – The USEPA's list of Resource Conservation and Recovery Information System (RCRIS) - Treatment, Storage and Disposal facilities (updated April 2006).
- RCRA COR – The USEPA's list of Corrective Action Sites (updated April 2006).
- RCRA GEN – The USEPA's list of large and small quantity hazardous waste generators (updated April 2006).
- ERNS – The USEPA's list of emergency response actions (Emergency Response Notification System) (updated December 2005).

State Databases:

- SCL – The LDEQ list of facilities and/or locations recognized with potential or existing environmental contamination (updated quarterly).
- SWL – Solid waste landfills and transfer stations registered by LDEQ (updated January 1999).
- LUST – The LDEQ list of all leaking underground storage tanks (updated February 2006).
- RUST – The LDEQ list of all registered underground or above storage tanks (updated February 2006).

The following facilities were listed in the Federal and state environmental databases identified by GEC and Banks in 2006, 2007, and 2009. Additional information for each site, including addresses and distance from the ship channel, are provided in Appendix G. A description of each environmental database, along with a list of sites reported in each database, is also provided in Appendix G.

- AIR LIQUIDE AMERICA CORP.– LAKE CHARLES
- AIR LIQUIDE AMERICA CORP.– WESTLAKE
- ALCOA SPECIALTY CHEMICALS
- AMOCO PIPELINE
- AMOCO PRODUCTION CO.
- ARCH CHEMICAL
- ISLE OF CAPRI
- J.B. WAKINS #135
- J.B. WAKINS WELL NO. 239
- JOHN MICELLE MEAT PACKERS
- JOHN N JOHN TRUCK LINE INC.
- KRONOS LOUISIANA INC

- BAROID CAMERON FACILITY
- BASELL USA INC - WESTLAKE FACILITY
- BASELL USA INC LAKE CHARLES PLANT
- BIOLAB INC.
- BOLLINGER CALCASIEU LLC
- BRAMMER ENGINEERING
- BRIDGE POINT YACHT CENTER
- BROWN S EXXON
- BUREAU OF INDIAN AFFAIRS CONTACT I
- CALCASIEU REFINERY
- CALCASIEU REFINING CO
- CALHOUN HOLDINGS, LP CHARDELE MOBIL
- CAMERON PARISH SEWERAGE DISTRICT
- CERTAINTEED PRODUCTS CORP
- CHEVRON USA
- CHLORINE PROCESS UNIT
- CHLORINE SCRUBBER
- CII CARBON LLC LAKE CHARLES CALCINI
- CIRCLE A FOOD STORE
- CITGO PETROLEUM
- COLONIAL PIPELINE
- CONDEA VISTA
- CONOCO
- CONOCO PPG CO STA
- D S I TRANSPORTS
- DEBARGES CONVENIENT STORE
- DEVALL ENTERPRISES INC
- DEVALL TOWING AND BOAT SERVICE
- DIATSU OIL AND GAS
- DUNHAM-PRICE LLC - MIKE HOOKS ROAD
- FINA (CLOSED SITE)
- FIRESTONE POLYMERS
- FIRESTONE RUBBER AND LATEX
- FIRESTONE SYNTHETIC RUBBER
- GEOSPECIALTY CHEMICALS,INC.
- GIFFORD HILL & CO INC.-PLANT #58
- GLOBAL INDUSTRIES LTD
- GLOBAL MODULAR SOLUTIONS LLC - MANU
- GLOBAL POLLUTION SVCS INC.
- GOODWRENCH OIL
- HACKBERRY TERMINAL
- HALLIBURTON ENERGY SERVICES - LAKE
- HALLIBURTON ENERGY SERVICES INC
- L & L OIL CO.
- L AUBERGE DU LAC
- LAKE CHARLES HARBOR AND TERMINAL DIST.
- LAKE CHARLES STEVEDORES, INC.
- LAKE CHARLES, CITY OF WWTP BANDC
- LOUISIANA PIGMENT CO LP - TITANIUM
- LYONDELL CHEMICAL CO.
- MAINTENANCE SHOP LLC
- MANAGAN BUILDING MATERIALS, INC.
- MARTIN OPERATING PART.LP
- M-I DRILLING/WESTLAKE
- MICHELL PROPERTY
- MIKE HOOKS CO.
- MONTELL U.S.A., INC.
- OLIN CORP.
- OXY NGL INC.
- POLYMERS COGENERATIO CO
- PORT AGGREGATES INC - ELLENDER YARD
- PPG INDUSTRIES, INC.
- PRAXAIR INC
- QUEST/REYNOLDS METAL
- R E HEIDT CONST CO INC
- RAIN CII CARBON LLC
- REAGENT CHEMICALS
- REYNOLDS METALS
- SABINE GAS PLANT
- SABINE NATIONAL WILDLIFE REFUGE
- SABINE PIPELINE CO.
- SASOL NORTH AMERICA INC
- SHELL OIL CO. GAS PLANT
- SHELL WESTERN E & P
- SOCO OFFSHORE, INC.
- SPORTYS
- SULPHUR CITY OF - REGIONAL WWTP
- TESSENDERLO KERLEY INC.
- TETRA TECHNOLOGIES - WESTLAKE
- TEXACO-MUD LAKE STATION
- TOLUENE DIAMINE UNIT
- TRUCKLINE LNG COMPANY, LLC - LAKE C
- TRUNKLINE LNG COMPANY, LLC
- U.S. EPA HURRICANE RITA
- UNION PACIFIC RAILROAD
- VENCO LAKE CHARLES CALCINING PLANT

- HARVEST PIPELINE
- HEIDT HOTMIX ASPHALT FAC NR 6
- HOLCIM INC
- HOLNAM INC - LAKE CHARLES A
- HOUSTON MARINE SERVICES
- INDUSTRIAL CONSTRUCTION RENTALS
- W R GRACE CO - CONN - DAVISON DIV
- WESTLAKE POLYMERS CORP LAKE CHARLES
- WESTLAKE STYRENE CORP
- WESTLAKE STYRENE CORP MARINE TERM
- W-H HOLDINGS INC.
- WRIGHTS TEXACO
- ZAPATA HAYNIE CORP-CAMERON PLANT

Previous water quality studies conducted in the project corridor vicinity by LDEQ and the USEPA were also reviewed for evidence of contamination in the project corridor.

For the historic records review, historical quadrangle maps and aerial photographs were analyzed for structures, mines, quarries, clearings, wells, and land use in order to: (1) ascertain development of the project area since the early 20th century; and (2) identify indications of possible items of environmental concern. Historic city directories and Sanborn fire insurance maps, usually reviewed when conducting such research, do not exist for the project area.

For the site reconnaissance component of the initial HTRW assessment, a field evaluation to observe conditions and activities was conducted at sites within the project area that were accessible.

For the interview process, interviews with public officials familiar with the study corridor were conducted through a combination of telephone calls, emailed maps, and in-person interviews. Public officials were sought who had knowledge of environmental conditions in the project area. Four key government offices were identified who could provide such knowledge: (1) the Port of Lake Charles, (2) SNWR; (3) LDEQ Southwest Regional Office Surveillance Division; and (4) the Calcasieu and Cameron Parish Offices of Emergency Preparedness. Interviewees were asked to provide knowledge of any sites, incidents, conditions, businesses, etc., that could require further investigation or remediation, either surface or subsurface, and of which project planners should be aware.

3.6.3 Conclusions

Based on the site reconnaissance, records review, interviews, and best engineering judgment, the HTRW assessment revealed evidence of REC (recognized environmental concern) sites in connection with the project area. Table 3-28 provides a list of sites that may have adversely impacted environmental conditions in the project area.

Table 3-28. List of Potential REC Sites that May Have Adversely Impacted Environmental Conditions in the Project Area

Site Name	Street Address	Database	Distance From Project Area
Plottable Sites (within ASTM-recommended search radii)			
CITGO Petroleum Corporation	4401 Hwy 108	CERCLIS, RCRA TSD, RCRACOR, RCRAGN	0.21 mi NW

Site Name	Street Address	Database	Distance From Project Area
Olin Corporation/Lyondell Chemical/Arch Chemical/ Reagent Chemicals/Biolab, Inc./Praxair, Inc.	900/960 I-10 West	RCRA TSD, RCRACOR, RCRAGN (3), ERNS (26), RUST, SCL	0.15 mi SW
CITGO Petroleum Corporation- Clifton Barge Terminal	Lake Charles	SCL	0.43 mi NW
Sabine Pipeline Co.	Sulphur	SCL	0.61 mi NW
John Micelle Meat Packers	2045 West Sallier Rd.	LUST, RUST (2)	0.16 mi NE
Lockport Oil and Gas Field	Right descending channel bank between Coon Island and Rose Bluff Cutoff	LDNR Oil Wells Database	Onsite
East Moss Lake Oil and Gas Field	Left descending channel bank between Bayou Guy and Devil's Elbow	LDNR Oil Wells Database	Onsite
East Hackberry Gas Field	Both channel banks between Crab Gully and Hackberry	LDNR Oil Wells Database	Onsite
Cameron Oil and Gas Field	Both channel banks from St. Johns Island to Gulf of Mexico	LDNR Oil Wells Database	Onsite
Calcasieu Ship Channel at Bayou d'Inde (incl. Lockport Marsh)	Calcasieu Ship Channel	N/A (LDEQ Mercury Initiative, USEPA Calcasieu Estuary BERA)	Onsite
Calcasieu Ship Channel at Coon Island/Coon Island Loop	Calcasieu Ship Channel	N/A (LDEQ Mercury Initiative, USEPA Calcasieu Estuary BERA)	Onsite
Clooney Island Loop	Calcasieu Ship Channel	N/A (USEPA Calcasieu Estuary BERA)	Onsite
Calcasieu Ship Channel at Indian Wells Lagoon	Calcasieu Ship Channel	N/A (USEPA Calcasieu Estuary BERA)	Onsite
Middle Calcasieu River Reach	Calcasieu Ship Channel	N/A (USEPA Calcasieu Estuary BERA)	Onsite
Calcasieu Ship Channel at Long Point	Calcasieu Ship Channel	N/A (USFWS Interview)	Onsite
CITGO Oil Spill	Calcasieu Ship Channel from Coon Island to Choupique Island	N/A (LDEQ Interview)	Onsite
Shell Pipeline Company- Haymark Terminal	Calcasieu Ship Channel at Bayou Guy	N/A (site reconnaissance)	Onsite
Orphan Sites (potentially within ASTM-recommended search radii)			
Mike Hooks Co.	Mike Hooks Rd.	ERNS	Unknown

Source: Banks Information Solutions/GEC, 2006.

Comprehensive sampling of water and sediments was performed in association with this study. A discussion of the contaminants present in sediments of the Calcasieu Ship Channel is presented in Section 3.4, Surface Water and Sediment Quality.

3.7 AIR QUALITY

The Clean Air Act Amendment of 1990 directed the USEPA to establish National Ambient Air Quality Standards (NAAQS) for all regulated air pollutants. Federal air quality standards have been established for six criteria air pollutants:

- Carbon monoxide (CO);
- Nitrogen dioxide (NO_2);
- Ozone (O_3);
- Sulfur oxides (commonly measured as sulfur dioxide [SO_2]);
- Lead (Pb);
- Particulate matter no greater than 2.5 micrometers (µm) in diameter ($PM_{2.5}$); and
- Particulate matter no greater than 10 µm in diameter (PM_{10}).

The USEPA classifies air quality by Air Quality Control Region (AQCR). The Clean Air Act defines an AQCR as a contiguous area where air quality, and thus air pollution, is relatively uniform. AQCRs often correspond with airsheds and may cross parish and state lines. Each AQCR is treated as a unit for developing pollution control strategies to achieve National Ambient Air Quality Standards (NAAQS).

An AQCR or portion of an AQCR may be classified as attainment, nonattainment, or unclassified. A classification of "attainment" indicates that criteria air pollutants within the region are within NAAQS values; a "nonattainment" classification indicates that air pollution levels persistently exceed the NAAQS values; and a classification of "unclassified" indicates that air quality within the region cannot be classified (generally due to lack of data). A region designated as unclassified is treated as an attainment region.

The USEPA's *Nonattainment Areas for Criteria Pollutants* (Green Book) maintains a list of all areas within the United States that are currently designated nonattainment areas with respect to one or more criteria air pollutants. Parishes and metropolitan areas in the project area are not listed as non-attainment areas in the Green Book, indicating they are in attainment.

The USEPA's AirData database contains measurements of air pollutant concentrations for the entire United States. The measurements include both criteria air pollutants and hazardous air pollutants as compared to the NAAQS specified by the USEPA. The AirData database was queried for air quality data within the project area for the interval 2002-2006. Table 3-29 presents air quality values provided by the AirData database for Calcasieu Parish (data are not available for Cameron Parish). Each row of the table lists standards-related air pollution values for all six criteria pollutants for one year. The values shown are the highest reported during the year by all monitoring sites in the parish. As Table 3-30 illustrates, Calcasieu Parish is currently in attainment for all six criteria air pollutants. However, in 2005, the parish exceeded the NAAQS for Ozone by 0.005 parts per million (ppm).

Table 3-29. Air Quality Values for Calcasieu Parish, Louisiana

Year	CO (ppm)		NO_2 (ppm)	O_3 (ppm)		SO_2 (ppm)		$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)		PB (µg/m^3)
	2nd Max 1-hr	2nd Max 8-hr	Annual Mean	2nd Max 1-hr	4th Max 8-hr	2nd Max 24-hr	Annual Mean	98th Percentile	Annual Mean	2nd Max 24-hr	Annual Mean	Quarterly Mean
2002	*	*	0.004	0.096	0.074	0.017	0.004	34	10.7	*	*	*
2003	*	*	0.006	0.104	0.084	0.017	0.006	23	11.2	*	*	*
2004	*	*	0.007	0.114	0.082	0.012	0.003	30	10.4	*	*	*
2005	*	*	0.008	0.106	**0.085**	0.014	0.003	27	11.8	*	*	*
2006	*	*	0.009	0.07	0.06	0.008	0.003	*	*	*	*	*
NAAQS**	35	9	0.053	0.12	0.08	0.14	0.03	35	15	150	50	1.5

Notes:

***Some values are absent due to incomplete reporting.**

****National Ambient Air Quality Standards**

CO - Carbon Monoxide Air Quality Standards: 2nd Max 1-hr: 2nd-highest 1-hour average concentration for year. Rounded to nearest ppm, Should not exceed 1-hr standard (35 ppm).

2nd Max 8-hr: 2nd-highest non-overlapping 8-hr concentration for the year. Rounded to nearest ppm, should not exceed the level of the 8-hour standard (9 ppm). Computed as 8-hr avg concentration for each hr as a moving avg of eight 1-hour values.

NO_2 - Nitrogen Dioxide Air Quality Standard: Annual Mean- Arithmetic avg of all 1-hour values for the year. Should not exceed level of annual standard (0.053 ppm).

O_3 - Ozone Air Quality Standards:

2nd Max 1-hr: 2nd-highest "daily max value" – 2nd highest of the 1-hr value of each day, Rounded to nearest ppm. Should not exceed the 1-hr standard (0.12 ppm).

4th Max 8-hr: 4th-highest "daily max value" – 4th highest of the 8-hr values of each day. Rounded to nearest ppm. Should not exceed 8-hr standard (0.08 ppm). Computed as an 8-hr value for each hr of the day as a moving average of eight 1-hr values.

SO_2 – Sulfur Dioxide Air Quality Standards: 2nd Max 24-hr- Second-highest 24-hour average concentration (in ppm) for the year. This value, rounded to the nearest 0.01 ppm, should not exceed the level of the 24-hour standard (0.14 ppm). AQS software computes a midnight to midnight 24-hour average value for each day from 1-hour values.

Annual Mean- Arithmetic average of all 1-hour values for the year. This value should not exceed the level of the annual standard (0.030 ppm).

$PM_{2.5}$ – Particulate Matter smaller than 2.5 micrometers: 98th Percentile: 98th percentile 24-hour value (in µg/m^3). Should not exceed 24-hour standard (35 µg/m^3). The 98th percentile value is higher than 98 percent of 24-hr values for the year.

Annual Mean- Arithmetic mean of 24-hr values for the year. This value should not exceed the level of the annual standard (15.0 µg/m^3).

PM_{10} – Particulate Matter smaller than 10 micrometers: 2nd Max 24-hr: 2nd-highest 24-hour value for the year. Rounded to the nearest 10 µg/m^3. Should not exceed 24-hr standard (150 µg/m^3).

Annual Mean- Weighted arithmetic mean of 24-hr values for year. Compensates for scheduled sampling that did not occur. Should not exceed annual standard (50 µg/m^3).

Pb – Lead Air Quality Standards: Quarterly Mean: Highest of the quarterly mean values. Rounded to the nearest 0.1 µg/m^3. Should not exceed quarterly standard (1.5 µg/m^3). Each quarterly mean is the arithmetic average of 24-hour values for a calendar quarter: January-March (1), April-June (2), July-September (3), and October-December (4).

Source: USEPA AirData Database, 2006.

Table 3-30. Air Quality Index Summary for Calcasieu Parish and Lake Charles MSA, Louisiana

Year	# Days with AQI	Number of Days when Air Quality Was				AQI Statistics			Number of days main AQI pollutant was					
		Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Max	90^{th} Percentile	Median	CO	NO_2	O_3	SO_2	$PM_{2.5}$	PM_{10}
Calcasieu Parish														
2002	365	322	41	2	0	114	53	34	0	0	207	1	157	0
2003	365	275	86	4	0	140	63	40	0	0	148	0	217	0
2004	366	290	75	1	0	106	63	35	0	0	189	2	175	0
2005	344	232	106	6	0	122	70	42	0	0	155	1	188	0
2006	90	81	9	0	0	69	51	36	0	0	54	0	36	0
Lake Charles MSA														
2002	365	322	41	2	0	114	53	34	0	0	207	1	157	0
2003	365	275	86	4	0	140	63	40	0	0	148	0	217	0
2004	366	290	75	1	0	106	63	35	0	0	189	2	175	0
2005	344	232	106	6	0	122	70	42	0	0	155	1	188	0
2006	90	81	9	0	0	69	51	36	0	0	54	0	36	0

Notes:

 # Days with AQI: Number of days in the year having an Air Quality Index value. Number of days on which measurements from any monitoring site were reported to the AQS database.

Number of Days when Air Quality was…

These columns indicate how the daily AQI values for a county or MSA were distributed among four broad categories of air quality:

Good: Number of days in the year having an AQI value 0 through 50.

Moderate: Number of days in the year having and AQI value 51 through 100.

Unhealthy for Sensitive Groups: Number of days in the year having an AQI value 101 through 150.

Unhealthy: Number of days in the year having an AQI value 151 or higher. This includes the AQI categories *unhealthy*, *very unhealthy*, and *hazardous*. Very few locations (about 0.3 percent of counties) have any days in the very unhealthy or hazardous categories.

AQI Statistics: These columns provide simple statistical measures of the AQI values for a county or MSA:

Max: The highest daily AQI value in the year.

Highest possible AQI value is 500. If a pollutant concentration exceeds the level equivalent to AQI 500, it is given as 501 to indicate "greater than 500."

90th percentile: 90 percent of daily AQI values during the year were less than or equal to the 90th percentile value.

Median: Half of daily AQI values during the year were less than or equal to the median value, and half equaled or exceeded it.

Number of Days when AQI pollutant was...

A daily index value is calculated for each air pollutant measured. The highest of those index values is the AQI value, and the pollutant responsible for the highest index value is the "Main Pollutant." The criteria pollutants used to calculate AQI are:

Source: USEPA AirData Database, 2006.

The AirData database also provides annual summaries of Air Quality Index (AQI) values for counties or MSAs. The AQI is an approximate indicator of overall air quality because it takes into account all of the criteria air pollutants measured within a geographic area. The AQI summary values include both qualitative measures (i.e., days of the year having good air quality) and descriptive statistics (i.e., median AQI value). Table 3-10 presents an AQI summary for Calcasieu Parish and Lake Charles MSA for the interval 2002-2006.

As Table 3-10 indicates, air quality in the project area is generally good, with minimal periods in which air quality is classified as unhealthy for sensitive groups. Of the six criteria air pollutants, ozone and particulate matter of 2.5 µm or less are most likely to occur within the project area. However, Table 3-10 indicates that the air quality is within NAAQS limits for these parameters.

3.8 BIOLOGICAL RESOURCES

3.8.1 Introduction

The Calcasieu Ship Channel project corridor lies within the ecosystem identified by the USFWS as the Lower Mississippi River Ecosystem. The LDWF places the project area within the state's Gulf Coast Prairies and Marshes Ecoregion. 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.

3.8.2 Habitats

The distribution of habitats within five miles of the Calcasieu Ship Channel is quantified in Table 3-31 and depicted in figures 3-7 through 3-9. These figures and summary data are based on information from the National Wetlands Research Center (NWRC) Louisiana Land Use and Land Cover (LULC) dataset and represent conditions that existed prior to Hurricane Rita in September 2005, when storm surges inundated the area with seawater. The effects of the seawater on less saline marshes have been protracted, and marshes of the Calcasieu estuary have not yet returned to pre-hurricane conditions. Prior to Hurricane Rita, there were gradations among fresh, intermediate, and brackish marshes. Recent preliminary investigations indicate that much of the area now appears to be comprised of intermediate marsh, as evidenced by a predominance of marshhay cordgrass (personal communication, Ashley Mullens, Louisiana State University School of Plant, Environmental, and Soil Sciences, 2007). Coast-wide habitat surveys to update habitat maps are anticipated to include a detailed investigation of the status of the Calcasieu estuary.

3.8.2.1 Aquatic Habitats

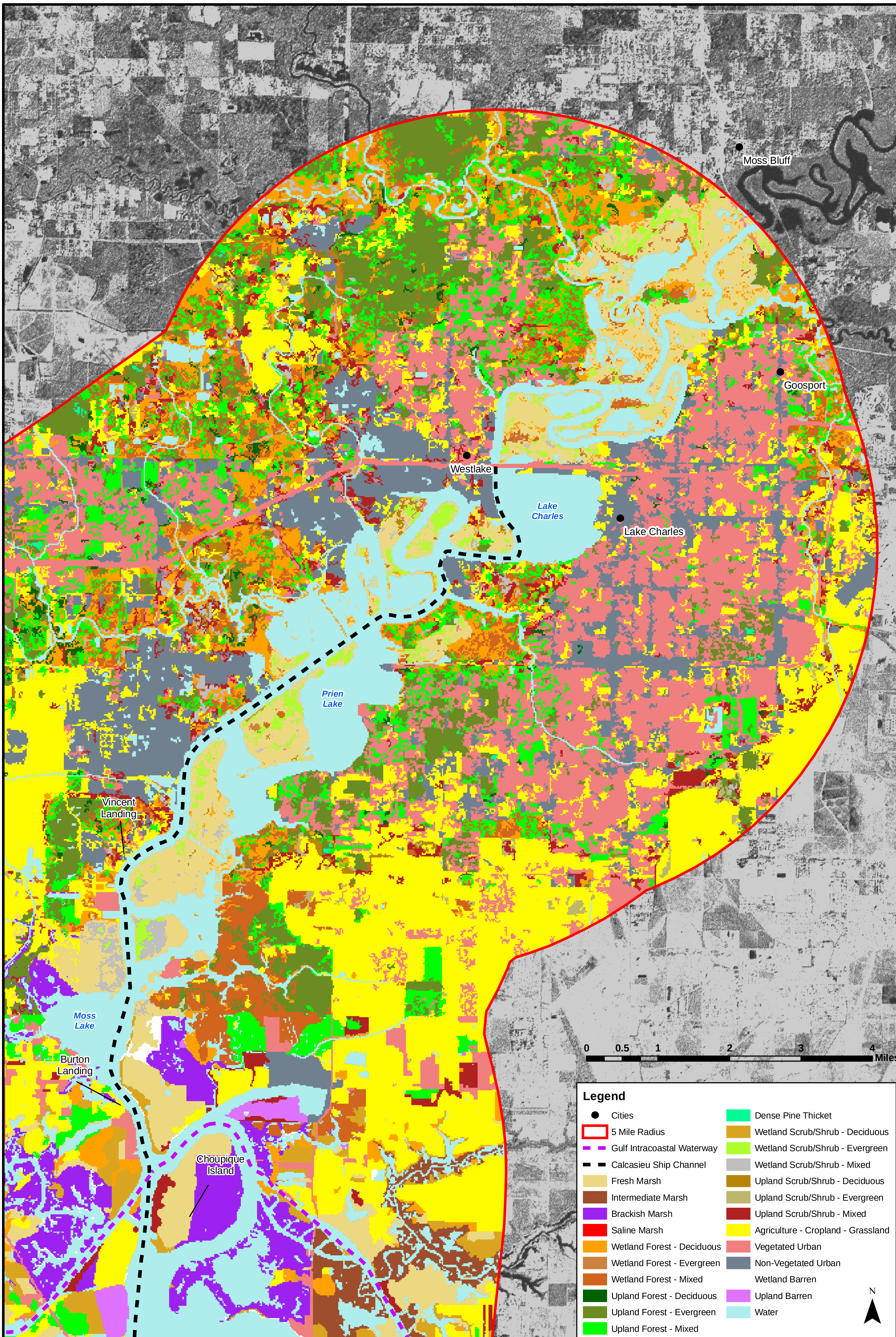
Freshwater. Freshwater habitats include tributaries feeding into the Calcasieu Ship Channel and freshwater marshes in the surrounding area. No freshwater streams would be influenced by the proposed project.

Brackish Water. Brackish water habitats are defined as having salinity concentrations ranging from 0.05 to 30 ppt (Hutchinson, 1957). Within the ship channel, brackish water habitat extends as far north as the saltwater barrier just north of the project end (at the I-10 Bridge). During December 2006, the salinity at the northern end of the project area was 11.94 ppt. The channel contained brackish water as far south as Mile Marker 5, the southern end of the Project Area, where the salinity was 26.3 ppt. Habitats in areas of brackish water include marshes with emergent herbaceous vegetation, as described below.

Table 3-31. Louisiana Land Use and Land Cover Habitat Types in Project Area

Habitat Description	Acres
Water	1,472,359
Agriculture - Cropland - Grassland	39,463
Brackish Marsh	22,688
Fresh Marsh	9,137
Intermediate Marsh	6,606
Saline Marsh	3,205
Vegetated Urban	12,549
Non-Vegetated Urban	6,779
Upland Barren	1,095
Upland Forest - Deciduous	340
Upland Forest - Evergreen	4,089
Upland Forest - Mixed	4,348
Upland Scrub/Shrub - Deciduous	252
Upland Scrub/Shrub - Evergreen	327
Upland Scrub/Shrub - Mixed	4,691
Wetland Forest - Deciduous	3,463
Wetland Forest - Mixed	2,757
Wetland Scrub/Shrub - Deciduous	2,666
Wetland Scrub/Shrub - Mixed	521
Wetland Barren	482
Wetland Scrub/Shrub - Evergreen	475
Wetland Forest - Evergreen	13
Dense Pine Thicket	146
Total	**1,598,452**

Source: NWRC LULC/GAP, 1988.



WETLAND AND UPLAND HABITATS

Calcasieu River & Pass
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 3-7	
Date: March 2009	
Scale: 1:80,000	
Source: LDEQ/NWRC/GEC	
Map ID: 27585107-1313	

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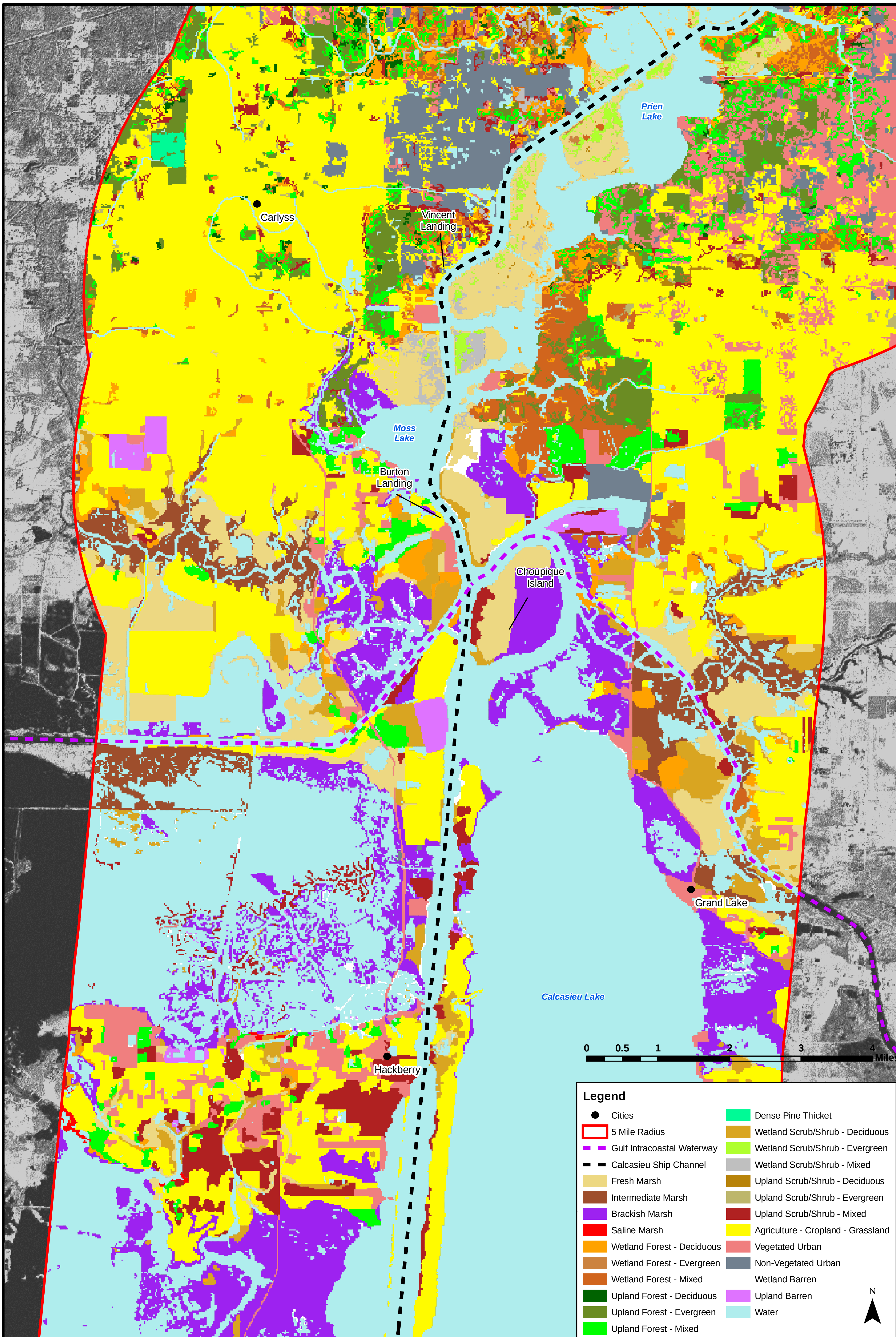

WETLAND AND UPLAND HABITATS

Calcasieu River & Pass
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 3-8
Date: March 2009
Scale: 1:80,000
Source: LDEQ/NWRC/GEC
Map ID: 27585107-1314

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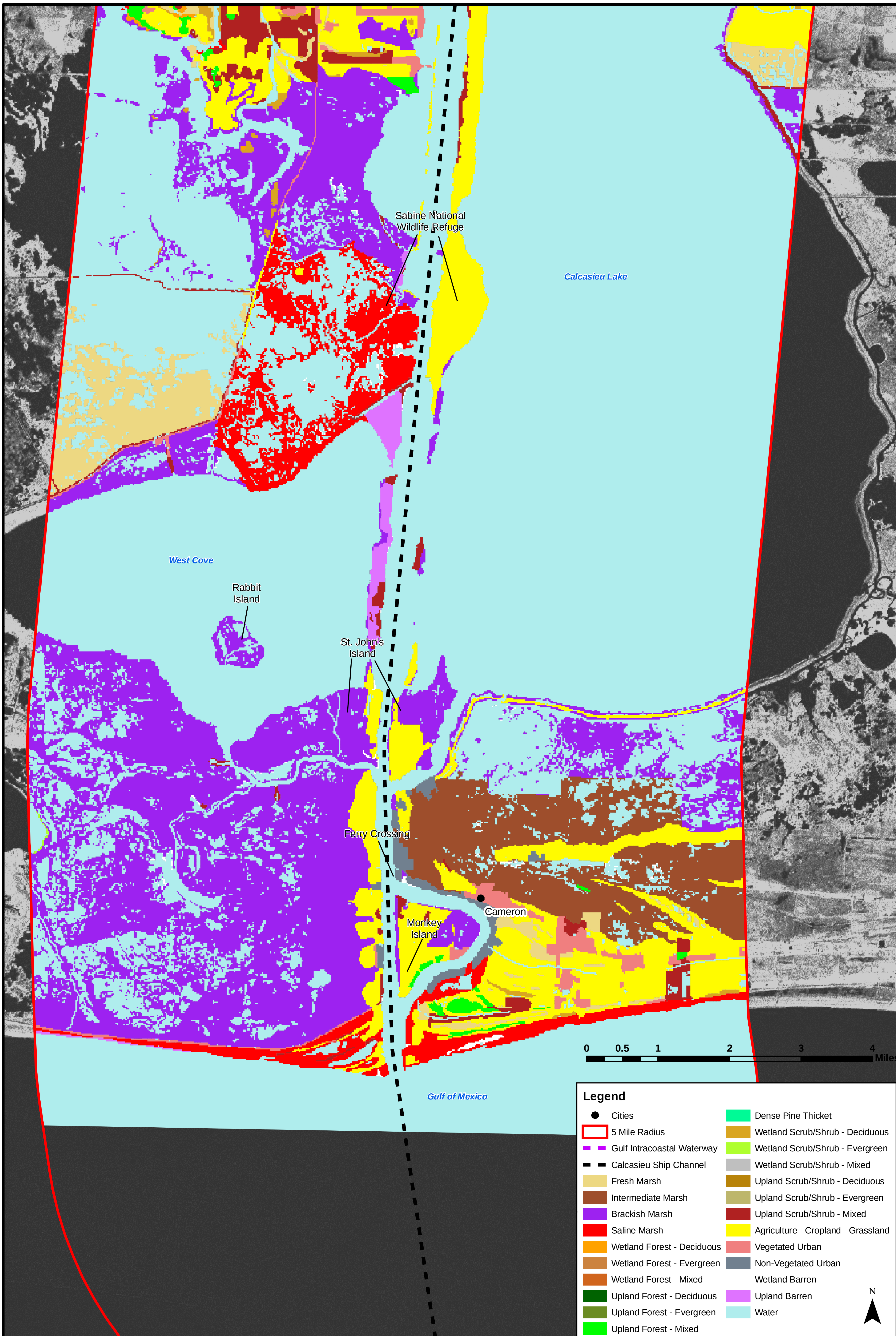


WETLAND AND UPLAND HABITATS

Calcasieu River & Pass
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

Figure: 3-9
Date: March 2009
Scale: 1:80,000
Source: LDEQ/NWRC/GEC
Map ID: 27585107-1315

Back

Saline Water. Saline habitats are defined as having a salinity of at least 30 ppt (Hutchinson, 1957). While no salinity measurements above 30 ppt were recorded during December 2006, it is likely that during periods of low rainfall, saline waters would enter the Channel. A bottom saltwater wedge in the ship channel can sometimes extend from the Gulf to the saltwater barrier, depending upon drought conditions in the area.

3.8.2.2 Wetlands

Wetlands are semiaquatic lands, flooded or saturated by water for varying periods of time. For an area to be delineated as a wetland, it must exhibit appropriate hydrology, contain hydric soils, and support hydrophytic vegetation (USACE, 1987). Figures 3-7 through 3-9 show the habitats, including wetlands, within five miles of the ship channel. Wetland area is quantified in Table 3-31.

Wetlands restore and maintain water quality by removing and retaining nutrients contained in stormwater runoff that would otherwise flow directly into the water column. These ecosystems provide critical habitat for a diversity of plants and animals, including fish, shellfish, waterfowl, shorebirds, wading birds, songbirds, and mammals. Wetlands provide flood control by retaining water that would otherwise flood nearby residential and agricultural areas. Wetlands also act as storm buffers from highly erosive wave action to surrounding areas in the Louisiana coastal zone. Furthermore, wetlands provide many recreational and economical benefits to Louisiana and the entire nation.

The loss of wetlands has been an issue of major concern in coastal Louisiana, including in the Calcasieu estuary. The causes vary, but all have resulted in the conversion of wetland habitats to large areas of open water. A total of 116,791 acres of wetlands in the Calcasieu-Sabine Basin has converted to open water since 1932 (USGS, 2007). The Calcasieu sub-basin lost 37,238 acres of land between 1933 and 1990, with an average annual acreage loss of 0.5 percent (LCWCRTF 1993).

Forested Wetlands. Approximately 6,233 acres of forested wetlands are located within five miles of the ship channel. Table 3-31 breaks out different types of forested wetlands in the project area. Forested wetlands, located at the landward end of estuaries, are divided into two vegetation zones: bottomland hardwood forests and bald cypress/tupelo swamps. The soils are nutrient-rich and high in organic matter. The presence of standing water allows for the growth of aquatic and emergent plants. Diverse microhabitats within the forested wetlands make this zone particularly species-rich.

Bottomland Hardwood Forests. Bottomland hardwood forests are forested, alluvial wetlands occupying broad floodplain areas that flank large river systems. Bottomland hardwood forests are characterized and maintained by a natural hydrologic regime of alternating wet and dry periods generally following seasonal flooding events. These forests support distinct assemblages of plants and animals associated with particular landforms, hydric soils, and hydrologic regimes. They are important natural communities for maintenance of water quality, providing a very productive habitat for a variety of fish and wildlife species, and are important in regulating flooding and stream recharge. In general, these habitats are mixtures of broadleaf deciduous, needleleaf deciduous, and evergreen trees and shrubs. Bottomland hardwood forests contain a number of species which can be aggregated into specific associations or communities based on environmental factors such as physiography, topography, soils, and moisture regime. Bottomland hardwood forests are found along the Calcasieu River north of Calcasieu Lake.

Bald Cypress/Tupelo Swamps. Cypress/tupelo swamps are forested, alluvial habitats on intermittently exposed soils most commonly found along rivers and streams but also occurring in backswamp depressions and swales. The soils are inundated or saturated by surface water or ground water on a nearly permanent basis throughout the growing season except during periods of extreme drought. Cypress/tupelo swamps have relatively low plant diversity. Bald cypress (*Taxodium distichum*), and water tupelo (*Nyssa aquatica)* are co-dominants. Common associates are swamp tupelo (*Nyssa biflora)*, Drummond's red swamp maple (*Acer rubrum* var. *drummondii)*, black willow (*Salix nigra)*, pumpkin ash *(Fraxinus profunda)*, green ash (*Fraxinus pennsylvanica)*, planertree (*Planera aquatica)*, water locust (*Gleditsia aquatica)*, sweetspire (*Itea virginica)*, and common buttonbush (*Cephalanthus occidentalis)*. Undergrowth is often sparse because of low light intensity and long hydroperiods. Cypress/tupelo swamps are found north of Calcasieu Lake and are often transitional between bottomland hardwood forest and riverine or freshwater marsh habitats.

Coastal Marshes. Coastal Louisiana is predominately marsh, indented by shallow bays that contain innumerable valuable nursery areas for fish and invertebrates. Total estuarine area in 1970 encompassed more than 7.2 million acres, of which over 3.9 million acres was marsh vegetation and more than 3.3 million acres was surface water area (Perret *et al*., 1971). These waters are generally shallow with over half between 0.0 and 5.9 feet deep. Sediments typically consist of mud, sand, and silt, and are very similar across the coast, ranging from coarse near the Gulf and barrier islands to fine in the upper estuaries (Barrett *et al*., 1971).

The following summarizes statewide information described in the Gulf of Mexico Estuarine Inventory (GMEI) within the study area (Perret *et al.*, 1971). Additional information is from the LDWF (LDWF, 2005). Coastal marshes consist of four main types:

- Saline marsh is the marsh area typically closest to the beach rim of the Gulf of Mexico, and, in general, varies from 1-15 miles in width. These marshes are regularly tidally flooded and dominated by salt-tolerant grasses. Small pools or ponds may be scattered. Saline marsh has the least plant diversity and the lowest soil organic matter content of any marsh type. The community is often totally dominated by smooth cordgrass (*Spartina alterniflora).* Other significant species includes saltmeadow cordgrass *(Spartina patens)*, saltgrass (*Distichlis spicata*), needlegrass rush (*Juncus roemerianus)*, and saltwort (*Batis maritima*). Soil and water conditions regulate plant growth and salinity appears to be the primary factor determining species composition. The mean salinity of saline marsh is about 16 ppt. The area of saline marsh is increasing, apparently due to salt water intrusion resulting in shifts in marsh salinity levels. Saline marsh acts as nursery areas for myriad larval and juvenile forms of shrimp, crabs, red drum, seatrout, menhaden, etc., and greatly enhances the production of marine organisms directly related to the enormous primary productivity of the marsh vegetation. Approximately 6,200 acres of saline marsh are present in the vicinity of the project (Table 3-11), primarily at the southern end.

- Brackish marsh is usually found between salt marsh and intermediate marsh, and has an average salinity of about 8 ppt. This community is irregularly tidally flooded and is dominated by salt-tolerant grasses. Plant diversity and soil organic matter content are higher in brackish marsh than in salt marsh. Brackish marsh is typically dominated by saltmeadow cordgrass. Other significant associated species include saltgrass, Chairmaker's bull rush (*Schoenoplectus americanus),* sturdy bulrush *(Schoenoplectus robustus*), dwarf spikerush (*Eleocharis parvula)*, needlegrass rush, and smooth cordgrass. Brackish marsh is of very high value to estuarine larval and juvenile forms of marine organisms such as shrimp, crabs, menhaden, etc. In the project area approximately 22,688 acres of brackish marsh (Table 3-11) are found mostly to the west of the ship channel in the vicinity of and south of the SNWR.

- Intermediate marsh is oligohaline (salinity of 3 to 10 ppt), and is dominated by narrow-leaved, persistent species. This marsh is characterized by a diversity of species, many found in freshwater marsh and some in brackish marsh. It is often dominated by saltmeadow cordgrass. Other characteristic species include roseau cane *(Phragmites australis*), bulltongue arrowhead (*Sagittaria lancifolia)*, spikesedge, three-cornered grass, and gulf cordgrass (*S. spartinae)*. Intermediate marsh occupies the least acreage of any of the four marsh types (approximately 6,606 acres). This marsh type is very important to many species of birds and supports large numbers of wintering waterfowl. It is also critical nursery habitat for larval and juvenile marine organisms. Gradual changes in salinity can cause this habitat to shift towards brackish marsh.

- Freshwater marsh is normally adjacent to intermediate marsh along the northern most extent of the coastal marshes. Salinities are usually less than 2 ppt and normally average about 0.5-1 ppt. Freshwater marsh has the greatest plant diversity and highest soil organic matter content of any marsh type. It is frequently dominated by maidencane *(Panicum hemitomon)*. Other characteristic species include spikesedge, alligatorweed, saltmeadow cordgrass, roseau cane, coon's tail (*Ceratophyllum demersum*), water hyacinth (*Eichhornia crassipes)*, pickerelweed (*Pontederia cordata*), pennyworts (*Hydrocotyle* spp.) common duckweed (*Lemna minor),* and cattails *(Typha* spp.). Within the vicinity of the project area, approximately 9,137 acres of freshwater marsh have been found at the northern edge of Calcasieu Lake. An area of the SNWR has been managed for freshwater marsh.

Prior to the initial dredging of the ship channel, there was a 3.5-foot-deep shoal at the mouth of the Calcasieu River. This natural bar acted as a barrier, minimizing saltwater intrusion and tidal inflow into the basin. Removal of the channel mouth bar, coupled with subsequent widening and deepening of the channel, allowed increased saltwater and tidal intrusion into the estuary, which resulted in marsh loss, tidal export of organic marsh substrate, and an overall shift to more saline habitats in the region (USDA, 1994).

Channels and canals dredged in the coastal marshes, largely to support oil and gas exploration and production, have caused further degradation of wetland habitats by providing conduits for the introduction of salt water into fresh and intermediate marshes (Appendix F, Biological Resources).

3.8.2.3 Uplands

Upland habitats within the project area consist of three major types: (1) Coastal Prairie habitat in the upper portion of the project area (primarily Calcasieu Parish); (2) Cheniers at the southern end of the project area; and (3) Upland habitats associated with CDFs. Further explanation of these terrestrial habitats is provided in the following sections. Table 3-31 and figures 3-7 to 3-9 list and depict upland habitats within five miles of the ship channel. The only uplands that would be affected by the project are located on CDFs.

Coastal Prairie. The Louisiana coastal prairie was a tallgrass prairie that included portions of 12 parishes in southwestern Louisiana and four counties in eastern Texas. Unlike Midwestern tallgrass prairie, where the growth of trees was limited by rainfall in some areas, the growth of trees in the coastal prairie was limited by heavy clay soils and frequent fires. This grassland was settled in the mid-1800s and converted to rice fields, cattle farming, and other uses. Only about 1,000 acres of the original 2.5 million acres of coastal prairie remain, and these are remnants in areas such as railroad rights-of-way that have remained undisturbed. Although the name “coastal prairie” is still used to denote the region, it is unlikely that any true coastal prairie is found in or in the vicinity of the project area.

Cheniers. Cheniers are coastal ridges exclusive to southwestern Louisiana that typically have higher relief than outlying barrier islands. These ridges are known for supporting maritime forests dominated by live oak trees (*Quercus virginiana*). Those forests that escaped the human impacts of deforestation and agriculture play an important ecological role as a temporary habitat for many migrating bird species. Additionally, because cheniers are above sea level, they are among the most important continuous habitats for mammals and birds in coastal Louisiana. Although cheniers are present in Cameron Parish, none are located within the project area.

3.8.2.4 Confined Disposal Facilities (CDFs)

The habitats on existing CDFs along the ship channel vary. Some CDFs have a scrub-shrub habitat, while others are more heavily forested. Some have extensive areas of pasture that are used for cattle grazing. Some of the facilities have ponded areas with emergent and peripheral wetland vegetation.

To determine the number of acres and habitats on the CDFs, Geographic Information Systems (GIS) technology compared the footprints of existing CDFs to the Louisiana Land Use and Land Cover (LULC) dataset, developed by the National Gap Analysis Program (GAP). A summary of the combined habitats of CDFs 1, 2, 3, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 19, 22, D, E, F, H, M, and N are presented in Table 3-32.

Table 3-32. Habitats Located on Existing CDFs

Habitat Type	Acres
Marsh	2,794.8
Cropland/grassland	1,741.2
Upland Barren	318.0
Water	292.2
Upland scrub/shrub	198.4
Upland Forest	0.5
Total:	**5,343.1**

Source: LULC/GAP, 1988.

Much of the variation among CDFs appears to be based on the frequency of use, the types of management employed, and the efficiency of ditching and draining activities. Appendix R lists the number of acres and habitats for each individual CDF.

Four CDFs (9, 10, 11, and 13) in the River reach of the project were visited in March 2007, plant species observed at the lower elevations included marshhay cordgrass, gulf cordgrass, saltmarsh bulrush, three-cornered grass, spike-rush (*Eleocharis* spp.), and black needlerush. Marsh-elder (*Iva frutescens),* salt-cedar (*Tamarix* sp.), and roseau cane generally dominated the upland vegetation at the higher reaches, and Chinese tallow (*Triadica sebifera)* was present on spoil banks and levees.

3.8.3 Biota

Appendix F, *Biological Resources*, presents an extensive list of species known to occur on the Cameron Prairie National Wildlife Refuge (NWR). A representative of the SNWR related that the Cameron Prairie listing is applicable to that refuge as well as to the project area in general.

3.8.3.1 Plants

As described above, marsh vegetation is typically herbaceous. Outside of the marshes, commonly encountered trees include Chinese tallow tree, Hercules' club (*Zanthoxylum clava-herculis)*, bald cypress, live oak, gums, sycamore (*Platanus occidentalis)*, plains cottonwood (*Populus deltoides)*, sugarberry (*Celtis laevigata*), and willows (*Salix* spp.). Plants found on CDFs, include roseau cane, marsh-elder, saltcedar, and Chinese tallow.

Invasive plant species are found in the project area. The most visible is the Chinese tallow tree, which has become established on many of the CDFs. The Chinese tallow is a successful invader of the chenier habitats. It has affected plant community structure by becoming the most abundant woody species at many locations. It has the potential to invade surrounding marshes and convert them from herbaceous to woody plant communities (Neyland and Meyer, 1997). A second highly visible invasive is the kariba-weed (*Salvinia molesta*), present in the marshes and canals north of the town of Cameron. It can form dense mats that cover entire bodies of water with a thick layer that blocks sunlight, thereby reducing photosynthesis, reducing dissolved oxygen, and causing fish kills.

Submerged aquatic vegetation (SAV) occurs along the coastal areas of Louisiana, but it was not observed in Calcasieu Lake during a survey of oyster resources for this project (Appendix I). NMFS (1999) reported that SAV coverage in Calcasieu Lake was low and decreasing, primarily due to alterations in the watershed and to point-sources of pollution. Jerald Horst, a long-time fisheries biologist with the Louisiana State University Extension Service, related that the SAV had completely disappeared from Calcasieu Lake (2006).

However, areas of protected shallow open water within Sabine NWR and Cameron Prairie NWR are known to support SAV habitat. According to Billy Leonard, Oil and Gas Specialist/Wildlife Biologist with the Southwest Louisiana National Wildlife Refuge Complex, SAV has been observed within the proposed Sabine beneficial use site 18 (Personal communication, August 13, 2008). Water control structures constructed under the CS-23 CWPPRA project were designed to reduce salinity spikes in the area, and the area of Unit 1A is semi-impounded allowing salinity levels to be further reduced. SAVs are expected to gradually increase through time in this area. *Ruppia spp.* has been observed in the Cameron Prairie NWR in concentrations as high as 80 percent cover by Cameron Prairie NWR personnel prior to Hurricane Rita. With the repair of the Cameron-Creole Watershed project in the near future, those percentages are expected to return.

3.8.3.2 Animals

Terrestrial Animals. The diverse of habitats within the vicinity of the project area is home to a wide variety of animals. Common mammals within the project area include the Virginia opossum, nine-banded armadillo, coyote, raccoon, white-tailed deer, nutria, muskrat, and swamp rabbit. Game species include squirrel, rabbit, and deer. Trapping for furbearers is a traditional activity that although allowed, has decreased in recent years due to reduced demand for furs. Major furbearing species are raccoon, opossum, mink, bobcat and nutria.

More than one-half of the species of birds in North America are resident in the state or spend a portion of their migration in Louisiana. At lease 265 species of birds have been recorded in the Cameron Prairie NWR (see Appendix F). Of these, migratory wildfowl are abundant and include several species of ducks and geese that spend the winter on the tidal marshes. Wintering ducks and geese arrive in November; common snipe and woodcock also arrive in the fall and spend the winter.

Sabine NWR and Cameron Prairie NWR were created to support, protect, and provide winter habitat for migratory waterfowl. The refuges provide nesting colonies of egrets, herons, cormorants, ibis, and anhingas. Roseate spoonbills are seen feeding from late summer to early winter. Numerous shore birds congregate and feed in the managed moist-soil area along the Pintail Wildlife Drive. Among the more common water birds include the laughing gull, royal tern, brown pelican, and black skimmer. Other birds commonly found in the marshes include the marsh wren, seaside sparrow, red-winged blackbird, Wilson snipe, woodcock, and various species of sandpipers (http://www.fws.gov/swlarefugecomplex/).

In addition to migratory waterfowl, the area is important to neotropical migratory birds. Louisiana lies in the center of the flight path of migratory birds crossing the Gulf of Mexico to and from the Yucatan peninsula. An enormous number of migratory songbirds pass over the Cameron Parish coast each spring and fall. In the spring when the wind is from the south and the weather is clear, most migrants pass over the coastal areas to land miles inland. However during inclement weather, “great numbers of trans-Gulf migrants are precipitated on the first available land, and this results in enormous concentrations on wooded coastal islands and chenieres” (Lowery, 1955, p.75). When birds reach the Louisiana coast, their energy reserves are exhausted. Without coastal woodlands for a resting and feeding area and for protection from predators and weather, some portion of millions of songbirds that nest in the United States and Canada probably would not survive (Lowery, 1955).

Alligators are common in the project area. Other reptiles found in the area include turtles, lizards, salamanders, snakes, and frogs.

Aquatic Animals. 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.

<u>Invertebrates</u>**.** Benthic invertebrates are important in the food webs of an estuarine system. Additionally, invertebrates may provide indications of the quality of water and sediments. Table 3-33 provides a listing of the benthic macroinvertebrates known to occur in the Calcasieu estuarine system.

<u>Oyster Resources.</u> Of particular economic and recreational importance in the project area is the oyster habitat found in Calcasieu Lake. Calcasieu Lake has been designated by the LDWF as a Public Oyster Tonging Area. The distribution of the eastern oyster (*Crassostrea virginica*) in Calcasieu Lake depends on several factors, including the suitability of the substrate, salinity, and water quality (particularly suspended solids). Besides sustaining oyster populations, oyster reefs support a diverse and complex biological community.

Table 3-33. Invertebrates Reported to Occur in the Calcasieu Estuary

Annelida	Arthropoda
Capitella capitata	*Almyracuma* sp.
Galathowenia oculata	Araneae
Glycinde solitaria	*Callianassa jamaicense*
Hypereteone heteropoda	Chironomidae
Hobsonia florida	Cirripedia
Laeonereis culveri	Coleoptera
Lumbriculidae	*Corophium lacustre*
Mediomastus ambiseta	*Corophium louisianum*
Monopylephorus helobius	*Corophium* sp.
Naididae	Diptera
Neanthes succinea	*Edotea triloba*
Oligochaeta	Ephemeroptera
Parandalia americana	*Grandidierella bonnieroides*
Paraprionospio pinnata	*Hargeria rapax*
Pectinaria gouldii	*Hyalella azteca*
Podarkeopsis levifuscina	*Mysidopsis almyra*
Polydora sp.	Odonata
Polydora cornuta	*Orchestia* sp.
Polydora socialis	*Pinnotheridae sp.*
Serpulidae	*Procambarus acutus*
Spionidae	*Procambarus clarkii*
Stenoninereis martini	*Rhithropanopeus harrisii*
Streblospio benedicti	Tabanidae
Thalassodrilus belli	*Taphromysis bowmani*
Tubifex tubifex	**Mollusca**
Tubificidae	*Amygdalum papyrium*
Tubificoides benedeni	*Crassostrea virginica*
Tubificoides denouxi	*Cyrenoida floridana*
Tubificoides heterochaetus	*Geukensia demissa*
Other Taxa	*Hydrobiidae*
Hydrozoa	*Macoma mitchelli*
Nemertea	*Mytilopsis leucophaeta*
Urochordata	Physidae
	Rangia cuneata
	Tagelus plebeius
	Tellinidae spp.

Sources: CDM and Gaston, 2001; Shirley and Loden, 1982.

The LDWF has established water bottom types to characterize public oyster areas based on substrate conditions (Table 3-34). These water bottom types are used to determine compensation for impacts to public oyster areas.

Table 3-34. Water Bottom Types in Public Oyster Areas

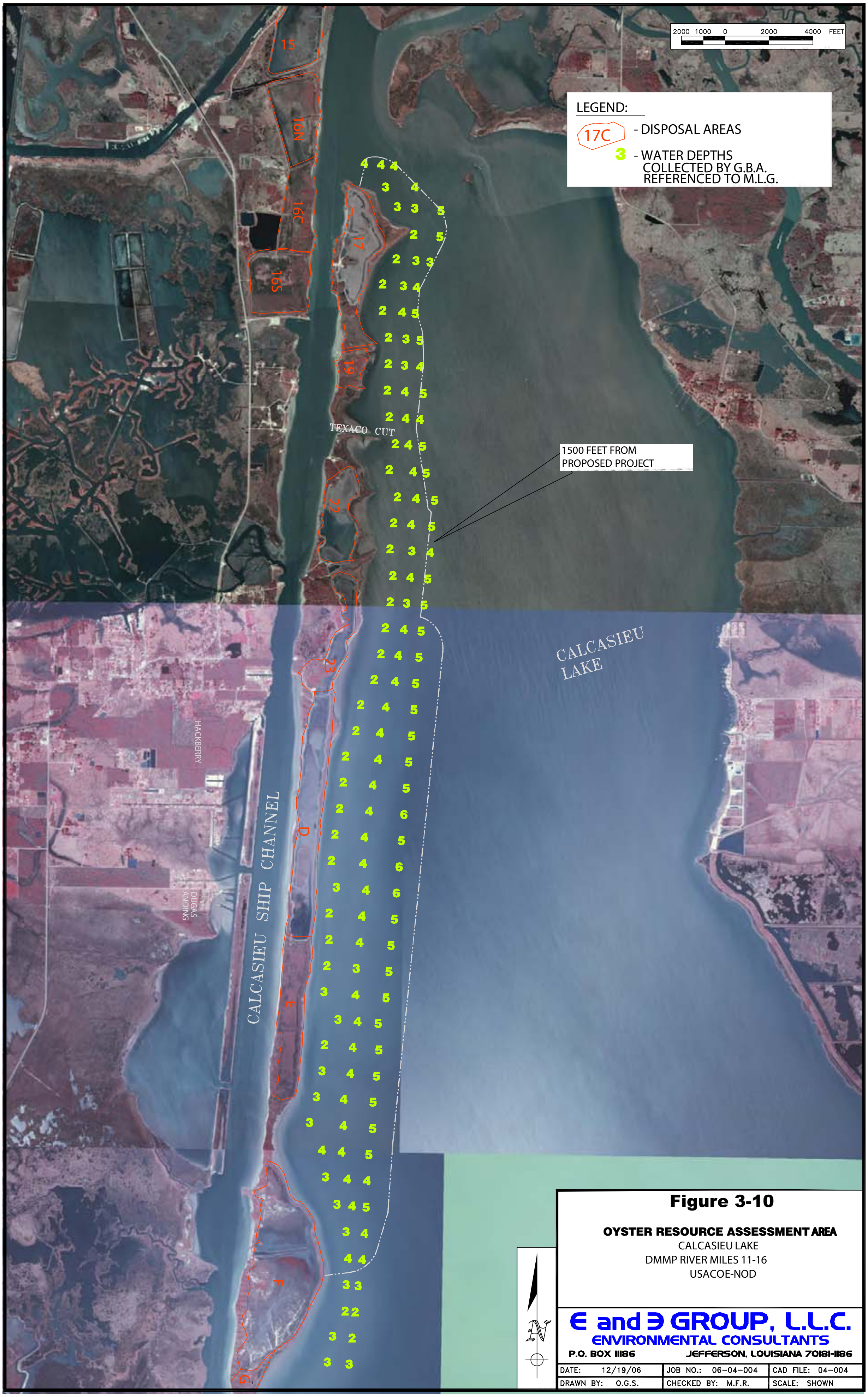
Water Bottom Type	Category	Description
Type I	Soft Mud	Soft, slushy mud – would not support small pieces of clutch material
Type II	Moderately Firm Mud	Bottom that would support small pieces of clutch material
	Firm Mud or Sands	Compact muddy or sandy substrate
	Buried Shells	Shells buried under sediment
Type III	Exposed Shell	Single or scattered shells, or hard substrates such as clam shells, limestone, concrete aggregate, etc.
	Reef	Thick Shell

Source: LDWF.

To assess potential impacts and mitigation requirements associated with elements of the DMMP, CEMVN contracted with E & E Group, LLC, for a detailed assessment of oyster resources to be performed in accordance with the May 1, 2005, Revised Sampling Protocol for Projects in Public Oyster Areas. A copy of the protocol is included in Appendix I, Oyster Resources. The area assessed, shown in Figure 3-10, was 1,500 feet of the estimated maximum area for any potential placement of dredged material. Detailed descriptions of materials and methods, as well as findings, are contained in the *Oyster Resource Assessment of a Portion of the Louisiana Department of Wildlife and Fisheries Calcasieu Lake Public Tonging Area*, located in Appendix I, Oyster Resources.

The area assessed comprises a total of 6.13 square miles (3,923 acres). The assessment used three types of data to identify productive oyster grounds in Calcasieu Lake: poling, diver observations and sampling, and dredge sampling. First, poling and sidescan data were collected to identify areas that may be productive oyster grounds (Type III bottoms). Second, in areas identified as potential Type III bottoms, divers collected oyster samples and reported first-hand observations of the presence or absence of surface or buried shell, or live oysters. Third, in areas identified as Type I or II bottoms (few if any oysters present), a hand dredge was used to collect water bottom samples.

Based on poling data alone, which is meant to be verified by diver observations, the area potentially contained 715 acres of Type I bottom, 2,950 acres of Type II bottom, and 257 acres of Type III bottom. However, because poling data often provides false positive results, a combination of poling, diver observations, and oyster sample data were used together to provide a more accurate picture of the oyster resources in the project area.


2000 1000 0 2000 4000 FEET
LEGEND:
17C - DISPOSAL AREAS
3 - WATER DEPTHS COLLECTED BY G.B.A. REFERENCED TO M.L.G.
15
16N
16C
16S
17
19
22
23
D
E
F
G
TEXACO CUT
1500 FEET FROM PROPOSED PROJECT
CALCASIEU LAKE
HACKBERRY
DUGAS LANDING
CALCASIEU SHIP CHANNEL
N
Figure 3-10
OYSTER RESOURCE ASSESSMENT AREA
CALCASIEU LAKE
DMMP RIVER MILES 11-16
USACOE-NOD
E and E GROUP, L.L.C.
ENVIRONMENTAL CONSULTANTS
P.O. BOX 11186
JEFFERSON, LOUISIANA 70181-1186
DATE: 12/19/06
JOB NO.: 06-04-004
CAD FILE: 04-004
DRAWN BY: O.G.S.
CHECKED BY: M.F.R.
SCALE: SHOWN

The diver observations and oyster samples showed that in the central portion of the assessed area, much of what was thought to be Type III bottom (productive oyster area) is predominately or entirely buried shells of Atlantic rangia clam (*Rangia cuneata*)l with little or no exposed oyster or clam shell or live oysters. Diver observations and oyster samples in the northern and southern ends of the assessed area showed that these areas have the highest standing crops of oysters. Sampling locations at the northern end ranged from 356 to 1,719 sacks of oysters per acre; sampling at the southern end showed over 1,000 sacks per acre.

Dredge sampling confirmed that the firm, moderately firm, and soft bottom areas of the Type I and Type II areas delineated by poling are barren of oysters and shell. A few live oysters were collected in the largest continuous areas of buried shell (Type II) bottom in the assessed area. The oysters collected were apparently widely scattered over the surface of the mud-rangia shell matrix where the occasional clam shell was exposed. It was concluded that fewer than 0.01 oysters per square foot are present in the Type II area.

Greater detail on the oyster resources of the project are can be found in Appendix I.

<u>Fisheries.</u> Many of the fishes of the Gulf of Mexico are estuarine-dependent; they depend on estuaries for reproduction, nursery areas, food production, or migrations. Approximately 75 percent of the commercially important fish and shellfish depend on estuaries at some stage of their life cycle (NMFS, 2007). An extensive list of fishes known to occur at the Cameron Prairie NWR is provided in Appendix F. Among these, common species include Gulf menhaden (*Brevoortia patronus*), killifish (*Fundulus* spp.), sheepshead minnow (*Cyprinodon variegatus*), mosquitofish (*Gambusia affinis*), silversides (*Menidia beryllina*), striped mullet (*Mugil cephalus*), Atlantic croaker (*Micropogonias undulatus*), spot (*Leiostomus xanthurus*), hardhead catfish (*Arius felis*), silver perch (*Bairdiella chrysura*), hogchoker (*Trinectes maculatus*). The major freshwater families occurring in the project area are Lepisosteidae (gars), Amiidae (bowfins), Ictaluridae (catfishes), Cyprinidae (minnows and carp), and Centrarchidae (sunfishes, basses, and crappies).

Fishing is a major recreational activity in the Calcasieu estuary. At the upper end of the system freshwater game fishes include catfishes, centrarchids (sunfishes, basses and crappies), and bowfin (choupique) (*Amia calva*). The principal finfish harvested by marine recreational fishermen in 2006 in Louisiana were saltwater catfishes, black drum, red drum, spotted seatrout, and southern flounder, all of which are found in the Calcasieu system (http://www.st.nmfs.gov).

Commercial fishing is an important economic resource to the area. The principal finfish harvested are Atlantic croaker, black drum (*Pogonias cromis*), gafftopsail catfish (*Bagre marinus*), red drum, sand seatrout (*Cynoscion arenarius*), sheepshead (*Cynoscion arenarius)* , southern flounder (*Paralichthys lethostigma*), and spotted seatrout (*Cynoscion nebulosus*). Other important commercial species include gulf menhaden, white shrimp, Atlantic croaker, brown shrimp, striped mullet, southern flounder, and unclassified bait-fish. In 2005 and 2006 Louisiana ranked second only to Alaska in commercial landings. In 2005, the Louisiana commercial fishery landed 844 million pounds with a value of $202 million. In 2006 landings consisted of 850 million pounds with a value of $252 million (http://www.st.nmfs.gov/st1/fus/fus06/02_commercial2006.pdf).

<u>Essential Fish Habitat Designations within the Project Area</u>**.** The Magnuson-Stevens Fishery Conservation and Management Act, as amended, PL 104-208, addresses the authorized responsibilities for the protection of Essential Fish Habitat (EFH) by NMFS in association with regional fishery management councils. The act establishes eight regional fishery management

councils responsible for the protection of marine fisheries within their respective jurisdictions. EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” This definition extends to habitat specific to an individual species or group of species; whichever is appropriate within each Fishery Management Plan.

The act also authorizes the designation of Habitat Areas of Particular Concern for marine fisheries. These areas are subsets of EFH that are rare, susceptible to human degradation, ecologically important or located in an ecologically stressed area. Any Federal agency that proposes any action that potentially affects or disturbs any EFH must consult with the Secretary of Commerce and Fishery Management Council authority per the Magnuson-Stevens Act, as amended. Interim final rules were published on December 19, 1997, in the Federal Register (Vol. 62. No. 244) to establish guidelines for the identification and description of EFH in fishery management plans. These guidelines include impacts from fishing and non-fishing activities as well as the identification of actions needed to conserve and enhance EFH. The rule was established to provide protection, conservation, and enhancement of EFH. A more detailed discussion of EFH is located in Appendix F, Biological Resources.

The estuarine and marine waters of Calcasieu and Cameron parishes are included in the EFH managed area. EFH located within the project area are:

- Estuarine Emergent Wetlands;
- Mud/Sand/Shell/Rock Substrates; and
- Estuarine Water Column.

Various species have been designated as being Federally managed species or species groups potentially found within the Calcasieu Lake, Calcasieu Pass, and the entire ecosystem.

- **Shrimp Species.** Shrimp species include the brown shrimp (*Farfantepenaeus aztecus*) and the white shrimp (*Litopenaeus setiferus*) (*Farfantepenaeus duorarum*). Adult penaeids generally occupy offshore areas of higher salinity, where spawning occurs. After hatching, larvae enter estuaries and remain there throughout the juvenile stage. Estuarine habitat serves as a nursery area offering a suitable substrate, an abundant food supply, and protection from predators. Subadult shrimp consume organic matter, including marsh grasses and microorganisms found in estuarine sediments. Adult shrimp are omnivorous. EFH includes shallow inshore waters, marsh edge, SAV, tidal creeks, inner marsh, mud bottoms, and sand/shell substrate. Habitat Area of Particular Concern (HAPC) includes tidal inlets and state nursery and overwintering habitats. These areas contain a high abundance of juvenile specimens and are critical for early growth and development. HAPC within the study area includes the mouth and all tidally influenced portions of the Calcasieu River and associated nearshore habitat.

- **Gulf Stone Crab.** Gulf stone crabs (*Menippe adina*) occur throughout the Gulf of Mexico, although the majority of fishing occurs along the Gulf Coast of Florida. Stone crabs are benthic and can be found from the shoreline out to depths of 200 feet. Juveniles can be found on shell bottom, sponges, and *Sargassum* mats, as well as in channels and deep grass flats. Stone crab larvae are planktonic and require warm water 30^{o}C and high salinity (30-35 ppt) for most rapid growth. The stone crab is a high trophic predator and is primarily carnivorous at all life stages. Juveniles feed on small molluscs, polychaetes, and crustaceans. EFH for the Gulf stone crab includes inshore waters of less than 59 feet, estuarine hard bottoms, estuarine sand/shell, estuarine SAV, nearshore hard bottoms, and nearshore sand/shell. Gulf stone crab HAPC within the study area includes the mouth and all tidally influenced portions of the Calcasieu River and associated nearshore habitat.

- **Red Drum.** Red drum (*Scianeops ocellatus*) is an important recreational gamefish found in coastal waters throughout the Gulf of Mexico. Adults inhabit nearshore waters, particularly areas within the surf zone or in the vicinity of inlets. Spawning occurs in nearshore areas, and eggs and larvae are transported by tides and wind currents into estuaries. Larvae and juveniles occupy estuarine environments until maturation. Red drum are predatory in all stages of life; however, the type of prey consumed varies with life stage. Subadult red drum primarily consume small marine invertebrates including mysids and copepods, while adult specimens feed on large marine invertebrates, including shrimp and crabs, and small fishes. EFH for red drum includes tidal inlets, mud bottoms, SAV, the marsh-water interface, mangrove communities, oyster reefs, and nearshore waters with depths of less than 164 feet. HAPC for red drum includes tidal inlets, state nursery areas, spawning sites, and SAV. Red drum HAPC within the study area includes the mouth and all tidally influenced portions of the Calcasieu River and associated nearshore habitat.

- **Reef Fish.** There are 15 species of reef fish likely to be found within the study area. Although species within this complex generally occupy similar ecological niches and exhibit similarities in behavior and life stages, a considerable variation in diet and habitat use exists among individual species. Member species of the complex are generally predatory, but the type of prey varies widely among species and ranges from small invertebrates to fishes, including other species within this complex. Larvae and juvenile specimens may be pelagic or estuarine, and adults may occupy estuarine, nearshore, or pelagic environments. EFH for the reef fish includes SAV, mangrove communities, lagoons, hardbottoms, nearshore habitat, and estuarine sands and muds. HAPC for the complex includes hardbottom, mangrove communities, SAV, oyster/shell substrates, inlets, and state nursery areas. HAPC for the reef fish within the study area includes the mouth and all tidally influenced portions of the Calcasieu River and associated nearshore habitats. The lane snapper (*Lutjanus synagris)* and dog snapper (*Lutjanus jocu)* are federally listed marine managed species within the study area. EFH has been designated in the study area for the juvenile life stage of these two species. These species occupy inshore areas during their juvenile stages where they feed on estuarine dependent prey (Gulf of Mexico Fishery Management Council, 1998).

- **Coastal Migratory Pelagic Species.** Coastal Migratory Pelagic Species are marine fishes that inhabit coastal waters of the Gulf of Mexico from the shoreline to the continental shelf edge. These species migrate seasonally within these coastal waters. Members of this assemblage that are likely to be present within the study area include the king mackerel (*Scomberomorus cavalla*), cobia (*Rachycentron canadum*), and the bonnethead shark (*Sphyrna tiburo*) in its juvenile life stage. Coastal migratory pelagics are predatory and generally occupy open marine waters, but subadults may occupy tidal inlets and estuarine environments. EFH for Coastal Migratory Pelagic Species includes shallow nearshore waters, beaches, and estuarine environments. No HAPC for the assemblage occurs within the project area. EFH for Coastal Migratory Pelagic Species within the project area includes the mouth and all tidally influenced portions of the Calcasieu River and associated nearshore habitats.

3.8.4 Protected Species

The Louisiana Natural Heritage Program (LNHP) of the LDWF has developed lists and tracks rare, threatened and endangered species and natural communities for each parish of the state. The lists include information by species including state rank, global rank, state status and Federal status. The species and habitats listed by the State of Louisiana may be found in Appendix F, Biological Resources.

Federally threatened and endangered species present in Calcasieu and Cameron parishes are listed in Table 3-35. According to LNHP (personal communication, April 21, 2008), plans are underway in Louisiana to delist the bald eagle. Of the 12 state and/or Federally listed species, only two are likely to be observed within the vicinity of the project area: the piping plover and the brown pelican. The brown pelican was delisted in December, 2009. However, it continues to be protected under the Migratory Bird Treat Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

Piping Plover. Federally listed as a threatened species, piping plovers are small shorebirds approximately seven inches long with sand-colored plumage on their backs and crown and have white underparts. Piping plovers winter in Louisiana and may be present eight to 10 months of the year. They feed extensively on intertidal beaches, mudflats, sandflats, algal flats, and wash-over passes with no or very sparse emergent vegetation. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape. The piping plover, as well as its designated critical habitat, occur along the Louisiana coast. Critical habitat does not occur in the project area. They have been observed south of the project area between Holly Beach and the Calcasieu Ship Channel. Major threats to this species include the loss and degradation of habitat due to development, coastal erosion, disturbance by humans and pets, and predation.

Brown Pelican. Brown pelicans are large, dark gray-brown water birds with white about the head and neck. Immature brown pelicans are gray-brown above and on the neck, with an underside of white. Adults can reach up to eight pounds and have wingspreads of over seven feet. Brown pelicans nest in colonies mostly on small coastal islands. Normal clutch size is three eggs. Feeding occurs primarily in shallow estuarine waters where the birds seldom venture more than 20 miles out to sea. In the project area, a rookery is located on Rabbit Island in Calcasieu Lake. Major threats to this species have been chemical pollutants, colony site erosion, disease, and human disturbance. (Tom Hess, Biological Manager, LDWF, personal communication, 2007).

Endangered Species Act Consultation. Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, requires:

> *Each Federal agency shall, in consultation with and with the assistance of the secretary, insure that any action authorized, funded, or carried, out by such agency…. Is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species. . . .*

Table 3-35. Threatened (T) and Endangered (E) Species in Calcasieu and Cameron Parishes

Common Name	Scientific name	Federal Status	State Status	Parish
American Alligator	*Alligator mississippiensis*	T (S/A)	Not listed.	Calcasieu and Cameron
Bald eagle	*Haliaeetus leucocephalus*	Delisted	E	Calcasieu and Cameron
Brown Pelican	*Pelecanus occidentalis*	Delisted	E	Cameron
Green sea turtle	*Chelonia mydas*	T	T	Cameron
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T	T	Cameron
Hawksbill sea turtle	*Eretmochelys imbricata*	E	E	Cameron
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E	Cameron
Leatherback sea turtle	*Dermochelys coriacea*	E	E	Cameron
Loggerhead sea turtle	*Caretta caretta*	T	T	Cameron
Piping plover	*Charadrius melodus*	T	T; Critical Habitat	Cameron
Red-cockaded woodpecker	*Picoides borealis*	E	E	Calcasieu
West Indians Manatee	*Trichechus manatus*	E	E	Cameron

Source: USFWS, April 2007.

To provide compliance with the ESA, a Biological Assessment (BA) (Appendix L) was prepared pursuant to the ESA and implementing regulation (50 CFR 402.14). Additional jurisprudence includes the National Environmental Policy Act (NEPA) of 1969, 42 U.S.C. section 4321, *et seq.;* the Fish and Wildlife Conservation Act of 1958 (PL 85-624; 16 U.S.C. 661 *et seq*.); the Marine Mammal Protection Act of 1972; and the Bald Eagle Protection Act of 1940. The BA provides an assessment of the effects of the project on the protected species in the vicinity of the project. Copies of the BA were provided to USFWS and NMFS for review as part of the consultation process required by the ESA.

See Appendix L for more information on T&E species in Calcasieu and Cameron parishes and specifically in the project area.

3.9 NATIONAL WILDLIFE REFUGES

3.9.1 Sabine National Wildlife Refuge

The SNWR is a Federally managed refuge located in Cameron Parish in southwest Louisiana. The SNWR is located on Louisiana State Route 27, approximately eight miles south of Hackberry and 12 miles north of Holly Beach, Louisiana (Figure 3-11). The western end of the refuge borders Sabine Lake; the eastern end reaches Calcasieu Lake. The refuge borders about five miles of the Calcasieu Ship Channel.

The SNWR is the largest refuge on the Louisiana's Gulf Coast, containing 124,511 acres of marsh. The complex of water management operations includes over 115 miles of canals, 61 miles of levees, and eight water control structures.

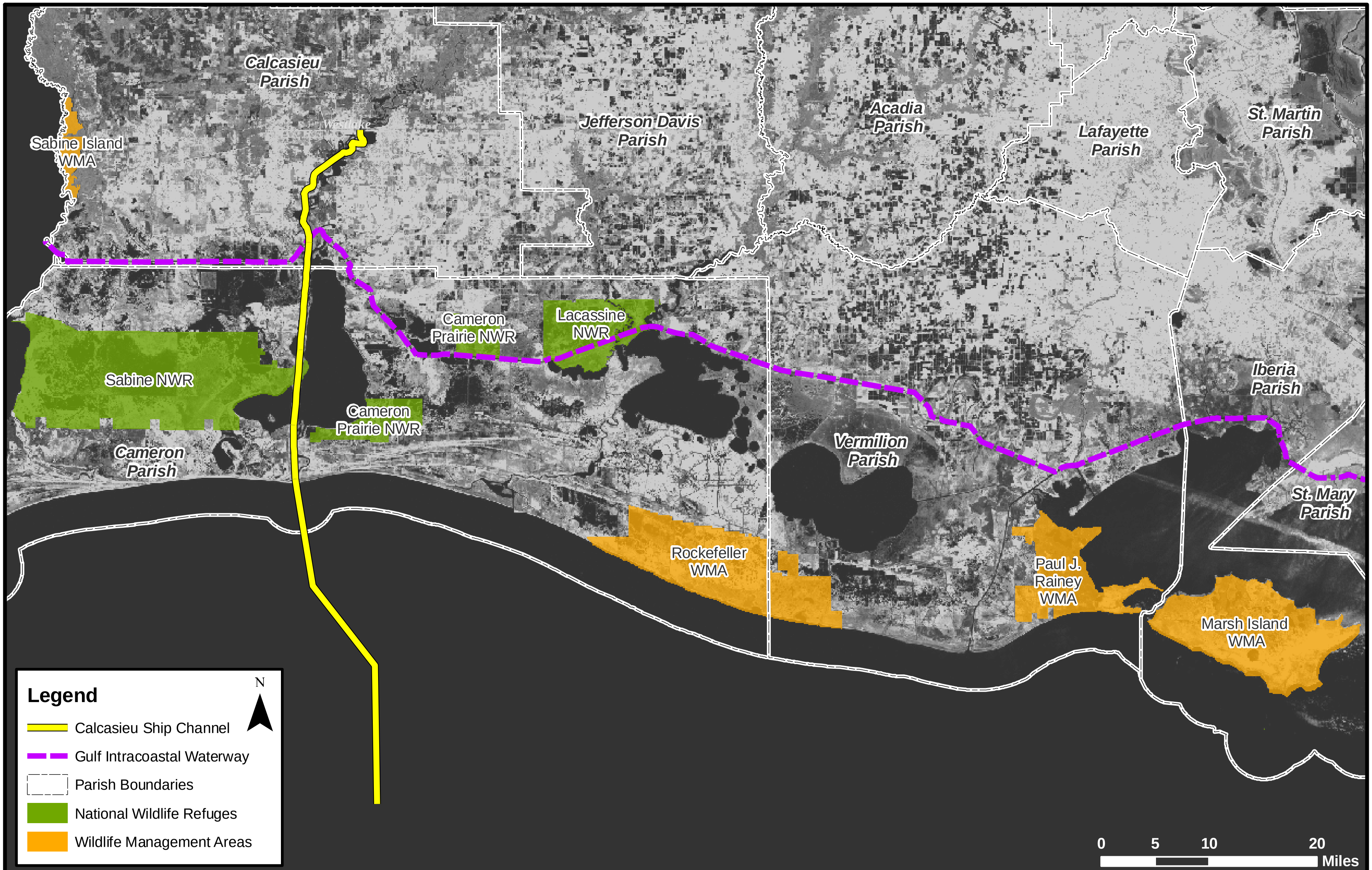
The refuge is one of the largest estuarine-dependent marine species nurseries in southwest Louisiana. Wetlands are maintained using prescribed burning, cattle grazing, and water level and water quality manipulation. The primary management objective is to maintain and perpetuate Gulf Coast wetlands for wintering waterfowl from the Mississippi and Central Flyways. It encompasses 33,000 acres of impounded freshwater marsh and 91,511 acres of brackish to intermediate marsh.

Public activities include the 1.5-mile-long Wetland Walkway, a particularly popular attraction where interpretative panels and dioramas depict the various habitats found on the refuge and provide visitors with some insight into a coastal marsh environment. Other activities include:

- Wildlife Observation: Many types of wildlife may be seen year-round, but best viewing is from the Wetland Walkway.
- Boating: Over 150 miles of refuge canals, bayous, and waterways are open to boat travel.
- Recreational Fishing: Both freshwater and saltwater fishing are available.
- Crabbing: Blue crabs may be harvested year-round.
- Recreational Castnet Shrimping: Brown and white shrimp are seasonally available in refuge canals.
- Waterfowl hunting: During the teal and regular duck seasons, hunting is permitted on 34,000 acres.

3.9.2 Cameron Prairie National Wildlife Refuge

Cameron Prairie NWR was established in 1988 as the first refuge formed under the North American Waterfowl Management Plan, a treaty among Canada, Mexico, and the United States. The refuge is located in Cameron Parish and consists of two separate and distinct units. The Gibbstown Unit, with 9,621 acres of fresh marsh, coastal prairie, and old rice fields, provides food for wintering waterfowl and other water birds. The 14,927-acred East Cove Unit, which was transferred from nearby SNWR in 1992, borders about two miles of the Calcasieu Ship Channel (Figure 3-11).



PROJECT AREA WILDLIFE MANAGEMENT AREAS & NATIONAL WILDLIFE REFUGES

Calcasieu River and Pass, Louisiana
Dredged Material Management Plan

Landsat Thematic Mapper Satellite Image: 2002 RGB753-Pan merge, LDEQ (2002)

GEC

Figure: 3-11
Date: March 2009
Scale: 1:800,000
Source: LDEQ/GEC/USACE
Map ID: 27585107-1310

Resource management programs on Cameron Prairie NWR are designed to preserve and improve habitat for wildlife. The Gibbstown Unit is managed for moist soil plants that provide food for wildlife. Refuge prairie lands are being restored by periodic burning, mowing, and disking. Previously constructed earthen levees have been repaired and water control structures installed to maximize water management in the marshes for waterfowl. Some of the marshes are drained or burned periodically in the fall to promote the growth of natural forage.

The East Cove Unit has water control structures that are managed to maintain salinity levels that are similar to those of historic marshes and optimal for wildlife habitat. Popular activities on the refuge include birding, nature photography, wildlife viewing, boating, fishing, and bow hunting for white-tailed deer.

3.10 RECREATION

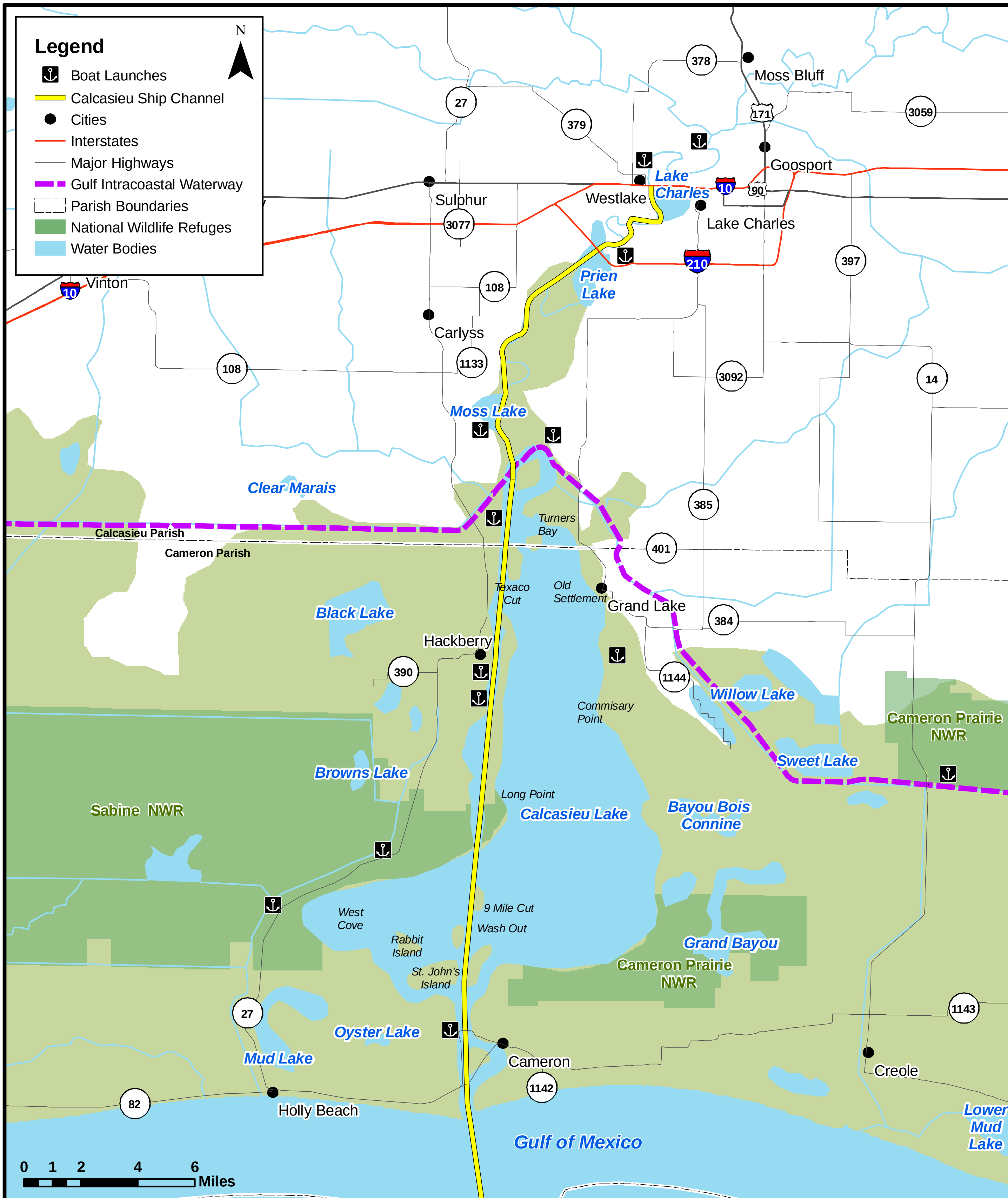
Public recreation in the project area consists of outdoor activities such as fishing, hunting, boating and bird watching. The project area bisects some of the richest coastal marshlands in the country in terms of wildlife diversity and recreational opportunities, as evidenced by the establishment of five national wildlife refuges and two state wildlife refuges within the general project area. The Calcasieu Ship Channel traverses the SNWR; to the east is the Cameron Prairie NWR and the Lacassine NWR; to the west is the Texas Point NWR and the McFadden Marsh NWR (both in Texas); and to the southeast, along the coast, are the Rockefeller Wildlife Refuge and the Marsh Island Wildlife Refuge, both operated by the State of Louisiana.

Figure 3-11 is a map of the project area showing the locations of the surrounding wildlife refuges. Numerous recreational opportunities exist at these Federal and state facilities, including:

- Marsh trails and wildlife observation towers;
- Salt and freshwater public fishing, crabbing and castnetting for shrimp;
- Visitor centers with interpretive displays;
- Boat launches with recreational areas;
- Canoeing and kayaking canals, bayous and bays;
- Wildlife photography;
- Waterfowl, deer, dove, snipe and alligator hunting;
- Furbearer trapping; and
- Environmental educational opportunities.

The most popular recreational use of the project area is fishing in Calcasieu Lake, Moss Lake, Prien Lake and Lake Charles. The lakes, ship channel, and saltwater marshes in the project area provide salt and brackish water fishing, shrimping and crabbing. The tributaries and freshwater marshes provide freshwater fishing. Calcasieu River at the Gulf of Mexico provides open water, saltwater fishing for some species that do not typically travel north into the channel. The main game fish sought in the open waters of the project area include bull red drum, cobia, tripletail, Spanish and king mackerel, pompano, bluefish, snapper, jack crevalle, and sharks.

According to a local sport fishing and hunting guide, there are approximately 14 public boat launches and twice that number of private boat launches in the project area. Figure 3-12 presents the approximate locations of the public boat launches within the project area, along with other features of the project area.



PROJECT AREA BOAT LAUNCHES AND WATER BODIES

Calcasieu River & Pass
Dredged Material Management Plan

GEC

Figure: 3-12
Date: March 2009
Scale:1:300,000
Source: LOSCO/GEC
Map ID: 27585107-1311

In addition to a thriving sport fishing environment, Calcasieu Lake also supports oyster habitat. Recreational and commercial oyster harvesting is allowed in the lake, but harvesting by dredges is prohibited. The oyster beds, in turn, attract red drum, one of the most popular game fish caught in the lake. Spotted seatrout and flounder are also highly sought after game fish in the lake and surrounding waters. Other desirable brackish water species available include black drum, sand seatrout, sheepshead, Atlantic croakers and ladyfish.

Shrimping is popular in season and takes place in nearly all the lakes, as well as in the river channel. Methods used to harvest shrimp include trawling with nets behind power boats and cast netting by hand from banks, piers and boats. Blue crabs are also harvested by fishermen year round mainly through trawling, seining and bait netting.

Second to sport fishing in recreation popularity is hunting, primarily for waterfowl. The open waters of the river, lakes and tributaries, as well as the secluded waters of the surrounding marshes, provide prime habitat for migrating waterfowl and permanent resident bird populations.

Waterfowl harvested in the area include mallard, canvasback, pintail, teal, mottled duck, black duck, wood duck, redhead, scaup, coots, mergansers, blue and snow geese, white-fronted geese and Canada geese, among others. Upland game birds harvested in the project area include woodcock, snipe and dove.

Game species of mammals include rabbit, deer and squirrel, with furbearers such as raccoon, opossum, mink, bobcat, muskrat, and nutria also being harvested (mainly by trapping, except for bobcat). The harvesting of alligators and feral hogs is also popular among some hunters.

Pleasure boating and water skiing are enjoyed throughout the project area on the lakes, rivers and Gulf of Mexico. Both power pleasure boats (including jet skis) and sailboats frequent the project area. Camping and picnicking are also popular recreational activities during the warmer months and take place mainly within the borders of the wildlife refuges and along the beaches of the Gulf of Mexico.

The project area serves as one of the first and last landing points for migrating birds in their annual movement from the U.S. and Canada to Mexico, Central America and South America, making bird watching a popular recreational activity. The Sabine NRW has been designated as an Internationally Important Bird Area because of the numerous wading, water and marsh birds that inhabit it throughout the year.

3.11 CULTURAL RESOURCES

Research for historic and archaeological resources was conducted by Coastal Environments, Inc. (CEI), from March through June 2007. The purpose of the study was to identify and assess National Register of Historic Places (NHRP) eligibility of historic properties within the vicinity of the project and to survey potential archaeological sites. This work complies with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and the Archaeological and Historic Preservation Act of 1974. Investigations showed that the project area is rich in cultural resources and contains archaeological sites, historic standing structures, and shipwrecks. The full report can be found in Appendix H. CEI's findings are summarized below.

3.11.1 Archaeological Sites

Review of the archaeological site files at the State of Louisiana Division of Archaeology revealed 49 previously recorded archaeological sites in the project area. Seven of these sites are historic, 34 prehistoric, and eight have both historic and prehistoric components.

Of the 49 known archaeological sites, two are eligible for the NRHP. They include two historic houses and their associated archaeological deposits. They are located on Brown's Lake and date from the 19th century. Twenty-two sites are not eligible for the NRHP, seven are potentially eligible, and 18 are of undetermined eligibility.

3.11.2 Standing Structures

A review of the standing structure files at the State of Louisiana Division of Historic Preservation revealed 235 recorded standing structures over 50 years in age within the study area. Of these, 220 are private homes (mostly bungalows dating from circa 1900 to 1961). Fifteen are non-residential buildings and include the Calcasieu River Bridge, Cameron Parish Courthouse, commercial buildings, school outhouses, and a railroad track switcher. The Calcasieu River Bridge has been recommended as eligible for the NRHP. However, this recommendation has not yet been addressed by the Louisiana Division of Historic Preservation. Two structures are potentially eligible for the NRHP, one of which is the Cameron Parish Courthouse, which would likely be found to be eligible for the NRHP. Twenty-nine recorded standing structures are of undetermined eligibility, and 203 structures are ineligible.

3.11.3 Shipwrecks

Forty shipwrecks were reported in the vicinity of the project area. Fifteen occurred in Calcasieu Parish, 24 in Cameron Parish, and one in either Calcasieu or Cameron parishes. The earliest known shipwreck is the frigate *El Corazon de Jesus y Santa Barbara*, which sank in the Gulf of Mexico during a storm on September 6, 1766. Eight ships were lost on the Calcasieu River and two near the mouth of the Mermantau River during the Civil War. During the postwar period, 14 wrecks were documented. The 14 remaining shipwrecks occurred between 1976 and 1985.

U.S. Department of Commerce maps dating from 1957 through 1998 and USGS maps from 1955 depict an additional 13 locations in the project area where at least 18 shipwrecks have occurred. A third source of information on shipwrecks in the project area is a remote sensing survey conducted in Calcasieu Lake (Enright *et al*., 2005). Eighty-eight magnetic anomalies were identified, all of which were interpreted as potential historic-period shipwrecks.

3.12 SOCIOECONOMICS

3.12.1 Commercial Navigation Industries

The Calcasieu River supports several large commercial navigation industries that rely on deep-draft and shallow-draft vessels and barges. As of 1990, the USACE had records for 174 commercial piers, wharves, and docks owned by the Port of Lake Charles on the river. Table 3-36 summarizes a 10-year time series of Waterborne Commerce Statistics Center (WCSC) data for the annual tonnages of major commodity groups reported to be handled at Calcasieu River docks. The typical year records a total of about 50 million tons of cargo handled at Calcasieu River. The major cargo flows are foreign, typically comprising over

50 percent of total annual tons, with domestic receipts and internal shipments each comprising nearly 15 percent.

Table 3-36. Summary of WCSC Commodity Tons Handled at Port of Lake Charles, 1995 – 2004

Commodity	Total									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Coal	63	131	144	85	118	163	149	169	190	239
Total petroleum and petroleum products	37,787	39,707	40,707	42,413	40,785	77,926	44,056	39,017	44,865	45,503
Total chemicals and related products	3,168	3,354	3,433	3,405	3,303	3,473	3,035	3,027	3,029	3,691
Total crude materials, inedible except fuels	2,598	2,940	3,236	3,577	2,800	2,147	2,021	2,553	2,651	2,574
Total primary manufactured goods	442	520	492	543	621	387	432	389	270	275
Total food and farm products	1,870	1,220	1,124	1,273	1,074	933	792	1,011	781	641
Total all manufactured equipment, machinery, and products	552	1,147	1,915	2,156	1,740	2,427	2,278	1,247	1,485	1,668
Total waste and scrap nec	0	81	147	115	91	72	75	74	82	62
Total unknown or not elsewhere classified	3	1	1	0	12	1	2	35	7	114
Total	46,483	49,101	51,281	53,567	50,544	87,529	52,840	47,522	53,360	54,767

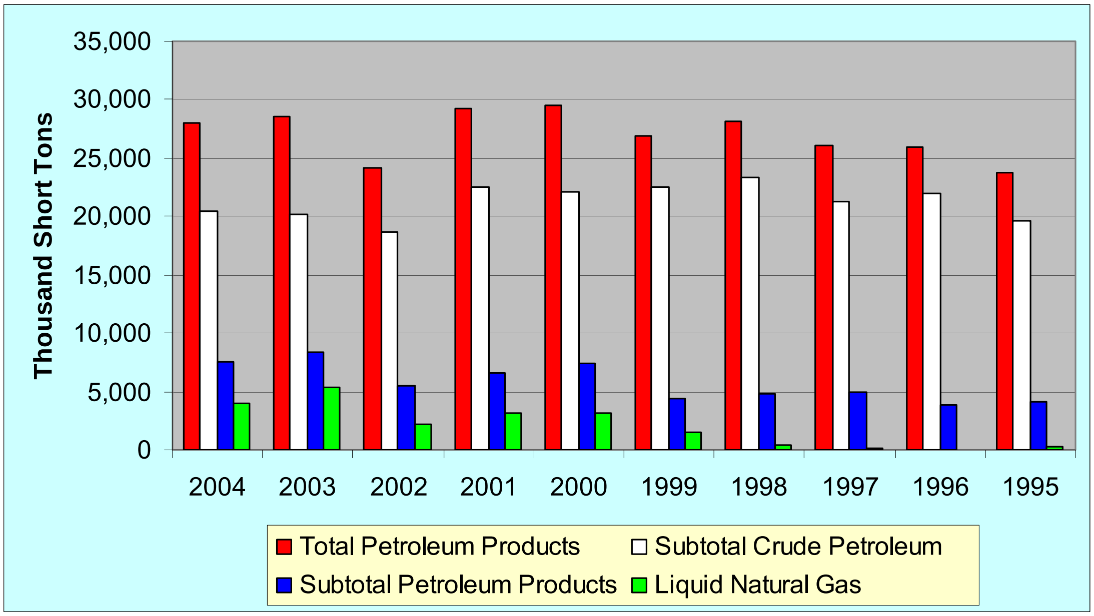
Source: Waterborne Commerce Statistics Center.

The major cargo by volume handled at the port is petroleum products -- mostly crude oil and LNG, which constitute nearly 80 percent of total annual tons. Foreign imports were over one-half of the total volume of petroleum product tonnages. Figure 3-13 compares trends in foreign imports of crude petroleum, petroleum products, and LNG.

According to Port of Lake Charles data for the period March through June 2006, the major shippers and receivers of the port include CITGO (1.1 million metric tonnes/month), Conoco (0.9 million tonnes/month), and the Trunkline LNG plant (400,000 metric tonnes/month). The major refineries operated by CITGO and Conoco are heavily committed to sourcing oil from foreign sources, primarily Venezuela.

Liquefied natural gas is natural gas that has been frozen, reducing its volume by a factor of 610. There are four onshore regasification facilities constructed in the U.S. and only one offshore facility completed worldwide. It is located offshore, almost directly south of Lake Charles. In recent years, there has been increased interest in LNG terminals because of rising natural gas prices, decreases in domestic natural gas production, technological advances, and changes in Federal Energy Regulatory Commission policies. LNG imports are projected by the Energy Information Administration's to grow from 650 billion cubic feet in 2004 to 4.4 trillion cubic feet in 2030.

See Appendix E, Economics, for a more detailed discussion of Calcasieu River's commercial navigation industry.



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

Figure 3-13. Comparison of Foreign Imports for Petroleum and Petroleum Products Traveling on the Calcasieu River

3.12.2 Occupational and Industry Statistics

The industries in Calcasieu Parish employing the greatest percentage of workers are the manufacturing industry (14.9 percent of workers) and the educational, health, and social services industry (19.9 percent of workers) (Table 3-37). The majority of manufacturing in Calcasieu Parish consists of petroleum, coal, chemical, aerospace and transportation equipment manufacturing. In Cameron Parish, the industries with the largest percentage of workers are agriculture, forestry, fishing and hunting, and mining; and the educational, health and social services industry (696 and 677 workers, respectively).

More than a quarter of Calcasieu Parish's labor force holds a job in a management or professional occupation (27.2 percent). Sales and office occupations employ 25.6 percent of workers. These occupations employ the greatest percentage of workers in Cameron Parish as well, with sales and office occupations accounting for 22.8 percent of jobs, and management, professional, and related occupations accounting for 18.5 percent of jobs.

3.12.3 Population Demographics

The population for Calcasieu and Cameron parishes in 2000 was 183,577 and 9,991 residents, respectively (Table 3-38). The ratio of males to females and the median age of both parishes compare closely with those of U.S. averages, with approximately one percent more females than males and a median age of about 35. Calcasieu Parish includes approximately 11.5 percent more African Americans and three percent fewer Asians than the national average Cameron Parish's population is predominantly white (93.8 percent) and most of the remaining residents are African American or Hispanic (3.5 percent and 2.1 percent, respectively).

Table 3-37. Occupation and Industry of Workers Calcasieu and Cameron Parishes, 2000

Demographic	Calcasieu	Cameron	U.S.	Calcasieu	Cameron	U.S.
	Number			Percentage		
Industry						
Total Male & Female	79,408	4,184	129,721,512	100%	100%	100%
Agriculture, forestry, fishing and hunting, & mining	1,668	696	2,426,053	2.1%	16.6%	1.9%
Construction	7,418	470	8,801,507	9.3%	11.2%	6.8%
Manufacturing	11,822	295	18,286,005	14.9%	7.1%	14.1%
Wholesale trade	2,255	143	4,666,757	2.8%	3.4%	3.6%
Retail trade	9,142	426	15,221,716	11.5%	10.2%	11.7%
Transportation & warehousing, & utilities	3,870	396	6,740,102	4.9%	9.5%	5.2%
Information	1,799	52	3,996,564	2.3%	1.2%	3.1%
Finance, insurance, real estate and rental & leasing	3,417	155	8,934,972	4.3%	3.7%	6.9%
Professional, scientific, management, admin-istrative, & waste manage-ment services	5,325	206	12,061,865	6.7%	4.9%	9.3%
Educational, health & social services	15,837	677	25,843,029	19.9%	16.2%	19.9%
Arts, entertainment, recreation, accommodation & food services	9,147	269	10,210,295	11.5%	6.4%	7.9%
Other services (except public administration)	4,378	213	6,320,632	5.5%	5.1%	4.9%
Public administration	3,330	186	6,212,015	4.2%	4.4%	4.8%
Occupation						
Management, professional, & related occupations	21,588	772	43,646,731	27.2%	18.5%	33.6%
Service occupations	14,414	718	19,276,947	18.2%	17.2%	14.9%
Sales & office occupations	20,367	954	34,621,390	25.6%	22.8%	26.7%
Farming, fishing, & forestry occupations	241	199	951,810	0.3%	4.8%	0.7%
Construction, extraction, & maintenance occupations	11,020	594	12,256,138	13.9%	14.2%	9.4%
Production, transportation, & material moving occupations	11,778	947	18,968,496	14.8%	22.6%	14.6%

Source: U.S. Census Bureau.

Table 3-38. Demographic Profile for Calcasieu and Cameron Parishes, 2000

Demographic	Calcasieu	Cameron	U.S.	Calcasieu	Cameron	U.S.
	Number			Percentage		
Gender and Age						
Total Population	183,577	9,991	281,421,906	100%	100%	100%
Male	89,308	4,964	137,916,186	48.6%	49.7%	49.0%
Female	94,269	5,027	143,505,720	51.4%	50.3%	51.0%
Median age (years)	34.5	35.0	35.3	34.5	35.0	35.3
Race						
White alone	135,224	9,371	211,353,725	73.7%	93.8%	75.1%
Black or African American alone	43,529	354	34,361,740	23.7%	3.5%	12.2%
American Indian and Alaska Native alone	620	51	2,447,989	0.3%	0.5%	0.9%
Asian alone	1,096	34	10,171,820	0.6%	0.3%	3.6%
Native Hawaiian and Other Pacific Islander alone	71	0	378,782	0.0%	0.0%	0.1%
Some other race alone	982	102	15,436,924	0.5%	1.0%	5.5%
Two or more races	2,055	79	7,270,926	1.1%	0.8%	2.6%
Hispanic or Latino (of any race)	3,166	207	35,238,481	1.7%	2.1%	12.5%
Unemployment						
In labor force (population 16 years and older)	85,415	4,384	138,820,935	46.5%	43.9%	49.3%
Unemployed	5,917	200	7,947,286	6.9%	4.6%	5.7%
Income						
Median household income in 1999	$35,372	$34,232	$41,994	$35,372	$34,232	$41,994
Median family income in 1999	$41,903	$39,663	$50,046	$41,903	$39,663	$50,046
Per capita income in 1999	$17,710	$15,348	$21,587	$17,710	$15,348	$21,587
Poverty Status						
Individuals below poverty level:	27,582	1,220	33,899,812	15.4%	12.3%	12.4%
Families below poverty level:	6,304	247	6,620,945	12.8%	9.1%	9.2%

Source: U.S. Census Bureau, 2000.

The unemployment rate in Calcasieu Parish is slightly higher than the U.S. average, with 6.9 percent of the labor force unemployed in 2000. The unemployment rate in Cameron Parish -- 4.6 percent -- is lower than the U.S. average of 5.7 percent.

3.12.4 Economic Demographics

The median household income in Calcasieu and Cameron parishes in 1999 was $35,372 and $34,232, respectively. These income figures are significantly lower than the U.S. average median household income of $41,994. The median family income and per capita income for the two parishes are also significantly lower than U.S. averages (Table 3-18).

A greater percentage of families are below the poverty level in Calcasieu Parish, as compared to Cameron Parish and the U.S. average. In Calcasieu Parish, 12.8 percent of families are below the poverty level, while the percentage of families below the poverty level in Cameron Parish and the U.S. are 9.1 percent and 9.2 percent, respectively.

3.13 TRANSPORTATION

3.13.1 Port of Lake Charles

The Port of Lake Charles encompasses 203 square miles. It owns and operates three marine terminals, the City Docks, Bulk Terminal No. 1, the Industrial Canal, and also two industrial parks. The Port of Lake Charles is the 11th largest seaport in the U.S. According to the USACE, the port is the tenth largest Port District in the United States in foreign waterborne tonnage, and its largest volume cargo is energy products. The Port accommodates five million tons of cargo annually at its public facilities.

In terms of energy importance, the Port is the second largest strategic petroleum reserve facility in U.S. (219 million barrels of oil or 33 percent of the U.S. total). Important refineries and manufacturers within the Port District are located on the Calcasieu Ship Channel and include:

- CITGO;
- Conoco/Phillips;
- PPG Industries;
- Westlake Petrochemicals;
- Trunkline LNG;
- Sempra LNG (under construction); and
- Cheniere Creole Trail LNG (proposed).

The Port of Lake Charles is the current home of the largest LNG storage and regasification plant (Trunkline) in the U.S. By 2011 it is expected to handle over 60 million tons of LNG annually, equaling 20 percent of U.S. consumption. Currently 4.5 percent of all U.S. motor fuel is supplied by producers on the Calcasieu Ship Channel. A nine-day closure of the Channel in 2006 cost U.S. gasoline consumers $710 million and natural gas consumers $313 million with a total burden of over one billion dollars to the nation in nine days. Future plans call for the construction of the largest synthetic natural gas plant in U.S. to be built by Lake Charles Cogeneration. The Port District on the Calcasieu Ship Channel is a vital element of the U.S. energy infrastructure. It is a Strategic Energy Waterway.

U.S. Commerce Deputy Secretary David A. Sampson has said, “Ports like Lake Charles are extremely important to the United States economy because of the role they play in facilitating waterborne commerce which contributes more than $742 billion to the United States gross domestic product and creates employment for more than 13 million citizens.”

3.13.1.1 City Docks

The City Docks is 34 miles inland from the Gulf of Mexico and is connected to the Gulf by the Calcasieu Ship Channel. The City Docks contains the general cargo facilities and the Lake Charles Public Grain Elevator, as well as a vegetable oil packaging plant. The City Docks is located in Foreign Trade Zone 87.

3.13.1.2 Port Terminals

The automated terminal (Contraband Bayou Terminal) has an 189,000 square foot warehouse equipped with palletizers, depalletizers, railcar unloaders, and spiral conveyors. The multi-modal facility is accessible by rail, truck, barge or conveyors from the bagging facility.

The dry bulk terminal is located on 71 acres at Rose Bluff Cutoff on the Calcasieu Ship Channel (located 30 miles inland from the Gulf of Mexico). The bulk terminal has a 2,200 foot long wharf and a 40 foot projected depth at dockside that can load two vessels simultaneously. The site is capable of transfer from vessel to vessel, vessel to rail, vessel to truck, or to open storage. The terminal handles dry bulk products such as petroleum coke, calcined coke, barite, rutile, woodchips, and other dry bulk commodities.

A port-owned and operated bulk grain and rice elevator located within the City Docks area of the Port is the port's third terminal. Other terminals include the Inbound Terminal, Fournet Street Terminal, and the Westlake Terminal.

3.13.1.3 Industrial Canal

The Port's Industrial Canal (also known as "Devil's Elbow") is three miles long, has a 1,400-foot by 1,400-foot turning basin at its east end, a project depth of 40 feet, and a bottom width of 400 feet. The principal cargoes moving through the Port's terminals are bagged rice, flour and other food products, forest products, aluminum, petroleum coke and other petroleum products, woodchips, barites, and rutile. The canal is located 12 miles south of Lake Charles and 22.4 miles from the Gulf of Mexico at the intersection of the Calcasieu Ship Channel and the Gulf Intracoastal Waterway. The port-owned railroad tracks specifically serve industries located on the Canal. The Union Pacific railroad serves the area and the over-the-road motor carriers offer service to the area.

The Trunkline LNG terminal and regasification facility, located on the turning basin, is one of the most technologically advanced liquefied natural gas terminals in the world and is designed to receive an LNG vessel at six-day intervals. The LNG is then stored at the facility in three 600,000 barrel tanks in its liquid state.

3.13.2 Railroads

Rail service in the area is provided by a full-service Amtrak train station and the Union Pacific railroad in Lake Charles, Louisiana. The Amtrak station operates three times weekly between Los Angles, California, and Orlando, Florida. The Union Pacific railroad transports industrial cargo between Houston and Lake Charles, and it also services the City Docks and Fournet Street terminal of the Port of Lake Charles.

3.13.3 Highways and Roadways

Interstate 10 (I-10) passes through Lake Charles, connecting the city with Sulphur, Vinton, and eventually the Louisiana-Texas state border to the west; to the east lie the towns of Iowa and Jennings and the City of New Orleans. Interstate-210 loops through the southern half of Lake Charles. Louisiana Highway 27 connects with I-10 and runs south along the west side of Calcasieu River, Calcasieu Lake, and Mud Lake until it reaches State Highway 82 in the town of Holly Beach, located on the Gulf Coast. Louisiana Highway 82 crosses the ship channel north of Monkey Island and continues east through the town of Cameron.

3.13.4 Airports

The Lake Charles Regional Airport (LCH) provides air travel for southwest Louisiana. Air transportation is provided by Continental Airlines, which provides service to their global hub in Houston, Texas. Lake Charles' Chennault International Airport, while a fully operational airport, is strictly an industrial and maintenance center.

3.13.5 Gulf Intracoastal Waterway

The GIWW is the portion of the Intracoastal Waterway located along the Gulf Coast. It is a navigable inland waterway running approximately 1,050 miles from Carrabelle, Florida, through Louisiana to Brownsville, Texas. The waterway provides a channel with a controlling depth of 12 feet, designed primarily for barge transportation. The GIWW intersects the Calcasieu Ship Channel 12 miles south of the Port's City Docks.

3.14 NOISE

Noise is defined as unwanted sound and, in the context of protecting public health and welfare, implies potential effects on the human and natural environment. Noise is a significant concern associated with construction, dredging, and transportation activities and projects. Ambient noise levels within a given region may fluctuate over time because of variations in intensity and abundance of noise sources.

The degree of disturbance or annoyance of unwanted sound depends on (1) the amount and nature of intruding noise, (2) the relationship between the background noise and the intruding noise, and (3) the type of activity occurring at the location where the noise is heard. Human response to noise varies from individual to individual and is dependent on the ambient environment in which the noise is perceived. Wind, temperature, and other conditions can change the sound volume perceived at distances from the noise source.

The magnitude of noise is described by its sound pressure. A logarithmic scale is used to relate sound pressure to a common reference level, as the range of sound pressure varies greatly. This is called the decibel (dB) and a weighted decibel scale is often used in environmental noise measurements (weighted-A decibel scale or dBA). This scale emphasizes the frequency range to which the human ear is most susceptible. A 70-dBA sound level can be moderately loud, as in an indoor vacuum cleaner, a 120 dBA can be uncomfortably loud, as in a military jet takeoff at 50 feet, and a 40-dBA sound level can be very quiet and is the lowest limit of urban ambient sound.

Noise is administered under the Noise Control Act of 1972, as amended. The USEPA has also established noise guidelines recommending noise limits for indoor and outdoor noise activities. Under these guidelines, an average noise level over a 24-hour period of 70 A-weighted decibels (dBA) is listed as the threshold for hearing loss. An outdoor 24-hour average sound level of 55 dBA is recommended for residential areas.

Additionally, the U.S. Department of Housing and Urban Development (HUD) has also developed a noise abatement and control policy codified in 24 CFR Part 51. According to HUD policy, noise at or below 65 dBA is acceptable in all situations, noise between 65 and 75 dBA is generally acceptable, and noise exceeding 75 dBA is unacceptable in all situations. Noise monitoring and impacts are typically evaluated by the local government.

The Calcasieu Ship Channel includes significant urban and industrial development. Ambient noise in the area is generated by a broad range of sources, both natural and anthropogenic. Natural noise sources include climatic sources, such as wind and precipitation. Potential sources of anthropogenic sound include commercial shipping, dredging and construction activities, industrial activities, and commercial and residential waterborne and highway traffic. No ambient noise monitoring appears to have been conducted in the project area; consequently, no quantitative data on noise levels within the project area are available for analysis.

3.15 AESTHETICS

Portions of the project area can be viewed from the Creole Nature Trail Scenic Byway. The 180-mile Creole Nature Trail was one of the first national scenic byways designated by the U.S. Secretary of Transportation in the Gulf South, and that designation was upgraded in 2002 to the highest category, an All-American Road. The portion of the scenic trail that occurs in the project area includes Highway 27 from the GIWW to Mud Lake. Brackish marsh and oil wells dominate the viewshed north of Hackberry. The eastern end of Sabine NWR, which is included in the project area, can be viewed from two scenic overlooks on the Creole Nature Trail. These overlooks afford panoramic views of coastal marsh, oak cheniers, waterfowl, and alligators. One Sabine NWR scenic overlook is along the Blue Goose Walking Trail, which includes an observation tower where song birds, migratory fowl, and oak trees can be seen. Four miles to the south, there is an I.5-mile wetland walkway into the Sabine NWR. The walkway ends at an elevated observation tower for prime bird and alligator viewing. From November to February, snow and blue geese are usually present in the mornings. Wading and water birds and marsh fur-bearers are easily viewed from the wetland walkway as well.

Panoramic views of the project area can also be made possible by exploring the area by boat. A boat launch is located along the scenic trail just south of Hackberry.

4.0 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 2-16. The assessments of environmental effects are organized by evaluating the No-Action Alternative (Alternative A), and the “action alternatives,” Alternatives B (the Recommended Plan), and Alternative C); the latter would entail actions on the part of the Federal government.

Although the ODMDS was eliminated as an alternative (see Section 2.0, Alternatives), It remains an option as a potential disposal site for dredged material in case of emergencies, as is currently the case.. Environmental effects of the placement of dredged material in the ODMDS have been assessed in a separate NEPA document (for a summary of the report, see Section 1.9.4, Final Environmental Impact Statement for Calcasieu River and Pass Ocean Dredged Material Disposal Site Designation (USEPA, 1987)).

4.1 PHYSICAL CONDITIONS

No-Action Alternative. Existing hydrodynamic conditions, as presented in Section 3.2, would not change as a result of the No-Action Alternative.

Action Alternatives. A hydrodynamic and transport model was developed to identify sediment processes within the Calcasieu ship channel, and to assess the effects of the action alternatives on circulation and sediment transport patterns. The model was calibrated using bathymetric, tidal, water level, current, and meteorological measurements of the system. The model evaluated the following changes to the system as it existed at the time of modeling.

- CDF H: Rock/rip-rap dike along CDF H on the western side of the ship channel (approximate channel mile 8.5 to 9.5).
- CDF D/E: Rock/rip-rap dike along the eastern side of the ship channel (approximate channel mile 11 to 16). The toe of the proposed rock dike is seaward of the existing shoreline. Another change would be the expansion of the CDF into Calcasieu Lake from approximate channel mile 11.5 to 16.
- CDF 17/19: Expansion of CDF 17/19 into Calcasieu Lake and construction of a rock dike along the western side of the ship channel from approximate channel mile 18.5 to 20.

Recommended Plan: Based on the model results, the rock/rip-rap dikes on the margins of the channel near approximate mile 11 to 16 and mile 18.5 to 20 would increase nearshore flow velocities and bed shear stresses; however, this influence would be relatively localized, with no evidence of regional changes to sediment transport patterns. Due to higher flow velocities along the proposed rock dikes, a reduction in sedimentation within these channel stretches would be anticipated. Portions of the ship channel north and south of the rock dikes would expect an increase in sedimentation rates; however, model results indicate that this influence is expected to be minor. In the period since the development of the model, the proposed rock/rip-rap foreshore dikes have been constructed along the channel between miles 11 and 20; no other modifications to the channel banks are planned.

The improvements associated with CDF H are minor and are anticipated to result in negligible changes to the system hydrodynamics and sediment transport patterns.

No effects on the physical conditions of the system, including the salinity regime of the system would result from the Recommended Plan.

Alternative C: No effects on the physical conditions of the system, including the salinity regime, would result from Alternative C.

4.2 GEOLOGY AND SOILS

No-Action Alternative. The No-Action Alternative consists of continuing the current operation and maintenance dredging at the constructed channel dimensions and placing the dredged material at the existing placement sites without modification. This alternative is not expected to have a direct, long-term effect on geology in the project area, but could change the character of some wetland soils. Selection of the No-Action Alternative would result in the continued placement of dredged material into CDFs. As CDF capacity decreases, there would likely be increased emphasis on placing dredged material at beneficial use sites for marsh restoration. Soils formed from the placement of dredged material for beneficial use would have a higher inorganic content than the naturally occurring soils typical of coastal marshes; they would likely be denser and possibly less subject to erosion.

Action Alternatives. Implementation of the alternatives for dredged material placement is not expected to have a direct, long-term effect on geology in the project area. However, as in the case of the No-Action Alternative, a change in the character of wetland soils would be expected. Soils formed from the placement of dredged material for beneficial use would have a higher inorganic content than the naturally occurring soils typical of coastal marshes; they would likely be denser and possibly less subject to erosion. No prime or unique farmland would be affected.

4.3 WATER QUALITY

No-Action Alternative. The No-Action Alternative is unlikely to have a significant adverse effect on water quality in the short term. Erosion of active and inactive CDFs would continue to create areas with elevated levels of suspended solids. Decant water from CDFs could also contain elevated suspended solids. Effects would be localized and are considered to be of minor consequence.

Placement of material in beneficial use sites in association with the CWPPRA or other coastal restoration efforts is expected to continue. The use of beneficial use sites would affect water quality through localized, temporary elevations in suspended solids concentrations. Suspended solids would be released as temporary dikes are constructed to retain the dredged material, as excess water from pumping dredged material is released from the beneficial use sites, and as the temporary dikes erode and degrade. The effects are anticipated to be minor.

As with short-term consequences, the major constituent with a potential to affect water quality over the long term is suspended solids. Continued use of CDFs and the resulting reduction in CDF capacity would require either identifying alternative placement sites, reducing the amount of material to be dredged by decreasing the channel dimensions, or a combination of both. Alternative placement sites would include additional beneficial use sites and the ODMDS.

Action Alternatives. Both the Recommended Plan and Alternative C would use CDFs and beneficial use sites for the disposal of dredged material. Elements of the two action alternatives would produce similar effects on the water quality of the project area.

Compliance with State Water Quality Standards. Analysis of elutriates and results from water column toxicity tests (elutriate bioassays) indicate that the proposed discharge of effluent from potential disposal areas into receiving waters in broken marsh, Calcasieu Lake, or into the Calcasieu River would comply with state water quality standards or with other equivalent benchmarks within LDEQ regulatory mixing zones.

Ammonia and copper were the only analytes detected in elutriates that exceeded acute water quality criteria (WQC). Five analytes without WQC, including barium and chromium, antimony, delta-BHC, and GRO, also were detected in the elutriates.

Compliance with EPA WQC for ammonia would be accomplished by oxidation of ammonia by implementation of one or more management practices as follow: (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.

The CORMIX model predicted that mixing zones required for sufficient dilution of copper to state WQC are no greater than 39 feet for broken marsh and 60 feet for Calcasieu Lake. For discharges into the Calcasieu River, the model predicted sufficient dilution of copper to state WQC within 33 feet of the discharge. The predicted values are well within the LDEQ sanctioned mixing zones of 200 feet for coastal lakes and bays, and the estimate 9,944 feet for the Calcasieu River.

Impacts of COC without WQC and synergistic effects were evaluated using water column toxicity tests (elutriate bioassays). Significant differences in mean survival were observed between the control treatment and the 100 percent elutriate treatment for two DMMUs, 3 and 6. The CORMIX model was used to determine if analytes detected in the elutriates and sediments from these DMMUs would be diluted within the disposal area and LDEQ sanctioned mixing zone to concentrations at or below established benchmarks. Predicted mixing zones for shallow open water disposal areas within broken marsh and Calcasieu Lake were 39 feet and 60 feet, respectively. For discharge into the Calcasieu River, the predicted mixing zone was 33 feet. The predicted mixing zones are well within LDEQ's regulatory mixing zones.

Potential for Contaminant-Related Impacts to Aquatic Resources that Would Result in Significant Degradation of the Aquatic Ecosystem. Neither the results of the benthic toxicity tests nor of the bioaccumulation tests indicate a reason to believe that discharge of dredged material from the navigation channel at potential shallow open water disposal sites in broken marsh or the Calcasieu Lake for wetland development would result in significant degradation of the aquatic ecosystem or produce an unacceptable adverse effect on survival, growth or reproduction of aquatic organisms or pose a human health risk due toxicity or bioaccumulation.

Results from the 10-day benthic toxicity tests/solid phase bioassays using the amphipod, *Leptocheirus plumulosus*, indicated high mortality in sediment from the Calcasieu River navigation channel and both reference areas. Because sediment chemistry revealed no significant levels of contamination, these results indicate that the observed toxicity was likely a response to a non-contaminant confounding factor such as the grain size of the sediments. Sediments from both the navigation channel and the references areas are physically similar and are composed of silts and clay with high plasticity. Clays in both sediments are classified as "fat clays", which are characterized as inorganic clays with liquid limits greater than 50 and high plasticity. Fat clays are cohesive and compressible, difficult to work when damp, but strong when dry. Additional tests with *L. plumulosus* and two other benthic species, another amphipod and a polychaete, and relatively, "clean" sediment from DMMU 5 support the conclusion that the observed mortality is a response to grain size of the sediments and not chemical contamination.

Metals and PAHs bioaccumulated in the tissues of the clam, *Macoma nasuta*, exposed to in-channel sediment during the 28-day solid phase bioaccumulation tests. Tissues exposed to sediments from the reference areas revealed only the bioaccumulation of metals. Tissue concentrations of arsenic, copper, lead, and selenium in clams exposed to channel sediments were significantly higher than concentrations of these metals in clams exposed to reference sediments but the magnitude of the difference (0.8 to 1.5) is negligible and does not warrant further examination of ecological significance.

Neither the magnitude of bioaccumulation of metals nor the total PAH tissue residues in tissues of organisms exposed to sediment from the navigation channel indicate a cause for concern for aquatic organisms living at the proposed placement sites or for humans who may consume those organisms. The discharge of dredged material into shallow open water disposal areas for wetland development is not likely to have an unacceptable adverse effect on survival, growth, or reproduction of aquatic organisms, or pose a human health risk due to bioaccumulation.

Barium concentrations in tissues of clams exposed to sediment from the navigation channel was statistically greater than the concentrations of barium in tissues of clams exposed to sediment from both reference areas. The order of magnitude ranged from factors of 3.8 to 15.6 for the Sabine NWR reference area and 1.8 to 7.4 for the Calcasieu Lake reference area. A screening level ecological risk evaluation revealed that the highest concentration of barium in tissue of clams exposed to sediment from the ship channel (10.9 mg/kg) is 624 times lower than the estimated No Observed Effect Concentration (6,800 mg/kg). The observed bioaccumulation of barium also does not appear to be of toxicological significance with respect to human consumption of contaminated shellfish, as the observed bioaccumulation of barium is 25-fold less than the EPA's screening criteria for use in fish advisories. Therefore, there does not appear to be a significant concern related to human health risk as a result of the observed bioaccumulation of this metal.

Calculated Critical Body Residues (CBRs) of all PAHs in tissues of clams exposed to sediment from each DMMU were 1000 times less than the levels at which chronic narcotic effects might be expected and 10,000 times less than the levels at which acute narcotic effect might be expected. The CBRs also were 1000 times less than the Narcosis Final Chronic values derived with the target lipid model.

Evaluation of the results from the benthic toxicity tests/solid phase bioassays and bioaccumulation tests indicate that the discharge of dredged material from the ship channel into proposed shallow open water disposal areas for wetland development is not likely to have an unacceptable adverse effect on survival, growth, or reproduction of aquatic organisms due toxicity or bioaccumulation of contaminants.

CDF Rehabilitation. CDFs of the Recommended Plan and Alternative C would be rehabilitated to provide additional capacity and enable improved maintenance. Part of the rehabilitation process would consist of reconstructing and raising dikes surrounding the CDFs. During construction activities adjacent to the ship channel and Calcasieu Lake, turbulence and runoff from exposed bare earth would result in elevated concentrations of suspended solids in adjacent waters. Impacts associated with rehabilitation would be evident during construction operations and for a short time following construction. However, rehabilitation of CDFs and the raising of dikes at the various CDFs would take place frequently throughout the 20-year project.

Best management practices (BMPs) to reduce suspended solids from runoff include installing silt fences and hay bales. 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 revegetation of slopes with non-woody-stemmed, and drought-resistant vegetation along the levee crowns and upper slopes to reduce erosion.

Erosion control measures, including the placement of rock along the unprotected banks of the channel would be installed. Rock foreshore dikes were constructed by the USACE near CDFs D and E, 17, 19, and 22. These dikes are anticipated to reduce erosion resulting from ship wakes.

Placement of Dredged Material in CDFs. During the pumping of dredged material into CDFs, a potential exists for the discharge of decant water with elevated suspended solids. Management practices call for the monitoring of total suspended solids concentrations at spill boxes and weirs during dewatering operations to minimize the introduction of suspended materials to nearby waters.

It is anticipated that the effects on water quality would be greatest during weir discharge. Practices to reduce the short-term and long-term effects of construction activities on water quality are described above.

Construction of Beneficial Use Sites. In general, construction of beneficial use sites would be constructed in two ways. A low containment dike would be constructed around an area of a few hundred acres at a time to form a "cell." The cell would then be filled to capacity with dredged material, and the dredged material would be allowed to consolidate to form a substrate for the establishment of intertidal marsh. Additional cells would be constructed at the site for subsequent dredging cycles. For the properties on the national wildlife refuges, cells would not be constructed. Instead, the entire area designated for receipt of the dredged material may be diked. During the pumping of dredged material, the material would be allowed to flow throughout the site, and the substrate for the establishment of marsh would form over several dredging cycles. Because suspended solids would result from construction of containment dikes, it would be necessary to implement BMPs similar to those described above to minimize adverse effects. See Section 5.0, Implementation, for additional information about beneficial use site construction.

Placement of Dredged Material in Beneficial Use Sites. Elevated suspended solids could also result during the pumping of dredged material into the contained area of a beneficial use site. It may be necessary to place silt curtains near the points of discharge from the beneficial use site to minimize the introduction of suspended solids to nearby waters.

The dikes around beneficial use 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 the soil at beneficial use sites. These effects would occur primarily during the first year or two after the completion of dredged material placement at the site. Earthen dikes may require mechanical degradation following sediment consolidation if natural erosive processes do not degrade them sufficiently to meet fisheries and tidal access needs. The establishment of marsh vegetation on the dredged material would provide stability to the sediment and reduce erosion. The establishment of vegetation would rely on natural recruitment.

Conclusions. It is concluded that the overall effects of both the Recommended Plan and Alternative C on water quality would be beneficial when compared to the No-Action Alternative. The rehabilitation of CDFs would enable improved maintenance and operations of the sites, which would, in turn, improve the quality of discharges. Shoreline protection would reduce the erosion of CDFs and the introduction of the materials into the water column. The reestablishment of marsh habitats would provide the opportunity for trapping and filtering the water, thereby improving water quality.

4.4 SEDIMENT QUALITY

No-Action Alternative. The No-Action Alternative is unlikely to have a significant adverse effect on sediment quality in the short term. Erosion of active and inactive CDFs would continue to re-deposit material previously dredged from the ship channel into open water areas adjacent to CDFs. Examination of the substrate of Calcasieu Lake in the vicinity of eroded CDFs has shown that eroded material has generally remained localized (Appendix I, Oyster Resources).

Placement of material in beneficial use sites in association with the CWPPRA or other coastal restoration efforts is expected to continue. The placement of dredged material in beneficial use sites is not expected to have any adverse effect on the sediment quality of the receiving site (Appendix J, Clean Water Act Section 404(b)(1) Report). The construction of access channels and containment dikes would use *in-situ* materials, resulting in no change to the quality of sediments.

No long-term effects on sediment quality are anticipated. However, continued use of CDFs and the resulting reduction in CDF capacity would require either identifying alternative placement sites, reducing the amount of material to be dredged by decreasing the channel dimensions, or a combination of both. Alternative placement sites could include beneficial use sites and/or the ODMDS. Coordination with the USEPA would be required prior to the use of the ODMDS.

Action Alternatives. Both the Recommended Plan and Alternative C would use CDFs and beneficial use sites for the disposal of dredged material. Elements of the two action alternatives would produce similar effects on the sediment quality of the project area.

CDF Rehabilitation. Confined disposal facilities of the Recommended Plan and Alternative C would be rehabilitated to provide additional capacity and enable improved maintenance operations. Part of the rehabilitation process would consist of reconstructing and raising dikes surrounding the CDFs. During construction activities adjacent to the ship channel and Calcasieu Lake, turbulence and runoff from exposed bare earth would likely result in some erosion and deposition of material in adjacent waters. Impacts associated with rehabilitation of an individual CDF would be evident during construction operations and for a short time following construction. However, rehabilitation of CDFs and the raising of dikes at the various CDFs would take place frequently throughout the 20-year project.

Bank stabilization is incorporated into the Recommended Plan and Alternative C to reduce shoaling and erosion rates in the channel and along the lakeside of the CDFs. Best management practices to reduce erosion include installing silt fences and hay bales. Other actions to reduce long-term erosion include the revegetation of slopes with non-woody-stemmed, drought resistant vegetation along the levee crowns and upper slopes to reduce erosion.

While erosion and re-deposition of material may affect the physical characteristics of sediments, the chemical quality of the sediment is unlikely to be affected by construction associated with CDF rehabilitation.

Placement of Dredged Material in CDFs. As discussed in the Section 404(b)(1) Report (Appendix J), no adverse effects on sediment quality is anticipated from the placement of dredged material in CDFs.

Construction of Beneficial Use Sites. Construction of beneficial use sites would be as described in Section 4.3, Water Quality. Additional details are given in Section 5.0. Earthen containment dikes would be constructed from native material. The material dredged to construct the dike would create temporary physical alterations of the sediment, but no long-term adverse effects on the sediments of the area would result. It would be necessary to implement BMPs similar to those described above to minimize adverse effects.

Placement of Dredged Material in Beneficial Use Sites. The pumping of dredged material into a diked beneficial use site would alter the existing sediment and change the area from an open water site to a wetland. It may be necessary to place silt curtains near the points of discharge from the beneficial use to minimize the re-deposition of suspended solids on sediments of adjacent areas.

The dikes around the beneficial use sites are designed to deteriorate slowly 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 alter physical characteristics of sediments in areas of re-deposition. In addition, wind and wave activity may cause erosion of the soil at beneficial use sites. These effects would occur primarily during the first year or two after the completion of dredged material placement at the site. Earthen dikes may require mechanical degradation following sediment consolidation if natural erosive processes do not degrade them sufficiently to meet fisheries and tidal access needs. The establishment of vegetation on marsh areas would provide stability and reduce erosion. During the USACE's operation and maintenance procedures, the vegetation of marsh areas would rely on natural recruitment. However, marsh vegetation, such as *Spartina alterniflora*, may be planted by other agencies and organizations as desired.

4.5 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

No-Action Alternative. HTRW assessments have revealed evidence of 18 sites that may have adversely impacted environmental conditions in the project area. The No-Action Alternative is not anticipated to affect or contribute to HTRW in the region.

Action Alternatives. The project would not result in any direct adverse effects associated with HTRW. There is a potential for indirect effects on HTRW to result from the project. Maintaining the channel at the authorized dimensions could allow for the continued operation and expansion of petrochemical and other industries along the ship channel. Spills or other releases of materials from these industries could result in HTRW contamination of sediments. A comprehensive sediment sampling effort revealed no materials in concentrations that would cause HTRW concerns; therefore, it is concluded that conditions at existing and future sites would be contamination-free or of low levels that would not present a material risk of harm to public health or the environment.

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

4.6 AIR QUALITY

No Action Alternative. Selection of the No Action Alternative would not affect air quality.

Action Alternatives. There would be no overall adverse effects of the project on regional air quality. Once dredged material placed in CDFs dries, there is a potential for wind erosion of soil to create dust, especially as it is manipulated with heavy equipment as part of CDF maintenance operations. Wind erosion would be minimized by vegetation and other control measures. Material used for wetland restoration would remain wet and would not become airborne.

Operation of heavy equipment in the rehabilitation of CDFs as well as the operation of dredges would produce localized and short-term engine emissions, but impacts on regional air quality would be negligible.

4.7 BIOLOGICAL RESOURCES

4.7.1 Introduction

Biological communities found in or near the project area include uplands (CDFs) and wetlands. The most visible wetlands are emergent marshes, which are comprised mainly of wetland vegetation rooted in seasonally or permanently flooded soils, and vegetative parts of the plant are above water. The biology of the area transitions from the less saline northern portion of the project to the more saline southern portion near the Gulf of Mexico.

4.7.2 Habitats

4.7.2.1 Aquatic Habitats

Freshwater. Because no fresh open-water habitats are located within the project area or within the area affected by the project, none would be affected by any of the project alternatives.

Brackish Water. Most of the open water within the Calcasieu estuary is brackish; therefore, the distribution of brackish habitats would be influenced by the proposed project.

No-Action Alternative. In the short term, as CDFs continue to erode, brackish open-water habitat would replace the upland habitats supported by the CDFs. Marsh subsidence and erosion would continue to occur with brackish open-water habitat replacing wetlands. As CDFs reach their capacities, alternative means of dredged material disposal must be identified if the Calcasieu Ship Channel remains at its authorized dimensions. The current practice of placing the dredged material at beneficial use sites in association with coastal restoration practices could reduce the rate of transition of wetlands to open water.

In the long term, if the Calcasieu Ship Channel remains operational at its current dimensions, it would be necessary to identify disposal sites to replace or augment existing sites. These could be new or expanded CDFs, beneficial use sites, or a combination of the two. The environmental effects of these actions would be similar to those effects identified for the Recommended Plan and Alternative C.

Action Alternatives. The Recommended Plan would involve the expansion of CDFs 17, 19, and 22 into the open-water area impounded by the prior construction of the foreshore dike along the left descending bank of the ship channel (Table 4-1). Short-term effects would include the placement of dredged material into this area, thereby converting 99 acres of impounded brackish water to uplands and 25 acres of terrestrial habitat to uplands.

Table 4-1. CDF Expansions of the Recommended Plan

Expanded CDFs	Existing Acreage	Impounded brackish water filled during CDF expansion	Terrestrial Habitat Filled during CDF Expansion
17	140	16	--
19	106	38	--
22	157	45	25
Total	**403**	**99**	**25**

Long-term effects of the Recommended Plan include the potential restoration, creation, and nourishment of an estimated 5,840 acres of subsided marsh and estuarine habitat.

Long-term effects of Alternative C include the potential restoration, creation, and nourishment of an estimated 10,030 acres of subsided marsh and estuarine habitat.

Saline Water. Saline habitats (those with salinity greater than 30 ppt) would be found within the Calcasieu Ship Channel during periods of low rainfall and in the saltwater wedge at the bottom of the channel. It is unlikely that the presence or distribution of saltwater conditions would be affected by any of the project alternatives.

4.7.2.2 Wetlands

Forested Wetlands. Bottomland hardwood forests and cypress/tupelo swamp forests are present along the Calcasieu River north of Calcasieu Lake. None of the alternatives would affect the presence or distribution of existing forested wetlands. It is possible that when CDFs reach capacity, landowners may allow them to become forested; wetland margins of the former CDFs could become vegetated with species typical of bottomland hardwoods or swamps.

Coastal Marshes.

No Action Alternative**.** No changes from the existing method of handling dredged material would occur in the short term. Effects on wetlands would involve the occasional placement of dredged material for the restoration of subsided marsh, generally in association with coastal restoration projects and with costs shared with other agencies. In the longer term, as more CDFs become filled and unusable, the use of dredged material for marsh restoration would be an important factor needed to keep the ship channel open. Maintaining the navigability of the channel could result in such emergency actions as the creation of new CDFs in environmentally sensitive areas, which may require high mitigation costs. A piecemeal approach to disposal, which would include separate studies and NEPA documents, could be viewed unfavorably by regulatory agencies.

Action Alternatives. Under both the Recommended Plan and Alternative C, many of the confined disposal areas would be rehabilitated within the confines of their existing footprints, the continued use of which would not affect wetlands. However, beneficial use sites would create wetlands during the 20-year life of the project and beyond.

Quantitative assessments of the value of wetlands established or lost from the project were determined using the Wetland Value Assessment Methodology for Coastal Marsh Community Models (Roy, 2007) (Appendix P). The Wetland Value Assessment (WVA) Coastal Marsh Community Models were developed by the CWPPRA Environmental Work Group to determine the suitability of marsh and open water habitats in the Louisiana coastal zone. The intent of the model is to define an optimal combination of habitat conditions for fish and wildlife species living in Louisiana coastal marsh ecosystems.

The WVA model is a quantitative, habitat-based assessment developed to estimate anticipated environmental impacts and benefits to wetlands. The WVA is a modification of the Habitat Evaluation Procedure (HEP) developed by the USFWS. HEP is widely used by the USFWS and other Federal and state agencies in evaluating the impact of development projects on fish and wildlife resources. A notable difference exists between the two methodologies, however, in that HEP generally uses a species-oriented approach, whereas the WVA uses a community or habitat-level approach.

The WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each wetland type. Each model consists of: (1) a list of variables that are considered important in characterizing community-level fish and wildlife habitat values; (2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Index) and different variable values; and (3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI). The product of an HSI value and the acreage of available habitat for a given target year is known as the Habitat Unit (HU) and is the basic unit for measuring project effects on fish and wildlife habitat. HUs are annualized over the project life to determine the Average Annual Habitat Units (AAHUs) available for each habitat type. The change (increase or decrease) in AAHUs for each future with-project scenario, compared to future without-project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the fish and wildlife community within that habitat type; a net loss of AAHUs indicates that the project would adversely impact fish and wildlife resources.

The WVA has become a standard tool for assessing wetlands values in Louisiana by Federal and state agencies, including not only coastal restoration projects but also regulatory actions. The WVA model was used in this study to maintain consistency and enable comparisons to other studies. WVAs were prepared in a collaborative effort by the USACE, USFWS, NMFS, and LDWF for all BU and CDF sites in the DMMP/SEIS that are expected to create or impact wetlands in the project area.

Details on the WVA assessments of each site, including assumptions and methodology, can be found in Appendix P. Results are summarized below.

The WVA models forecast the net marsh and estuarine habitat benefits of implementing the Recommended Plan and Alternative C starting the year project construction begins and ending 50 years after the start of the project. Tables 4-2 and 4-3 summarize the marsh impacts and benefits of the two plans.

Table 4-2. Summary Effects of the Recommended Plan on Marsh and Open Water Habitat

Site	Acreage Available for Beneficial Use of Dredged Material	Marsh Created (acres)	Marsh Converted to Uplands (acres)	Open Water/Estuarine Habitat Converted to Uplands (acres)	Total AAHU
BU 5	3,083	3,000	0	0	500.37
BU 18	1,572	1,000	0	0	129.83
BU 19	1,026	300	0	0	70.36
BU 20	1,867	300	0	0	63.33
BU 49	639	600	0	0	167.61
BU 50	887	640	0	0	251.67
Totals	**9,074**	**5,840**	**0**	**0**	**1,183.17**

Table 4-3. Summary Effects of Alternative C on Marsh and Open Water Habitat

Site	Acreage Available for Beneficial Use of Dredged Material	Marsh Created (acres)	Marsh Converted to Uplands (acres)	Open Water/Estuarine Habitat Converted to Uplands (acres)	Total AAHU
BU 4	1,279	476	0	0	165.17
BU 5	3,083	3,000	0	0	500.37
BU 6	990	564	0	0	104.45
BU 7	2,498	1,694	0	0	246.39
BU 18	1,572	1,000	0	0	129.83
BU 19	1,026	300	0	0	70.36
BU 20	1,867	300	0	0	63.33
BU 24	2,327	490	0	0	97.01
BU 48	1,475	708	0	0	162.75
BU 49	639	600	0	0	167.61
BU 50	887	640	0	0	251.67
BU 52	258	258	0	0	76.14
Totals	**17,901**	**10,030**	**0**	**0**	**2,035.08**

Results show that The Recommended Plan would cause a net increase of approximately 1,183.17 AAHUs because of the beneficial use of dredged material planned for this alternative. A total capacity of 9,074 acres would be potentially usable for the beneficial use of dredged material during the 20-year life of the project. The WVAs estimated the acreage of marsh that may be created as a result of the project based on cubic yardage allocated for each site in the DMMP/SEIS along with water depth data. Using the WVA methodology, it is estimated that approximately 5,840 acres of marsh and estuarine habitat would be created as a result of the plan. If, in the future, more dredged material becomes available for beneficial use, it is assumed that more habitat acreage would be created within the boundaries of the BU sites identified in the DMMP/SEIS.

Because Plan C involves fewer CDF expansions and more beneficial use sites than the Recommended Plan, Plan C would create more habitat benefits. Plan C would cause a net increase of 2,035.08 AAHUs and would create an estimated 10,030 acres of marsh and estuarine habitat. A total of 17,901 acres would be potentially useable for the beneficial use of dredged material over the life of the project.

Pipelines to transport sediment to beneficial use placement areas of the Recommended Plan and Alternative C would generally be routed along public waterways. However, the pipeline to the Cameron Prairie NWR site may cross private land, and it may be necessary to secure rights from the landowner to cross this property. A permanent pipeline for conveying material to the Sabine NWR is in the process of being constructed. Temporary pipelines are expected to cause no significant adverse impacts to marsh.

4.7.2.3 Uplands

Coastal Prairie. Because no coastal prairie is known to occur within or near the project area, coastal prairie habitat would not be affected by any of the alternatives.

Cheniers. Cheniers are not present in the study area or in an area potentially affected by the project. None of the alternatives would have an effect on Chenier habitats.

4.7.2.4 Confined Disposal Facilities

As discussed in Section 3.8.2, Habitats, habitats on existing CDFs include mainly agricultural land and fresh marsh, as well as brackish marsh, uplands, wetlands, and water**.** According to the USDA's Natural Resources Conservation Service (NRCS), none of the agricultural land in the project area has been classified as prime or unique farmland and is therefore not protected by the Farmland Protection Policy Act.

No-Action Alternative. There is insufficient CDF capacity under current management practices for the next 20 years. For the Calcasieu Ship Channel to remain operational with its currently authorized dimensions, new or expanded facilities would be necessary for confined disposal. It would also be necessary to continue to use dredged material beneficially for coastal marsh restoration, as is currently accomplished in association with CWPPRA and other authorizations. If improvements to the existing program are not forthcoming, alternative means of retaining the ship channel may include reducing its dimensions and/or placing dredged material in the ODMDS.

Under the without-project conditions, some CDFs would continue to deteriorate through erosion from ship wakes in the channel and from wind and wave action along Calcasieu Lake. As CDFs reach capacity and become unusable, real estate easements would expire. The fate of each CDF would lie with the interests of the landowners: some may wish to use their facilities as pastures or other uses, while others may opt to allow woody or scrubby vegetation to overtake the site.

The capacity for dredged material placement may be increased by CDF mining. Once mined, the material may be used by private or public parties for a variety of functions, including fill material for construction or landscaping projects, marsh creation, and other uses. The sediment mined from CDFs would have no adverse environmental effects if appropriate best management practices are followed.

Action Alternatives. To determine the number of acres and habitats affected by the project, Geographic Information Systems (GIS) technology was used to determine expanded and unexpanded acreages.

Recommended Plan. CDFs 17, 19, and 22 would be expanded in association with the deposition of dredged material into the area behind the foreshore dike. Approximately 124 acres of impounded brackish water and terrestrial habitat would be converted to upland habitat (Table 4-1).

Land uses on existing CDFs, as determined through the Louisiana Land Use and Land Cover (LULC) dataset, developed by the National Gap Analysis Program (GAP), include Agricultural-Crop-Grassland, Upland Scrub/Shrub, Wetland Barren, Wetland Scrub/Shrub, Brackish Marsh, and Water. As dredged material is placed into CDFs, the habitat types would be altered. It is likely that the habitat types present in the approximately 4,858 acres of CDFs associated with the Recommended Plan would be converted to one another as ponding and drying take place over time.

Alternative C**.** Dredged material would be placed in approximately 3,986 acres of CDFs. No horizontal expansions would take place under this alternative. As with the Recommended Plan, habitats on the CDFs would be altered through the placement of dredge material at the sites, and would likely vary during the life of the project.

4.7.3 Biota

4.7.3.1 Plants

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. 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.

Changes to the species composition and distribution of plant communities of the project area would take place under the various alternatives.

No-Action Alternative. To maintain the Calcasieu Ship Channel at its current dimensions without implementing the project, the identification of additional means for disposing material dredged from the channel would be required. When CDF capacity is no longer available, choices for dredged material disposal include its use for beneficial use, the construction or rehabilitation of CDFs, and the use of the ODMDS.

The use of the ODMDS for dredged material placement would have no effect on the ongoing trends in the deterioration of plant communities in the Calcasieu marshes. CDF expansion could result in a loss of plant communities that may be located in expansion areas. The beneficial use of dredged material would reduce the rate of loss of marsh plant communities.

A variety of both upland and wetland plant communities are located on CDFs (Appendix R), with the variety apparently resulting from management practices and frequency of use. It is anticipated that the No Action Alternative would allow existing management practices to continue, and enable a continuation of the existing communities. When CDFs reach capacity and easements for dredged material disposal expire, the types of plant communities that develop on the CDFs would depend on types of management, if any, implemented by the landowner.

Reductions in the authorized dimensions of the ship channel may become necessary to decrease the amount of material to be dredged and disposed. This would, in turn, affect plant communities by decreasing the amount of material available for beneficial use, decreasing the potential for CDF expansion, and possibly altering the structure of plant communities located on CDFs.

Action Alternatives

Recommended Plan. Beneficial use of dredged material would restore and nourish 5,840 acres of subsided and existing coastal marsh. Based on current characteristics of the area, it is anticipated that much of this would be comprised of the intermediate marsh community dominated by marshhay cordgrass.

Alternative C would also result in the restoration of intermediate marsh. Beneficial use of dredged material under this alternative is anticipated to restore and nourish 10,030 acres of subsided and existing coastal marsh. Plant communities on CDFs would be lost during the rehabilitation, reconstruction, and ongoing maintenance planned for both the Recommended Plan and Alternative C.

4.7.3.2 Animals

Terrestrial Animals. It is doubtful that either the No Action Alternative or the action alternatives would have any effect on terrestrial animals. Wetland species, such as nutria, muskrat, waterfowl, etc., could easily avoid disturbances associated with construction activities at CDFs or beneficial use sites. Birds, including migratory birds that might use CDFs for resting, foraging, or loafing would have ample alternative locations available for use. Upland species of mammals or reptiles that may inhabit CDFs are likely to react to disturbances by relocating to adjacent CDFs or other uplands

Aquatic Animals

No Action Alternative. In the short term, as CDFs continue to erode and material from the CDF is deposited on the bottom of Calcasieu Lake and other waterbodies in and near the project area, aquatic habitats would continue to become altered. Any CDF expansion or beneficial use site construction would eliminate aquatic habitats. Fishes may be able to relocate to other areas, while existing benthic invertebrate communities would be eliminated and/or replaced by more tolerant forms. 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.

Action Alternatives. The restoration and creation of wetlands through the beneficial use of dredged material would have a major beneficial effect on recreational and commercial fisheries. NMFS 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/habitatconservation/publications). Recreational and commercial fisheries are of major importance to the local and state economies, and communities such as Cameron 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 Recommended Plan would result in the restoration and nourishment of approximately 5,840 acres of marsh and estuarine habitat. Alternative C would restore and nourish approximately 10,030 acres. Both alternatives would provide significant benefits to aquatic organisms and the fisheries that depend on them.

Oyster Resources. Calcasieu Lake has been designated as a public oyster tonging area and is managed by the LDWF. To assess potential impacts and mitigation requirements associated with elements of the DMMP, the USACE contracted for a detailed assessment of oyster resources to be performed in accordance with the May 1, 2005, LDWF Revised Sampling Protocol for Projects in Public Oyster Areas. A copy of the protocol is included in Appendix I, Oyster Resources. The area assessed, shown in Figure 3-10, was 1,500 feet of the estimated maximum area for any potential placement of dredged material. Detailed descriptions of materials and methods, as well as findings, are contained in the *Oyster Resource Assessment of a Portion of the Louisiana Department of Wildlife and Fisheries Calcasieu Lake Public Tonging Area*, located in Appendix I.

No-Action Alternative. No direct impacts would result from the No-Action Alternative. Secondary adverse impacts could occur as deterioration of existing CDFs continues and sediment and suspended solids from the erosion of CDFs inhibit the establishment of oyster production near the ship channel. As marshes in the project area also continue to deteriorate and transform into open water habitats, the oyster habitat area could expand, depending on the quality of the resulting bottom conditions.

Action Alternatives. No direct impacts would result from either the Recommended Plan or Alternative C. Rehabilitation and improved management of the CDFs adjacent to Calcasieu Lake would benefit oyster habitat through the reduction of dike erosion and the introduction of suspended solids into the water column.

Essential Fish Habitat. There are approximately 67 square miles (42,000 acres) of open water and mud/sand/shell habitat in Calcasieu Lake, and many thousands of additional acres of marsh (estuarine emergent wetlands) and open water (estuarine water column habitat) in its associated estuarine system. Essential Fish Habitat (EFH) affected by the disposal of dredged material from maintenance operations in the ship channel would include estuarine emergent wetlands, mud/sand/shell substrates, and the estuarine water column.

No-Action Alternative: Sediment dredged from the Calcasieu Ship Channel would continue to be placed in CDFs, as capacities allow, thereby not directly affecting EFH. However, as CDFs reach capacities, it may be necessary to reduce the dimensions of the channel to minimize the amount of dredged material for disposal. CDF capacity could be extended by implementing sound maintenance practices and erosion control measures, and by expanding CDFs outside of the DMMP process. Maintaining the navigability of the channel may result in such emergency actions as the disposal of material in the ODMDS or creation of new CDFs in environmentally sensitive areas. It is likely, however, that as CDFs become filled and unusable, alternate sources of dredged material placement sites would be sought.

Action Alternatives: Under the Recommended Plan and Alternative C, many of the confined disposal areas would be rehabilitated within the confines of their existing footprints. The continued use of these CDFs would not affect EFH.

The Recommended Plan calls for the expansion of CDFs 17, 19, and 22 to the west as dredged material is placed into the area that was impounded by the construction of the foreshore dike. An EFH assessment of the impacts of the foreshore dike was completed in a previous NEPA document, *Environmental Assessment, Calcasieu River And Pass Foreshore Rock Dikes and Bank Armoring, Cameron Parish, Louisiana, EA #485* (FONSI dated 08/19/2009).

Additionally, on the channel side of CDF D and E, the CEMVN has constructed a foreshore rock dike from approximate mile 11.2 to 15.6 (Figure 2-16). The dike has been placed along the historic shoreline of the channel, providing dredged material placement from -3 to +20 feet for an average width of 500 feet. Approximately 281 acres of estuarine water column habitat would be converted to uplands.

Beneficial use of dredged material under the Recommended Plan would potentially restore and nourish 5,840 acres of subsided and existing coastal marsh and estuarine habitat. Beneficial use sites, which include areas of degraded marsh (presently mud/shell/sand and estuarine water column habitats), would receive dredged material to create estuarine emergent wetland habitat. Average annual habitat units resulting from the restoration of the coastal marshes are presented in Table 4-2 above.

Beneficial use of dredged material under alternative C would potentially restore and nourish 10,030 acres of subsided and existing coastal marsh. This action would convert existing mud/shell/sand and estuarine water column habitats to estuarine emergent wetlands. Alternative C would not involve the expansion of CDFs along Calcasieu Lake. Beneficial use sites, acreages, and resultant habitat units are presented in Table 4-3.

However, Alternative C would involve the expansion of CDF D and E along the channel. On the channel side of CDF E and E, the CEMVN has constructed a foreshore rock dike from approximate mile 11.2 to 15.6 (Figure 2-16). The dike has been placed along the historic shoreline of the channel, providing dredged material placement from -3 to +20 feet for an average width of 500 feet. Approximately 281 acres of estuarine water column habitat would be converted to uplands.

4.7.4 Threatened and Endangered Species

Of the 12 protected species discussed in Section 3.8, *Rare, Threatened, and Endangered Species*, and Appendix L, Endangered Species Biological Assessment, only two are likely to be encountered within the project area: the piping plover (*Charadrius melodus*) and brown pelican (*Pelecanus occidentalis*).

No-Action Alternative. Maintaining the existing conditions and operations would have little, if any, effect on protected species of the area. A reduction in the channel dimensions from decreased dredging would reduce the amount of traffic on the waterway. Therefore, the probability of a collision with a Kemp's ridley sea turtle would be likewise reduced. The other protected species in the project area would remain generally unaffected.

Action Alternatives. A Biological Assessment (BA) was prepared in accordance with the provisions of Section 7 of the Endangered Species Act (ESA) of 1973, as amended, and submitted to USFWS for coordination on July 2, 2007 (Appendix L). The BA concluded that the project may affect but is not likely to adversely affect the brown pelican or the piping plover or their critical habitat. By letter of November 14, 2007, the USFWS concurred with the USACE's determination that the project is not likely to adversely affect either the brown pelican or the piping plover. Since the BA was prepared and consultation was completed, the brown pelican was removed from the List of Threatened and Endangered Species in December, 2009. However, it continues to be protected under the Migratory Bird Treat Act (MBTA, 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

A copy of the BA was provided to NMFS, with whom coordination is also required under Section 7 of the ESA. By email of October 11, 2007, NMFS also concurred that no effect is expected for ESA species listed under the purview of NMFS (Appendix L).

Effects of the Recommended Plan and Alternatives C on protected species would be equivalent.

Brown Pelican. If any of the CDFs in the project area are used by brown pelicans for roosting or loafing habitats, the placement of dredged material in CDFs may interfere with those activities. However, ample sites for roosting and loafing are available. The placement of material for beneficial use would reduce open water habitat by converting it to marsh, thereby reducing available foraging habitat. However, the reduction in the amount of open water is negligible compared to the amount remaining. Brown pelicans are mobile and operations involving the placement of dredged material are unlikely to harm or interfere with their activities. It is concluded that the Action Alternatives may affect but are not likely to adversely affect the brown pelican.

All activity occurring within 2,000 feet of a brown pelican rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this activity window could be altered based upon the dynamics of the individual colony. The LDWF's Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. Brown pelicans are known to nest on barrier islands and other coastal islands in St. Bernard, Plaquemines, Jefferson, Lafourche, and Terrebonne Parishes, and on Rabbit Island in lower Calcasieu Lake, in Cameron Parish.

Piping Plover. The placement of dredged material in CDFs would not interfere with foraging or other activities by the piping plover. Dredged material disposal operations are likely to temporarily displace any birds that might be present in the vicinity of the dredging or dredge material disposal to other areas. The placement of material for beneficial use would have no effect on piping plover habitat because the bird's habitat (beaches, mud flats, etc.) is south of the project limits. Therefore, it is concluded that the Action Alternatives may affect but are not likely to adversely affect the piping plover.

4.8 NATIONAL WILDLIFE REFUGES

No-Action Alternative. Selection of the No-Action Alternative would result in no change to the Sabine and Cameron Prairie National NWRs. Marsh restoration efforts through such programs as those established through CWPPRA would likely continue.

Action Alternatives. Effects of the Recommended Plan and Alternative C on the two national wildlife refuges would be the same. Restoration of 4,000 acres of wetlands within the Sabine NWR (BU sites 5 and 18) would complement the refuge's primary management objective "to maintain and perpetuate Gulf Coast wetlands for wintering waterfowl from the Mississippi and Central flyways" [USFWS, Undated (1)]. Habitat for wading birds, marsh birds, and water birds would be enhanced, as would habitat for saltwater and freshwater fishes and other aquatic and marsh-dwelling organisms. Likewise, the restoration of 600 acres of wetlands in the Cameron Prairie NWR (BU sites 19 and 20) would assist in its management to "provide natural foods for wintering waterfowl and water birds" [USFWS, Undated (2)]. As with the Sabine NWR, wetland restoration in the Cameron Prairie NWR would also enhance habitats for numerous aquatic and marsh-dwelling organisms. Habitat improvement would, in turn, improve such recreational activities as hunting, fishing, birding, wildlife viewing, and other activities on the Sabine and Cameron Prairie NWRs.

4.9 RECREATION

No-Action Alternative. Selection of the No-Action Alternative would result in no change to recreation in the region of interest.

Action Alternatives. Short-term effects of the project are likely to consist of disruptions to recreational fishing during periods of construction at placement sites and during dredging and pumping operations. Following the placement of dredged material at beneficial use sites, there may be an intermediate period prior to the establishment of wetland vegetation when habitat quality is low. However, following the establishment of wetland vegetation over many thousands of acres, the project is expected to result in long-term enhancement of recreational fishing in Calcasieu Lake. According to Gahagan and Bryant, Inc. (Personal Communication, 2008), marsh restored in a similar project in Galveston Bay, Texas, improved recreational fishing in the estuary; areas of restored marsh have become popular fishing locations. Similar results are expected from this project.

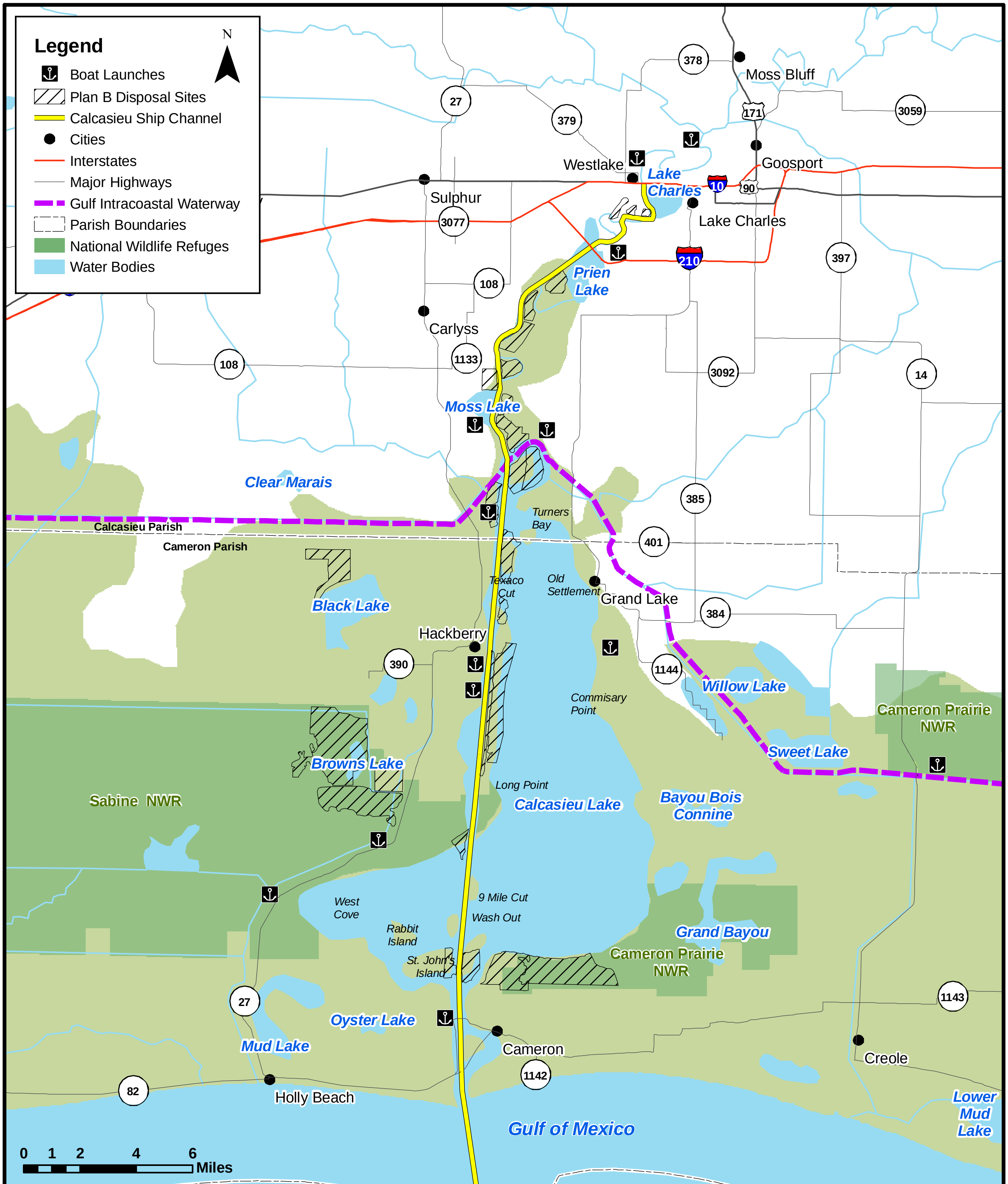
It is expected that improved wetland habitat would improve other recreational activities (hunting, birding, wildlife viewing). No impacts to boat launches would be expected (Figure 4-1).

4.10 CULTURAL RESOURCES

Neither the No Action Alternative nor the Action Alternatives is expected to have any impact on cultural resources judged to be eligible for listing in the National Register of Historic Places, as documented in Appendix H, Cultural Resources. The State Historic Preservation Office has concurred with this finding.

4.11 SOCIOECONOMICS

No-Action Alternative. The Calcasieu Ship Channel is a vital element of the U.S. energy infrastructure. Currently, 4.5 percent of all U.S. motor fuel is supplied by producers on the ship channel. A lack of dredged material disposal capacity could reduce the ability to maintain the



PROJECT AREA BOAT LAUNCHES, WATER BODIES, AND PLAN B DISPOSAL SITES

Calcasieu River & Pass
Dredged Material Management Plan

Figure: 4-1	
Date: March 2009	
Scale:1:300,000	
Source: LOSCO/GEC/USACE	
Map ID: 27585107-1316	

channel to authorized dimensions. Reduced channel dimensions would, in turn, impact the extent to which vessels continue to call at the Port of Lake Charles.

A temporary closure or reduction in operations would have local and national economic impacts. A nine-day closure of the channel in 2006 cost U.S. gasoline consumers $710 million and natural gas consumers $313 million for a total burden to the nation of over one billion dollars. Reduced operations at the port would also impact the local and national water-borne commerce labor market.

The economic analysis in Appendix E estimates the increase in annual deep-draft vessel voyage costs assuming two future without-project shoaling rates (draft reduction rates): (1) one foot of draft reduction every two years (one-half foot a year), and (2) one foot of draft reduction per year. It is assumed that for each successive foot reduction in sailing draft, annual vessel voyage costs would escalate as a result of having to sail with lighter loads, therefore having to make more trips (and use more fuel) for transporting the same amount of cargo. For existing crude oil and LNG cargo volumes, a one-foot reduction in sailing draft (from 40 to 39 feet) would increase annual vessel voyage costs nearly $6.2 million.

A complete cessation of all maintenance dredging would result in an estimated natural water depth of between four to six feet, effectively closing the ship channel to commercial navigation. Existing crude oil imports could possibly be handled through other ports and sent by pipeline to Calcasieu River refineries, assuming that there is pipeline capacity and connections for the refineries at Calcasieu River. Similarly, in the cessation of dredging, an offshore LNG unloading facility and pipeline could be constructed to the affected plants. The capital and operating costs of these actions to compensate for channel size reductions are not known, but they would probably necessitate large one-time capital expenditures in addition to operations costs.

Action Alternatives. Both action alternatives would provide capacity for dredged material placement for channel dimensions to be maintained for at least the next 20 years. Therefore, no significant adverse economic impacts are expected from implementation of the proposed project. However, impacts to landowners may occur as a result of the project. Landowners in the project area may lose the use of their land if their properties are acquired for the disposal of dredged material by the Federal Government through eminent domain. Eminent domain is the inherent power of the Federal Government to seize a citizen's private property, expropriate property, or seize a citizen's rights in property with due monetary compensation, but without the owner's consent.

Benefit Cost Analysis. To address the uncertainty associated with forecasting future shoaling rates and operating capacity of the three LNG plants, transportation cost savings were developed for two shoaling rates and three alternative LNG facility operating scenarios. The two shoaling rates (draft reduction rates) assumed: (1) one foot of draft reduction every two years (one-half foot a year), and (2) one foot of draft reduction per year. The three LNG operating scenarios consisted of: (1) Scenario 1 excluded tonnages associated with the approved Cheniere LNG facility, (2) Scenario 2 assumed all three LNG facilities operate at 50 percent of their baseline capacity, and (3) Scenario 3 assumed that the Trunkline and Sempra LNG facilities operate at 50 percent of capacity and the Cheniere facility is not developed. Crude petroleum movements were assumed to remain constant at 19.95 million tonnes for all scenarios.

The benefit-to-cost ratios for the Recommended Plan, assuming 1-foot of draft reduction every two years, ranged from 2.56 for Scenario 1, 2.04 for Scenario 2, and 1.43 for Scenario 3. The benefit-to-cost ratios assuming 1-foot of draft reduction every year, ranged from 4.44 for Scenario 1, 3.54 for Scenario 2, and 2.49 for Scenario 3. The benefit/cost ratios for the three LNG development scenarios under the two assumed shoaling rates indicate that there are substantial increased costs resulting from slight reductions in sailing drafts relative to a cessation of dredging and commercial navigation. The benefit-to-cost ratios indicate that very slight draft reductions in the range of one to two feet per year for the Calcasieu River (river miles -32 through 36) under "no action" dredge alternative would result in substantially higher transportation costs relative to the costs of the DMMP Recommended Plan.

The full Economic Report can be found in Appendix E.

4.12 TRANSPORTATION

No-Action Alternative. A lack of dredged material disposal capacity could reduce the channel dimensions, which would impact the extent to which deep-draft vessels continue to call at the Port of Lake Charles. The economic analysis in Appendix E estimates the increase in annual deep-draft vessel voyage costs assuming two future shoaling rates (draft reduction rates): (1) one foot of draft reduction every two years (one-half foot a year), and (2) one foot of draft reduction per year. For each successive foot reduction in sailing draft, annual vessel voyage costs escalate as a result of diseconomies of scale for the underutilized fleet. At some point, vessels would likely call at other ports, displacing nearly 50 million tonnes of cargo that is currently handled by commercial navigation in the channel. This displacement of cargo would significantly affect rail, truck, and barge traffic that normally transport cargo to and from the Port's facilities.

Action Alternatives. Both action alternatives would create sufficient capacity for dredged material placement for authorized channel dimensions to be maintained. Therefore, no significant adverse impacts on transportation are expected from implementation of the proposed project.

4.13 NOISE

No Action Alternative. The No-Action Alternative would not increase ambient noise levels in the project area. Therefore, no impacts are expected to result due to selection of this alternative.

Action Alternatives. Noise impacts to the natural and human environment are expected to be localized and short-term, occurring during construction and operations. Earth-moving equipment and engines from barges, dredges, and launches would contribute to noise at the project site during construction. Unloaders, on-site equipment, and tugs transporting scows to and from the site would contribute to noise at the project site during operations. Dredging activities can intermittently generate noise levels as high as 85 to 88 dBA (California Department of Water Resources, 2000) and earth-moving 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 and operations could affect echolocation receptors in nearby marine mammals (i.e., dolphins), but the effects would be short term and localized, and the animals could easily relocate to areas of less noise during such times.

4.14 AESTHETICS

No Action Alternative. This alternative would have no effect on aesthetic resources in the project area.

Action Alternatives. Both the Recommended Plan and Alternative C include beneficial use sites 18 and 49 in or adjacent to the Sabine NWR. The creation of marsh in these areas may be viewable from the Creole Nature Trail. Pumping activities would be seen. Once the newly created marsh has become established, panoramic views of the coastal wetlands may be provided by observation platforms. The restored wetlands are expected to provide additional habitat for waterfowl, which would increase opportunities for wildlife viewing.

4.15 CUMULATIVE IMPACTS

4.15.1 Introduction

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.*

In assessing cumulative impact, consideration is given to (1) the degree to which the proposed action affects public health or safety, (2) unique characteristics of the geographic area, (3) the degree to which the effects on the quality of the human environment are likely to be highly controversial, (4) the degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks, and (5) whether the action is related to other actions with individually insignificant but cumulatively significant impacts on the environment.

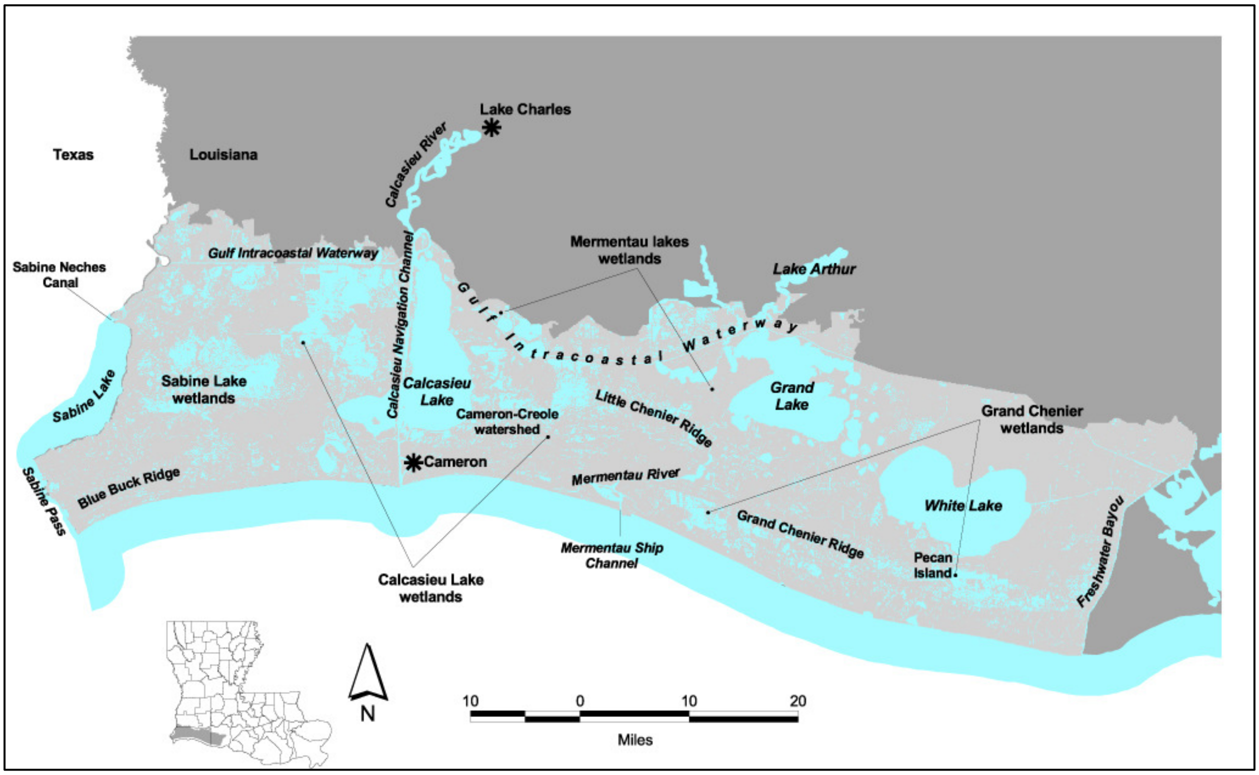
Cumulative effects can result from many different activities, including the addition of materials to the environment from multiple sources, repeated removal of materials or organisms from the environment, and repeated environmental changes over large areas and long periods. Complicated cumulative effects occur when stresses of different types combine to produce a single effect or suite of effects. Large, contiguous habitats can be fragmented, making it difficult for organisms to locate and maintain populations in disjunct habitat fragments. Cumulative impacts may also occur when the timing of perturbations are so close in space that their effects overlap.

4.15.2 Geographic Boundaries

Although the project area is limited to the Calcasieu River and estuary, cumulative impacts involve the broader coastal basin. For that reason, most of the information in this cumulative impacts analysis applies to the Calcasieu-Sabine Basin in Louisiana's Chenier Plain. The information used in this report has been gathered from published sources and government documents.

4.15.3 Calcasieu-Sabine Basin

The Calcasieu-Sabine Basin is the westernmost coastal basin in Louisiana's Chenier Plain. Composed of the Calcasieu-Sabine and Mermentau hydrologic basins, the Chenier Plain was formed 3,000-4,000 years ago during periods when the Mississippi River followed a westerly course (LCWCRTF, 2002). The sediments were reworked by marine forces into low ridges and intervening wetland swales parallel to the coastline. These ridges, which consisted mainly of sand and shell, were typically higher in elevation than surrounding marshes and were colonized by live oaks. The Chenier Plain extends from the western bank of the Freshwater Bayou Canal westward to the Sabine River on the Louisiana-Texas border, and from the marsh area north of the Gulf Intracoastal Waterway (GIWW) south to the Gulf of Mexico in Vermilion, Cameron, and Calcasieu parishes (Figure 4-2).



Source: U.S. Army Corps of Engineers. 2004. Louisiana Coastal Area (LCA) Ecosystem Restoration Study. Volume I: Main Report. CEMVN. Page 2-16.

Figure 4-2. Louisiana's Chenier Plain

The Calcasieu-Sabine Basin consists of approximately 630,000 acres, 50 percent of which is classified as marsh. The northern boundary of the basin is defined by the GIWW. The eastern boundary follows the eastern leg of State Highway 27; the western boundary is the Sabine River and Sabine Lake; and the southern boundary is the Gulf of Mexico (USGS, 2007).

The basin consists of two semi-distinct hydrologic units, the Calcasieu River Basin and the Sabine River Basin, which are continuous between Louisiana and Texas. The Calcasieu, Sabine, and Neches rivers are the principal sources of freshwater inflow into this region. The Sabine and Calcasieu rivers follow a north-south gradient, whereas the Neches River flows into

Sabine Lake from the northwest. Additionally, an east-west flow occurs between the basins via the GIWW and existing canals on the Sabine National Wildlife Refuge (USGS, 2007).

Managed wetlands are a significant feature of the Calcasieu-Sabine Basin. About 24 percent (148,600 acres) of the basin lands is publicly owned as Federal refuges (USGS, 2007).

4.15.4 Temporal Boundaries

The cumulative impacts on the Calcasieu-Sabine Basin began with the construction of navigation channels in the Calcasieu and Sabine rivers in the early 1870s and 1880s, respectively. The channels were continuously deepened and widened for the next 100 years, causing saltwater intrusion coupled with significant marsh loss and vegetation change. More than 82 percent, over 100,000 acres, of documented marsh loss in the Calcasieu-Sabine Basin occurred between 1955 and 1974, the period in which the largest incremental changes were made to the navigation channels. Because the navigation channels would remain authorized until Congress determines otherwise, their status must be considered indefinite.

4.15.5 Natural Resources

This SEIS includes considerations of the effects of dredged material placement alternatives on natural resources of the area, including fish habitat, protected species, oyster grounds, wetlands, and others. This cumulative impacts discussion focuses on the primary issue affecting these natural resources--land loss and plant community changes due to saltwater intrusion. The hydrologic alterations that have had the most significant impact on these resources are navigation corridors. The Calcasieu and Sabine-Neches navigation channels have been expanded incrementally to the extent that the existing channel cross-sections are more than 40 times larger than when the channels were first dredged in the late 1800s. These changes have affected hydrology by channeling saltwater into the historically low-salinity estuary. Secondary causes of landscape change include storms, petrochemical exploration, and herbivory.

4.15.6 Past Actions

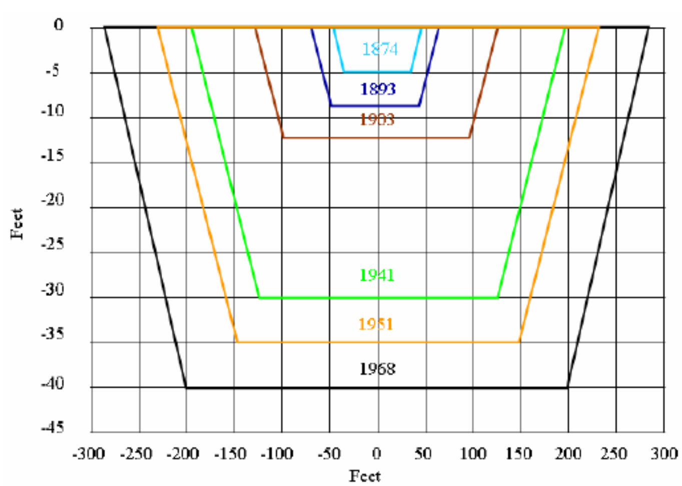
Historical Landscape Change. Abundant evidence indicates that the Calcasieu-Sabine Basin was historically fresher than it is today. Both O'Neil (1949) and a 1951 Soil Conservation Service vegetation map of Cameron Parish show broad expanses of unbroken Jamaica swamp sawgrass (*Cladium mariscus*) marsh (USDA, 1951, in LCWCRTF, 2002). Sawgrass is found in fresh and intermediate marshes and tolerates salinities between 0 and 2 ppt (Penfound and Hathaway 1938). At the time of the 1951 survey, sawgrass marsh covered approximately 475 square-miles of Cameron Parish and was the dominant vegetative community.

Water from Calcasieu Lake was fresh enough to be used in the irrigation of rice fields in Cameron Parish around 1875-1910 (David Richard, Stream Companies, Inc., personal communication, in LCWCRTF, 2002). Water from Calcasieu Lake must have been essentially fresh during this period, because rice is adversely affected by water salinities that exceed 0.6 ppt (Hill, 2001). In the early 1900s, lower Calcasieu Lake was considered marginal habitat for oysters because of the frequency of freshwater and low-salinity events. Oysters, which cannot survive in fresh water, inhabit waters within the salinity range of 5-30 ppt (Galtsoff, 1964), are now found throughout much of the Calcasieu Lake bottom (USDA, 1994, in LCWCRTF, 2002). In contrast to these formerly fresh conditions in Calcasieu Lake, average salinities at five Cameron Prairie Refuge monitoring stations within Calcasieu Lake ranged from 8.01 to 11.66 ppt during 1994-95 (LCWCRTF, 2002).

A total of 116,791 acres of wetlands in the Calcasieu-Sabine Basin has converted to open water since 1932 (USGS, 2007). Biologists, ecologists, and natural resource managers who possess intimate knowledge of the historical events that shaped the ecosystem were interviewed by the Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF) to determine specific causes of land changes in the basin. The scientists attribute virtually all of the habitat changes and land losses in the basin to a combination of human-induced hydrologic changes, sometimes accompanied by severe storm events. The hydrologic alteration that has had the most impact is the Calcasieu Ship Channel, a major avenue for saltwater and tidal intrusion, which has caused extremely severe marsh losses (LCWCRTF, 2002).

Hydrologic Modifications for Navigation. Freshwater inflow to the basin occurs primarily through the Calcasieu and Sabine lakes via the Calcasieu and Sabine rivers. Marshes within the basin historically drained into these two large lakes. This process was altered by the construction of channels to enhance navigation and mineral extraction activities. Navigation channels now dominate the hydrology of the basin.

Calcasieu River and Ship Channel. The lower Calcasieu River and the Calcasieu Ship Channel have been maintained for navigation since 1874, when the USACE first constructed a 5-foot-deep x 80-foot-wide x 7,500-foot-long navigation channel through the outer bar of Calcasieu Pass, between Calcasieu Lake and the Gulf of Mexico. Prior to the initial dredging of the Calcasieu Ship Channel, there was a 3.5-foot-deep shoal at the mouth of the Calcasieu River (War Department, 1897). This natural bar acted as a constriction, minimizing saltwater and tidal inflow into the basin. Removal of the channel mouth bar, coupled with subsequent widening, deepening, and lengthening of the ship channel, allowed increased saltwater and tidal intrusion into the estuary, resulting in catastrophic marsh loss, tidal export of vast quantities of organic marsh substrate, and an overall shift to more saline habitats in the region (USDA, 1994, in LCWCRTF, 2002). In addition, the ship channel permits the upriver flow of denser, more saline water as a saltwater wedge. Figure 4-3 shows the historical channel dimensions of the Calcasieu Ship channel.

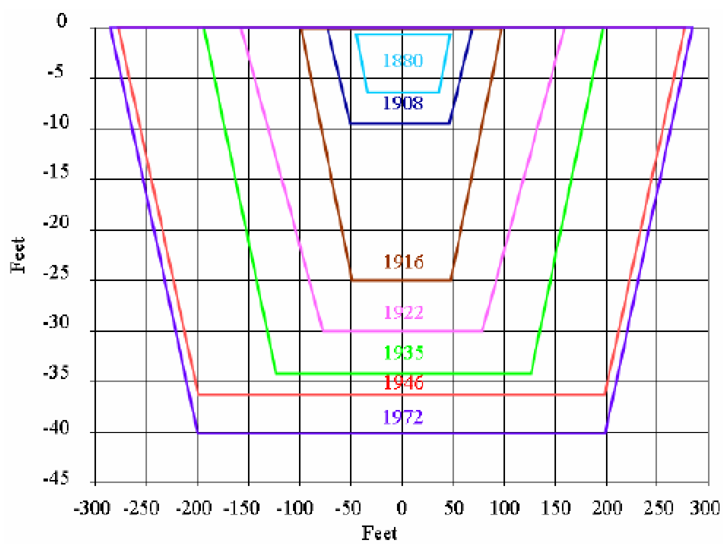


Source: LCWCRTF, 2002.

Figure 4-3. Historical Channel Dimensions of the Calcasieu Ship Channel

In 1968, the USACE completed construction of the Calcasieu River Saltwater Barrier on the Calcasieu River north of the City of Lake Charles. This barrier minimized the flow of the saltwater wedge into the upper reaches of the Calcasieu River to protect agricultural water supplies. The structure consists of navigation gates and a flood control barrier with five adjustable tainter gates.

Sabine River, Neches River, and Sabine Lake. The Sabine River is the dominant influence across most of the Calcasieu-Sabine Basin in moderating Gulf salinity and tidal fluctuations. Sabine Pass was first dredged for navigation in 1880. Before this, the river had an outer bar depth of 3.5 feet. In 1880, a channel six feet deep x 70-100 feet wide was dredged through the bar (War Department 1890). Over time, the channel was progressively deepened to its present depth of 40 feet. The Sabine-Neches Canal (later to become the Sabine-Neches Ship Channel) was constructed in the early 1900s, when the USACE dredged the channel along the west bank of Sabine Lake to a depth of 9 feet and a width of 100 feet. In 1914-1916, the channel was deepened to 25 feet and extended to Beaumont, Texas. This deepening led to the first reports of saltwater intrusion in the channel (Wilson 1981, in LCWCRTF, 2002). Since that time, the channel has gradually been deepened and widened to its present dimensions of 40 feet deep and 400 feet wide (Figure 4-4).



Source: LCWCRTF 2002.

Figure 4-4. Historical Channel Dimensions of the Sabine-Neches Ship Channel

Saline water from the Gulf of Mexico travels up the Sabine-Neches channel, resulting in an atypical estuarine salinity gradient. Construction of the Sabine-Neches Ship Channel and the deepening of both rivers, in conjunction with increased withdrawals of freshwater upstream for industry and agriculture, have resulted in major changes in system hydrology and saltwater intrusion in both Texas and Louisiana. The channel also funnels freshwater inflows more directly to the Gulf, largely bypassing the adjacent marshes in Louisiana and Texas (LCWCRTF, 2002).

The Gulf Intracoastal Waterway. The GIWW from the Sabine River to the Calcasieu River was constructed in 1913-1914 with a width of 40 feet and a depth of 5 feet. In 1925, the channel was enlarged to 100 feet wide by 9 feet deep. Prior to the deepening of the Calcasieu

Ship Channel in the late 1930s, the GIWW reach from the Sabine River to the Calcasieu River was deepened to 30 feet to facilitate navigation to the Port of Lake Charles. This section was then known as the Lake Charles Deep Water Channel. In 1941, the channel was thereafter maintained as part of the GIWW, at a depth of 12 feet and a width of 125 feet (USDA, 1994, in LCWCRTF, 2002).

Construction of the GIWW significantly altered regional hydrology by connecting the two major ship channels. Prior to the construction of the GIWW, the Calcasieu and Sabine estuaries were mostly distinct and were more influenced by the Calcasieu and Sabine rivers, respectively. The Gum Cove Ridge once separated the Sabine Basin from the Calcasieu Basin, with little water exchange between the two. Removing the mouth bars and deepening the Calcasieu and the Sabine-Neches channels, as well as the GIWW and interior canals bisecting the Gum Cove Ridge, dramatically altered the hydrology of what were once separate basins, merging them into the present-day Calcasieu-Sabine Basin. In addition to effectively combining the two basins, the GIWW cut off all the natural bayous and upland sheet flow that historically affected marshes, and channelized more freshwater inflow to the Gulf of Mexico (LCWCRTF 2002).

4.15.7 Land Management and Wetland Restoration

CWPPRA: Numerous land stewardship projects have been implemented in the Calcasieu-Sabine basin to help restore its estuaries and protect its shoreline. Table 4-4 lists completed and ongoing restoration and management projects in the basin funded by the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA). These projects have or are expected to have beneficial impacts on natural resources in the study area. CWPPRA was the first Federal statutory mandate for restoration of Louisiana’s coastal wetlands. As of July 2008, 145 active CWPPRA projects have been approved, 74 have been constructed, 17 are under construction, and 26 have been de-authorized or transferred to other programs. Many of these projects have occurred in the Calcasieu River and Pass project area.

Table 4-4. CWPPRA Restoration Sites for the Calcasieu-Sabine Basin

Agency	Project Name	Type	Net Benefit after 20 Years (acres)
NRCS	Black Bayou Culverts Hydrologic Restoration	Hydrologic Restoration	540
NMFS	Black Bayou Hydrologic Restoration	Hydrologic Restoration	3,594
NRCS	Brown Lake Hydrologic Restoration	Hydrologic Restoration	282
USFWS	Cameron Creole Plugs	Hydrologic Restoration	865
NRCS	Cameron-Creole Maintenance	Hydrologic Restoration	2,602
USACE	Clear Marais Bank Protection	Shoreline Protection	1,067
NRCS	East Mud Lake Marsh Management	Marsh Management	1,520

Agency	Project Name	Type	Net Benefit after 20 Years (acres)
USFWS	East Sabine Lake Hydrologic Restoration	Hydrologic Restoration	225
NRCS	GIWW - Perry Ridge West Bank Stabilization	Shoreline Protection	83
NRCS	Highway 384 Hydrologic Restoration	Hydrologic Restoration	150
NRCS	Holly Beach Sand Management	Shoreline Protection	330
NRCS	Perry Ridge Shore Protection	Shoreline Protection	1,203
NRCS	Plowed Terraces Demonstration	Sediment and Nutrient Trapping, Demonstration	N/A
USFWS	Replace Sabine Refuge Water Control Structures at Headquarters Canal, West Cove Canal, and Hog Island Gully	Marsh Management	953
USFWS	Sabine National Wildlife Refuge Erosion Protection	Shoreline Protection	5,542
USACE	Sabine Refuge Marsh Creation, Cycle 1	Marsh Creation	214
USACE	Sabine Refuge Marsh Creation, Cycle 2	Marsh Creation	261
USACE	Sabine Refuge Marsh Creation, Cycle 3	Marsh Creation	187
USACE	Sabine Refuge Marsh Creation, Cycle 4	Marsh Creation	163
USACE	Sabine Refuge Marsh Creation, Cycle 5	Marsh Creation	168
NRCS	Sweet Lake/Willow Lake Hydrologic Restoration	Shoreline Protection	5,796
NRCS	West Hackberry Vegetative Planting Demonstration	Vegetative Planting Demo.	N/A

Source: USGS, 2007.

CIAP: An environmental assessment (EA) has recently been completed by the USACE for the Black Lake (Marcantel) property. The Port and state received Coastal Impact Assistance Program (CIAP) funds and the Minerals Management Service (now the Bureau of Ocean Energy Management) agreed that such funds could be used as gratuitous contribution for 100 percent incremental cost for the beneficial use of dredged material at Black Lake. The Finding of No Significant Impact was signed November 7, 2008. This disposal site would restore approximately 350 acres of eroded marsh approximately one mile south of the Gulf Intracoastal Waterway, along the former northern/northwestern rim of Black Lake. The general purpose of the project would be to create a diversity of habitat from beneficially used dredged material from maintenance of the Calcasieu Ship Channel.

4.15.8 Reasonably Foreseeable Future Actions

The USACE anticipates continuing maintenance dredging of the Calcasieu Ship Channel indefinitely. Other reasonably foreseeable future actions, which may contribute to cumulative impacts, include:

- CWPPRA. It is anticipated that additional CWPPRA projects would be implemented in the vicinity of Calcasieu Lake.

- CIAP. CIAP was originally authorized by Congress in 2001 in the Outer Continental Shelf (OCS) Lands Act, as amended (31 U.S.C. 6301-6305). Section 384 of the Energy Policy Act of 2005 (Public Law 109-58) authorized CIAP funds to be distributed to OCS oil and gas producing states to mitigate the impacts of OCS oil and gas activities for fiscal years 2007 through 2010. The state liaisons for this program are LDNR in Louisiana. The CIAP allocations have been used to fund various state and local coastal activities and projects including: monitoring, assessment, research, and planning; habitat, water quality, and wetland restoration; coastline erosion control; and control of invasive non-native plant and animal species.

- Construction of a general anchorage in the Calcasieu Ship Channel. Deep-draft vessel traffic on the Calcasieu Ship Channel suffers costly delays due to the width of the inland reach of the ship channel, which prohibits most deep-draft vessels from passing head-on in the channel. These delays are exacerbated by LNG vessel traffic, which cannot meet and pass in the ship channel, including the 32-mile long Gulf reach. The USACE is currently undertaking a feasibility study to construct anchorage areas along the channel where deep-draft vessels can layover closer to their destinations and to provide passing lanes where non-LNG vessels can meet and pass closer to their destinations.

- Construction of new LNG terminals. Onshore regasification facilities that use imported LNG have been in existence in the U.S. since 1969. However, only four were constructed, the largest of which is the Trunkline facility. Two new LNG facilities have been approved by FERC to be constructed in the project area: the Cameron LNG, owned by Sempra Energy, and the Creole Trail LNG, owned by Cheniere LNG. Future installation of LNG terminals should be evaluated for environmental impacts and required mitigation.

- The Trans-Texas Water Program. The 1968 Texas Water Plan was prepared by the Texas Water Development Board as a comprehensive 50-year plan for securing the future water supply needs of the State of Texas. Recommendations for the program include the transfer of surplus "state" waters from basins having surplus supplies to basins that experience water shortages. The Sabine River was identified as one source of freshwater for southeast Texas. Potential adverse effects of altering river inflows to the Sabine Basin should be mitigated or avoided.

- Rycade Canal Hydrologic Restoration Project. The Rycade Canal project (C/S-02) is a semi-impounded marsh management project located in Cameron Parish, Louisiana. The project area consists of approximately 6,575 acres of brackish marsh in and adjacent to the Sabine National Wildlife Refuge in Cameron Parish. Rycade Canal, built in the 1940's as an oil well location canal, is an avenue for salt water from the Gulf Intracoastal Waterway (GIWW) via Black Lake, and from the Calcasieu Ship Channel via Hog Island Gully. The project objectives are to protect low salinity marsh by reducing rapid water fluctuations and water circulation patterns that encourage salt water intrusion and tidal scouring, and reestablish historic hydrologic boundaries and flow patterns by structural repairs, levee repair/reconstruction, and embankment repair on the GIWW.

- Southwest Louisiana Coastal Feasibility Study. WRDA 2007 authorized funding for a number of coastal restoration and hurricane protection projects in the Louisiana Coastal Area. Section 7010 included the Southwest Coastal Louisiana Hurricane and Storm Damage Reduction Study. A reconnaissance study completed in 2007, which recommended levee alternatives, was broadened in focus by the state and the Corps to include both levee and restoration alternatives. The Corps and the state have agreed to cost-share a feasibility study that will include building levees and undertaking coastal restoration projects to protect populated areas in Vermilion, Calcasieu, and Cameron parishes while improving wildlife habitat. The study will include an environmental impact statement engineering appendix with baseline cost estimates, and other supporting appendices documenting the formulation of hurricane protection and coastal restoration alternatives. This represents the first time an integrated coastal protection and hurricane protection study has been undertaken for Southwest Louisiana.

- Section 204 Study, Calcasieu River and Pass Project. WRDA 2007 provided for the funding of a Continuing Authorities Program (CAP) study under Section 204 of WRDA 92 to use the material from maintenance dredging to restore estuarine habitat in the Sabine NWR. The CAP 204 program would be used to pay the incremental costs between the Federal standard and the beneficial use of the same material. Several potential sites have been identified for the receipt of material dredged between channel miles 5 and 14. Sites covered by this proposed DMMP would be eliminated from consideration for the 204 project, as those would become part of the definition of the Federal standard. A feasibility study has been initiated.

4.15.9 Incremental Effects of Proposed Project

Cumulative impacts associated with past actions have produced a natural environment that is markedly different from that of 140 years ago. However, the Calcasieu estuary is still a valuable ecosystem. The proposed project would not affect the overall dimensions of the Calcasieu Ship Channel, and therefore would not exacerbate existing salinity issues. The proposed project would result in thousands of acres of marsh creation through the placement of dredge material for beneficial use. Other sites for marsh creation/restoration may become available in the future. The environmental effects of the proposed project would not contribute adverse increments to the cumulative effects of past, present, and reasonably foreseeable actions.

4.16 MITIGATION

USACE 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 that were incorporated to avoid and minimize potential adverse environmental effects include the engineering and rehabilitation of existing deteriorated CDFs to provide for more efficient settling of solids prior to the discharge of decant water. Rehabilitation would avoid or minimize concentrations of suspended solids and turbidity in the vicinity of the discharge, thereby benefiting water quality and the aquatic ecosystem. The rehabilitation of CDFs would reduce erosion of the side slopes, providing benefits by minimizing environmental impacts associated with elevated levels of suspended solids and turbidity. In addition, rehabilitated CDFs would promote more efficient dewatering and consolidation of dredged material. This material would be made available to agencies, contractors, and industries as a resource for such purposes as environmental enhancement, industrial uses, or fill.

4.16.1 Protected Species

Dredging contracts issued by the USACE require contractors to comply with procedures to protect West Indian manatees. These contract specifications are appended to the Biological Assessment located in Appendix L, Endangered Species Coordination.

As discussed in Appendix M, Fish and Wildlife Coordination Act Report, a need exists for creating and restoring nesting habitat for the brown pelican. As part of the development of this DMMP, the USACE considered the use of dredged material for nesting habitat restoration at Rabbit Island and the augmentation of nesting habitat by creating islands in Calcasieu Lake. While neither of these options was included in the DMMP, the USACE would continue to coordinate with USFWS, NMFS, LDWF and LDNR during updates of the DMMP to assess the desirability and feasibility of providing additional nesting habitat.

4.16.2 Wetlands

In preliminary versions of the DMMP, the river reach included a potential for the horizontal expansions of CDFs 9, 10, 11, 13, 17, 19, and 22 into adjacent marsh and open water habitats if, in the future, it would be determined that additional dredged material disposal capacity were needed. This would have resulted in the loss of 1,056 acres of marsh and open-water habitats. Through discussions with USFWS and comments from LDWF and LDNR, it was decided by

CEMVN to remove these CDF expansions from the Recommended Plan and Alternative C to avoid possible impacts on wetlands.

For Alternative B, the loss of 124 acres of impounded brackish water and terrestrial habitat from the expansions of CDFs 17, 19 and 22 would be more than compensated by the potential restoration, creation, and nourishment of approximately 5,840 acres of coastal wetlands (Table 4-2). Alternative C would potentially create, and nourish approximately 10,030 acres of coastal wetlands (Table 4-3). It is concluded that the thousands of acres of wetlands restored by this project would more than compensate for the acres filled.

4.16.3 Water Quality

Construction companies contracted to rehabilitate CDFs 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.

4.17 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 plans would offer benefits to the socioeconomic and natural environments. The project would be beneficial to the regional and national economy by maintaining a navigable waterway to transport necessary goods (e.g., petroleum, natural gas, etc.) to the Port of Lake Charles. The use of dredged material to restore subsided marsh 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, restored marsh would offer an incremental benefit in minimizing hurricane damage.

4.18 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The No-Action Alternative would involve no irreversible or irretrievable commitments of resources. Action alternatives would require irreversible and irretrievable commitments. The expenditure of funding, energy, labor, and materials would be required for both action alternatives, including the Recommended Plan.

The proposed maintenance 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 proposed maintenance actions.

Project implementation would irreversibly and irretrievably commit some lands, including wetlands, to uplands, water control structures, and other features of confined disposal facilities.

4.19 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

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

Reduced dredging due to a lack of dredge material disposal options associated with the No-Action Alternative would result in smaller channel dimensions, effectively closing the ship channel to commercial navigation and displacing nearly 50 million tonnes of annual cargo. This displacement of cargo would significantly affect rail, truck, and barge traffic that normally transport cargo to and from the Port's facilities. Relocating refineries and other petrochemical industries from the Port of Lake Charles to other ports and/or constructing pipelines from offshore facilities or other ports to petrochemical industries in Lake Charles would necessitate large one-time capital expenditures in addition to increased operating costs. A complete cessation of dredging in reaches with high shoaling rates could restrict commercial navigation within only a few years.

The selection of the Recommended Plan was the culmination of a process to select an alternative plan that retains the congressionally authorized Calcasieu Ship Channel while minimizing adverse effects to the socioeconomic and natural environment. The project would provide environmental benefits through the use of dredged material to restore coastal wetlands.

4.20 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 DMMP would allow the continued use of the ship channel to one of the largest ports in the nation. The transport of oil and gas via the channel provides the raw material for the petrochemical industry, a major component of the economy of the region and the nation. The Port of Lake Charles is a major port of entry for the importation of petroleum products into the United States.

4.21 USACE ENVIRONMENTAL OPERATING PRINCIPLES

The study was conducted in accordance with U.S. Army Environmental Operating Principles and the Chief of Engineers' "Four Themes," derived from USACE actions for change to the corporate culture. The purpose of the Environmental Operating Principles and Actions for Change is to better serve the Nation's water resources infrastructure. USACE's Environmental Operating Principles are as follows:

- Strive to achieve Environmental Sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
- Recognize the interdependence of life and the physical environment, and consider environmental consequences of USACE programs and activities in all appropriate circumstances.
- Seek balance and synergy among human development activities and natural system by designing economic and environmental solutions that support and reinforce one another.

- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.
- Seek ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of the processes and work.
- Build and share an integrated scientific, economic and social knowledge base that supports a greater understanding of the environment and impacts of the work.
- Respect the views of individuals and groups interested in USACE activities; listen to them actively and learn from their perspective in the search to find win-win solutions to the Nation's problems that also protect and enhance the environment.

The Chief's Four Themes to be employed in all studies are:

1. Employ a comprehensive systems approach in all projects, including adaptive planning and engineering, with a focus on sustainability.
2. Practice risk-informed decision making. Employ risk-based concepts in planning, design, construction and major maintenance.
3. Communicate risk to the public effectively. Establish public involvement risk reduction strategies.
4. Incorporate professional and technical expertise in staff. Invest in research and development.

5.0 IMPLEMENTATION

5.1 INTRODUCTION

This section provides a 20-year schedule of activities and annual costs for executing the tentatively selected dredged material management plan for the Calcasieu River and Pass, Louisiana project. This section also discusses initial plans and recommendations for the engineering, design, construction, and management of dredged material placement sites. Descriptions of recommended dredged material placement areas include planning-level technical assumptions. Geotechnical considerations and engineering designs of specific sites, configurations, and parameters would be accomplished during follow-up studies.

5.1.1 Uncertainties

It must be emphasized that this DMMP is a planning-level document. While the CEMVN has every intention of implementing the DMMP in its entirety, the DMMP is subject to the uncertainties that are inherent in the planning process when unknown conditions must be considered. Potential items that could affect the implementation of the DMMP include physical conditions that were modeled or inferred based on currently existing information, but the exact nature of which must await detailed surveys and engineering. Examples of physical uncertainties include forecasted dredging quantities, erosion rates, hydrodynamics, and geotechnical characteristics. Sociopolitical uncertainties include such examples as availability of Congressional, state, or local funding and the possibility of legal actions taken by third parties. In addition, there are catastrophic uncertainties that could affect the DMMP; these include hurricanes, chemical contamination from spills, and vessel accidents.

Such unforeseen events or conditions may result in the shifting of priorities for the placement of dredged material for beneficial use or the rehabilitation of CDFs, but it is not expected that these actions would affect the overall DMMP. In the event that it becomes necessary for the CEMVN to alter the Recommended Plan, the DMMP would be updated and the alterations would be fully coordinated with state and Federal agencies, and the public would be advised of the changes.

5.2 RECOMMENDED PLAN

As described in Section 2.0, the Recommended Plan is Alternative B. The Calcasieu Ship Channel has a 20-year dredging disposal need of approximately 97 million cubic yards and has an estimated remaining CDF capacity of about five million cubic yards. To reconcile this variance, the Recommended Plan would utilize a combination of disposal methods consisting of CDF rehabilitation and management and beneficial use placement. The beneficial use components of this plan are considered general navigation features because the beneficial use sites are part of the Federal Standard/Base Plan.

In developing a schedule for implementation of the DMMP, the following factors were considered;

- Lands, Easements, and Rights-of-Ways (LERs).
- Engineering and design
- Rehabilitation and expansion of the CDFs
- Disposal area management
- Construction of new placement areas for both upland and beneficial use

The design and construction of the expansion of existing CDFs or creation of new BUs will be cost-shared as GNF between the Corps and the Lake Charles Harbor and Terminal District (LCHTD) under the authority of Section 101 of WRDA 1986, as amended by Section 201 of WRDA 1996, and in accordance with Policy Guidance Letter Number 47. Prior to the start of design and/or construction, the Corps and LCHTD must execute a Design and/or Project Partnership Agreement for the applicable plan components. More than one PPA may be executed if it is desirable to group sites in separate PPAs.

Table 5-1 is a projected schedule for the implementation of the Recommended Plan. Table 2-5 in Section 2.0 shows the amount of dredged material capacity per site over the 20-year life of the DMMP. The costs to implement the plan are provided in Table 5-2; a more detailed representation of the costs is provided in Appendix D, Cost Estimates. Planning-level assumptions of how the Recommended Plan would be implemented are provided in the following subsections.

5.3 COST

Costs of the Recommended Plan shown in Table 5-2 are based upon:

- 2008 Dollars
- Dredging costs;
- CDF construction costs;
- Disposal area management costs;
- Beneficial use costs;
- Engineering, design, supervision, and administration costs;
- LERs;
- Contingency costs; and
- Escalation.

The estimate provides for the required direct cost expenditures by year and does not include any additional costs required by the sponsor, such as the additional 10 percent cost outlays for general navigation features, or possible creditable expenditures by the local sponsor, which will require prior HQ/ASA approval before such credit is addressed in the Project Participation Agreement (PPA) or an amendment to the PPA. Additional information regarding cost assumptions is provided in Appendix D.

The following items of local cooperation will be incorporated into the PPA:

a. Provide 10 percent of the total cost of construction of the general navigation features attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the general navigation features attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet; plus 50 percent of the total cost of construction of the general navigation features attributable to dredging to a depth in excess of 45 feet as further specified below:

1. Provide 25 percent of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

Table 5-1. Implementation Schedule

Reach	Section	(Yrs)	Qty (CY)	Sites	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
River	Port	5	88,000	1	R/LIFT	PUMP	DAMP	DAMP		PUMP	DAMP			LIFT	PUMP	DAMP								
	Coon Isl, 34 to 36	10	622,000	2	R/LIFT	PUMP	DAMP	DAMP						LIFT	PUMP	DAMP				PUMP	DAMP			
	Clooney Isl	5	278,000	3	R/LIFT	PUMP	DAMP	DAMP		LIFT	PUMP	DAMP				PUMP	DAMP							
	30 to 34, T.B.	10	740,000	7	DAMP	DAMP		R/LIFT								PUMP	DAMP		LIFT		PUMP	DAMP		
	26 to 30	6	1,763,400	7				R/LIFT	PUMP	DAMP	DAMP								LIFT	PUMP	DAMP			
				8				R/LIFT	PUMP	DAMP	DAMP		LIFT	PUMP	DAMP									
				9									R/LIFT	PUMP	DAMP	DAMP			LIFT	PUMP	DAMP			
	22 to 26	2	1,270,600	10			R/LIFT	PUMP	DAMP	DAMP					LIFT	PUMP	DAMP			PUMP	DAMP			
				11	R/LIFT	PUMP	DAMP	DAMP				PUMP	DAMP		LIFT	PUMP	DAMP			PUMP	DAMP			
				12A			R/LIFT	PUMP	DAMP	DAMP		PUMP	DAMP		LIFT	PUMP	DAMP			PUMP	DAMP			
				12B		PUMP	DAMP	DAMP		PUMP	DAMP		R/LIFT	PUMP	DAMP			PUMP	DAMP		LIFT	PUMP	DAMP	PUMP
Upper Lake	21 to 22	2	1,270,600	15	PUMP	DAMP	DAMP	R/SP/LIFT	PUMP	DAMP			PUMP	DAMP			PUMP	DAMP		LIFT	PUMP	DAMP		
				16N		R/SP/LIFT	PUMP	DAMP	DAMP		PUMP	DAMP		LIFT	PUMP	DAMP			PUMP	DAMP			PUMP	DAMP
	Devils Elbow	2	1,031,000	13 A	R/LIFT/PUMP		DAMP	DAMP	PUMP	DAMP		LIFT	PUMP	DAMP			PUMP	DAMP			PUMP	DAMP		
				13 B	R/LIFT		PUMP	DAMP	DAMP		PUMP	DAMP		LIFT	PUMP	DAMP			PUMP	DAMP			PUMP	DAMP
	16 to 21	2.5	2,485,800	BU 50	C/PUMP		C/PUMP					C/PUMP								C/PUMP		C/PUMP		
				FSD	C/PUMP	DAMP	PUMP	DAMP				PUMP	DAMP	CONST	PUMP	DAMP								
				17 W/NEW FSD												D/CONST	PUMP	DAMP			CONST	PUMP	DAMP	
				19 W/NEW FSD				D/CONST		PUMP	DAMP		CONST		PUMP	D/CONST	PUMP	DAMP						
				22 W/NEW FSD				D/CONST		PUMP	DAMP		CONST		PUMP	D/CONST	PUMP	DAMP		PUMP	DAMP			
	12 to 16	2.5	2,434,500	BU 5	C/PUMP		C/PUMP										C/PUMP			C/PUMP		C/PUMP		
				FSD						PUMP	DAMP						PUMP	DAMP		PUMP	DAMP	PUMP	DAMP	
				D/E				CONST		PUMP	DAMP	PUMP	DAMP	CONST	PUMP	DAMP	PUMP	DAMP						
Lower Lake	9.5 to 12	3	1,389,300	Cameron SB (BU49)				CONST	PUMP		CONST	PUMP		CONST	PUMP									
				Sabine (BU18)	CONST	PUMP					CONST	PUMP		CONST	PUMP		CONST	PUMP		CONST	PUMP		CONST	PUMP
	5 to 9.5	3	1,628,100	H	R/LIFT	PUMP	DAMP	DAMP										PUMP	DAMP					
				M				R/LIFT	PUMP	DAMP	DAMP				PUMP	DAMP		PUMP	DAMP	LIFT	PUMP	DAMP		PUMP
				N	R/LIFT	PUMP	DAMP	DAMP							PUMP	DAMP							LIFT	PUMP
				Cameron WR (BU19)							CONST	PUMP												
				Cameron WR (BU20)			CONST	PUMP																

Note: PUMP = ACTIVE DREDGING & PLACEMENT, DAMP = DISPOSAL AREA MANAGEMENT, LIFT = DIKE RAISE, C & CONST = CONSTRUCTION, RLIFT = SITE REHABILITATION AND DIKE RAISE, SP = SHORE PROTECTION/ROCK DIKE, M = MITIGATION.

***Dredging for the Bar Channel is annual to semi-annual on an as needed basis. No disposal area maintenance is necessary.

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Table 5-2. Cost Estimate for the Recommended Plan ($1,000)

Section	Placement Sites	Type	Cost Share	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
34 to 36	1	Local	25%	181									54											
		Federal	75%	543									163											
		O&M			1,416	31	32		471	35				1,731	38									
		Total		724	1,416	31	32	0	471	35	0	0	217	1,731	38	0	0	0	0	0	0	0	0	4,695
	2	Local	25%	131									47											
		Federal	75%	392									140											
		O&M			1,416	27	28							1,731	34				562	37				
		Total		523	1,416	27	28	0	0	0	0	0	187	1,731	34	0	0	0	562	37	0	0	0	4,545
30 to 34	3	Local	25%	233					115															
		Federal	75%	698					345															
		O&M			5,112	70	71			1,515	80				3,180	87								
		Total		931	5,112	70	71	0	461	1,515	80	0	0	0	3,180	87	0	0	0	0	0	0	0	11,506
	7	Local	25%				192											48						
		Federal	75%				575											144						
		O&M		77	78										3,180	98				1,917	108			
		Total		77	78	0	767	0	0	0	0	0	0	0	3,180	98	0	192	0	1,917	108	0	0	6,417
26 to 30	7	Local	25%				192											48						
		Federal	75%				575											144						
		O&M		77	78			3,659	87	88						98			4,645	106				
		Total		77	78	0	767	3,659	87	88	0	0	0	0	0	98	0	192	4,645	106	0	0	0	9,798
	8	Local	25%				396					99												
		Federal	75%				1,187					297												
		O&M						3,659	131	133			4,174	143										
		Total		0	0	0	1,583	3,659	131	133	0	397	4,174	143	0	0	0	0	0	0	0	0	0	10,219
	9	Local	25%									398						96						
		Federal	75%									1,194						288						
		O&M											4,174	125	127				4,645	139				
		Total		0	0	0	0	0	0	0	0	1,592	4,174	125	127	0	0	385	4,645	139	0	0	0	11,187
22 to 26	10	Local	25%			342								51										
		Federal	75%			1,026								152										
		O&M					2,332	87	92						1,870	105			2,008	112				
		Total		0	0	1,368	2,332	87	92	0	0	0	0	203	1,870	105	0	0	2,008	112	0	0	0	8,176
	11	Local	25%	320										50										
		Federal	75%	960										151										
		O&M			1,502	84	86				2,612	97			1,870	105			2,008	112				
		Total		1,280	1,502	84	86	0	0	0	2,612	97	0	201	1,870	105	0	0	2,008	112	0	0	0	9,958
	12A	Local	25%			407								60										
		Federal	75%			1,220								180										
		O&M					2,332	103	110		2,612	116			1,870	125			2,008	134				
		Total		0	0	1,627	2,332	103	110	0	2,612	116	0	240	1,870	125	0	0	2,008	134	0	0	0	11,276
	12B	Local	25%									951								132				
		Federal	75%									2,853								396				
		O&M			3,006	267	272		5,040	300			5,414	322			5,814	346			6,242	371	6,458	
		Total		0	3,006	267	272	0	5,040	300	0	3,804	5,414	322	0	0	5,814	346	0	528	6,242	371	6,458	38,183

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Table 5-2 (cont'd). Cost Estimate for Recommended Plan ($1,000)

21 to 22	15	Local	25%				1,783												140					
		Federal	75%				5,350												421					
		O&M		1,571	110	112		1,665	123			1,866	132			2,004	142			2,152	152			
		Total		1,571	110	112	7,134	1,665	123	0	0	1,866	132	0	0	2,004	142	0	561	2,152	152	0	0	17,725
	16N	Local	25%		1,329								110											
		Federal	75%		3,988								329											
		O&M				1,607	105	107		1,801	117			1,934	126			2,077	135			2,228	145	
		Total		0	5,317	1,607	105	107	0	1,801	117	0	438	1,934	126	0	0	2,077	135	0	0	2,228	145	16,138
Devil's Elbow	13A	Local	25%	492							120													
		Federal	75%	1,477							360													
		O&M		3,631		219	223	3,850	242			4,314	260			4,634	279			4,976	299			
		Total		5,601	0	219	223	3,850	242	0	480	4,314	260	0	0	4,634	279	0	0	4,976	299	0	0	25,377
	13B	Local	25%	492									124											
		Federal	75%	1,477									373											
		O&M				3,716	223	227		4,163	251			4,471	269			4,802	289			5,152	310	
		Total		1,970	0	3,716	223	227	0	4,163	251	0	497	4,471	269	0	0	4,802	289	0	0	5,152	310	26,339
16 to 21	17	Local	25%												1,101					248				
		Federal	75%												3,304					744				
		O&M													1,830	3,592	261				4,215	285		
		Total		0	0	0	0	0	0	0	0	0	0	0	6,236	3,592	261	0	0	993	4,215	285	0	15,582
	19	Local	25%				1,567					312			218									
		Federal	75%				4,700					935			653									
		O&M					2,208		4,929	184				3,556	201	1,994	208							
		Total		0	0	0	8,475	0	4,929	184	0	1,247	0	3,556	1,072	1,994	208	0	0	0	0	0	0	21,665
	22	Local	25%				1,778					579			278									
		Federal	75%				5,334					1,738			833									
		O&M					217		4,929	239				3,665	262	5,585	271		5,899	286				
		Total		0	0	0	7,330	0	4,929	239		2,317	0	3,665	1,373	5,585	271	0	5,899	286	0	0	0	31,895
	Meracantel (BU50)	Local	25%	114		116					133								153		159			
		Federal	75%	341		349					399								460		477			
		O&M		7,553		7,729					8,816								10,160		13,452			
		Total		8,008	0	8,195	0	0	0	0	9,348	0	0	0	0	0	0	0	10,773	0	14,088	0	0	50,413
	Foreshore Dike (FSD)	Local	25%	1,819																				
		Federal	75%	5,457																				
		O&M		4,378	181	4,480	187				5,109	213		3,556	225									
		Total		11,654	181	4,480	187	0	0	0	5,109	213	0	3,556	225	0	0	0	0	0	0	0	0	25,605

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Table 5-2 (cont'd). Cost Estimate for Recommended Plan ($1,000)

12 to 16	D,E Expanded (DEX)	Local	25%				2,887						1,027											
		Federal	75%				8,662						3,081											
		O&M					377		4,828	415	10,006	430		10,556	454	3,587	470							
		Total		0	0	0	11,927	0	4,828	415	10,006	430	4,108	10,556	454	3,587	470	0	0	0	0	0	0	46,782
	Foreshore Dike (FSD)	Local	25%										1,151											
		Federal	75%										3,452											
		O&M							4,828	206						1,883	233		5,771	246	4,247	255		
		Total		0	0	0	0	0	4,828	206	0	0	4,602	0	0	1,883	233	0	5,771	246	4,247	255	0	22,272
	Sabine (BU5)	Local	25%	73		73										93			98		101			
		Federal	75%	218		218										278			294		304			
		O&M		13,411		13,724										8,671			9,147		12,156			
		Total		13,701	0	14,015	0	0	0	0	0	0	0	0	0	9,042	0	0	9,538	0	12,562	0	0	58,858
9.5 to 12	Cameron SB (BU49)	Local	25%				119			131			138											
		Federal	75%				356			392			414											
		O&M						8,260			2,796			5,163										
		Total		0	0	0	474	8,260	0	523	2,796	0	551	5,163	0	0	0	0	0	0	0	0	0	17,768
	Sabine (BU18)	Local	25%	114						131			138			145			153			162		
		Federal	75%	341						392			414			436			460			485		
		O&M			7,695						6,816			4,976			9,922			10,468			11,022	
		Total		455	7,695	0	0	0	0	523	6,816	0	551	4,976	0	582	9,922	0	614	10,468	0	647	11,022	54,271
5 to 9.5	H	Local	25%	249																				
		Federal	75%	746																				
		O&M			2,751	88	89										2,129	114						
		Total		994	2,751	88	89	0	0	0	0	0	0	0	0	0	2,129	114	0	0	0	0	0	6,165
	M	Local	25%				710												163					
		Federal	75%				2,129												490					
		O&M						2,895	266	271				3,362	296		4,965	312		7,483	329		3,940	
		Total		0	0	0	2,839	2,895	266	271	0	0	0	3,362	296	0	4,965	312	653	7,483	329	0	3,940	27,612
	N	Local	25%	500																		152		
		Federal	75%	1,500																		456		
		O&M			2,751	137	139							3,362	168								3,940	
		Total		2,000	2,751	137	139	0	0	0	0	0	0	3,362	168	0	0	0	0	0	0	608	3,940	13,103
	Cameron WR (BU19)	Local	25%							91														
		Federal	75%							273														
		O&M									6,780													
		Total		0	0	0	0	0	0	364	6,780	0	0	0	0	0	0	0	0	0	0	0	0	7,144
	Cameron WR (BU20)	Local	25%				83																	
		Federal	75%				248																	
		O&M						5,134																
		Total		0	0	0	331	5,134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,465
	Total Project Mile 5-36 Option B	Local	25%	4,717	1,329	938	9,706	0	115	352	253	2,339	2,788	161	1,597	238	0	192	708	380	260	314	0	26,389
		Federal	75%	14,151	3,988	2,813	29,118	0	345	1,057	759	7,018	8,364	483	4,791	715	0	577	2,125	1,141	781	941	0	79,166
		O&M		30,699	26,096	32,291	8,918	29,645	26,076	9,350	45,996	7,038	14,153	48,653	15,998	32,569	24,696	7,651	47,276	28,169	41,201	8,291	25,815	510,583
		LER's		4,726	3,630	1,859	1,203	0	0	151	25	293	0	2	360	0	0	0	0	0	0	0	0	12,249
		Total		54,293	35,043	37,901	48,945	29,645	26,537	10,910	47,033	16,688	25,305	49,300	22,746	33,522	24,696	8,420	50,109	29,690	42,243	9,546	25,815	628,387

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Table 5-2 (cont'd). Cost Estimate for Recommended Plan

($1,000)

Section	Placement Sites	Type	Cost Share	Year 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Total
Bar Channel	ODMDS/ Agitation	Local	25%																					
		Federal	75%																					
		O&M		6,373	6,500	6,631	6,763	7,199	7,343	7,490	7,640	7,793	7,948	8,107	8,270	8,435	8,604	8,776	8,951	9,130	9,312	9,499	9,689	160,453
		LER's																						
		Total		6,373	6,500	6,631	6,763	7,199	7,343	7,490	7,640	7,793	7,948	8,107	8,270	8,435	8,604	8,776	8,951	9,130	9,312	9,499	9,689	160,453
	Total Project Mile 5-36 and Bar Channel Option B	Local	25%	4,717	1,329	938	9,706	0	115	352	253	2,339	2,788	161	1,597	238	0	192	708	380	260	314	0	26,389
		Federal	75%	14,151	3,988	2,813	29,118	0	345	1,057	759	7,018	8,364	483	4,791	715	0	577	2,125	1,141	781	941	0	79,166
		O&M		37,072	32,596	38,922	15,681	36,844	33,419	16,840	53,636	14,831	22,101	56,760	24,268	41,004	33,300	16,427	56,227	37,299	50,513	17,790	35,504	671,036
		LER's		4,726	3,630	1,859	1,203	0	0	151	25	293	0	2	360	0	0	0	0	0	0	0	0	12,249
		Total		**60,666**	**41,543**	**44,532**	**55,708**	**36,844**	**33,880**	**18,400**	**54,673**	**24,481**	**33,253**	**57,407**	**31,016**	**41,957**	**33,300**	**17,196**	**59,060**	**38,820**	**51,555**	**19,045**	**35,504**	**788,840**

Note: All costs are in thousands.

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

3. Provide, during construction, any additional funds necessary to make its total contribution for commercial navigation equal to 10 percent of the total cost of construction of the general navigation features attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the general navigation features attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet; plus 50 percent of the total cost of construction of the general navigation features attributable to dredging to a depth in excess of 45 feet;

b. Provide all lands, easements, and rights-of-way, including those necessary for the borrowing of material and the disposal of dredged or excavated material and perform or ensure the performance of all relocations all as determined by the Government to be necessary for the construction or operation and maintenance of the general navigation features;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the general navigation features, an additional amount equal to 10 percent of the total cost of construction of general navigation features less the amount of credit afforded by the Government for the value of the lands, easements, rights-of-way, and relocations provided by the sponsor for the general navigation features. If the amount of credit afforded by the Government for the value of the lands, easements, rights-of-way, and relocations provided by the sponsor for the general navigation features exceeds 10 percent of the total cost of construction of the general navigation features, the sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, rights-of-way, and relocations in excess of 10 percent of the total cost of construction of the general navigation features;

d. Accomplish all removals determined necessary by the Government other than those removals specifically assigned to the Government;

e. Provide, operate, maintain, repair, replace, and rehabilitate, at its own expense, the local service facilities (berthing areas, etc.); in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Government;

f. Do not use funds from other Federal programs, including any non-Federal contribution required as a matching share, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

g. Shall be responsible for 25 percent of the costs of constructing erosion and shoaling control features for the prevention or mitigation of erosion of shoaling damage attributable to the federal navigation works of the project, and shall be responsible for 100 percent of the operation and maintenance costs for any such features;

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

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

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

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

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

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

n. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the

Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element; and

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

5.4 COST SHARING

As shown in the tables above, the total cost of the Recommended Plan, in 2008 dollars, is $788,840,000. The cost of the Recommended Plan was recently updated by MVN to 2010 dollars. The 2010 updated cost is $799,327,000. Details of both the 2008 and 2010 cost estimates are provided in Appendix D.

Based on the updated 2010 costs, the cost-sharing provisions of the Recommended Plan for the 20-year term of the DMMP is shown in Table 5-3.

Table 5-3. Cost Sharing Provisions of the Recommended Plan ($1,000)

Purpose	Non Federal Share (%)	Federal Share (%)	Non Federal Cost	Federal Cost	Total Project Cost
Operation and Maintenance	0	100	0	654,798	654,798
General Navigation	25	75	32,485	97,454	129,940
10% Project Cost for GNF	10	0	12,994	(12,994)	0
LERRs	100	0	14,592	0	14,592
Subtotal			**60,071**	**739,258**	**799,329**
Potential Non-Federal Placement*			1,465	(1,465)	0
Creditable LERRs (Limited 10% GNF)**			(12,994)	12,994	0
Total Project Cost			**48,542**	**750,787**	**799,329**
*Costs of disposal capacity used by the Port of Lake Charles and other private entities (estimated 1.5 MCY) will be paid 100% by the users in accordance with PGL 47.					
**Since LERRs costs ($14,592) exceed 10% of GNF ($12,994), the credit for LERR is limited to 10% GNF ($12,994)					

*Costs are rounded to the nearest thousand.

The cost summary was developed using the cost-sharing provisions of WRDA 86, as amended by subsequent WRDAs. The estimated cost apportionment is $750,787,000 to the Federal Government and $48,543,000 to the non-Federal Sponsor, the Port of Lake Charles.

The non-Federal share of costs is applied as follows:

- Costs for operation and maintenance of the channel and general navigation features are 100 percent Federal responsibility.
- The Federal Government will pay 75 percent of the costs for design and construction during each period of construction for general navigation features of the project, consisting primarily of major non-routine dike construction and/or raising, new facility construction, facility expansion and associated shore protection, and mitigation costs.
- The non-Federal Sponsor will pay 25 percent of the costs for design and construction of general navigation features of the project, which would consist primarily of major non-routine dike construction and/or raising, new facility construction, facility expansion and associated shore protection and mitigation costs. This cost-share is to be paid concurrent with Federal expenditures during each period of construction throughout the term of the DMMP as prescribed by the terms of the PPA (for which this DMMP serves as the decision document).
- The non-Federal Sponsor will repay with interest, beginning with a period not to exceed 30 years following completion of each period of construction of the project, an additional 0 to 10 percent of the total cost of construction of general navigation features depending upon the amount of credit given for the value of lands, easements, rights-of-way and relocations provided by the non-Federal sponsor for the general navigation features. The sponsor will be required to provide all LERRs, irrespective of the cost. The sponsor will receive credit only for the additional 10 percent of GNF construction, but even if the LERRs and associated costs exceed that amount, the sponsor is still required to contribute all LERRs, even if no cash contribution is required for that 10 percent.

The current estimate for LERRs costs of the DMMP during the 20-year plan is $14,592,000. The 10 percent amount of the general navigation features is $12,994,000.

5.4.1 Private Dredging Needs and Costs

ER 1105-2-100, Appendix E-15, Dredged Material Management Plans, and EP 1165-2-1, Chapter 11, state:

> *Non-Federal, permitted dredging within the related geographic area shall be considered in formulating Management Plans to the extent that disposal of material from these sources affects the size and capacity of disposal areas required for the Federal project(s).*

The Port of Lake Charles, Trunkline LNG, Sempra LNG, Cheniere LNG, CITGO, and Conoco are the only non-Federal entities identified during this study through the Lake Charles Harbor Safety Committee. CITGO, Conoco, and Trunkline LNG were contacted numerous times during this study to determine their dredged material placement needs. Only the Port of Lake Charles and CITGO responded to the requests. Sempra and Cheniere LNG have established their own dredging disposal areas. Therefore, the non-Federal dredging considered in this plan for disposal capacity include CITGO and the Port of Lake Charles, with a total non-Federal dredging quantity of approximately 1.5 million cubic yards. Non-Federal dredging capacity needs were considered for CDF placement within the River Reach of the project. Details can be found in Appendix A, Shoaling.

While the non-Federal capacity need was identified and considered in this DMMP, the actual timeframes and dredging needs for permitted non-Federal dredging may not be consistent with the Federal interests at the time the non-Federal dredging placement is requested because they may occur during an active Federal dredging cycle or during construction activities and operation and maintenance of a CDF(s). The placement of permitted non-Federal dredging will require the approval of and direct coordination with CEMVN and the Port of Lake Charles and shall be consistent with all Federal and state laws and regulations. The costs for the placement of permitted non-Federal dredging shall be consistent with the provisions of WRDA 1996, PGL 47, the Project PPA and subsequent Laws, Regulations, and Policy at the time requested.

5.5 LERS

The USACE has requested the acquisition of real estate interests in the form of perpetual or long-term easement/servitudes for the various project activities, including placement of material, construction of containment dikes, or installation of permanent or long-term pipelines for the transmission of dredged material. Temporary rights for access and staging areas may also be acquired. Long-term easements/servitudes for CDFs 12A, 12B, 13, 15, 16, and the Black Lake beneficial use site (BU site 50) are required for maintaining the channel at its authorized dimensions. The remaining sites would then follow in order of importance as determined by shoaling and capacity need. The non-Federal sponsor would perfect easements as needed and requested by the Federal Government as Federal funds for the project become available or appropriated. As determined through the terms of the PPA, a Project Coordination Team (PCT) would be established with members from both CEMVN and the Port to plan and discuss the project and to provide the mechanism for both the Federal Government and non-Federal sponsor to monitor real estate actions and all other aspects of the DMMP.

The cost for the acquisition of LERs would depend upon:

- Whether the land is purchased or easements are used,
- The market value at the time of acquisition. In critical areas, expropriation or condemnation may be necessary.

A copy of the Real Estate Plan can be found in Appendix T.

5.6 ENGINEERING DESIGN

Tables 2-5 and 5-1 were prepared using 20-year gross dredging quantities and do not take into account CDF capacity gains from active site management and fill consolidation. The actual CDF capacities would increase by implementing site management. Additional CDF capacity is necessary to provide needed freeboard and to allow ponding during the dredging process. As described in the following subsections, a thorough topographic and/or hydrographic survey, subsurface geotechnical investigations, and site-specific engineering would be part of the implementation process. Geotechnical surveys, including soil borings, would provide an accurate characterization of the foundation materials. Incorporation of that information into final designs would enable adjustments to be made in the estimated site capacities.

For the preparation of the DMMP, historical geotechnical data were evaluated and used to determine the consolidation factors of the dredged material in both upland and open water settings. The estimated cut-to-fill ratio of managed materials within a CDF is 0.70. The estimated cut-to-fill ratio of managed materials placed at beneficial use sites is 0.80. The cut-to-fill ratio would be used as a tool along with site-specific foundation consolidation factors during preparation of final designs of the placement areas.

Slope stability calculations for dike construction and rehabilitation were based on data gathered at CDFs 11, 13, and 17. Both the Method of Planes, prescribed by CEMVN, and the UTEXAS 4 modeling program were used. These three sites were selected to represent the best and worst-case scenarios for slope stability by CEMVN based on their experience with CDFs in the project area. The initial analysis indicated that the configurations proposed for construction and raising of dikes is feasible from a geotechnical perspective. Additionally, slope stability analyses were conducted for existing beneficial use sites in the project area. The conceptual dike designs for the proposed beneficial use sites are based on the designs of beneficial use dikes previously constructed in the Sabine NWR through the CWPPRA program and for the Black Lake site under the CIAP program. Representative cross-sections of CDF and beneficial use dikes are shown in figures 5-1 and 5-2.

The height, width, and slopes of the dikes at each of the placement areas would be decided on a site-by-site basis with updated geotechnical data collected during implementation of this plan.

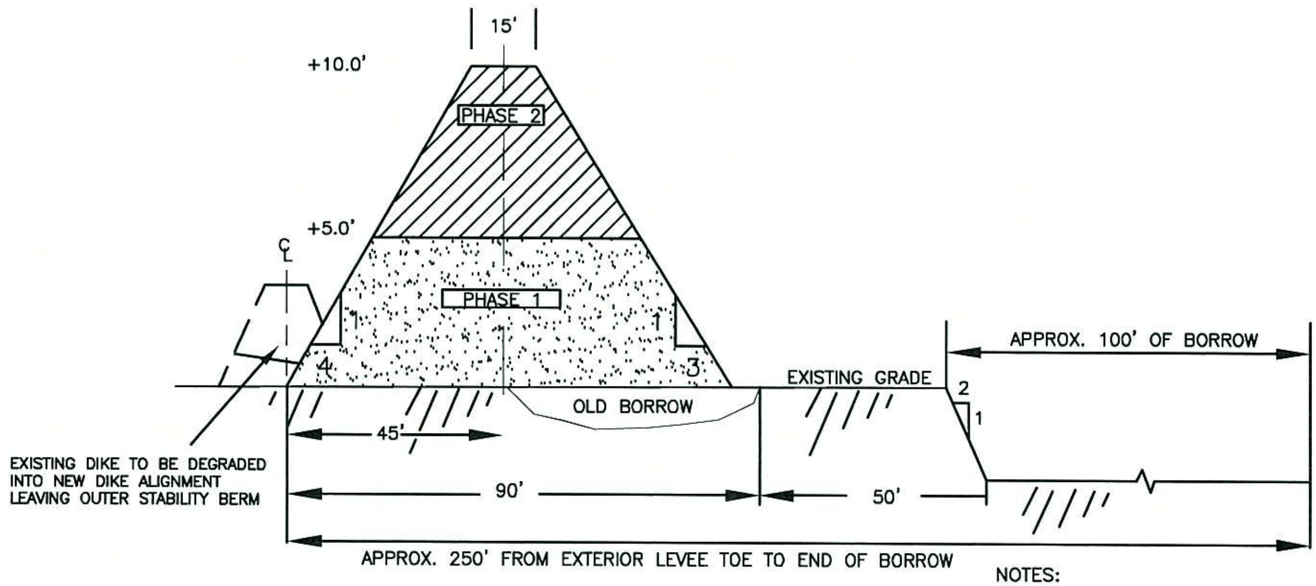
A discussion of the findings and analysis of existing geotechnical data can be found in Appendix B, Geotechnical Report.

5.7 CDF REHABILITATION

Existing CDFs would require significant rehabilitation to replace the existing weirs or spillboxes, add additional drainage structures, drain the sites, and strengthen and raise the existing dikes in multiple lifts. Site investigations of all the Calcasieu Ship Channel CDFs during July 2006 indicated that the dikes typically have higher elevations along the edge adjacent to the ship channel and lower, less substantial dikes along the opposite sides. Some CDFs were found to have little or no drainage. Many of the weirs and spillboxes are in disrepair.

Most CDFs have side cast borrow ditches that were excavated with draglines or marsh excavators. Unconsolidated dredged material was used to construct the existing dikes. These activities typically have been accomplished immediately before the dredging event and as part of the dredging contract. Little or no maintenance of the CDFs has been performed between dredging events to promote drying and consolidation of the dredged material or to stockpile materials against the interior slope of the dike for future dike construction. This has allowed weak, unconsolidated material to erode, which has resulting in dike decay between dredging events. Once dredging contracts were complete, contractors were not responsible for maintaining disposal areas. This has resulted in sites that have deteriorated to conditions that require extensive rehabilitation.

For the purposes of this DMMP, it was assumed that each CDF would have new spillboxes and dewatering structures, an initial ditching and draining, and a first dike raise of five feet during the initial stages of this plan. A later, second dike raise would range from an additional three to five feet in height.



NOTES:

1.) BORROW MATERIAL FOR DIKE CONSTRUCTION CAN BE OBTAINED FROM ADJACENT BORROW AREAS WHERE AVAILABLE.

2.) AREAS WHERE NO ADJACENT BORROW IS UNAVAILABLE, DIKE CONSTRUCTION MATERIAL WILL HAVE TO BE HAULED FROM THE NEAREST AVAILABLE SITE AND SUPPLEMENTED BY HYDRAULIC FILL.

3.) PHASE 2 MAY REQUIRE A 10' OFFSET AT ELEVATION 6', DEPENDING ON LONGTERM CONSOLIDATION OF THE LEVEE FOUNDATION.

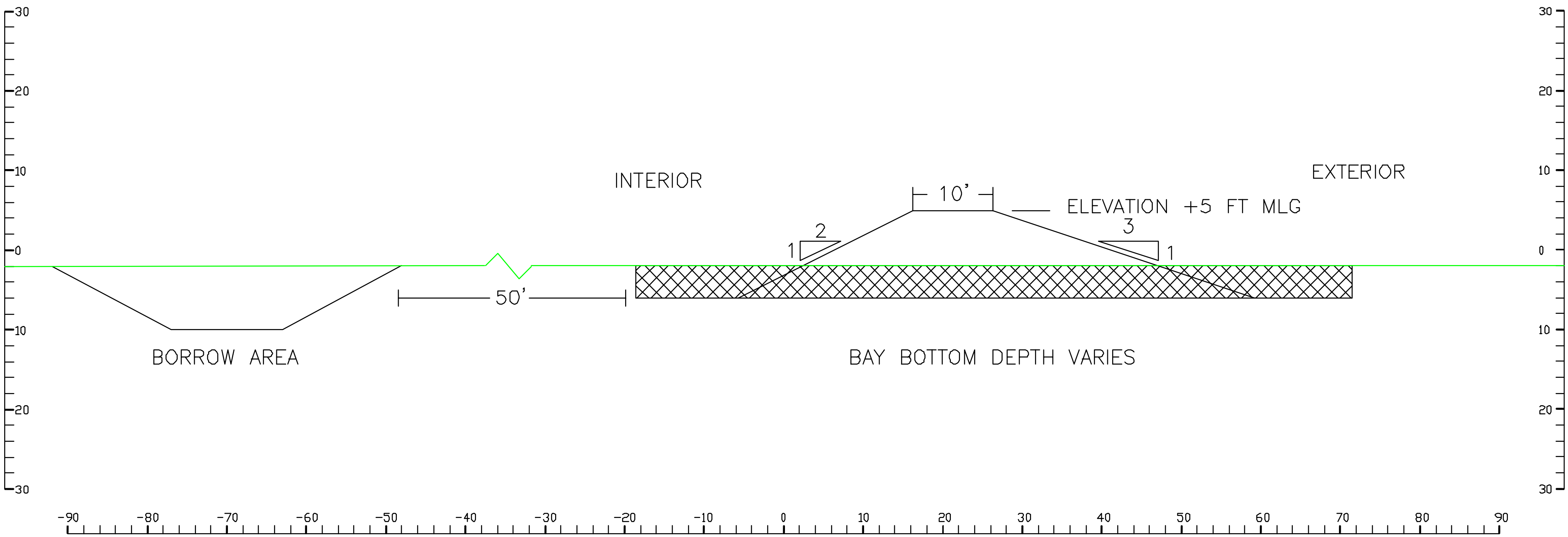
4.) DOES NOT ACCOUNT FOR SHRINKAGE DUE TO DITCHING AND ADDED DRAINAGE

5.) ANALYSIS ASSUMES SITE MANAGEMENT IS ONGOING TO PROVIDE POSITIVE DRAINAGE

FIGURE 5 – 1

CALCASIEU RIVER
AND PASS CONFINED PLACEMENT AREAS
TYPICAL DIKE REHAB CROSS SECTION

Lake Charles, LA



NOTES:

1.) BORROW MATERIAL FOR DIKE CONSTRUCTION CAN BE OBTAINED FROM ADJACENT BORROW AREAS WHERE AVAILABLE.

2.) ASSUMES THAT THE DIKE ELEVATION WILL BE CONSTRUCTED TO +5.

3.) WATER DEPTH VARIES BY SITE

FIGURE 5 – 2

CALCASIEU RIVER
AND PASS BENEFICIAL USE
TYPICAL DIKE CROSS SECTION

Lake Charles, LA

5.8 CDF MANAGEMENT

The principle features of this program are:

- Directing the quantity and location of placement for each site;
- Maximizing the drainage of each site;
- Installing and maintaining spillboxes, weirs, and dewatering structures;
- Crust management;
- Managing non-pay excess dredging quantities.

5.8.1 Directing the Placement of Material

As stated, most CDFs have dikes that are higher on the ship channel side of the CDF and less substantial and weaker on the opposite side. This condition has resulted from continued dredged material discharge in the same location. Heavier clays and sands deposit at or near the discharge location, while the finer silts, clays, and muds deposit farther away from the discharge location at the rear of the site.

Proper CDF management would involve dredge pipe discharge locations that vary for each dredging event in an effort to prevent stacking on one side of the CDF (short-circuiting) and to fill low areas of ponds to promote proper drainage. Depending on the volume and characteristics of the material to be placed, the discharge pipe should be relocated one or more times during the dredging event. Because relocating the discharge pipe can increase costs, careful consideration and economic evaluation would be given to relocations. Flexibility should be considered in dredging and water quality permits to allow for discharges from more than one weir location.

5.8.2 Maximizing Drainage of Each Site

The level of boards in the spillway determines the water level in the disposal area after dredging is complete. During and immediately after the dredging cycle, the boards would be kept at the lowest possible level that meets water quality requirements. After decanting, the boards would be removed to the lowest level that would prevent sediment from flowing through the spillway. This would facilitate drainage of the site and reduce ponding due to precipitation. The boards would be monitored at regular intervals to ensure that they are lowered to account for the settlement and consolidation of dredged material.

5.8.3 Crust Management

Crust management is a method for increasing available site capacity by improving surface drainage and thereby maximizing the desiccation, shrinkage, and consolidation of dredged material within the site. This is accomplished by constructing an extensive network of shallow ditches that lowers the water table within the CDF.

Water control and surface ditching promote evaporative drying of fine-grained dredged materials. Under appropriate conditions, the drying and desiccation of fine-grained materials gives two important results:

- It reduces the occupied volume in the placement site to as much as one-half or less of the volume of cut in the channel.

- It creates dried material in the site suitable for constructing dikes, thus eliminating the need for transporting material for dike construction.

Both results lower costs by maximizing the life of placement sites, reducing the need for additional real estate, and reducing the cost of periodic dike raising.

A crust management program promotes the shrinkage of dredged material by providing drainage for precipitation and water released by excess pore water pressure. Shrinkage of the contained material would be achieved by:

- <u>Constructing a Perimeter Ditch</u>. The first step is to create a ditch along the inside of the dikes. This would be done after the water has completely drained from the interior and a skin has formed on the surface with evidence of desiccation cracking (usually three to six months after the dredging event). The perimeter ditch would be placed a sufficient distance inside the dikes not to create foundation and borrow area problems that may affect future dike raising. Construction would generally involve excavating the ditch by casting excavated material onto the inside of the dike where it would dry and consolidate to become available for dike raising.

- <u>Constructing Interior Ditches</u>. The expense of using a dragline for trenching the interior of most CDFs is cost-prohibitive. A low-ground-pressure vehicle equipped with a plow or rotary ditcher is generally the most practical means for ditch construction. The ditcher creates a small trench of sufficient width and depth to provide drainage and promote formation of desiccation cracks, which expose more surface area to evaporative drying. The procedure to be used would be for the ditcher to begin work at a weir or some point of the perimeter trench and proceed along the alignment of the drainage pattern. The drainage pattern is governed by spillbox and weir location, topography, and management budget.

Once evaporation and shrinkage have reached the point where the material has dried to the bottom of the trenches, the dragline and ditcher would repeat the above procedure and deepen the trenches created in the first pass. This procedure is repeated until the thickness being managed has dried entirely and formed crust.

At the end of the drying season, a survey would be performed to document the shrinkage and settlement. Surveys and calculations of the levee and interior site conditions would be performed to determine the need and amount, if any, of levee raising that may be required for future dredging operations. The resulting volume computations would generate cost and performance indices used to design and manage future crust management activities and levee raisings and provide information that may be useful for managing other CDFs.

5.8.4 Installing and Maintaining Spillboxes, Weirs, and Dewatering Structures

Spillboxes, weirs, and other dewatering structures would be placed strategically within each CDF in a manner that provides the most efficient dewatering and consolidation. In some instances, it may be necessary to relocate or add spillway, weir boxes, and/or other dewatering structures. This would be determined on a site-by-site basis during the engineering and design phase of implementation.

Prior to placing materials into the CDF, spillways would be inspected for structural integrity, corrosion, quantity of spillway boards available, and sediment buildup. Small sumps or depressions would be created at the entrances of the spillways to prevent excessive sediment buildup, which forms barriers and causes ponding. This process would increase CDF capacity by allowing the site to drain, dry, and consolidate.

5.8.5 Managing Non-pay Excess Dredging Quantities

For estimating quantities for a dredging project, an allowance for 10 percent non-pay overdepth dredging is typically used. However, reviews of historic dredging records for the Calcasieu Ship Channel indicate that overdepth dredging has been in excess of 20 to 30 percent (which is included in the capacity requirement estimates). In order to properly design the CDFs and plan for required capacities, the amount of dredged material must be managed. Incentives or disincentives to limit a contractor's non-pay overdepth dredging would be included as part of the management plan. The CECW-CO issued a letter providing guidance on "Assuring the Adequacy of Environmental Documentation for Overdepth Dredging and Clarification of the Dredging Process." Among the guidelines for planning, engineering and design, and maintenance of projects are the following:

- Contracts should contain appropriate incentives and disincentives to limit over-depth-dredging while assuring that the design profile is achieved. This is normally achieved by defining an allowable or paid over-depth and not providing payment beyond this depth and/or width. Environmental compliance documents and permits also provide an upper limit on the dredging and disposal quantities, and dredging beyond these quantity limits are subject to environmental compliance enforcement.

- Reference to the dredging process contained in environmental documentation should be included in project specifications.

- The pre-construction conference should address the dredging process, and the expectations and limitations contained in the environmental documentation.

5.9 CONSTRUCTION AND MAINTENANCE OF DIKES FOR CDFs

Dike construction and maintenance would be planned and carried out with sufficient lead time to allow newly constructed dikes to reach their maximum strength before dredged material is introduced into the CDF.

Crowns of the dikes would be used for the transport of equipment; therefore, the crown would be kept smooth and sufficiently wide to allow for safe passage. Interior and exterior equipment access ramps to the crowns of the dikes would also be maintained. Because of the anticipated use of the dikes for transporting equipment, special consideration must be given to the design and construction of dike foundations, which must provide adequate support.

As mentioned in Section 5.5, Engineering Design, slope stability analyses were performed for CDFs 11, 13, and 17 using both the Method of Planes and the UTEXAS 4 modeling program. The analyses indicated that the configurations proposed for construction and raising of dikes are feasible from a geotechnical perspective. Site-specific engineering and geotechnical analyses would be necessary to confirm and or revise the dike sections on a site-by-site basis prior to construction. Figure 5-1 outlines a conceptual design for offsetting and raising each of the CDF dikes in two separate lifts. The results of this analysis can be found in Appendix B, Geotechnical Report.

Vegetation control at the CDFs is an important maintenance activity. Dikes must be kept free of woody-stemmed vegetation with large root structures that may affect dike structural integrity. Maintenance activities may include tree and stump removal, brush removal, weed control, and clearing and grubbing. Dikes would be planted with low-lying herbaceous vegetation to reduce erosion.

Construction and maintenance of dikes at beneficial use sites are discussed in Section 5.10.2, Beneficial Use.

5.9.1 Erosion Control

Rock or riprap would be placed along the channel edges of the dikes, especially in the lake reaches of the project, to reduce erosion, reduce deterioration of dikes, and regain CDF capacities lost to past erosion from storm surges and ship wakes. A foreshore dike was recently constructed by USACE from approximate mile 11.2 to 15.6 on the eastern side of the channel. The combination foreshore rock dike and/or general shore protection would be placed on both the ship channel and bay sides of the CDFs and adjacent land from approximate mile 12 to 20, which includes CDFs 17, 19, 22, 23, D and E. The placement of shore protection in these areas is anticipated to reduce the dredging need over the 20-year life of the DMMP by 12 million cubic yards. In addition, rock shore protection is planned on the west side of the ship channel from approximate mile 16.7 to 18.7 to protect the shorelines in this narrow, high-energy section of the channel. Erosion control structures are planned at a +8 MLG top elevation to a -2 MLG elevation on a 3:1 slope. Although rock and/or riprap shore protection was evaluated as part of this DMMP, other cost-effective methods of shore protection may be considered during follow-up site-specific engineering and geotechnical evaluations, as well as possible value engineering studies during implementation.

Grasses or other low-lying, herbaceous, drought-resistant vegetation would be planted along the levee crowns and upper slopes to reduce erosion and subsequent channel shoaling. In low lying areas along water bodies outside of the high energy environment directly adjacent to the ship channel, marsh grasses, such as smooth cordgrass, would be planted to reduce erosion and wave energy.

5.10 CONSTRUCTION

The schedule and sequence for construction of various CDF rehabilitations, beneficial use sites, and site expansions are shown in Table 5-1.

5.10.1 CDF Rehabilitation

Each of the CDFs would require rehabilitation with the installation of new spillboxes and dewatering structures as well as dike rehabilitation. Dike rehabilitation would consist of offsetting the existing dike structure, consolidating the foundation, and elevating the dike by approximately five feet in the first lift. Subsequent lifts would range from approximately three to five feet depending on the site and the disposal capacity needed. Engineering and geotechnical analyses would be conducted for each CDF prior to construction to determine ultimate dike configurations. Management activities associated with dike rehabilitation would consist of perimeter and interior ditching, as previously discussed.

5.10.2 Beneficial Use

For each of the beneficial use sites, containment features would be required for retaining dredged material within the site boundary. For the majority of the beneficial use placement described in this DMMP, it was assumed that dredged materials would be placed in a manner that would allow for water circulation, terracing, and marsh creation. These assumptions were considered to be the most conservative and were not meant to limit placement alternatives at any site.

In most cases, the beneficial use components of the DMMP would be implemented before any horizontal expansions of CDFs take place.

Construction at beneficial use sites is anticipated to include the following:

- <u>Containment Dikes:</u> It was assumed that each beneficial use area would be diked to contain the dredged materials until the materials have consolidated and wetland vegetation has become established. A low containment dike would be constructed around an area of a few hundred acres at a time to form a "cell." The cell would then be filled with dredged material to a target fill height as determined by geotechnical, engineering, and survey analysis for the planned habitat. The dredged material would be allowed to consolidate to form a substrate that would be conducive for marsh development to take place. Additional cells would be constructed at the site for subsequent dredging cycles.

  For the properties on the national wildlife refuges, cells would not be constructed. Instead, the entire area designated for receipt of the dredged material would be diked. During the pumping of dredged material, the material would be allowed to flow throughout the site, and the substrate for the establishment of marsh would form over several dredging cycles.

  In either case, the earthen dikes would be constructed by side casting adjacent clay materials. Where feasible, the dike construction materials would be excavated from the interior of the placement area. The side cast borrow ditch may increase circulation of the beneficial use area by creating a natural depression. For the purposes of this plan and cost estimation, a conceptual dike cross-section was developed as shown in Figure 5-2. Actual sizes and configurations of the dikes would depend on site-specific design parameters determined during engineering and design. It should be noted that the dike configurations shown in Figure 5-2 have already been constructed at the Black Lake and both areas of the Sabine NWR and are considered feasible and constructible.

- <u>Dike Degradation:</u> The dikes around beneficial use sites and cells would be designed to slowly deteriorate and subside to the level of the adjacent marsh substrate, thereby promoting the tidal exchange of water. Earthen dikes may require mechanical degradation to the settled elevations of the disposal area if natural erosive processes do not degrade them sufficiently to meet fish and tidal access needs. Such breaches would be undertaken after consolidation of the dredged sediments and vegetation has become established on the exposed soil surface.

- <u>Target Elevations:</u> The target elevations of placed and consolidated fill at each beneficial use site would be determined through geotechnical analyses. These analyses would consider long-term settlement of the dredged materials and placement area foundations, as well as elevation surveys of the nearby planned wetland habitat to determine the appropriate target range. These elevation targets would be coordinated with resource agencies prior to construction. It is anticipated that the final result of the dredged material placement would be a combination of wetlands and shallow open water habitat within the placement site. Dredged material slurry would be allowed to overflow over existing emergent marsh vegetation within the proposed disposal areas, but would not be allowed to exceed a height of about one foot above the existing marsh elevation.

- <u>Vegetation:</u> The establishment of vegetation on marsh areas would provide stability and reduce erosion. The vegetation of marsh areas would rely on natural recruitment. However, marsh vegetation, such as smooth cordgrass, may be planted by other agencies and organizations as desired.

- <u>Access Corridors:</u> Access corridors from the ship channel to beneficial use sites would be a maximum of about 200 feet wide and would cross over uplands, wetlands, and shallow open water as necessary. Access corridors also may be placed across or along the crown of existing levees in the project vicinity.

- <u>Flotation Access Corridors:</u> Channels would be excavated as needed in shallow open water areas to allow construction equipment to access sites. If necessary, flotation access channels would be excavated by a mechanical dredge to maximum dimensions of approximately 80 feet wide and 10 feet deep. Flotation access channel material would be used in dike/closure construction or refurbishment, to backfill flotation access channels, or be placed adjacent to and behind the dikes and closures in shallow open water to an elevation conducive to wetlands development following consolidation of the material. Flotation access channel material used to backfill the flotation access channels following completion of disposal work would be temporarily stockpiled on water bottoms adjacent to the flotation access channels.

  If existing canals are used for access, they may be dredged to facilitate the flotation of pipelines and the transport of other necessary equipment from the dredging site on the ship channel to pipeline discharge sites within the beneficial use sites. Dredged material removed from existing canals would be placed on adjacent levees and/or into shallow open water on either side of canals. Canal dredged material placed in shallow open water areas would be placed at a height conducive for wetlands development.

- <u>Existing Levee Access Corridors:</u> If construction equipment and discharge pipelines are placed across or along the crown of existing levees in the project vicinity, the levees may be refurbished using borrow material from adjacent shallow open water to facilitate their use as access corridors for construction equipment and discharge pipelines. Access corridors crossing existing levees would be no wider than about 100 feet.

  Levees surrounding beneficial use sites may be degraded as necessary to provide access into the disposal site. If levees are degraded for construction access, they may be rebuilt following completion of disposal activities. Degraded levee material would be placed/stockpiled either in shallow open water adjacent to the degraded levee sections or on adjacent levees. Material degraded from levees may be used to rebuild degraded levee sections. If borrow material is required to rebuild degraded levee sections, borrow material would be excavated from adjacent shallow water. If levees are not to be rebuilt using material removed during levee degradation activities, any levee material that was placed in shallow open water would be degraded, if necessary, to a height conducive to wetlands development.

- <u>Staging Areas:</u> The construction or designation of staging areas may be necessary for construction equipment and for the unloading of pipeline and other equipment necessary to perform disposal operations. Staging areas would be a maximum of about 300 feet by 300 feet in area. If necessary, materials such as gravel, sand, dirt, shell, or some combination of materials would be permanently placed over existing upland, wetland, and shallow open water habitat to construct staging areas.

- <u>Board Roads:</u> Temporary board roads may be constructed along access corridor alignments and staging areas wherever emergent marsh exists. Board roads would be removed when work is completed. Fill material may be deposited where the board road would be located to offset damage to the underlying marsh caused by soil compression. Board road fill material may be degraded to adjacent marsh elevations following completion of disposal activities either by placing excess material into nearby shallow open water to elevations conducive to wetlands development, by placing material on existing uplands/levees, or by removing material from the project vicinity.

Minimal site-specific data exist for the majority of the proposed beneficial use sites. An interactive approach would be taken with landowners and resource agencies, as necessary, to determine the type of beneficial use at each site.

A collaborative, adaptive management strategy that involves engineers, scientists, and resource agencies would be employed throughout the life of the DMMP to improve design, construction, and post-construction procedures to promote circulation, establish vegetation, and manage beneficial use sites. The intent of adaptive management for this project is to account for uncertainties and allow decision-making and implementation to proceed while acknowledging that some structural or operational changes may be necessary (EC 1105-2-409 [31 May 2005; expired 30 September 2007]. Although this project is not an ecosystem restoration project, it would comply with the adaptive management guidance of ER 1105-2-100, paragraph 3-5b(8), which states:

> *For complex specifically authorized projects that have high levels of risk and uncertainty of obtaining the proposed outputs, adaptive management may be recommended.*

As dredged material placement sites are constructed and completed, the adaptive management process would be used to adjust and improve the DMMP and the disposal of dredged material. During construction of the beneficial use sites, agencies and landowners would be advisors but final decision-making will rest with the USACE and the local sponsor.

5.11 FINALIZING THE DMMP/SEIS

This DMMP/SEIS has been prepared pursuant to the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and Council on Environmental Quality Regulations (40 CFR Parts 1500-1508). Following the preparation and distribution of the Draft DMMP/SEIS and the solicitation of public comment on the document, a Final DMMP/SEIS would be published for public distribution. Not less than 30 days after the publication of the EPA's Notice of Availability of the Final document, USACE may issue a Record of Decision (ROD) documenting its decision concerning the proposed action. Signing the ROD would complete the Federal requirements for finalizing the DMMP/SEIS. The decision that is documented in the ROD would determine the cost sharing requirements that would lead to the preparation and negotiation of a Project Participation Agreement (PPA) between the local sponsor and the Federal Government.

5.12 DMMP REVIEWS

A 20-year conceptual management plan has been developed. Although this plan is based on the best information currently available, the dredged material quantities, dredging frequency, the effects of site and sediment management activities, and other factors influencing the plan are highly variable. Minimal site management, engineered designed construction, and beneficial use practices have been previously implemented on the Calcasieu River and Pass Project. Accordingly, adjustments that employ adaptive management protocols would need to be made in response to conditions and situations experienced, as well as to evaluate long-term sustainability of the project elements. The DMMP would be reviewed and updated periodically to reflect significant changes in project conditions or other regulatory or environmental conditions.

As stated throughout this document, sufficient capacity for dredged material placement to meet the ongoing navigation need is not available. In order to continue to maintain navigation, some components of this plan may be utilized prior to the finalization of this DMMP/SEIS as per the guidelines of WRDA 2007 SEC. 5081. CALCASIEU SHIP CHANNEL, LOUISIANA**.**

> *The Secretary shall expedite completion of a dredged material management plan for the Calcasieu Ship Channel, Louisiana, and may take interim measures to increase the capacity of existing disposal areas, or to construct new confined or beneficial use disposal areas, for the channel.*

Interim measures taken over the next few months are not expected to affect the DMMP. The DMMP will be revised to account for any changes during periodic updates.

5.13 INTERAGENCY COORDINATION

The CEMVN plans to conduct annual coordination meetings with interested Federal and state agencies. The meetings are anticipated to provide an opportunity for the CEMVN to present dredging plans for the upcoming year and provide a forum for discussion. Through these meetings, CEMVN will keep agencies involved and notified of the project's ongoing compliance with environmental laws and requirements related to future dredging operations. Other considerations for discussion may include proposed changes to the DMMP, newly identified beneficial use opportunities, changed environmental conditions, anticipated problems, and other topics related to dredging and dredged material disposal.

6.0 CONCLUSIONS

Based on the comparisons and the scoring of the alternatives, the PDT has determined that Alternative B is the Recommended Plan. It is the lowest cost alternative and is consistent with environmental and engineering requirements. It provides for the placement of material dredged from the Navigation Channel of the Calcasieu River and Pass for a minimum of 20 years. Even minor reductions in sailing draft would result in substantially higher transportation costs relative to the costs of the Recommended Plan.

Planning Objectives. The Recommended Plan would comply with each of the planning objectives:

- Maintain the navigation channel to authorized dimensions.
- Place the dredged material in the most cost-effective location consistent with environmental and engineering requirements.
- Beneficially use dredged material.
- Maintain dredged material disposal sites in a manner to optimize capacities and comply with sound economic and environmental principles.
- Provide for the placement of material dredged by private parties.

Screening Criteria. The Recommended Plan would be compatible with Constraints, Considerations, and Opportunities identified in the plan formulation process.

<u>Constraints:</u>

- <u>Contaminated Materials</u>. The Recommended Plan would avoid areas with potentially contaminated materials
- <u>Public Oyster Grounds.</u> The Recommended Plan would not affect Public Oyster Grounds.
- <u>Impingement on Public Access</u>. The Recommended Plan would not impinge on access by the public to any location.

<u>Considerations</u>:

- <u>Costs.</u> The Recommended Plan is economically sound.
- <u>Real Estate Acquisitions.</u> The Recommended Plan would account for all necessary real estate acquisitions.
- <u>Public Use Enhancement.</u> The Recommended Plan would enhance public use through the beneficial use of dredge material for habitat restoration and enhancement.
- <u>Long-Term Facilities Operation and Maintenance Costs.</u> The Recommended Plan accounts for long term operations and maintenance (O&M) costs.

- Mitigation Requirements. No compensatory mitigation would be required.

Opportunities:

- Use of Dredged Material for Habitat Restoration and Improvement. The Recommended Plan would provide for habitat restoration and improvement.

- Provide Opportunities for Mining of CDFs by Third Parties for Construction, Fill, Beneficial Use, or Other Actions. Although mining of CDFs is not an integral component of the Recommended Plan, the plan would provide opportunities for the excavation and use of dredged material for construction, fill, beneficial use, or other actions.

- Placement of Material from Private Dredging. The Recommended Plan would provide for the placement capacity for material dredged by private parties.

- Recreation. The Recommended Plan is expected to enhance recreation through the creation of marsh and estuarine habitat amenable to hunting, fishing, and wildlife viewing.

- Storm Damage Abatement. The Recommended Plan would result in the restoration of subsided marsh, thereby assisting in the abatement of damage from storms.

Planning Criteria. The Recommended Plan would comply with each of the four P&G planning criteria:

Acceptability. The Recommended Plan is anticipated to be workable and viable with respect to acceptance by state and local entities and the public, and compatibility with existing laws, regulations, and public policies. The Recommended Plan is feasible and achievable in the context of technical, environmental, economic, and social considerations.

Completeness. The Recommended Plan would include and account for all necessary financial investments, long-term operation and maintenance costs, or other actions.

Effectiveness. The Recommended Plan provides attainment of the planning objectives.

Efficiency. The Recommended Plan provides for the continued operation of the Calcasieu Ship Channel. It is technically and environmentally sound and provides both monetary and non-monetary cost effectiveness. It provides for the realization of opportunities and considers constraints and other considerations.

7.0 RECOMMENDATIONS

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 provide for the disposal of dredged material for maintenance of the Calcasieu River and Pass, Louisiana project for a minimum of the next 20 years, the District Commander recommends the implementation of the Recommended Plan.

The total estimated cost for the project, in 2008 dollars, is $788,840,000 inclusive of associated investigation, environmental, engineering and design, construction, and supervision. The cost of the Recommended Plan was recently updated by MVN to 2010 dollars. The 2010 updated cost is $799,327,000. Details of both the 2008 and 2010 cost estimates are provided in Appendix D. Costs for the project would be shared by the Federal Government and the Local Sponsor, the Lake Charles Harbor and Terminal District, in accordance with the cost sharing provisions of the Water Resources Development Act of 1986, as amended.

The recommendation contained herein reflects the information available at this time and current Departmental 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 it is transmitted to the Congress as proposals for authorization and/or implementation funding.

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8.0 LIST OF STUDY TEAM MEMBERS AND REPORT PREPARERS

Table 8-1. DMMP/SEIS List of Preparers

Name	Discipline/ Expertise	Organization	Role in Document Preparation
Tracy Falk	Operations & Maintenance	USACE	Reviewer
Mark Wingate	Planning	USACE	Reviewer
Darrel Broussard	Planning	USACE	Reviewer
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Richard Boe	Environmental	USACE	Reviewer
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Joseph Wyble	Geologist	G.E.C., Inc.	EIS Preparation
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Joanne Ryan	Cultural Resources	C.E.I, Inc.	DMMP Preparation
Michael Rayle	Biologist	E & E Group	DMMP Preparation

8.1 DISTRIBUTION LIST

The DMMP/DEIS was distributed to Federal, state, parish, and local agencies; Tribes; businesses; libraries; museums; universities; environmental organizations, groups and individuals; and scoping participants. The complete distribution list is located in Appendix N.

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10.0 INDEX

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11.0 LIST OF ACRONYMS

AQCR – Air Quality Control Region

AQI – Air Quality Index

ASTM – American Society for Testing and Materials

BMP – best management practice

BU – beneficial use

CDF – confined disposal facility

CECW-CO – Corps of Engineers Headquarters, Directorate of Civil Works, Operations CoP

CEMVN – Corps of Engineers, New Orleans District

CEQ – Council on Environmental Quality of the White House

CFR – Code of Federal Regulations

CIAP – Coastal Impact Assistance Program

CWA – Clean Water Act

CWPPRA – Coastal Wetlands Planning, Protection, and Restoration Act

DAMP – disposal area management program

DMMP – dredged material management plan

DMMU – dredged material management units

EFH – essential fish habitat

EIA – U.S. Energy Information Administration

EPA – U.S. Environmental Protection Agency

ER – engineering regulation

ERDC – Engineer Research and Development Center of the U.S. Army Corps of Engineers

FERC – Federal Energy Regulatory Commission

FMC – Fishery Management Council

FMP – fishery management plan

GIWW – Gulf Intracoastal Waterway

GMEI – Gulf of Mexico Estuarine Inventory

HAPC – Habitat Areas of Particular Concern of the U.S. National Oceanic and Atmospheric Administration

HTRW – Hazardous, Toxic, and Radioactive Waste

HUD – U.S. Department of Housing and Urban Development

LCWCRTF – Louisiana Coastal Wetlands Conservation and Restoration Task Force

LDEQ – Louisiana Department of Environmental Quality

LDNR – Louisiana Department of Natural Resources

LDWF – Louisiana Department of Wildlife and Fisheries

LERR – Lands, Easements, Rights-of-Way, and Relocations

LGS – Louisiana Geological Survey

LNG – liquid natural gas

LULC – Land Use/Land Cover

MLG – Mean Low Gulf, a reference plane that represents the average limits within which the water level would normally be located

MSA – metropolitan statistical area of the U.S. Census Bureau

NAAQS – National Ambient Air Quality Standards

NEPA – National Environmental Policy Act of 1969

NMFS – National Marine Fisheries Service of NOAA

NWRC – National Wetlands Research Center of the U.S. Geological Survey

NOA – notice of availability

NOAA – National Oceanic and Atmospheric Administration of the U.S. Department of Commerce

NWR – national wildlife refuge

NWRC – National Wetlands Research Center of the U.S.G.S.

O & M – USACE Operation and Maintenance

ODMDS – Ocean Dredged Material Disposal Sites

PA – placement area

PAH – polycyclic aromatic hydrocarbons

PCB – polychlorinated biphenyls

PDT – project development team

REC – recognized environmental condition

ROD – record of decision

ROI – region of interest

SAV – submerged aquatic vegetation

SEIS – supplemental environmental impact statement of the USACE

SNG – synthetic natural gas

T & E – threatened and endangered

TSP – Tentatively Selected Plan

USACE – U.S. Army Corps of Engineers

USDA – U.S. Department of Agriculture

USEPA – U.S. Environmental Protection Agency

USFWS – U.S. Fish and Wildlife Service

USGS – U.S. Geological Survey

WRDA – Water Resources Development Act

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