US Army Corps of Engineers®
New Orleans District

Louisiana Coastal Area (LCA), Louisiana

Ecosystem Restoration Study

November 2004
Final
Volume 2:
Programmatic Environmental Impact Statement

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Cover picture is a Live Oak tree on the eastern shoreline of Lake Salvador.
Picture provided by Lane Lefort of the U.S. Army Corps of Engineers, New Orleans District.

FINAL

PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Louisiana Coastal Area (LCA), Louisiana Ecosystem Restoration Study

LEAD AGENCY: U.S. Army Corps of Engineers (USACE) - Mississippi Valley, New Orleans District (District). Cooperating Agencies include: U.S. Environmental Protection Agency, Minerals Management Service, Natural Resources Conservation Service, National Marine Fisheries Service, U. S. Geologic Survey, and the U. S. Fish and Wildlife Service.

ABSTRACT: Three of 15 alternative plans were considered in detail: Alternative Plan B focused on river reintroductions; Alternative Plan D focused on restoring geomorphic structures. **The LCA Plan is the Recommended Plan** and includes both river diversions and restoration of geomorphic structures. The LCA Plan would facilitate the implementation of critical restoration features, essential science and technology demonstration projects, increased beneficial use of dredged material, and modification of selected existing projects to support coastal restoration objectives. The Science and Technology Program would provide for acquisition of data and development of analytic tools to further resolve scientific uncertainties and support program implementation. The remaining recommended plan components would provide the basis for continued restoration within an established framework. The cost of the five Near-Term Critical Restoration Features recommended for specific Congressional authorization, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents, (referred to as "conditionally authorized" elsewhere in the report) is estimated at $864,065,000. The total cost of the Science and Technology Program, the Demonstration Projects, the Program for the Beneficial Use of Dredged Material, and Investigations of Modifications of Existing Structures is estimated at $310,000,000. The combined total cost of the previously stated components of the LCA Plan is estimated at $1,174,065,000. The total cost of Other Near-Term Critical Restoration Features and Studies Requiring Future Congressional Construction Authorization, and Large-Scale and Long-Term Concepts Detailed Studies is estimated to be $821,916,000. The total cost of the LCA Plan is estimated to be $1,995,981,000. Currently, the annual operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs are estimated at $7,883,000. OMRR&R costs are the responsibility of the non-Federal sponsor. These costs can be found in **tables 7-3** to **7-5**. Information presented in the LCA Main Report and supporting volumes and appendices are incorporated by reference in this FPEIS.

Comments: Please send comments or questions on this Final Programmatic Environmental Impact Statement to the U.S. Army Corps of Engineers, New Orleans District, Attention: William P. Klein, Jr., P.O. Box 60267, New Orleans, LA 70160-0267. Telephone: (504) 862-2540; Fax (504) 862-1892. **The official Closing Date for receipt of comments will be 30 days from the date on which the Notice of Availability of this Final PEIS appeared in the *Federal Register*.**

SUMMARY

S.1 GENERAL

This Final Programmatic Environmental Impact Statement (FPEIS) for the Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study (hereinafter LCA Study) was prepared by the U.S. Army Corps of Engineers - Mississippi Valley, New Orleans District (District). Cooperating Agencies (as defined under 40 CFR 1501.6) include: U. S. Environmental Protection Agency (USEPA); U.S. Department of Interior – U. S. Fish and Wildlife Service (USFWS) and U. S. Geologic Survey (USGS); U. S. Department of Commerce – National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS); U. S. Department of Agriculture – Natural Resources Conservation Service (NRCS). The LCA Study builds on the restoration strategies presented in the Coast 2050 Plan (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (1998) and the May 1999, Reconnaissance Report "Section 905(b) (WRDA 86) Analysis: Louisiana Coastal Area, Louisiana—Ecosystem Restoration" (USACE 1999). The LCA Study is authorized through Resolutions of the U.S. House of Representatives and Senate Committees on Public Works, April 19, 1967, and October 19. 1967.

The LCA Study focuses on "lessons learned" from previous Louisiana coastal restoration efforts, the existing Coast 2050 restoration strategies, and the best available science and technology to develop a tentatively selected plan that addresses the most critical ecological needs of the coastal area and has features that can be implemented within the next 5-10 years, demonstration projects to resolve scientific and engineering uncertainty, and large scale studies of long-range feature concepts.

As reported in the September 17, 2004, Federal Register (volume 69, number 180), the USEPA rated the LCA Draft PEIS as LO - Lack of Objections; having no objections to the selection of the Tentatively Selected Plan of Action, and fully supporting the primary restoration strategies.

S.2 PURPOSE

The purpose of the LCA Study is to:

- Identify the most critical human and natural ecological needs of the coastal area;
- Present and evaluate conceptual alternatives for meeting the most critical needs;
- Identify the kinds of restoration features that could be implemented in the near-term (within 5 to 10 years) that address the most critical needs, and propose to address these needs through features that provide the highest return in net benefits per dollar of cost;
- Establish priorities among the identified near-term restoration features;
- Describe a process by which the identified priority near-term restoration features could be developed, approved, and implemented;

- Identify the key scientific uncertainties and engineering challenges facing the effort to protect and restore the ecosystem, and propose a strategy for resolving them;
- Identify, assess and, if appropriate, recommend feasibility studies that should be undertaken within the next 5 to 10 years to fully explore other potentially promising large-scale and long-term restoration concepts; and
- Present a strategy for addressing the long-term needs of coastal Louisiana restoration beyond the near-term focus of the Louisiana Coastal Area Ecosystem Restoration Plan (LCA Plan).

S.3 NEED

The accelerated loss of Louisiana's coastal wetlands has been ongoing since at least the early 1900s with commensurate deleterious effects on the ecosystem and possible future negative impacts to the economy of the region and the Nation. There have been several separate investigations of the problem and a number of projects constructed over the last 20 to 30 years that provide localized remedies. For example, the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) Program is an ongoing program comprised of relatively small projects to partially restore the coastal ecosystem. However, given the magnitude of Louisiana's coastal land losses and ecosystem degradation, it has become apparent that a systematic approach involving larger projects to restore natural geomorphic structures and processes, working in concert with smaller projects, will be required to effectively deal with a physical problem of such large proportions. Restoration strategies presented in the 1998 report entitled "Coast 2050: Toward a Sustainable Coastal Louisiana," which evolved into the Louisiana Coastal Area (LCA) 905(b) reconnaissance report, formed the basis for this broader-scale effort under the Louisiana Coastal Area Ecosystem Restoration Study (LCA Study).

The goal of the LCA Plan is to reverse the current trend of degradation of the coastal ecosystem. The plan maximizes the use of restoration strategies that reintroduce historic flows of river water, nutrients, and sediment to coastal wetlands, and that maintain the structural integrity of the coastal ecosystem. Execution of the LCA Plan would make significant progress towards achieving and sustaining a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus, contribute to the economy and well-being of the Nation. Benefits to and effects on existing infrastructure, including navigation, hurricane protection, flood control, land transportation works, agricultural lands, and oil and gas production and distribution facilities were considered in the formulation of coastal restoration plans.

Louisiana contains one of the largest expanses of coastal wetlands in the contiguous U.S., and accounts for 90 percent of the total coastal marsh loss occurring in the Nation. The coastal wetlands, built by the deltaic processes of the Mississippi River, contain an extraordinary diversity of habitats that range from narrow natural levee and beach ridges to expanses of forested swamps and freshwater, intermediate, brackish, and saline marshes. Taken as a whole, the unique habitats of upland areas and the Gulf of Mexico, with their hydrological connections to each other, and migratory routes of birds, fish, and other species, combine to place the coastal wetlands of Louisiana among the Nation's most productive and important natural assets. In human terms, these coastal wetlands have been a center for culturally diverse social development.

Approximately 70 percent of all waterfowl that migrate through the U.S. use the Mississippi and Central flyways. With over 5 million birds wintering in Louisiana, the Louisiana coastal wetlands are a crucial habitat to these birds, as well as to neotropical migratory songbirds and other avian species that use them as crucial stopover habitat. Additionally, coastal Louisiana provides crucial nesting habitat for many species of water birds, such as the endangered brown pelican. These economic and habitat values, which are protected and supported by the coastal wetlands of Louisiana, are significant on a National level.

Louisiana's coastal wetlands and barrier island systems enhance protection of an internationally significant commercial-industrial complex from the destructive forces of storm-driven waves and tides. A complex of deep-draft ports includes the Port of South Louisiana, which handles more tonnage than any other port in the Nation, and the most active segment of the Nation's Gulf Intracoastal Waterway (GIWW) (Waterborne Commerce Statistics Center (WCSC) 2002). In 2000, Louisiana led the Nation with production of 592 million barrels of oil and condensate (including the outer continental shelf (OCS)), valued at $17 billion, and was second in the Nation in natural gas production with $1.3 billion (excluding OCS and casing head gas) (Louisiana Department of Natural Resources (LDNR) 2003). In addition, nearly 34 percent of the Nation's natural gas supply and over 29 percent of the Nation's crude oil supply, moves through the state and is connected to nearly 50 percent of U.S. refining capacity (LDNR 2003b).

Additionally, coastal Louisiana is home to more than 2 million people, representing 46 percent of the state's population. When investments in facilities, supporting service activities, and the urban infrastructure are totaled, the capital investment in the Louisiana coastal area totals approximately $100 billion. Excluding Alaska, Louisiana produced the Nation's highest commercial marine fish landings (about $343 million) excluding mollusk landings such as clams, oysters, and scallops (National Marine Fisheries Service (NMFS) 2003). Recent data from the U.S. Fish and Wildlife Service (USFWS) show expenditures on recreational fishing (trips and equipment) in Louisiana to be nearly $703 million, and hunting expenditures were $446 million for 2001 (USFWS 2002).

Since the 1930s coastal Louisiana has lost over 1.2 million acres of land (485,830 ha) (Barras et al. 2003; Barras et al. 1994; and Dunbar et al. 1992). As recently as the 1970s, the loss rate for Louisiana's coastal wetlands was as high as 25,200 acres per year (10,202 ha/year). The rate of loss from 1990 to 2000 was about 15,300 acres per year (6,194 ha/year), much of which was due to the residual effects of past human activity (Barras et al. 2003). It was estimated in 2000 that coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year (2,672 ha/year) over the next 50 years. It is estimated that an additional net loss of 328,000 acres (132,794 ha) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands (Barras et al. 2003). The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and shifted the coastal area from a condition of net land building to one of net land loss.

While many studies have been conducted to identify the major contributing factors (e.g., Boesch et al. 1994; Turner 1997; Penland et al. 2000), most studies agree that land loss and the degradation of the coastal ecosystem are the result of both natural and human induced factors, producing conditions where wetland vegetation can no longer survive and wetlands are lost. Establishing the relative contribution of natural and human-induced factors is difficult. In many cases, the changes in hydrologic and ecologic processes manifest gradually over decades and in large areas, while other effects occur over single days and impact relatively localized areas. For barrier shorelines, complex interactions between storm events, longshore sediment supply, coastal structures, and inlet dynamics contribute to the erosion and migration of beaches, islands, and cheniers.

The measurable increase in coastal land loss in the mid to late 20th century can be linked to human activities that have fundamentally altered the deltaic processes of the coast and limited the ability to rebuild or sustain it. In the Chenier Plain, human activities have fundamentally altered the hydrology of the area, which has impacted the long-term sustainability of the coastal ecosystems. Because of the magnitude and variety of these human-induced changes, and their interaction with natural landscape processes, all of the factors contributing to coastal land loss and ecosystem degradation must be viewed together to fully understand how Louisiana's coastal ecosystem shifted from the historical condition of net land gain to the current condition of net land loss.

The past and continued loss of Louisiana's coastal wetlands will significantly affect the ecology, society, and economy of the region and the Nation. The continued decline of the natural ecosystem will result in a decrease in various functions and values associated with wetlands, including corresponding diminished biological productivity and increased risk to critical habitat of Federally-listed threatened and endangered species. The capacity of the coastal wetlands to buffer storm surges from tropical storm events will diminish, which will increase the risk of significant damage to oil, gas, transportation, water supply and other private and public infrastructure and agriculture lands and urban areas.

S.5 STUDY AREA

The study area, which includes the Louisiana coastal area from Mississippi to Texas, is comprised of two wetland-dominated ecosystems, the Deltaic Plain of the Mississippi River and the closely linked Chenier Plain, both of which are influenced by the Mississippi River. For planning purposes, the study area was divided into four subprovinces, with the Deltaic Plain comprising Subprovinces 1, 2, and 3, and the Chenier Plain comprising Subprovince 4 (see **figure S-1**).

Today, the Deltaic Plain is a vast wetland area stretching from the eastern border of Louisiana to Freshwater Bayou. It is characterized by several large lakes and bays, natural levee ridges (up to 20 feet [6.1 meters] above sea level), and bottomland hardwood forests that gradually decrease in elevation to various wetland marshes. The Deltaic Plain contains numerous barrier islands and headlands, such as the Chandeleur Islands, Barataria Basin Barrier Islands, and Terrebonne Basin Barrier Islands. The Chenier Plain extends from the Teche/Vermilion bays to Louisiana's western border with Texas, and is characterized by several large lakes, marshes, cheniers, and coastal beaches.

Within the broadly delineated zones of marsh habitat types, a variety of other wetland habitats (with distinct surface features and vegetative communities) occur in association with the marshes. These include swamp and wetland forests, beach and barrier islands, upland, and other important habitats. There are also unique vegetative communities in the coastal area, such as floating marshes, tidal fresh marshes and maritime forests, that contribute to the extensive diversity of the coastal ecosystem and which are essential to the overall stability of the ecosystem.

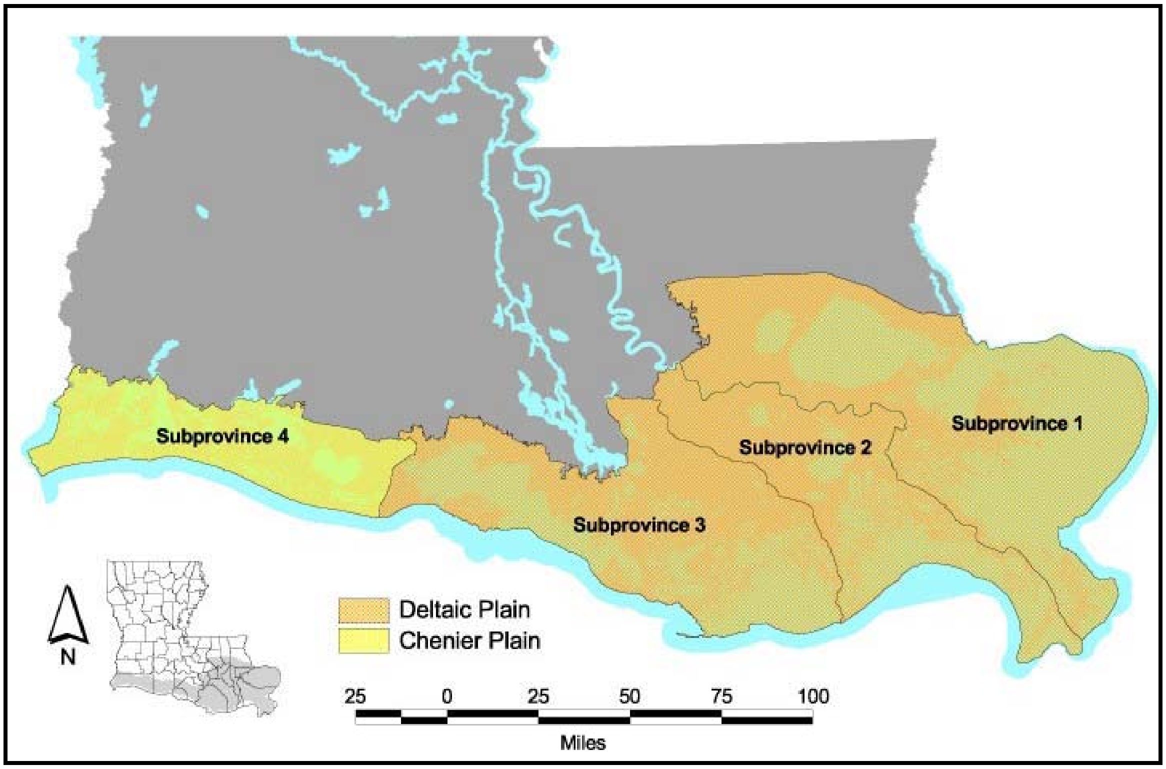

Figure S-1. LCA Study Area and Subprovinces.

S.6 PUBLIC INVOLVEMENT

Description of scoping activities and other public and stakeholder meetings are presented in Chapter 5 PUBLIC INVOLVEMENT AND COORDINATION.

Volume III PUBLIC COMMENTS AND USACE RESPONSES of the Main Report describes the public's comments and the District's responses regarding the DPEIS for the LCA Study and are incorporated in their entirety into this FPEIS. Volume III also presents comments of the National Technical Review Committee (NTRC), which provided external, independent technical review of the LCA Study. The purpose of the NTRC was to ensure quality and credibility of the results of the planning process. Volume III is incorporated in its entirety into this FPEIS. In accordance with the NEPA, the District issued a Notice of Availability, dated July 2, 2004, inviting public participation to comment on the DPEIS and draft LCA Study report. In addition, the USEPA issued in the July 9, 2004 *Federal Register* Volume 69, Number 131 a notice of availability to comment on the LCA DPEIS and draft Study Report.

Volume III PUBLIC COMMENTS AND USACE RESPONSES presents the public's comments and the U.S. Army Corps of Engineers, New Orleans District (the District) responses regarding the DPEIS for the LCA Study. In accordance with the NEPA of 1969 the District issued a Notice of Availability, dated July 2, 2004, inviting public participation to comment on the DPEIS and draft LCA Study report. In addition, the U.S. Environmental Protection Agency (USEPA) issued in the *Federal Register* Volume 69, Number 131, a Notice of Availability to comment on the LCA DPEIS and draft Study Report.

Comments on the DPEIS and the draft Study Report were requested during the 45-day comment period from July 9, 2004, to August 23, 2004. In addition, written comments on the DPEIS and the draft Study Report were requested by letter postmarked not later than August 23, 2004. Distribution of the DPEIS for review and comment included mailing the document to Federal, state, and local agencies; Tribes; libraries; and other interested parties. During this public comment period, six public meetings were held throughout the Louisiana coastal area; additional meetings were conducted in Texas, Mississippi, and Tennessee. A total of 355 people attended and a total of 77 individuals offered oral comments at the nine public meetings. The District received 82 comment letters postmarked within the comment period.

All substantive comments received on the draft statement are included in this report whether or not the comment is thought to merit individual discussion in the text of the statement.

The oral testimonies and letters were reviewed by the LCA Planning Development Team and were considered in the study process, in the preparation of the FPEIS and the final LCA Study report. Salient comments, questions, and concerns expressed in both the oral and written comments were identified. Several comments warranted revision to the FPEIS and final LCA Study report. Although no major changes to the document content were warranted or conducted as a result of the public review, revisions to the text included minor clarifications and inclusions of updated and additional information. None of the changes made to either the FPEIS or the final LCA Study Report are believed to have any profound effect on the findings and conclusions that were presented in the DPEIS and the draft LCA Study Report.

All registered comment meeting participants, as well as those providing written comments, will be provided a copy of the FPEIS and this report. In addition, the final LCA Report will be posted on the study web site located at http://www.lca.gov.

S.7 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

1. Conflict concerning the operation of the Mississippi River Gulf Outlet (MRGO).

2. Public concern that litigation from parties negatively impacted by restoration projects will make restoration prohibitively expensive.

3. Concern about the priority of certain restoration projects.

- Demand by Terrebonne and Barataria Basin residents for the immediate restoration of the Barataria-Terrebonne Estuary before other regions of the coastal ecosystem.
- Public support for the construction of restoration projects in areas that will maximize the benefits to society, culture, and the regional economy.
- Public concern for additional salinity controls in the Chenier Plain and inclusion of additional restoration features for this subprovince in the implemented LCA Plan.

4. Concern with inaction and perceived lack of urgency with respect to restoration.

- Public support for comprehensive, long-term restoration efforts beyond near-term restoration efforts.
- Public demand for the immediate construction of restoration actions versus requirements for conducting additional study of restoration problems.

5. Concern about the necessity for sediment and water quality testing for each restoration feature.

6. Conflicts may result when balancing economic interests with coastal restoration, especially when multiple stakeholders share common coastal resources.

- Public concern that diversions will over-freshen receiving basins and concern that diversions could create widespread algae blooms in interior bays and lakes.
- Concern with changing the existing operational scheme of the Old River Control Structure in regulating river flows in the Mississippi and Atchafalaya Rivers.
- Concern that LCA Plan restoration features in Subprovince 3 would excessive amounts of water and sediment into the area.
- Real property rights issues including public access, mineral rights, and the perception that Federal monies would be spent to restore private properties.
- Concern with impediments to navigation and proposed re-routing of the Mississippi River and the Atchafalaya River Navigation channels.
- The effect of coastal restoration on flood control projects.

S.8 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

An interagency Project Delivery Team (PDT) was assembled to conduct the prerequisite studies and analyses and develop the alternative plans and report for the LCA Study. The team was composed of staff from the U.S. Army Corps of Engineers (USACE), State of Louisiana (the non-Federal sponsor), USFWS, NMFS, USEPA, USGS, and the NRCS. To ensure that development of alternative restoration plans was based upon the best available science and engineering, the USACE and the State of Louisiana also enlisted the aid of over 120 scientists, engineers, and planners from across the Nation to provide advice and guidance, carry out complex modeling efforts, and review results.

The LCA Study planning process used by the PDT evolved over 2 years, ultimately resulting in the selection of a recommended near-term course of action. During this time, the PDT used an iterative decision making process to identify and evaluate the merits of individual restoration features, the effects of combining these features into different coast wide frameworks, and ultimately the ability of these frameworks to address the most critical ecological needs in the Louisiana coastal area.

The most suitable LCA Plan is identified as the one that best meets the study objectives, is based upon identification of the most critical natural and human ecological needs, and proposes a program of highly cost effective features to address those needs. During program implementation, feasibility-level decision documents would be completed to fully analyze and justify specific features based upon standard planning guidance using National Environmental Restoration (NER) and National Economic Development (NED) analyses.

Planning Constraints

The development and evaluation of restoration alternatives within coastal Louisiana was constrained by several factors. Foremost among these factors was the fundamental premise that restoration of deltaic processes would be accomplished, in part, through reintroductions of riverine flows, but that natural and historical "channel switching" of the Mississippi River would not be allowed to occur. The availability of freshwater, primarily water transported down the Mississippi River, was considered a planning constraint because minimum levels or water flows are required to maintain navigation and flood control, and limit saltwater intrusion. The availability of sediment for restoration efforts was also considered a planning constraint for this study because there is not an unlimited, easily accessible, and low-cost source for restoration efforts.

Another significant category of constraints is the scientific and technological uncertainties inherent in large-scale aquatic ecosystem restoration projects. While many of these were known as the plan formulation process began, others became more evident as the formulation process was completed. A summary of the key scientific uncertainties and technological challenges as they are currently understood, along with proposed strategies to address these uncertainties and challenges, is presented below.

- **Type 1 - Physical, chemical, geological, and biological baseline condition uncertainties -** This general type of uncertainty is best resolved through continued improvement of tools and networks that would better establish baseline conditions and allow for more detailed and coast wide monitoring and assessment, which would better support program-level, as well as project-level, Adaptive Management;
- **Type 2 - Engineering concepts and operational method uncertainties -** This general type of uncertainty is best resolved through implementation of appropriately scaled demonstration projects and associated monitoring programs to gauge results;

- **Type 3 - Ecological processes, analytical tools, and ecosystem response uncertainties -** This general type of uncertainty is best resolved through research, monitoring, and assessment of ecological processes and ecosystem responses, and improving analytical tools, such as models; and
- **Type 4 - Socio-economic/political conditions and responses uncertainties -** This general type of uncertainty is best resolved through focused research and application of socioeconomic modeling and assessment methods to better establish socioeconomic linkages that will inform more complete NED/NER analysis.

S.9 THE RECOMMENDED PLAN (THE LCA PLAN)

LCA Plan Recommendations

Based upon the best available science and engineering, professional judgment, and extensive experience in coastal restoration in Louisiana and beyond, the LCA Study identifies, evaluates, and recommends to decision makers an appropriate, coordinated, feasible solution to the identified critical water resource problems and opportunities in coastal Louisiana. This LCA Study report provides a complete presentation of the study process, results, and findings; indicates compliance with applicable statutes, executive orders, and policies; documents the Federal and non-Federal interest; and provides a sound and documented basis for decision makers at all levels to evaluate the request for the following LCA Plan components:

- Specific Congressional authorization for five near-term critical restoration features for which construction can begin within 5 to 10 years, with implementation subject to approval of feasibility-level decision documents by the Secretary of the Army (hereinafter referred to as "conditional authorization" in the Report and accompanying Programmatic Environmental Impact Statement);
  - Programmatic Authorization of a Science and Technology Program;
  - Programmatic Authorization of Science and Technology Program Demonstration Projects;
  - Programmatic Authorization for the Beneficial Use of Dredged Material;
- Programmatic Authorization for Investigations of Modification of Existing Structures;
- Approval of investigations and preparation of necessary feasibility-level reports of 10 additional near-term critical restoration features to be used to present recommendations for potential future Congressional authorization (hereinafter referred to as "Congressional authorization"); and
- Approval of investigations for assessing six potentially promising large-scale and long-term restoration concepts.

Near-Term Critical Restoration Features for Conditional Authorization

The LCA Plan includes five near-term critical restoration features, which are recommended for specific authorization for implementation subject to approval of feasibility-level decision documents by the Secretary (conditional authorization). Implementation of these five restoration features would be subject to completion of NED/NER analyses, NEPA compliance requirements, and appropriate feasibility-level decision documentation. These feasibility-level decision documents would be developed utilizing current policies and guidelines to provide a sound basis for decision makers at all levels.

Initial analysis indicates that these features address the most critical ecological needs of the Louisiana coastal area in locations where delaying action would result in a "loss of opportunity" to achieve restoration and/or much greater restoration costs. All of these features, based on preliminary estimates, appear to be cost effective and provide significant value to address critical natural and human ecological needs. These five critical near-term features present a range of effects essential for success in restoring the Louisiana coast. The benefits provided by these features include: the sustainable reintroduction of riverine resources; rebuilding wetlands in areas at high risk for future loss; the preservation and maintenance of critical coastal geomorphic structure; the preservation of critical areas within the coastal ecosystem; and, the opportunity to begin to identify and evaluate potential long-term solutions. Based on a body of work both preceding and including this study effort, the PDT produced an estimate of average annual costs and benefits for these five features. This information shows that average annual environmental output for this authorized feature package would be on the order of 22,000 habitat units[1] at an average annualized cost of $2,700 per unit provided.

The ecologic model output for land building estimates that the plan would offset approximately 62.5 percent of the 462,000 acres projected to be lost within the coast under the no action alternative. The estimated land building for Subprovince 1 exceed projected no action losses. In Subprovinces 2 & 3 the models estimated that the LCA plan prevented almost 50 percent of the expected losses in each basin. These estimates do not include any projects in Subprovince 4.

The LCA Plan presents significant capacity for the prevention of future wetland loss with a smaller component of wetland building capacity. Although the LCA Plan acts significantly to reduce future loss of ecosystem structure and function, overall levels of environmental outputs will remain significantly reduced compared to historical conditions. This is especially true in Subprovince 4 where limited actions are recommended in the LCA Plan.

Upon completion of the feasibility-level decision documents for the restoration features included in this component, the projects will be forwarded to the Secretary of the Army for implementation approval and subsequent inclusion in the USACE annual budget cycle. The five features are:

- Mississippi River Gulf Outlet (MRGO) environmental restoration features
- Small diversion at Hope Canal[2]
- Barataria Basin barrier shoreline restoration (Caminada Headland and Shell Island reaches)
- Small Bayou Lafourche reintroduction[2]
- Medium diversion with dedicated dredging at Myrtle Grove[2]

[1] For Habitat Units: See Glossary
[2] Diversion/Re-introduction sizes: Small diversion: 1,000 cfs – 5,000 cfs; Medium diversion: 5,001 cfs to 15,000 cfs; Large diversion: > 15,000 cfs

Science and Technology Program

While the LCA Plan is based upon the best available science and technology and takes advantage of more than 20 to 30 years of experience gained from previous Louisiana coastal restoration efforts, such as CWPPRA, there remain scientific and technical uncertainties associated with some of the proposed Louisiana coastal area restoration efforts (see section 3.1 for a detailed discussion of uncertainties). The USACE and the non-Federal sponsor have developed a Science and Technology Program (S&T Program) to provide a strategy, organizational structure, and processes to facilitate integration of science and technology into the decision-making processes for Program Management, the Program Execution Team, and the Science and Technology Plan (S&T Plan). Programmatic authorization and implementation of this S&T Program would ensure that the best available science and technology are available for use in the planning, design, construction, and operation of the LCA Plan components, as well as other coastal restoration projects and programs, such as CWPPRA. There are five primary elements in the LCA S&T Program, and each element has a different emphasis and requirement. These elements include: (1) Science Information Needs, (2) Data Acquisition and Monitoring, (3) Data and Information Management, (4) Modeling and Adaptive Management, and (5) Research. (Additional information on the structure and purpose of the S&T Program is provided in appendix A, SCIENCE AND TECHNOLOGY PROGRAM.) The S&T Program is designed to encourage creativity and scientific collaboration in responding to the needs of the restoration program. Scientific and technological uncertainties would also be addressed through the identification, development and implementation of appropriate demonstration projects.

Science and Technology Program Demonstration Projects

The purpose of the recommended LCA S&T Program Demonstration Projects is to resolve critical areas of scientific, technical, or engineering uncertainty while providing meaningful restoration benefits whenever possible. The types of uncertainty that are best resolved through implementation of appropriately scaled demonstration projects are the "Type 2" uncertainties presented in section 3.1. After design, construction, monitoring, and assessment of individual demonstration projects, the LCA program will leverage "lessons learned" to improve the planning, design, and implementation of other LCA restoration projects.

Demonstration projects may be necessary to address uncertainties that would be identified in the course of individual project implementation or during the course of studies of large-scale and long-term restoration concepts. Nominated demonstration projects would be subject to review and approval of individual project feasibility-level decision documents by the Secretary of the Army. In addition to standard feasibility-level decision document information, the demonstration project feasibility-level documents would address:

- Major scientific or technological uncertainties to be resolved; and
- A monitoring and assessment plan to ensure that the demonstration project would provide results, and that contributes to overall LCA program effectiveness.

It is proposed that demonstration projects developed by the S&T program be funded as a construction item at an amount not to exceed $100 million over 10 years, including a maximum cost of $25 million per project. Five initial candidate demonstration projects were developed by the PDT , but these may be modified or replaced by demonstration projects of higher priority as determined by the S&T Director. In order to support continued development of the LCA plan through AEAM, it is possible that additional and/or different demonstration projects will be needed. The PDT identified the following five candidate demonstration projects:

- Marsh restoration and/or creation using non-native sediment
- Marsh restoration using long-distance conveyance of sediment
- Canal restoration using different methods
- Shoreline erosion prevention using different methods
- Barrier island restoration using offshore and riverine sources of sediment

Programmatic Authorization for the Beneficial Use of Dredged Material

The USACE, Mississippi Valley Division, New Orleans District (the District) has the largest annual channel operations and maintenance (O&M) program in the USACE, with an annual average of 70 million cubic yards (mcy) (53.6 million cubic meters) of material dredged. At this time, approximately 14.5 mcy (11.1 million cubic meters) of this material is used beneficially in the surrounding environment with funding from either the O&M program itself or the Continuing Authorities Program (CAP) defined by the WRDA 1992 Section 204 for beneficial use of dredged material. The amount of material generated by O&M operations, the volume of material recovered for beneficial use in existing operations, and the potential total volume of material that can be reused varies considerably from year to year, based on the type of dredging operations being performed and their environmental setting. The LCA Plan's effectiveness would be enhanced by a programmatic authorization for expanding the beneficial use of dredged material. The proposed beneficial use program would allow the District to take greater advantage of existing sediment resources made available by maintenance activities to achieve restoration objectives. Annualized, there is reasonable potential to use an additional 30 mcy (23 million cubic meters) of material beneficially if funding were made available. (A portion of the average annual material total of 70 mcy (53.6 million cubic meters) is not available for beneficial use because it is re-suspended from upstream maintenance). Other limitations within particular areas include threatened and endangered species operating restrictions; cultural resource site operating restrictions; and unfavorable maritime working conditions. The following projects are a small subset of the many areas with significant opportunity for additional beneficial use:

- The MRGO, LA, project;
- The bay reach of the Barataria Bay Waterway, LA project;
- The [lower] MR&T project, Head of Passes and Southwest Pass;
- The Atchafalaya River and Bayous Chene, Boeuf, and Black, LA, project;
- The inland reach of the Calcasieu River and Pass, LA, project; and
- The Houma Navigation Canal.

The LCA Plan recommends authorization of $100 million in programmatic authority for the additional funding needed for beneficial use of dredged material generated by existing programs.

Past Section 204 projects have demonstrated an incremental cost of $1.00 per cubic yard (cy) for beneficial placement. Additionally, these projects have demonstrated approximately 0.00025 acre created per cy. Based on the requested funds and a 10-year period of implementation, it is expected that the LCA beneficial use of dredged material could attain 21,000 acres (8,502 ha) of newly created wetlands. This recommended beneficial use program represents a significant opportunity to contribute to the accomplishment of the LCA objectives.

Programmatic authorization for the beneficial use of dredged material would allow the application of funds appropriated through LCA under guidelines similar to those of the Continuing Authorities Program defined by Section 204 of the Water Resources Development Act (WRDA) of 1992. Implementation would proceed with a more detailed analysis of the potential beneficial use disposal sites, a process that would be repeated annually within the O&M "Base Plan" cycle.

Programmatic Authorization for Investigations of Modifications of Existing Structures

Coastal Louisiana is a dynamic environment that requires continual adaptation of restoration plans. With this recognition, opportunities for modifying or rehabilitating existing structures and/or their operation management plans to contribute to the ecosystem restoration objectives may be required in the future. Initiation of investigations of modifications to existing structures requires advanced budgeting. Standard budgeting may limit responsiveness to recommendations made within the LCA Plan. As a result, the LCA Plan seeks programmatic authorization to initiate studies of existing structures using funds within the LCA appropriations, not to exceed $10 million.

Near-term Critical Restoration Features Recommended for Study and Future Congressional Authorization

The following component of the LCA Plan is not proposed for immediate construction authorization, but it is included in the plan for study and preparation of design and decision documents. These projects would then be submitted to Congress for construction authorization in future Water Resource Development Acts. Based on an analysis of the current plan implementation schedule, the recommended features would have feasibility-level decision documents or Feasibility Reports completed and ready to submit to Congress through FY 2013. Plan implementation would begin with basin-by-basin studies evaluating hydrodynamic and ecological responses of the critical restoration features that have been recommended for Congressional authorization. The projected outputs for these features would be evaluated by Cost Effectiveness / Incremental Cost Analysis (CE/ICA) to determine the cost-effective alternatives for implementation. This CE/ICA analysis would support the feasibility-level decision documents submitted for Congressional authorization.

The LCA Plan recommends 10 additional critical near-term restoration features throughout coastal Louisiana for further studies, in anticipation that such features may be subsequently recommended for future Congressional authorization. Proposed restoration features employ a variety of restoration strategies, such as freshwater and sediment diversions; interior shoreline protection; barrier island and barrier headland protection; and use of dredged material for marsh restoration. The USACE and the non-Federal sponsor concur that each of the identified restoration opportunities could begin construction within the next 10 years. The 10 restoration features recommended for study and future Congressional authorization in the LCA Plan are:

- Multi-purpose operation of the Houma Navigation Canal Lock;
- Terrebonne Basin barrier shoreline restoration;
- Maintain land bridge between Caillou Lake and Gulf of Mexico;
- Small diversion at Convent/Blind River;
- Increase Amite River Diversion Canal influence by gapping banks;
- Medium diversion at White's Ditch;
- Gulf shoreline stabilization at Point Au Fer Island;
- Convey Atchafalaya River water to northern Terrebonne marshes – via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, and enlarging constrictions in the GIWW, and enlarging constrictions in the GIWW below Gibson and Houma, and Grand Bayou conveyance channel construction/enlargement;
- Modification of Caernarvon diversion; and
- Modification of Davis Pond diversion.

Large-Scale and Long-Term Concepts Requiring Detailed Study

Several candidate large-scale and long-term concepts for potential incorporation into the LCA Plan were identified during plan formulation. These restoration concepts exhibited significant potential to contribute to achieving restoration objectives in 1) the subprovince within which they would be located, 2) adjacent subprovince(s), and/or 3) substantial portions of Louisiana's coastal ecosystem. Accordingly, the corresponding benefits and costs for these potential plan features should be further analyzed and confirmed to determine how best to incorporate them, if at all, with other plan features. Upon completion of detailed feasibility studies as part of the LCA Plan, recommendations for action would be documented and proposed for Congressional authorization.

The LCA Plan recommends the initiation of six feasibility studies of large-scale and long-term restoration concepts which, based on scope and/or complexity, would require more time and further study prior to implementation. The large-scale and long-term study initiatives identified in the plan include:

- Mississippi River Hydrodynamic Study
- Mississippi River Delta Management Study
- Third Delta Study
- Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study
- Acadiana Bays Estuarine Restoration Feasibility Study
- Upper Atchafalaya Basin Study (this study would include evaluation of alternative operational schemes of Old River Control Structure and will be funded under MR&T)

S.10 COMPARISON OF IMPACTS

In the future without-project conditions, offshore sand deposits would be subject to the multiple uses presently occurring. ALT B, which focuses on restoration of critical deltaic processes, would have no impact on these deposits. ALT D, which focuses on restoration of critical geomorphological structures, would require about 61,100,000 cubic yards (cy) of sands that would probably be removed from Ship Shoal and the Barataria Basin offshore sites. There would be temporary adverse impacts on benthos. Disturbance of large areas of gulf bottoms could change wave and littoral drift dynamics. The LCA Plan, which is a combination of ALT B and ALT D features, would remove these same resources and have impacts similar to ALT D.

Hydrodynamic models of the future without-project conditions indicated salinities fresher than those presently found in the influence areas of the Caernarvon and Davis Pond Diversions; this was due, in part, to both of these structures operating at a much greater capacity than at present. The Subprovince 3 model indicated salinities of less than four parts per thousand (ppt) over much of the basin except in Vermilion Bay to the west and Timbalier and Terrebonne Bays with their northern wetlands and areas south of the Marmande and Mauvais Bois Ridges. None of the restoration opportunities would change salinity in the Chenier Plain. ALT B increases introduction of Mississippi River water and sediment, as well as improves management of Atchafalaya River water in Subprovince 3, which provides significant improvements in connectivity and material exchange. Salinity regimes with ALT B would be similar to the future without-project conditions, except there would be localized freshening in the following areas: Lake Borgne, the northern part of Breton Sound, Caminada Bay and the nearby headland areas, and the upper reaches of the Terrebonne and Timbalier Bays and marshes directly north of these bays. ALT D would essentially not change salinity regimes from the future with no action. The LCA Plan would change salinities in a manner similar to ALT B.

Louisiana's barrier resources are expected to appreciably decline in the future without-project conditions due to continuing natural and human-induced processes. ALT BALT B would have essentially no impact on these resources. ALT D would have the long-term impact of restoring approximately 47.6 miles (76.6 km)of these resources. The LCA Plan would be more beneficial than ALT D because it would not only restore the approximately 47.6 miles (76.6 km) of the barrier system, but would also provide diversions that would synergistically impact the estuarine system.

About 328,000 acres (132,840 hectares [ha])of Louisiana's marshes and swamps could be lost by 2050. ALT B would increase the acreage of all wetland habitats compared to future without-project conditions. However, over the 50-year project life, a net decrease in total wetland vegetative habitats from today's acreage is predicted to occur. In the Deltaic Plain, ALT B would minimally-to-significantly increase fresh and intermediate marsh and swamp wetland forest. It would slightly increase brackish and saline marsh. The rate of loss of barrier shoreline vegetation would be similar to the future without-project conditions. ALT D would increase barrier shoreline vegetation in Subprovinces 2 and 3. In Subprovince 4, all marsh types could slightly increase. There could be an increase in all marsh types, depending on the location of the beneficial use sites. Although there would be a net gain in vegetated wetlands compared to no action conditions, there would be a decrease from present conditions. The cumulative impacts of the LCA Plan would be a synergistic result over and above the additive combination of impacts of ALT B and ALT D. The diversions and restored barrier islands and shorelines would complement each other and together result in more benefits to vegetated wetlands than either alone.

Louisiana's coastal wetlands would continue suffering extensive land loss in the future without-project conditions thereby decreasing the quantity and quality of habitats for amphibians, reptiles, mammals, and birds. There would be less stopover habitat for neotropical migratory birds. Endangered piping plover critical habitat would continue to be lost. ALT B would benefit wildlife that prefers fresher conditions (most game mammals, furbearers, reptiles and amphibians). Wintering habitat for waterfowl would be created/protected. ALT D would especially benefit migratory avian species because important stopover habitat for neotropical migrant birds would be protected. Habitat for threatened and endangered species, especially critical piping plover habitat, would also be increased. The LCA Plan would have positive synergistic impacts over and above the additive combination of impacts of ALT B and ALT DALT D.

The LCA study area supports one of the most productive fisheries in the Nation. Fishery resources are expected to decline in the future without-project conditions as open water replaces wetland habitat and the extent of marsh-water interface begins to decrease. The multiple diversions in ALT B would have the potential to significantly freshen large areas within, and possibly an entire basin. Less fresh water tolerant species, such as brown shrimp and spotted seatrout may be displaced from areas near diversions or entire hydrologic basins. The extent of this impact is dependent on the diversion location, size and operation. Species such as Gulf menhaden, blue crab, white shrimp and red drum would likely benefit from ALT B as would freshwater fishery species. With ALT D, adverse impacts to fisheries would be appreciably less. The LCA Plan should have impacts similar to ALT B. All of these restoration opportunities would have an overall benefit to fisheries compared to the future without-project conditions.

Oyster resources are anticipated to decline in the future without-project conditions as the quality of their habitat decreases and they are more exposed to the open gulf. ALT B would cause continued sedimentation and over freshening, which could result in permanent loss of oyster, populations especially in Subprovinces 1 and 2. Some populations outside the over freshened areas could benefit. ALT D would have minimal, localized impacts due to increased turbidity and siltation caused by construction, dredging and disposal activities. The LCA Plan would have synergistic impacts over and above the additive combination of impacts of ALT B and ALT DALT D.

There would be continued loss and degradation of essential fish habitat (EFH) as well as the ability of the LCA study area to support Federally managed species in the future without-project conditions. ALT B would preserve some highly productive categories of EFH that would be lost in the future without-project conditions. ALT D would also preserve some highly productive forms of EFH, this preservation is not expected to be sustainable. The LCA Plan best preserves some highly productive categories of EFH.

Continued coastal land loss and deterioration under future without-project conditions would also adversely impact threatened and endangered species that utilize the study area. The piping plover, brown pelican, and sea turtles would be the most impacted. ALT B would have little impacts on these species. In contrast, ALT D would significantly enhance and create piping plover critical habitat. Sea turtles beach habitat would also benefit. The LCA Plan would have synergistic positive impacts over and above the additive combination of impacts and benefits of ALT B and ALT D.

Should the trend of increased precipitation and climate warming continue, there would be increased runoff which may affect the total volume of fresh water in each subprovince. Overall flow in rivers and channels would remain above long-term averages, which would maintain an increased sediment load. Increased urbanization and construction could also increase runoff and sedimentation. ALT B would cause an increase in the volume of water and sediment entering each diversion receiving area, which may result in changes in water levels. ALT D would have minimal impacts on water levels; however, construction of restoration features may relocate sediment depocenters. Impacts of the LCA PLAN would be a synergistic combination of ALT B and ALT D.

Most fresh surface water supplies would be from the Mississippi and Atchafalaya Rivers and their distributaries in the future. However, salinities could increase in Bayou Lafourche, which would mean users would have to treat water for salinity or find new freshwater sources. The medium diversions along the Mississippi River under ALT B could reduce freshwater supplies to users downstream. ALT B would increase flows into receiving areas of Subprovinces 1 and 2, Bayou Lafourche, and the Terrebonne marshes, which would increase freshwater supplies to these users. ALT D would have negligible impacts. The LCA Plan would have impacts similar to ALT B.

The LCA study area, in the future without-project, would still be affected by other activities that would have both beneficial and detrimental effects on water quality. ALT B would increase sediments in the coastal zone with accompanying minor increases in trace metals and also increase agrochemicals. Nutrient enrichment could possibly lead to increased algal blooms. ALT D would have negligible effects on water quality. The LCA Plan would have impacts similar to ALT B.

Gulf hypoxia would continue, in the future without-project, to present the problems it does today. ALT B would result in a relatively small reduction in nutrients discharged into the northern gulf from the Mississippi River. Such a reduction would have a minor positive effect on hypoxia. ALT D would have no impact on hypoxia. The LCA Plan would have impacts similar to ALT B.

In the future without-project conditions, historic and cultural resources in the study area would continue to be impacted by the same forces impacting them today. With any restoration opportunity, actions would need to be examined on a project-by-project basis.

As the existing freshwater areas convert to salt-water marsh and then to open water in the future without-project conditions, recreation opportunities would decline accordingly. Another major impact could be the loss of facilities and infrastructure that support or are supported by recreational activities. ALT B would result in an increase in freshwater recreation activities and a displacement and decrease in saltwater activities in areas of freshwater reintroduction. There would be an overall positive effect on most wildlife dependent recreation. Reduction of land loss and increased land building may protect valuable infrastructure that supports certain recreation activities. ALT D would have long-term positive benefits to saltwater recreation activities. Impacts of the LCA Plan would be a synergistic combination of ALT B and ALT D.

Populations in coastal communities are expected to shift inland in the future without-project conditions. With the loss of current wetlands that provide storm surge protection it is likely that coastal infrastructure would suffer increased damages. Slow growth in employment is also expected to occur. Economic opportunities related to wetland resources would be adversely affected as these resources are depleted. With ALT B the inland population shift would be slower. Subsistence fishermen would potentially have to relocate to follow fisheries as salinities change. ALT B would also reduce the necessity for relocation, repair or replacement of infrastructure. Coastal jobs, property and population could be better protected than if nothing were done. ALT D would not require fishermen to relocate. Positive impacts would be similar to, but less than ALT B. Impacts of the LCA PLAN would be a synergistic combination of ALT B and ALT D.

Saltwater intrusion would continue in the future without-project conditions, except in areas where existing freshwater diversions are able to reverse that trend. Wetland habitat losses would decrease productivity of Louisiana's coastal fisheries. The seafood industry would likely suffer major losses in employment in the future without-project conditions as shrimp, oysters and other valuable species decline. ALT B would cause changes in fishing patterns, including fishery relocations and species harvested. ALT D would not cause fishery relocations. Impacts of the LCA Plan would be similar to those of ALT B, except the barrier island and shoreline restoration features of the LCA Plan would not cause fishery relocations. However, these preliminary estimates require additional analysis that would be accomplished during later study phases.

Saltwater intrusion would continue in the future without-project conditions, except in areas where existing freshwater diversions are able to reverse that trend. Production from oyster leases would decline gradually as areas of suitable salinity move inland and overlap with areas closed due to fecal coliform. ALT B includes diversions of a combined capacity that could potentially result in the loss of production on a large percentage of the total leased acreage in Louisiana. It is unknown whether increased harvest from other areas could offset this loss. The barrier island and shoreline restoration features of ALT D would have minimal, localized impacts in areas where construction occurs. Diversions and barrier system restoration features of the LCA Plan would generally have synergistic impacts (probably both negative and positive) on oyster leases, the extent of which is difficult to predict at this time. However, these preliminary estimates require additional analysis that would be accomplished during later study phases. Oyster surveys and modeling, where appropriate, should be conducted to determine the spatial, temporal, and cumulative impacts to private and public oyster resources in the affected environment.

Onshore oil and gas facilities and pipelines are generally not designed to accept wind and wave forces that could be experienced in the future without-project conditions. The owners would be faced with the decision to protect these facilities or curtail production. If any of the supply bases that service the offshore industry were impacted as a result of future erosion, the operational cost of offshore production could increase. Impacts to the price of crude oil or natural gas could ripple through the National economy. ALT B would provide some protection to these assets, potentially avoid the cost of relocation, and protect jobs. ALT D would provide an increased level of protection to the LOOP Facility by restoration of some of the Caminada-Moreau Headland. Impacts of the LCA Plan would be a synergistic combination of ALT B and ALT D.

All Louisiana's major ports and waterways are projected to have positive annual growth over the next 50 years. ALT B would repair and improve the Gulf Intracoastal Waterway (GIW)W, which would have positive impacts to navigation. If the final MRGO restoration features in ALT D were to include a closure or restriction, there would be direct negative impacts to navigation traffic. Impacts of the LCA Plan would be a synergistic combination of ALT B and ALT D.

Most hurricane protection levees would be at greater risk in the future without-project conditions, than they are at present. ALT B would help preserve and rebuild some of the marsh that reduces storm surge thereby providing some protection to hurricane protection levees. ALT D would rebuild some marsh, as well as barrier systems that also would help reduce storm surge thereby providing some protection to levees. Impacts of the LCA Plan would be a synergistic combination of ALT B and ALT D.

Impacts to agriculture and forestry in the future without-project conditions would be negative: continued saltwater intrusion, continued coastal erosion, and increased damages from storms. ALT B would benefit agriculture and forestry by reducing saltwater intrusion into bayous and canals. ALT D would indirectly offer some protection to agricultural lands. Impacts of the LCA PLAN would be a synergistic combination of ALT B and ALT D.

In addition, the LCA Plan successfully meets the USACE Environmental Operating Principles.

S.11 CONSISTENCY WITH OTHER EFFORTS

The District recognizes the need to ensure that development activities do not undermine or conflict with coastal restoration efforts. All alternatives would include actions to help minimize potential conflict between coastal restoration efforts and hurricane protection projects, navigation projects, and other forms of coastal development.

S.12 ADAPTIVE MANAGEMENT AND MONITORING

Adaptive management and monitoring would be an integral part of the LCA effort. Monitoring may reveal where projects have exceeded or fallen short of a desired response. It would be necessary to constantly assess the landscape and ecosystem response to the restoration actions. Such information may necessitate changes in design and/or operation for both existing and future projects to ensure that the selected alternative reaches the expected targets. It is also possible that monitoring would reveal where the expectations for the ecosystem should be adjusted to reflect new understandings with respect to the effectiveness of specific projects or types of projects. Hence, both the expectations and the projects would be subject to change in response to new data and the evolving scientific understanding of coastal restoration in Louisiana.

S.13 CONCLUSIONS AND RECOMMENDATIONS

The proposed LCA Plan would facilitate the implementation of critical restoration features, essential science and technology demonstration projects, increased beneficial use of dredged material, and modification of selected existing projects to support coastal restoration objectives. The S&T Program would provide for acquisition of data and development of analytic tools to further resolve scientific uncertainties and support program implementation. The remaining recommended plan components would provide the basis for continued restoration within an established framework.

The cost of the five Near-Term Critical Restoration Features recommended for specific Congressional authorization, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents, (referred to as "conditionally authorized" elsewhere in the report) is estimated at $864,065,000. The total cost of the Science and Technology Program, the Demonstration Projects, the Program for the Beneficial Use of Dredged Material, and Investigations of Modifications of Existing Structures is estimated at $310,000,000. The combined total cost of the previously stated components of the LCA Plan is estimated at $1,174,065,000. The total cost of Other Near-Term Critical Restoration Features and Studies Requiring Future Congressional Construction Authorization, and Large-Scale and Long-Term Concepts Detailed Studies is estimated to be $821,916,000. The total cost of the LCA Plan is estimated to be $1,995,981,000. These costs can be found in table ES-2. Currently, the annual operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs are estimated at $7,883,000. OMRR&R costs are the responsibility of the non-Federal sponsor. These costs can be found in **tables 7-3** to **7-5.**

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FINAL

PROGRAMMATIC
ENVIRONMENTAL IMPACT STATEMEMENT

Louisiana Coastal Area (LCA), Louisiana
Ecosystem Restoration Study

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CHAPTER 1 INTRODUCTION

1.1 GENERAL

This final Programmatic Environmental Impact Statement (FPEIS) for the Louisiana Coastal Area (LCA), Ecosystem Restoration Study (LCA Study) was prepared by the U.S. Army Corps of Engineers (USACE)-Mississippi Valley, New Orleans District (the District), with input provided by the Louisiana Department of Natural Resources (LDNR), and other Federal and state coastal resource agencies. The following Federal agencies are a Cooperating Agency (as defined under 40 CFR 1501.6) for the LCA Study: Minerals Management Service (MMS), Natural Resources Conservation Service (NRCS), National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), and the U.S. Geological Survey (USGS).

The Louisiana coastal plain contains one of the largest expanses of coastal wetlands in the contiguous United States (U.S.), and accounts for 90 percent of the total coastal marsh loss in the Nation. The coastal wetlands, built by the deltaic processes of the Mississippi River, contain an extraordinary diversity of coastal habitats that range from narrow natural levee and beach ridges to expanses of forested swamps and freshwater, intermediate, brackish, and saline marshes. Taken as a whole, the unique habitats, with their hydrological connections to each other, upland areas, the Gulf of Mexico, and migratory routes of birds, fish, and other species, combine to place the coastal wetlands of Louisiana among the Nation's most productive and important natural assets. In human terms, these coastal wetlands have been a center for culturally diverse social development.

Approximately 70 percent of all waterfowl that migrate through the U.S. use the Mississippi and Central flyways. With more than 5 million birds wintering in Louisiana, the Louisiana coastal wetlands are crucial habitat to these birds, as well as to neotropical migratory songbirds and other avian species who use them as crucial stopover habitat. Additionally, coastal Louisiana provides crucial nesting habitat for many species of water birds, such as the endangered brown pelican. These economic and habitat values, which are protected and supported by the coastal wetlands of Louisiana, are significant on a National level.

Louisiana's coastal wetlands and barrier island systems enhance protection of an internationally significant commercial-industrial complex from the destructive forces of storm-driven waves and tides. A complex of deep-draft ports includes the Port of South Louisiana, which handles more tonnage than any other port in the Nation, and the most active segment of the Nation's Gulf Intracoastal Waterway (GIWW) (Waterborne Commerce Statistics Center (WCSC) 2002). In 2000, Louisiana led the Nation with production of 592 million barrels of oil and condensate (including the outer continental shelf (OCS)), valued at $17 billion, and was second in the Nation in natural gas production with $1.3 billion (excluding OCS and casing head gas) (Louisiana Department of Natural Resources [LDNR] 2003a). In addition, nearly 34 percent of the Nation's natural gas supply and over 29 percent of the Nation's crude oil supply moves through the state and is connected to nearly 50 percent of U.S. refining capacity (LDNR 2003a).

Additionally, coastal Louisiana is home to over 2 million people, representing 46 percent of the state's population. When investments in facilities, supporting service activities, and the urban infrastructure are totaled, the capital investment in the Louisiana coastal area adds up to approximately $100 billion. Excluding Alaska, Louisiana produced the Nation's highest commercial marine fish landings (about $343 million) excluding mollusk landings such as clams, oysters, and scallops (National Marine Fisheries Service (NMFS) 2003). Recent data from the U.S. Fish and Wildlife Service (USFWS) show expenditures on recreational fishing (trip and equipment) in Louisiana to be nearly $703 million, and hunting expenditures were valued at $446 million in 2001 (USFWS 2002).

Louisiana's coastal wetlands were built by deltaic processes involving the transport of enormous volumes of sediment and water by the Mississippi River. This sediment was eroded from the lands of the vast Mississippi River Basin in the interior of North America. For the last several thousand years, the dominance of the land building or deltaic processes resulted in a net increase of more than four million acres of coastal wetlands. In addition, there was the creation of an extensive skeleton of higher natural levee ridges along the past and present Mississippi River channels, distributaries, and bayous in the Deltaic Plain and beach ridges of the Chenier Plain. The landscape created by these deltaic processes gave rise to one of the most productive ecosystems on Earth.

Today, most of the Mississippi River's fresh water, with its nutrients and sediment, flows directly into the Gulf of Mexico, largely bypassing the coastal wetlands. Deprived of land-building sediment, the wetlands are damaged by saltwater intrusion and other causative factors associated with sea level change and land subsidence, and will eventually convert to open water. Deprived of the nutrients, the plants that define the surface of the coastal wetlands die off. Once the coastal wetlands are denuded of vegetation, the fragile substrate is left exposed to the erosive forces of waves and currents, especially during tropical storm events.

Since the 1930s coastal Louisiana has lost more than 1.2 million acres (485,830 ha) (Barras et al. 2003; Barras et al. 1994; and Dunbar et al. 1992). As recently as the 1970s, the loss rate for Louisiana's coastal wetlands was as high as 25,200 acres per year (10,202 ha per year). The rate of loss from 1990 to 2000 was about 15,300 acres per year (6,194 ha per year), mainly due to the residual effects of past human activity (Barras et al. 2003). It was estimated in 2000 that coastal Louisiana would continue to lose land at a rate of approximately 6,600 acres per year (2,672 ha per year) over the next 50 years. It is estimated that an additional net loss of 328,000 acres (132,794 ha) may occur by 2050, which is almost 10 percent of Louisiana's remaining coastal wetlands (Barras et al. 2003). The cumulative effects of human and natural activities in the coastal area have severely degraded the deltaic processes and shifted the coastal area from a condition of net land building to one of net land loss.

In 1990, passage of the Coastal Wetlands Planning, Protection and Restoration Act, (PL-101-646, Title III, CWPPRA), provided authorization and funding for the Louisiana Coastal Wetlands Conservation and Restoration Task Force to begin actions to curtail wetland losses. In 1998, after extensive studies and construction of a number of coastal restoration projects accomplished under CWPPRA, the State of Louisiana, and the Federal agencies charged with restoring and protecting the remainder of Louisiana's valuable coastal wetlands developed the

"Coast 2050: Toward a Sustainable Coastal Louisiana" report, known as the Coast 2050 Plan. The underlying principles of the Coast 2050 Plan are to restore or mimic the natural processes that built and maintained coastal Louisiana. This plan proposed ecosystem restoration strategies that would result in efforts larger in scale than any that had been implemented in the past.

The Coast 2050 Plan was the basis for the May 1999 report, entitled Section 905(b) ([Water Resource Development Act] (WRDA) 1986) Analysis Louisiana Coastal Area, Louisiana -- Ecosystem Restoration. This reconnaissance-level effort evaluated the Coast 2050 Plan as a whole and expressed a Federal interest in proceeding to the feasibility phase. In 2000, it was envisioned that a series of feasibility reports would be prepared over a 10-year period. The first feasibility efforts focused on the Barataria Basin and involved marsh creation and barrier shoreline restoration. However, early in fiscal year (FY) 2002, it was recognized that it would be more efficient to develop a comprehensive coastal restoration effort that could be submitted to Congress as a blueprint for future restoration efforts. As a result, the USACE and the State of Louisiana initiated the Louisiana Coastal Area (LCA) Comprehensive Coastwide Ecosystem Restoration Study. In FY 2004, recognition of Federal and state funding constraints and scientific and engineering uncertainties pertaining to some of the restoration features under consideration led to the determination that the coastal area ecosystem restoration effort should begin with the development and implementation of a restoration plan that identifies highly cost-effective restoration features that address the most critical needs of coastal Louisiana, as well as large-scale and long-term restoration concepts.

1.2 STUDY AUTHORITY

This LCA Ecosystem Restoration Study (LCA Study) is authorized through resolutions of the U.S. House of Representatives and Senate Committees on Public Works, 19 April 1967 and 19 October 1967. These resolutions contain the following language:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902, be, and is hereby requested to review the reports of the Chief of Engineers on the Mermentau River and Tributaries and Gulf Intracoastal Waterway and connecting waters, Louisiana, published as Senate Document Numbered 231, Seventy-ninth Congress, on the Bayou Teche, Teche-Vermilion Waterway and Vermilion River, Louisiana, published as Senate Document Numbered 93, Seventy-seventh Congress, on the Calcasieu River salt water barrier, Louisiana, published as House Document Numbered 582, Eighty-seventh Congress, and on Bayous Terrebonne, Petit Caillou, Grand Caillou, Dularge, and connecting channels, Louisiana, and the Atchafalaya River, Morgan City to the Gulf of Mexico, published as House Document Numbered 583, Eighty-seventh Congress, and other pertinent reports including that on Bayou Lafourche and Lafourche-Jump Waterway, Louisiana, published as House Document Numbered 112, Eighty-sixth Congress, with a view to determining the advisability of improvements or modifications to existing improvements in the coastal area of Louisiana in the

interest of hurricane protection, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resource purposes."

Attachment 1 includes summaries of other pertinent coastal restoration and related water resources authorizations that may be useful for implementing coastal restoration.

1.3 STUDY PURPOSE AND SCOPE

The purpose of the LCA Study is to:

- Identify the most critical human and natural ecological needs of the coastal area;
- Present and evaluate conceptual alternatives for meeting the most critical needs;
- Identify the kinds of restoration features that could be implemented in the near-term (within 5 to 10 years) that address the most critical needs, and propose to address these needs through features that provide the highest return in net benefits per dollar of cost;
- Establish priorities among the identified near-term restoration features;
- Describe a process by which the identified priority near-term restoration features could be developed, approved, and implemented;
- Identify the key scientific uncertainties and engineering challenges facing the effort to protect and restore the ecosystem, and propose a strategy for resolving them;
- Identify, assess and, if appropriate, recommend feasibility studies that should be undertaken within the next 5 to 10 years to fully explore other potentially promising large-scale restoration concepts; and
- Present a strategy for addressing the long-term needs of coastal Louisiana restoration beyond the near-term focus of the Louisiana Coastal Area Ecosystem Restoration Plan (LCA Plan).

The goal of the LCA Plan is to reverse the current trend of degradation of the coastal ecosystem. The plan emphasizes the use of restoration strategies that: reintroduce historical flows of river water, nutrients, and sediment to coastal wetlands: restore coastal hydrology to minimize saltwater intrusion; and maintain the structural integrity of the coastal ecosystem. Execution of the LCA Plan would make major progress towards achieving and sustaining a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the economy and well being of the Nation. Benefits to and effects on existing infrastructure, including navigation, hurricane protection, flood control, land transportation works, agricultural lands, and oil and gas production and distribution facilities were strongly considered in the formulation of coastal restoration plans.

The LCA Plan is based upon the extensive experience gained through the on-going CWPPRA implementation effort, best available science and engineering, professional judgment, and other extensive experience in coastal restoration in Louisiana and beyond. The LCA Plan identifies, evaluates, and recommends to decision makers an appropriate, coordinated, and feasible course of action to address the identified critical water resource problems and restoration opportunities in coastal Louisiana. This report provides a complete presentation of the study process, results, and findings; indicates compliance with applicable statutes, executive orders, and policies;

documents the Federal and non-Federal interest; and provides a sound and documented basis for decision makers at all levels to evaluate the request for:

- Specific authorization for implementation of five (5) near-term critical restoration features for which construction can begin within 5 to 10 years, subject to approval of feasibility-level decision documents by the Secretary of the Army (hereinafter referred to as "conditional authorization" in the Main Report and accompanying Final Environmental Impact Statement);
- Programmatic Authorization of a Science and Technology Program;
- Programmatic Authorization of Science and Technology Program Demonstration Projects;
- Programmatic Authorization for the Beneficial Use of Dredged Material;
- Programmatic Authorization for Investigations of Modification of Existing Structures;
- Approval of ten (10) additional near-term critical restoration features and authorization for investigations to prepare necessary feasibility-level reports to be used to present recommendations for potential future Congressional authorizations (hereinafter referred to as "Congressional authorization"); and
- Approval of investigations for assessing six potentially promising large-scale and long-term restoration concepts.

The approval of the LCA Plan would initiate development of a series of feasibility-level decision documents that would provide detailed project justification, design, and implementation data. These future feasibility-level decision documents would support requests for project construction and would provide the basis for the implementation of the plan documented in this study report.

1.4 STUDY AREA DESCRIPTION

The study area, which includes Louisiana's coastal area from Mississippi to Texas, is comprised of two wetland-dominated ecosystems, the Deltaic Plain of the Mississippi River and the closely linked Chenier Plain, both of which are influenced by the Mississippi River. For planning purposes, the study area was divided into four subprovinces, with the Deltaic Plain comprising Subprovinces 1, 2, and 3, and the Chenier Plain comprising Subprovince 4 (**figure 1-1**).

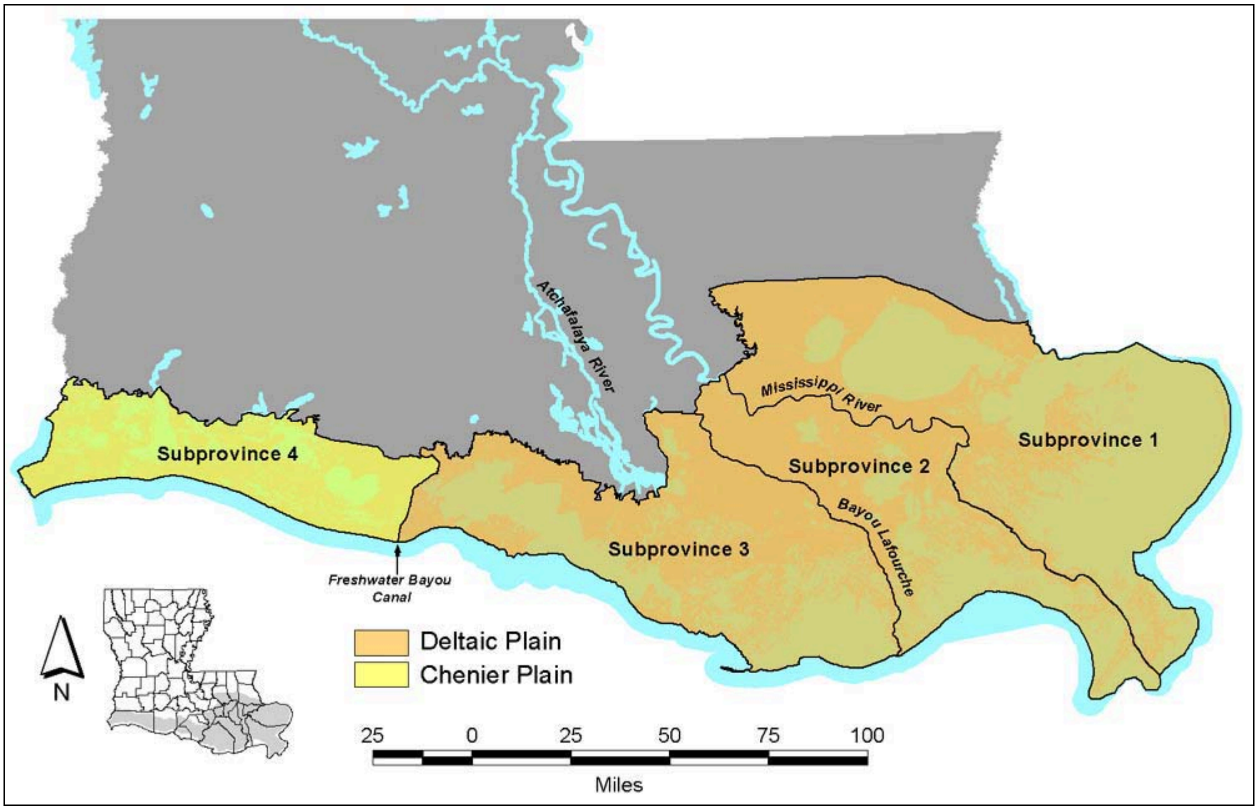

Figure 1-1. LCA Study Area and Subprovinces.

Louisiana parishes included in the study area are: Ascension, Assumption, Calcasieu, Cameron, Iberia, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and Vermilion (**figure 1-2**). Subprovince 1 covers portions of Livingston, Tangipahoa, St. Tammany, St. Bernard, Orleans, St. Charles, St. John the Baptist, St. James, Ascension, Plaquemines, and Jefferson Parishes. Subprovince 2 covers all or part of Ascension, Plaquemines, Jefferson, Lafourche, St. Charles, St. James, St. John the Baptist, and Assumption Parishes. Subprovince 3 contains all or part of Lafourche, Terrebonne, Assumption, Iberville, St. Martin, Iberia, St. Mary, and Vermilion Parishes. Subprovince 4 contains all or part of Vermilion, Cameron, and Calcasieu Parishes.

Today, the Deltaic Plain is a vast wetland area stretching from the eastern border of Louisiana to Freshwater Bayou. It is characterized by several large lakes and bays, natural levee ridges (up to 20 feet [6.1 meters] above sea level), and bottomland hardwood forests that gradually decrease in elevation to various wetland marshes. The Deltaic Plain contains numerous barrier islands and headlands, such as the Chandeleur Islands, Barataria Basin Barrier Islands, and Terrebonne Basin Barrier Islands. The Chenier Plain extends from the Teche/Vermilion bays to Louisiana’s western border with Texas, and is characterized by several large lakes, marshes, cheniers, and coastal beaches.

Within the broadly delineated zones of marsh habitat types, a variety of other wetland habitats (with distinct surface features and vegetative communities) occur in association with the marshes. These include swamp and wetland forests, beach and barrier islands, upland, and other important habitats. There are also unique vegetative communities in the coastal area, such as floating marshes and maritime forests, that contribute to the extensive diversity of the coastal ecosystem and which are essential to the overall stability of the ecosystem.

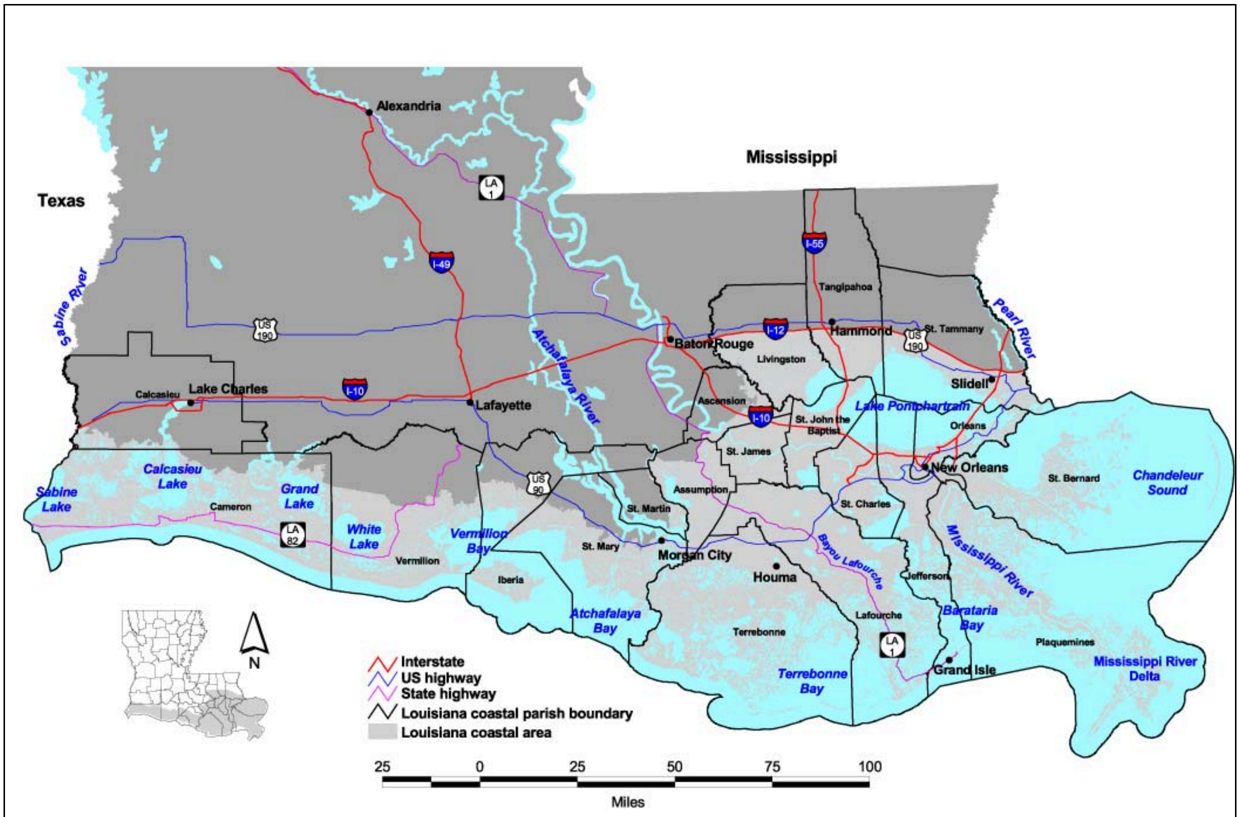

Figure 1-2. LCA Study Area Parishes, Major Water Bodies, and Highways.

Subprovince 1 includes Breton Sound, Pontchartrain Basin, portions of the Pearl hydrologic basin, and the eastern portion of the lower Mississippi River Delta (**figure 1-3**). The Pontchartrain Basin, the largest in the subprovince, is about 4,200 square miles (10,920 square kilometers) of estuarine habitat, and receives runoff from several smaller basins, including the Amite, Tickfaw, Tangipahoa, and Tchefuncte Basins. Lake Maurepas, Lake Pontchartrain, and Lake Borgne are the major lakes found in the basin. Pass Manchac connects Lake Maurepas with Lake Pontchartrain, while Chef Menteur Pass and the Rigolets connect Lake Pontchartrain with Lake Borgne and Mississippi Sound.

The Breton Sound Basin includes Lakes Lery and Big Mar, which are the largest water bodies in the northern part of the basin. Black Bay, California Bay, and Breton Sound are located in the southern part of the basin. Breton Sound is the largest water body in the subprovince. Currently, the Caernarvon Freshwater Diversion project introduces freshwater, sediment, and nutrients into the Lake Lery area of the upper Breton Sound marshes.

Major navigational channels include the MRGO, the GIWW, and the Mississippi River. The first two of these navigation channels introduce and/or compound marine influences in many of the coastal wetlands and water bodies within the subprovince.

The lower portion of the subprovince contains many tidal channels. This area contains great habitat diversity, including extensive bottomland hardwood forests adjacent to the Mississippi River. Cypress-tupelo swamp covers the upper portion of the subprovince. South of the swamps, marshes extend to the Gulf of Mexico and the Mississippi Delta. Fresh marshes are found in the north, with a band of intermediate marsh lying southward. Portions of the subprovince contain brackish marshes, and saline marshes fringe the Gulf of Mexico and Breton Sound.

The 46-mile-long (74-km long) Chandeleur barrier island system is the oldest barrier island arc in the Deltaic Plain and encloses Breton and Chandeleur Sounds in St. Bernard and Plaquemines Parishes and is now over 15 miles (24 kilometers) from the marshland fringes of Breton Sound Basin.

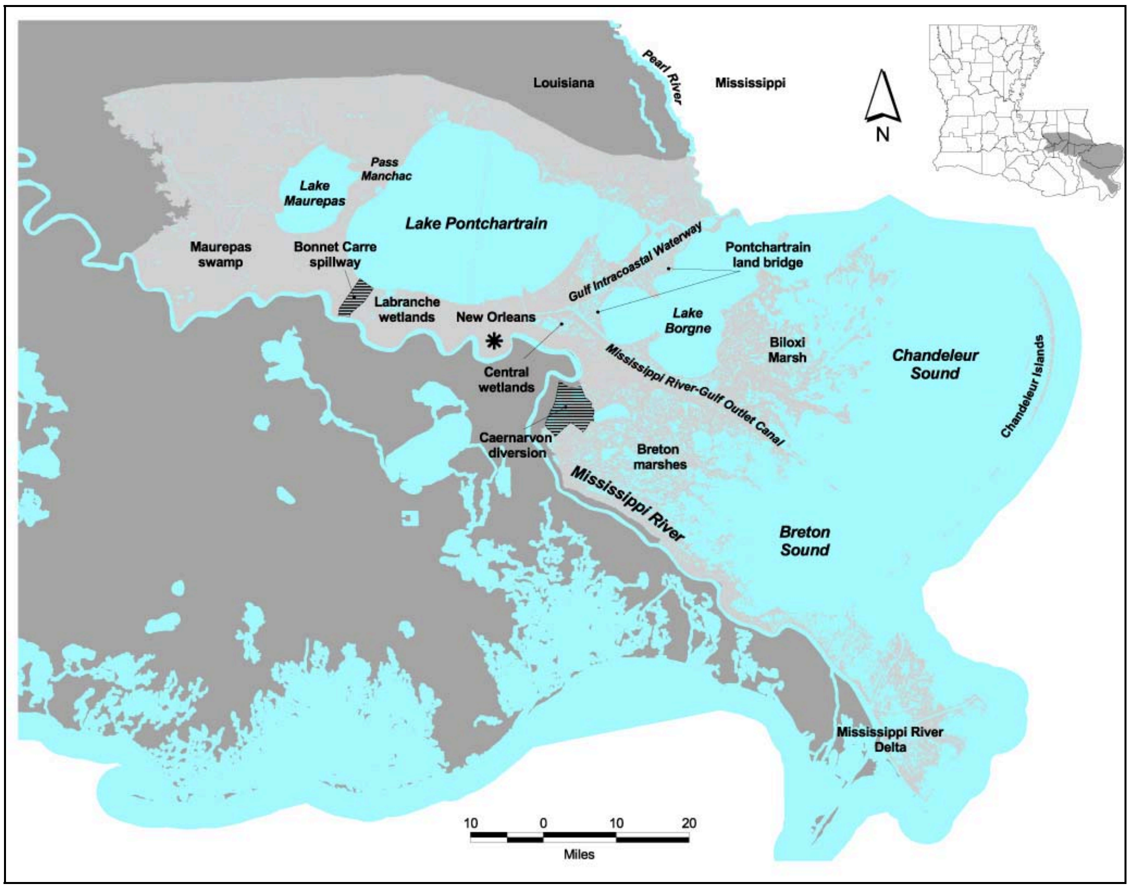

Figure 1-3. Major hydrologic features of Subprovince 1.

<u>Subprovince 2</u>

Subprovince 2 is defined by the hydrologic boundary of the Barataria Basin, which is approximately 2,446 square miles (6,359 square kilometers), and the western portion of the lower Mississippi River Delta. The basin contains four major lakes; Lake Salvador, Lake Cataouatche, Little Lake, and Lac Des Allemands (**figure 1-4**). The basin is separated from the gulf by a chain of barrier islands, which serve as a natural barrier to storm events and reduce marine influences on interior wetlands within the basin.

Currently, the Davis Pond Freshwater Diversion project directs Mississippi River water into the upper portion of the basin's wetlands. The primary purpose of the Davis Pond project has been to maintain salinity gradients in the central portion of the Barataria Basin. A majority of wetlands in the western portion of the basin are hydrologically isolated from riverine influences of the Mississippi River.

Major navigational channels in the subprovince include the Mississippi River, Barataria Bay Waterway, and GIWW. Barataria Bay Waterway and the GIWW introduce and/or compound marine influences in many of the interior coastal wetlands and water bodies within the subprovince. Subprovince 2 contains great habitat diversity, including extensive bottomland hardwood forests adjacent to the Mississippi River and Bayou Lafourche. Cypress-tupelo swamps cover the upper Barataria Basin. South of these swamps, fresh, intermediate, brackish, and saline marsh extend to the Gulf of Mexico.

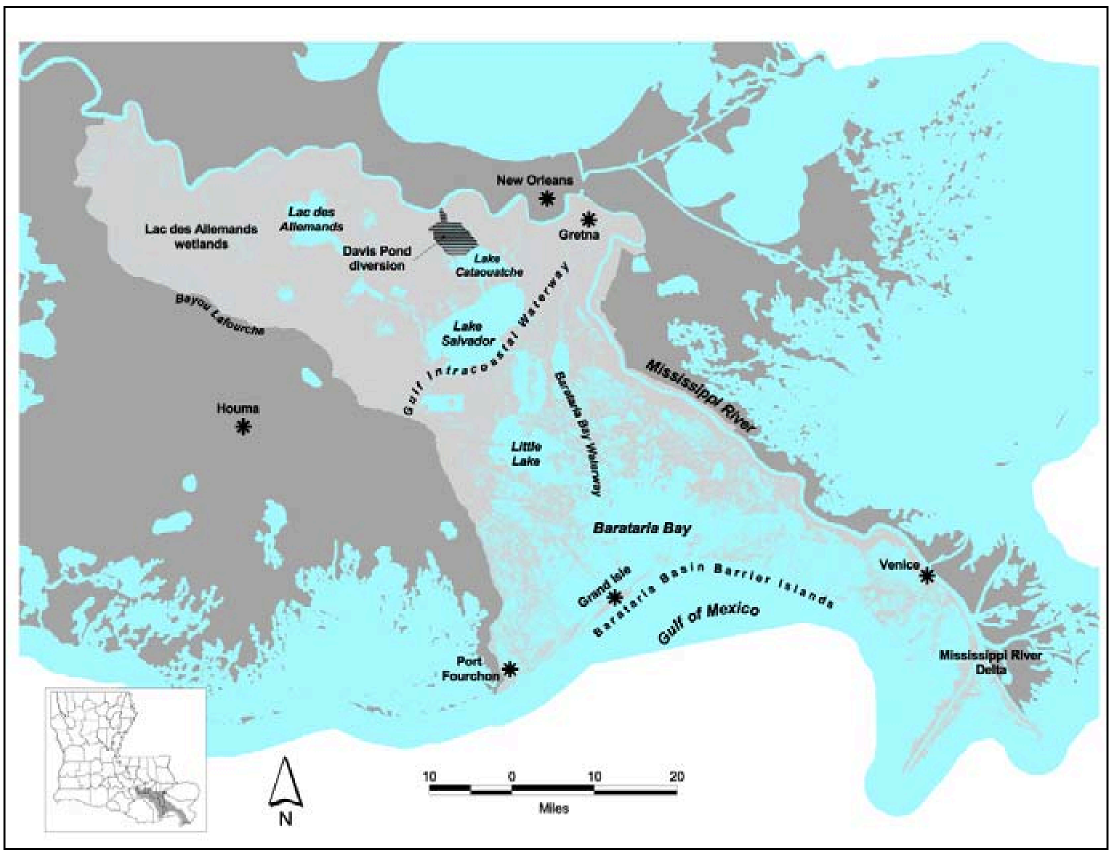

Figure 1-4. Major Hydrologic Features of Subprovince 2.

Subprovince 3

Subprovince 3 consists of the Teche/Vermilion and Terrebonne Basins, and portions of the Atchafalaya Basin. The Teche/Vermilion Basin extends from Point Chevreuil to Freshwater Bayou Canal and includes East and West Cote Blanche Bays, Vermilion Bay, and the surrounding marshes (**figure 1-5**). The Teche/Vermilion Basin has a drainage area of 3,040 square miles (7,904 square kilometers). The Atchafalaya Basin is part of the MR&T flood control system and has a drainage area of approximately 1,800 square miles (4,680 square kilometers). The Terrebonne Basin drainage area is approximately 1,455 square miles (3,783 square kilometers) in size.

The Atchafalaya River, a distributary of the Mississippi River, supports delta building and wetland creation at the Wax Lake Outlet and at the mouth of the Lower Atchafalaya River. In addition, the Lower Atchafalaya River nourishes the wetlands in the Teche/Vermilion Basin, located in the western portion of the subprovince. Wetland communities immediately adjacent to and west of the Lower Atchafalaya River are some of the healthiest wetlands in the Louisiana coastal area, fueled by the inputs of sediment and nutrients from the Atchafalaya River.

The wetland communities within the eastern portions of the Terrebonne Basin are hydrologically isolated. Wetlands in the southwestern portion of the Terrebonne Basin have some of the lowest loss rates in the state because they are nourished by the Atchafalaya River. However, the wetland communities within the northwestern portion of Terrebonne Basin, including those located both north and south of the GIWW, have been, in part, separated from the influence of the Atchafalaya River. Instead, the hydrology of these areas is influenced by a widely variable pattern of Atchafalaya River backwater effect, rainfall runoff events, and marine processes.

It is important to note that a majority of the sediment and freshwater that supports the active deltas in the Lower Atchafalaya River Basin pass through the Upper Atchafalaya River Basin, which is not within the LCA Study area. In essence, the upper basin acts as a large conveyance system and reservoir for freshwater and sediment material that eventually fuels delta building at the Wax Lake Outlet and the mouth of the Lower Atchafalaya River. While delivery of sediment material is necessary to sustain and, if possible, augment land-building processes in the LCA Study area, the continued accumulation of sediment affects the hydrology of the upper basin, and adversely impacts its cypress tupelo swamps communities.

Barrier islands separating the coast from the gulf include the Timbalier and Isles Dernieres barrier systems. These systems provide protection to interior areas by reducing marine influences, such as wave action and saltwater intrusion.

Major navigation channels in the subprovince are the Atchafalaya River, Wax Lake Outlet, Houma Navigation Canal, GIWW, and Lower Atchafalaya River (south of Morgan City). Each of these navigation channels introduces and/or compounds marine influences in many of the interior coastal wetlands and water bodies within the subprovince.

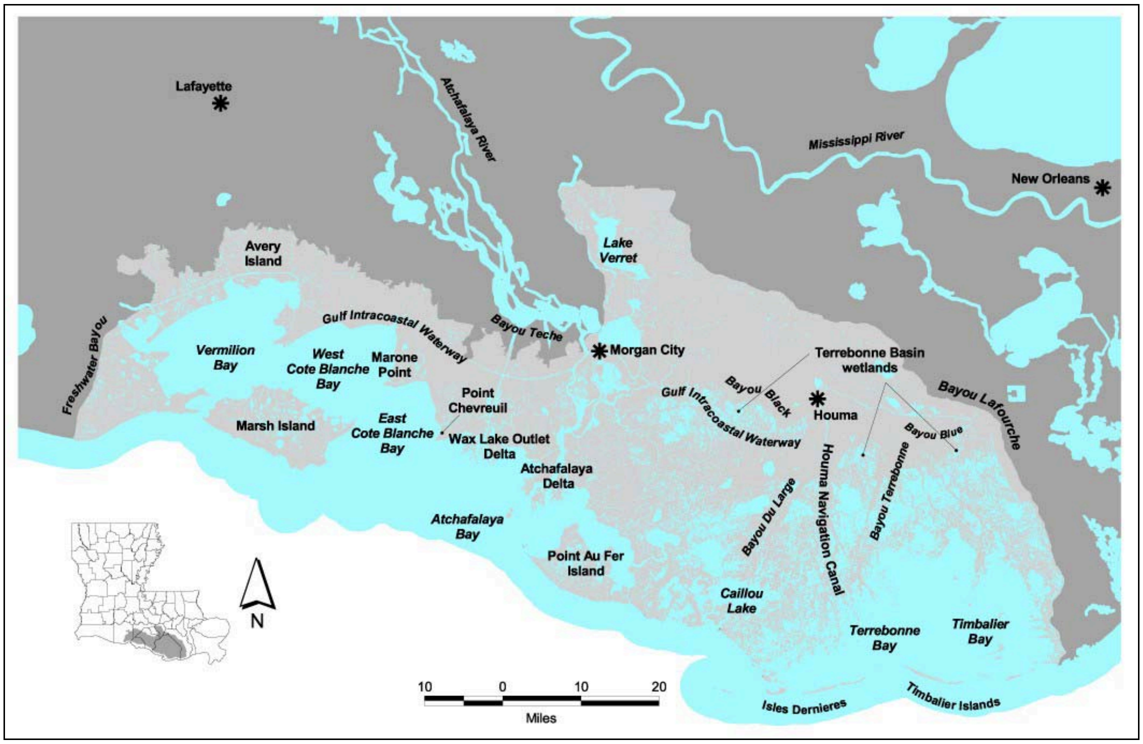

Figure 1-5. Major Hydrologic Features of Subprovince 3.

Subprovince 4

In contrast to the Deltaic Plain, the Chenier Plain formed to the west of the Mississippi River, away from active deltaic growth. The Chenier Plain extends from Freshwater Bayou, Louisiana to Sabine Pass, Texas (**figure 1-6**). As described in section 1 INTRODUCTION, Chenier Plain development is the result of the interplay of three coastal plain rivers, cycles of Mississippi River Delta development, and marine processes. Historically, cheniers acted as hydrologic barriers between the coastal salt marshes south of the cheniers and the inland fresh marshes and lakes to the north of the cheniers.

Two major hydrologic basins occur in the Chenier Plain, the Mermentau Basin and the Calcasieu/Sabine Basin. The Mermentau River is the primary freshwater supply for the Mermentau Basin, which has a drainage area of approximately 3,820 square miles (9,932 square kilometers). Hydrologic connectivity in some areas of the Chenier Plain, particularly within the Mermentau Basin, has been disrupted by several activities, including: the creation of dredge material banks from activities such as oil and gas canal dredging; the presence of east-west canals, such as the GIWW; and the operation of water control structures, such as the Calcasieu and Leland Bowman locks on the GIWW, the Freshwater Bayou Canal Lock, the Schooner Bayou Control Structure, and the Catfish Point Control Structure Grand Lake at the outlet for the Lower Mermentau River. These water control structures enable portions of the Mermentau Basin to be operated as a freshwater reservoir for agriculture, primarily rice and crawfish.

Other wetland communities have become "compartmentalized" and, in effect, hydrologically isolated through the creation of dredge material banks, roads and highways, and flood protection levees, all of which can restrict water flows into or out of the area. During extreme weather events, such as tropical storms, wetlands that are compartmentalized and/or subject to extremely slow drainage, can be particularly vulnerable to high precipitation levels, which can inundate wetlands with inches of water. In such cases, the typical result has been "ponding" of water over the wetlands. When properly managed, these may be important habitat for waterfowl. For example, the 16,000-acre (6478 ha) Pool of the Lacassine NWR and the 27,000-acre (10,931 ha) Pool 3 on the Sabine NWR were created to maintain adequate freshwater habitat for migratory waterfowl. However, excessive ponding over an extended duration of time in certain types of wetland habitats can kill the vegetative communities and result in the eventual wetland loss (conversion to open water).

The Calcasieu/Sabine Basin is a shallow coastal wetland system with freshwater input at the north end, and a north-south circulation pattern through the Calcasieu and Sabine Lakes. Some east-west water movement occurs along the GIWW and interior marsh canals. In the Calcasieu drainage basin, the drainage area north of the point where the river crosses the GIWW is 3,235 square miles (8,411 square kilometers). The Calcasieu River flows through three small lakes before flowing into Calcasieu Lake near the coast. The Sabine drainage basin has a drainage area of 9,760 square miles (25,376 square kilometers). The headwaters start in northeastern Texas and the river runs about 150 miles (241 kilometers) before it meets the Louisiana-Texas state line, then runs to the gulf. The Toledo Bend Reservoir and Sabine Lake are the major hydrologic features of the Sabine Basin.

The Sabine/Neches Waterway, Calcasieu River Navigation Channel, GIWW, Mermentau Ship Channel, and Freshwater Bayou Canal are navigational channels in the Chenier Plain that influence the hydrology within the subprovince, primarily by increasing marine influences (saltwater intrusion, wave energies) into freshwater and other interior marshes.

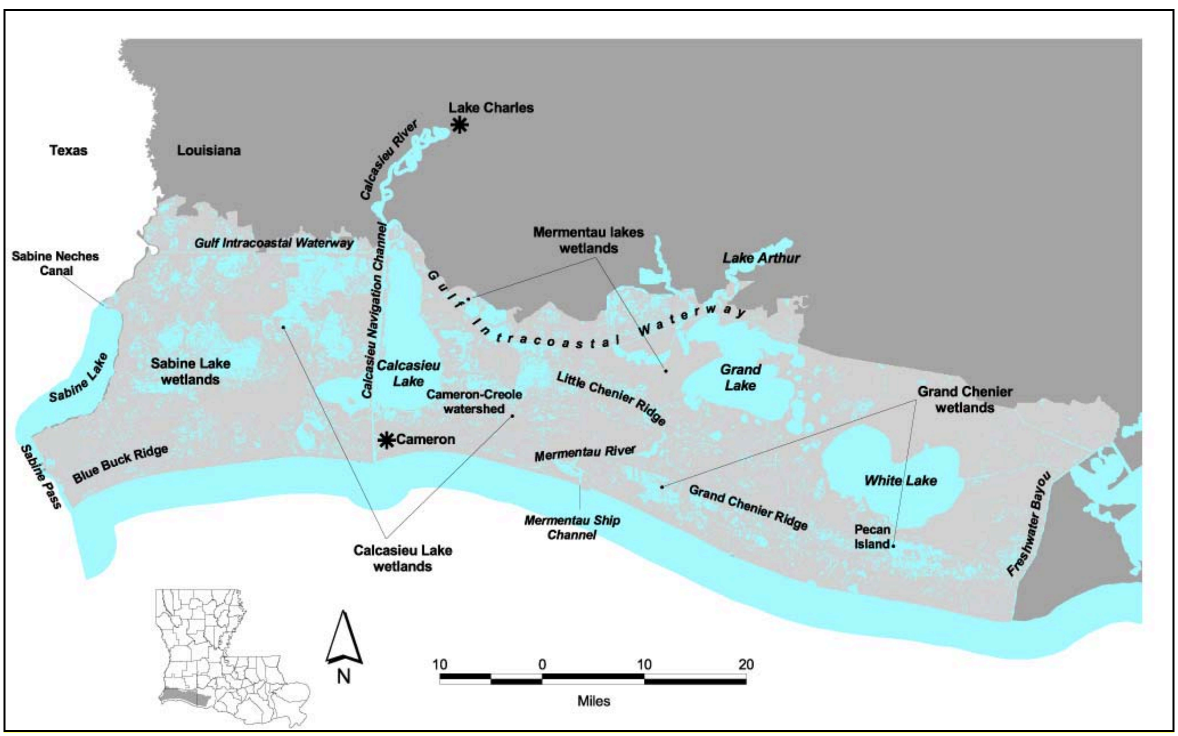

Figure 1-6. Major Hydrologic Features of Subprovince 4.

1.5 THE PROBLEM

1.5.1 Disrupting Coastal System Processes

The natural processes of subsidence, habitat switching, and erosion of wetlands, combined with a widespread human alteration, have caused significant adverse impacts to the Louisiana coastal area, including increased rates of wetland loss and ecosystem degradation. Without action, Louisiana's healthy and highly productive coastal ecosystem, composed of diverse habitats and wildlife, is not sustainable. Construction of levees along the Mississippi River has cut the coastal ecosystem off from a primary source of sediment and nutrients, and hindered the wetlands' ability to maintain their elevation in the face of sea level change and subsidence. This accompanying reduction of freshwater input has enabled saltwater to intrude into more sensitive freshwater habitats. Confinement of the Mississippi River to a channel has also resulted in the bed sediment load of the river being deposited in progressively deeper waters of the Gulf of Mexico; from these locations the sediment cannot efficiently nourish the coastal barrier shorelines. These shorelines are starved for sediment and are retreating. Infrastructure constructed for access into and across the wetlands has modified the hydrology of the coastal area, thus facilitating and accelerating saltwater intrusion and conversion of wetlands to open water. In addition, there has been a decline in the measured sediment load delivered by the Mississippi River from the rest of the drainage basin in the last 50 years.

These alterations have impacted the natural sustainability and quality of the Louisiana coastal ecosystem. This loss of sustainability has manifested itself as accelerated land loss. If recent loss rates continue into the future, even taking into account current restoration efforts, coastal Louisiana is projected to lose an additional 328,000 acres (13,284 ha) of coastal marshes, swamps, and barrier islands by the year 2050. Today, the high biological productivity of the coastal wetlands, most visibly expressed in abundant waterfowl and commercial and recreational fishery resources, masks the potential for a downward trend in biological productivity and coastal ecosystem health. The best available science on deltaic processes illustrates that biological productivity is highest during periods of wetland conversion and degradation, and that the current level of high biological productivity is unsustainable (**figure 1-7**). Unless the trend of accelerated land loss is reversed, the health and productivity of the coastal ecosystem cannot be sustained.

The loss of wetlands could result in ecosystem conversion to open water by placing the following ecosystem functions at risk:

- Vegetative habitat suitability and community diversity;
- Elevational maintenance and soil contribution from decomposing organic material;
- Protection against substrate erosion;
- Water quality improvement;
- Nutrient uptake and carbon sequestration;
- Important nursery habitat;
- North American Central Flyway and North American Mississippi Flyway waterfowl wintering habitat; and
- Resting and feeding areas for neotropical migrants.

The abundance and diversity of aquatic and terrestrial habitat types affects the biological productivity of the fish and wildlife resources in the estuarine-marsh complex. Measurement of the relationship between habitat and productivity of all resources is difficult and can best be discussed primarily in qualitative terms; that is, a beneficial or an adverse change in environmental conditions is followed by a corresponding change in productivity. However, the relationship of marsh vegetation to the productivity of the commercial fish and wildlife resources has been documented. Biologists generally agree that habitat reduction would be accompanied by diminished harvests (Craig et al. 1979). Shrimp and menhaden yields have been correlated directly to the area of intertidal wetlands (Turner 1979). Neotropical and other migratory avian species have been shown to depend on habitats that are in need of restoration and management in the coastal area (Barrow et al. 2000; Helmers 1992).

Land loss and ecosystem degradation also threaten the continued productivity of Louisiana's coastal ecosystems, the economic viability of its industries, and the safety of its residents. The following valuable social and economic resources could be impacted:

- Commercial harvest of fishery resources;
- Oil and gas production;
- Petrochemical industries;
- Recreational saltwater and freshwater fisheries;
- Ecotourism;
- Agriculture;
- Strategic petroleum reserve storage sites;
- Flood control, including hurricane storm surge buffers;
- Navigation corridors and port facilities for commerce and national defense; and
- Actual and intangible value of land settled 300 years ago and passed down through generations.

1.5.2 Causes of Wetland Loss

In preparation for subsequent discussions of existing and future without-project conditions, a summary of the major factors that contribute to coastal land loss and ecosystem degradation in Louisiana is necessary. While many studies have been conducted to identify the major contributing factors (e.g., Boesch et al. 1994; Turner 1997; Penland et al. 2000a), most studies agree that land loss and the degradation of the coastal ecosystem are the result of both natural and human induced factors, which interact to produce conditions where wetland vegetation can no longer survive and where wetlands are lost. Establishing the relative contribution of natural and human-induced factors is difficult. In many cases, the changes in hydrologic and ecologic processes manifest gradually over decades and in large areas, while other effects occur over single days and impact relatively localized areas. For barrier shorelines, complex interactions among storm events, longshore sediment supply, coastal structures, and inlet dynamics contribute to the erosion and migration of beaches, islands, and cheniers.

The measurable increase in coastal land loss in the mid- to late-twentieth century can be linked to human activities that have fundamentally altered the deltaic processes of the coast and limited their ability to rebuild and sustain it. In the Chenier Plain, human activities have fundamentally altered the hydrology of the area, which has impacted the long-term sustainability of the coastal ecosystems. Because of the magnitude and variety of these human-induced changes, and their interaction with natural landscape processes, all of the factors contributing to coastal land loss and ecosystem degradation must be viewed together to fully understand how Louisiana's coastal ecosystem shifted from the historical condition of net land gain to the current condition of accelerated net land loss.

1.5.2.1 Natural Factors Influencing Coastal Land Loss and Ecosystem Degradation

The following discussion identifies those predominantly natural factors of coastal land loss and ecosystem degradation. However, these factors are intrinsically linked with human factors of land loss and ecosystem degradation due to man's overwhelming influence over the natural system. Geologic faulting, compaction of muddy and organic sediment, river floods, global sea level change, wave erosion, and tropical storm events have shaped the coastal Louisiana landscape for thousands of years (Kulp 2000; Reed 1995). Over millennia, sea level change and subsidence were offset by delta building in the Deltaic Plain and mudstream accretion in the Chenier Plain. Erosion of barrier shorelines and disruption of fragile organic marshes by tropical storm events resulted in land loss, but also contributed to habitat and wildlife diversity. There is little direct evidence that any of these natural processes changed in the mid to late 20th century. The following is a brief summary of the natural factors contributing to land loss.

1.5.2.1.1 *Deltaic Geomorphology*

"Delta switching"--successive periods of delta growth and delta degradation--is responsible for constructing the Louisiana coastal plain over the last 7,000 years. The deltaic cycle is controlled by this switching and is characterized by a fluvial dominated regressive phase (delta building) and a marine-dominated transgressive phase (delta degradation). Ultimately, many areas of the Louisiana coast suffer from a lack of the abundant fresh water and sediment found in the Mississippi River. Since the river is no longer free to alter its course and leave its banks to inundate vast coastal areas, the effects of natural and human forces that promote wetland deterioration are compounded. In this respect, the relationship between the Mississippi River and the problems facing coastal wetlands is not limited to the river's delta, but extends across the entire Louisiana coast.

Land building and sustenance within the Mississippi River Deltaic Plain also occurred when floodwaters would overflow the riverbanks, or when river water would exit the main channel and travel through natural outlets, or distributaries, of the main river. In addition, floodwaters would periodically burst through weak points in the natural levees along the riverbank to create crevasses. Oftentimes, these floods deposited enormous amounts of sediments and were integral to land-building processes in the Deltaic Plain. Historical records indicate that major flooding events have created crevasses at 23 locations along the river in the Deltaic Plain (**figure 1-7**).

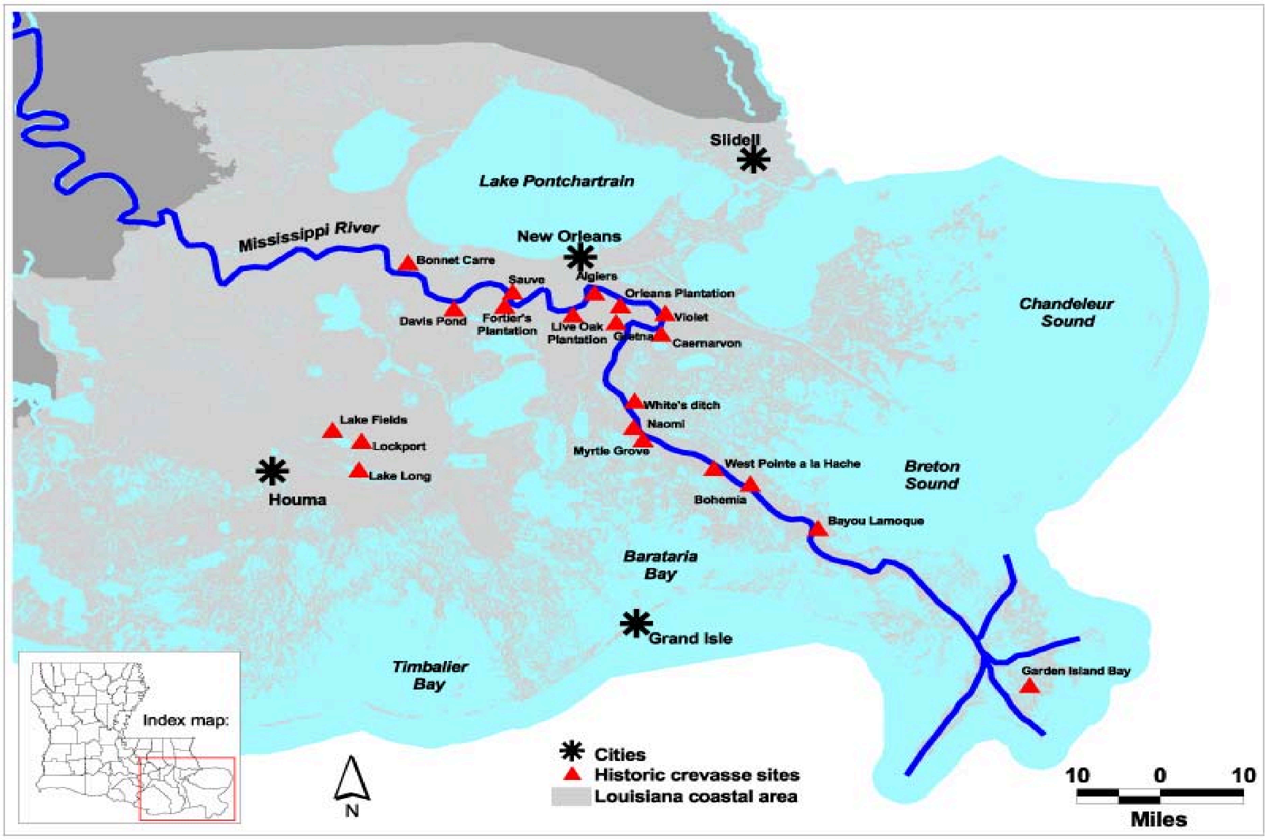

Figure 1-7. Locations of historic crevasses along the Mississippi River in the Deltaic Plain *(adapted from Colten 2001).*

1.5.2.1.2 *Loss of Coastal Geomorphology*

Geomorphic features such as natural levee ridges, lake rims, land bridges, cheniers, and barrier islands and shorelines are critical structural components of the ecosystem. These features generally represent the only natural areas with elevations appreciably above sea level. These features are the sites of coastal communities, commercial industries, and provide critical habitat for non-marsh plant and animal species. Coastal geomorphic features also play an important role in controlling the hydrology of the estuaries and act as valuable storm buffers. Their effectiveness has been severely degraded due to the combined effects of relative subsidence, erosion, and man-made impacts. As the geomorphic framework of the ecosystem is weakened and removed, the rate at which other degenerative processes work is increased. Geomorphic structure is critical to the system as a whole.

1.5.2.2 Barrier Island Degradation

Barrier islands are important elements of the geomorphic framework of the estuary. Barrier islands separate the gulf from the back-barrier estuarine environment helping to maintain the salinity gradients important to estuarine species. As islands erode and are breached, marine forces are allowed to affect the interior boundaries of the estuaries, thereby accelerating land loss. Barrier islands also serve as valuable storm buffers protecting communities, industry, and associated infrastructure from storm surges.

Barrier island degradation is a natural process and represents the latter phase of the deltaic process, as described in section 1 INTRODUCTION. Marine influences, particularly those associated with tropical storm events, gradually erode and rework the structure of the islands until they eventually disappear. While the acreage amounts associated with the loss of barrier islands may not contribute appreciably to the total acreage of land loss in the study area, their disappearance can result in significant and profound impacts on coastal land loss and ecosystem sustainability. Barrier islands serve as natural storm protective buffers and provide protection and limit erosion of Louisiana's coastal wetlands, bays, and estuaries, by reducing wave energies at the margins of coastal wetlands. In addition, barrier islands limit storm surge heights and retard saltwater intrusion. The historic rates of land loss for Louisiana's barrier islands are varied, and can average as high as 50 acres per year (20.3 ha per year), over several decades. Hurricane events can push the rate of land loss to surpass 300 acres per year (122 ha per year). For example, the Isles Dernieres have decreased in acreage from approximately 9,000 acres (3,645 ha) in the late 1880s to approximately 1,000 acres (405 ha) by 2000 (see appendix D LOUISIANA GULF SHORELINE RESTORATION REPORT).

1.5.2.2.1 *Sediment Reduction/Vertical Accretion Deficit*

Vertical accretion of wetland soils depends on soil formation from sedimentary material of two types: mineral sand, silts, and clays brought in by river water, floodwaters, or winds; and living and dead organic matter produced locally by plants. In Louisiana, organic matter accumulation is frequently more important than mineral sediment input to vertical accretion (Nyman et al. 1990; Nyman and DeLaune 1991), except during initial phases of delta building (van Heerden and Roberts 1988). Accretion deficits in Louisiana coastal marshes are caused primarily by inadequate organic matter accumulation (Nyman et al. 1993). Any environmental change that lowers productivity or increases the rate of organic matter removal increases the vertical accretion deficit.

For those areas of active delta building, sediment from the Mississippi River and its distributaries is an essential ingredient in the land-building process. However, upstream reservoirs, changes in agricultural practices and land uses, and bank stabilization measures have reduced average sediment loads in the lower Mississippi River by approximately 67 percent since the 1950s (Kesel 1988).

1.5.2.2.2 *Eustatic Sea Level Change*

Eustatic sea level change is the global change of the oceanic water level. Because the concentrations of greenhouse gases, such as carbon dioxide, and global temperatures have been rising, eustatic sea levels are expected to rise in the future at a higher rate than observed during the 20th century. EPA (1995) estimated that global warming is most likely to raise global sea levels 15 cm (5.9 inches) by the year 2050 and 34 cm by the year 2100 (13.4 inches). Other experts predict that the level of the world's oceans could rise over 20 cm (8 inches) over the next 50 years.

1.5.2.2.3 *Relative Sea Level Change*

Along the Louisiana coast, both changes in water level and changes in land elevation are occurring. Relative sea level change is the term applied to the difference between the change in eustatic sea level and the change in land elevation. Relative sea level change is also referred to as relative subsidence.

Land elevations decrease due to subsidence from compaction and consolidation of sediments, faulting, and groundwater depletion. Recent studies have shown that subsurface fluid (e.g., oil and gas) withdrawal may also be a contributor, but the magnitude of its contribution is not well understood (Morton et al. 2002). Land elevations increase due to sediment accretion from riverine and littoral sources and organic deposition from vegetation. For most of coastal Louisiana, sediment accretion is insufficient to offset subsidence, so land elevations are decreasing.

Changes in land elevation vary spatially along coastal Louisiana. In areas where subsidence is high and riverine influence is minor or virtually non-existent, such as in areas of western Barataria Basin and eastern Terrebonne Basin, wetland habitats sink and convert to open water. Estimated subsidence rates for the Deltaic Plain are between 0.5 to 4.3 ft/century (0.15 to 1.31 m/century) and 0.25 to 2.0 ft/century (0.08 to 0.61 m/century) for the Chenier Plain.

Taking into account changes in land elevation and water levels, the average rate of relative sea level change along coastal Louisiana is currently estimated to be between 3.4 to 3.9 ft/century (1.03 and 1.19 m/century).

1.5.2.2.4 *Hypoxia*

Hypoxia is a major environmental problem affecting coastal Louisiana and the northern Gulf of Mexico. It is also a problem of National importance, which will require action throughout the Mississippi River Basin to solve. While hypoxia is not a cause of land loss in coastal Louisiana, it is highly relevant to the broader coastal Louisiana ecosystem.

Hypoxia in the northern gulf is caused primarily by excess nitrogen in combination with stratification of gulf waters (CENR, 2000). For the period 1985 to 2001, the bottom area of the hypoxic zone ranged from 2,730 to over 7,700 square miles (7,070 to 20,000 square kilometers) (**figure 1-8**) (Rabalais et al. 1999). The reduced hypoxic zone during years 1988, 1989, and 2000 are anomalies due to severe drought (i.e., appreciably reduced water flows from the Mississippi River and its distributaries into the gulf).

The January 2001, "Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico" describes a National strategy to reduce the frequency, duration, size, and degree of oxygen depletion in the northern Gulf of Mexico. The Action Plan describes in general actions that are needed throughout the Mississippi River basin to address gulf hypoxia, including restoring de-nitrification and nitrogen retention in the coastal plain of Louisiana.

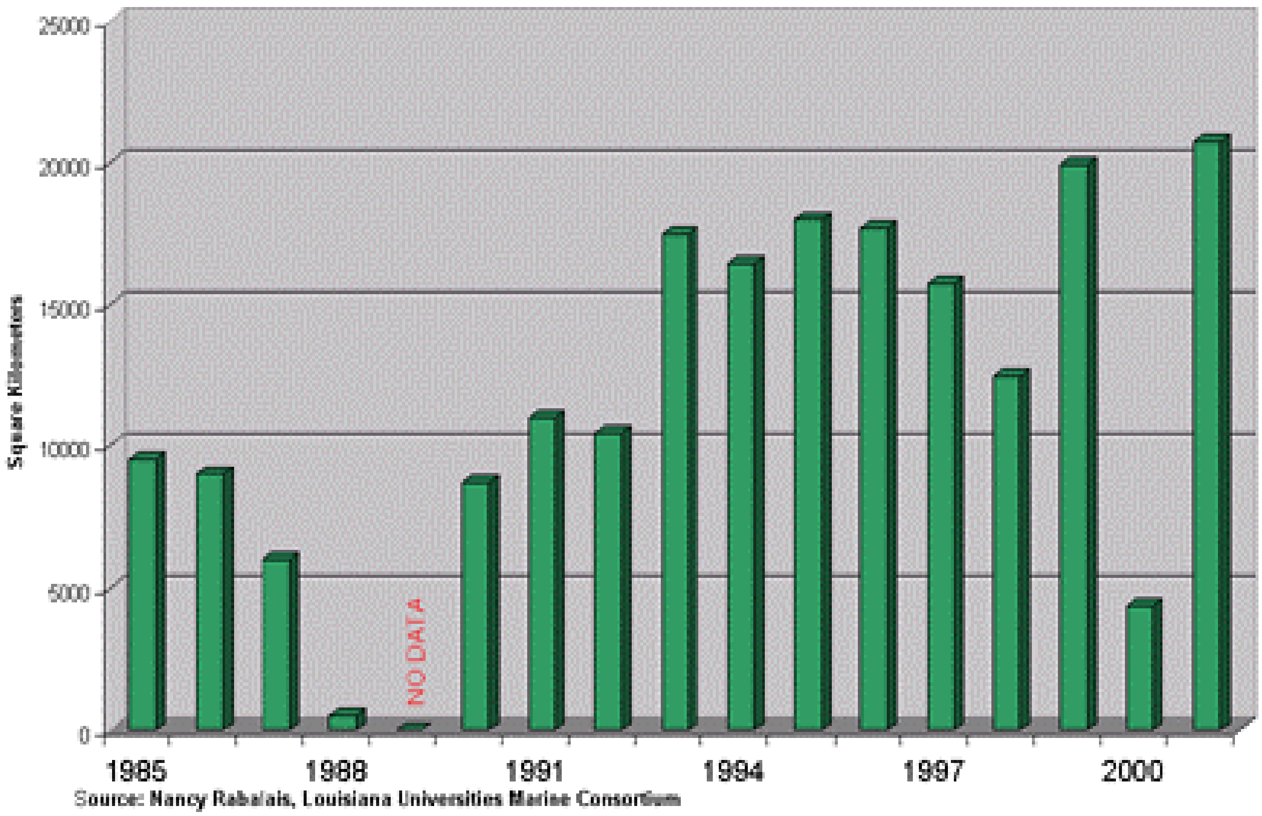

Figure 1-8. Comparative Size of the Hypoxic Area from 1985 to 2001 (*source Nancy Rabalais (2002; Louisiana Universities Marine Consortium*).

As described in section 1 INTRODUCTION, in the past, a portion of the Mississippi River's flow would occasionally divert into the coastal wetlands through crevasses or overbank flow. These flows into the wetlands would occur particularly during high river discharges when the maximum levels of sediment and nutrients were also being transported. These diversions would disperse a fraction of the sediment and nutrients into the wetlands, where the marsh vegetation would capture and incorporate them into the cycle of growth, thus reducing the total nutrient load reaching the gulf. Today, more nutrients pass though the study area and into the northern gulf as a result of the loss of wetlands (less wetlands to absorb the nutrients) and the reduction in hydrologic connectivity between the river and coastal wetlands (less ability to transport freshwater to wetlands that would absorb the nutrients).

1.5.2.2.5 *Saltwater Intrusion*

Saltwater intrusion occurs when freshwater flows decrease in volume, allowing saltwater from the gulf, which is heavier than freshwater, to move inland or "upstream". Saltwater can then infiltrate fresh groundwater and surface water supplies and damage freshwater ecosystems. Saltwater intrusion can result from natural causes as well as human-influenced activities. The rate of saltwater intrusion depends on the amount of freshwater flows traveling downstream and the water depth in the wetlands, channels, and/or canals. Generally, high-inflow/low-salinity periods occur from late winter to late spring and low-inflow/high-salinity periods from late spring to fall. Saltwater intrusion is the principle factor in the conversion of freshwater habitats to saline habitats. Extreme salinity changes can stress fresh and intermediate marshes to the point where vegetation dies and the wetlands convert into open water (Flynn et al. 1995).

Vegetation type is commonly used as a long-term indicator of salinity LDWF, USGS, LSU (1997). Changes in vegetation patterns are reflective of changes in salinity on a geographic or coast wide scale. Historic and present vegetation patterns are shown on **figures 3-11** and **3-12**; salinity patterns are discussed in Section 3.4 SALINITY REGIMES of this report. Changes from fresh to intermediate, intermediate to brackish, and brackish to saline indicate an increase in salinity within that area.

1.5.2.2.6 ***Historic Storms and Hurricanes***

Some of the most deadly hurricanes (57) and tropical storms (61) in U.S. recorded history (see **figure 1-9**; note that tropical storms Isidore and Lili are not displayed on this figure) have made landfall on or threatened the Louisiana coast (Roth 1998) due principally to proximity of the Gulf of Mexico, whose tropical waters are ideal for storm formation. Hurricanes and tropical storms have affected coastal Louisiana with impacts ranging from minor inconvenience to major property damage, as well as human and wildlife and fishery losses. These storm events have also had significant morphological impacts along the coast.

On average, since 1871 a tropical storm or hurricane is expected to affect Louisiana every 1.2 years (Stone et al. 1997; Roth 1998). Hurricanes are ranked (by the Saffir-Simpson Scale) from Category 1 (minimal) through Category 5 (catastrophic), with winds ranging from 75 mph to greater than 155 mph. Tropical depressions/tropical storms typically have winds less than 74 mph and cause minor wind and flood damage to business and residential areas. In contrast, a Category 5 hurricane can cause disastrous flooding and damage across the coast. However, even tropical depressions and storms can have significant impacts in coastal Louisiana due to generally relatively low elevations of the entire area.

The storm surge, a dome of water near the center of the storm, is perhaps the major component of destruction from a hurricane to coastal areas. Additional hazards from hurricanes are high winds, extreme rainfall rates, river flooding, salinity intrusion, sediment transport, tornados, levee collapse, and pollution of surge waters (Huh 2001, Pielke 1997). Louisiana's coastal areas range from approximately 1 to 2 feet (0.3 to 0.6 meters) above sea level, therefore a storm surge of great height can cause catastrophic damages to life and property. Storm surge flooding across Louisiana is greater than surrounding areas because of its orientation, approximately a 90-degree angle made by the Mississippi Delta in relation to the rest of the gulf coast, which amplifies the effects of the water surge (Roth 1998).

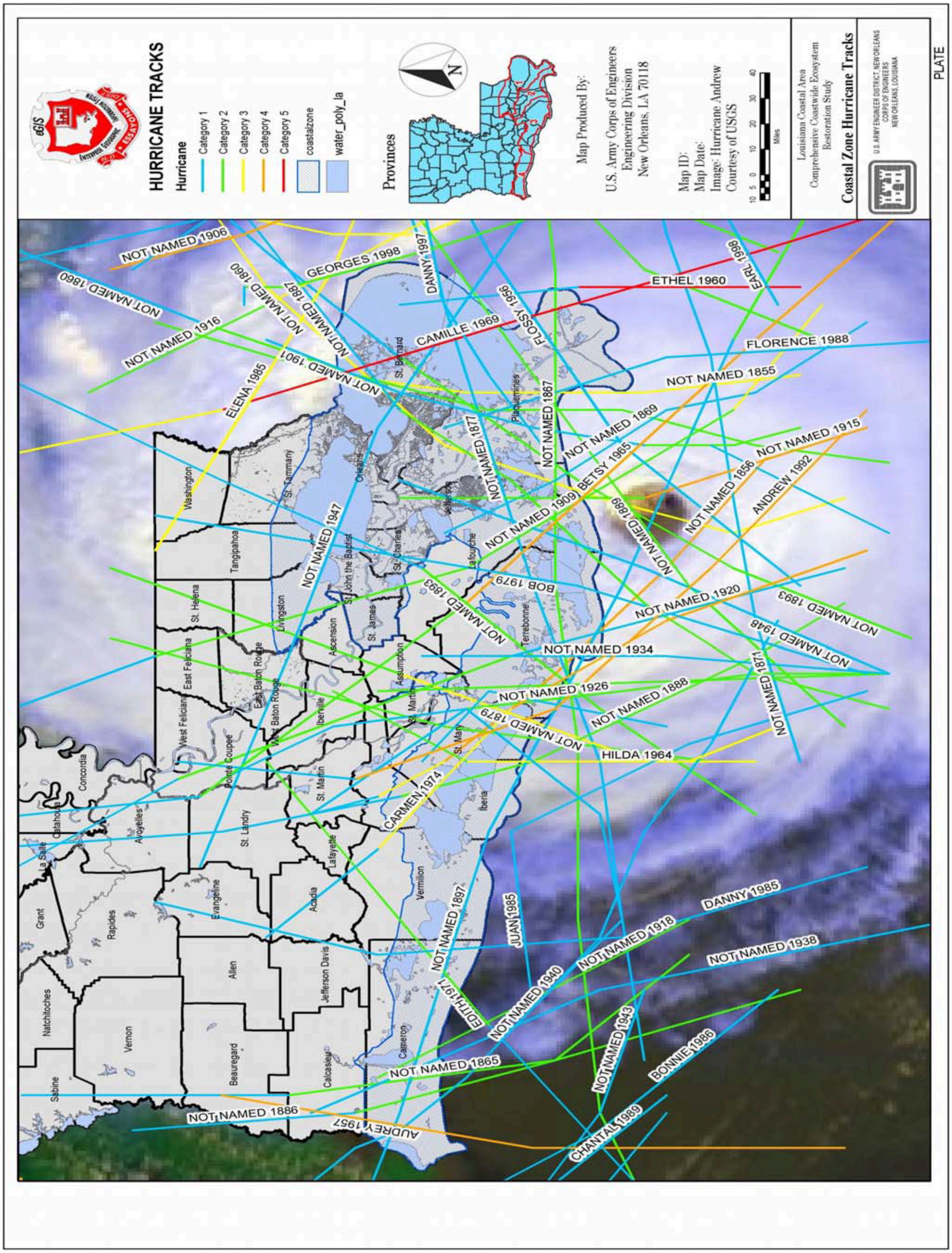

Figure 1-9 Historic hurricane storm tracks impacting Louisiana.

Hurricanes and tropical storms can result in billions of dollars in property damage and many human fatalities (see also section 3.23 SOCIOECONOMIC AND HUMAN RESOURCES). Approximately 3,000 lives have been claimed by hurricanes and tropical storms that made landfall in Louisiana (Roth 1998). Audrey, Louisiana's deadliest hurricane of modern time, was a Category 4 hurricane that killed between 390 and 550 people (**table 1-1**). Audrey destroyed 90 percent of the buildings in the city of Cameron (Sallenger 2000). The agriculture industry, as well as livestock and fisheries farming, can be heavily impacted by a serious storm. Louisiana crops such as sugar cane, cotton, citrus, pecan, and soybeans can be greatly diminished if not completely ruined. Offshore and coastal industries such as oil, public utilities and fisheries can experience loss of boats, ships, tugs, barges, and offshore installations. In addition, fisheries and livestock farming industries can also see a sharp decline in production as catastrophic storms can cause death to marine/freshwater fish and land animals.

Table 1-1
Deadliest Storms (nationally) that Impacted Louisiana From 1900-1996*

National Ranking	Hurricane	Year	Category	Deaths
6	Audrey (SW La/ N TX)	1957	4	390
8	La (Grand Isle)	1909	4	350
9	La (New Orleans)	1915	4	275
11	Camille (Ms/ La)	1969	5	256
18	Betsy (SE Fl/ SE La)	1965	3	75
20	SE Fl/ La/ Ms	1947	4	51
27	Hilda (La)	1964	3	38
28	SW La	1918	3	34

**Source: Center for Business & Economic Research, University of Louisiana at Monroe*

One major concern for the protection of human life is the limited number of evacuation routes from populated coastal areas. There are approximately 5 interstates and 30 state highways that are located throughout the coastal Louisiana region (**figure 1-10**). If these routes were to become flooded or impassable, then residents of those areas would not be able to escape a storm. In some areas in the coastal region, there is only one route into and out of the city. For example, Highway 1 is the only evacuation route for Grand Isle, Port Fourchon, and for the thousands of people working offshore in the Gulf of Mexico on rigs and platforms (Tyson 2002).

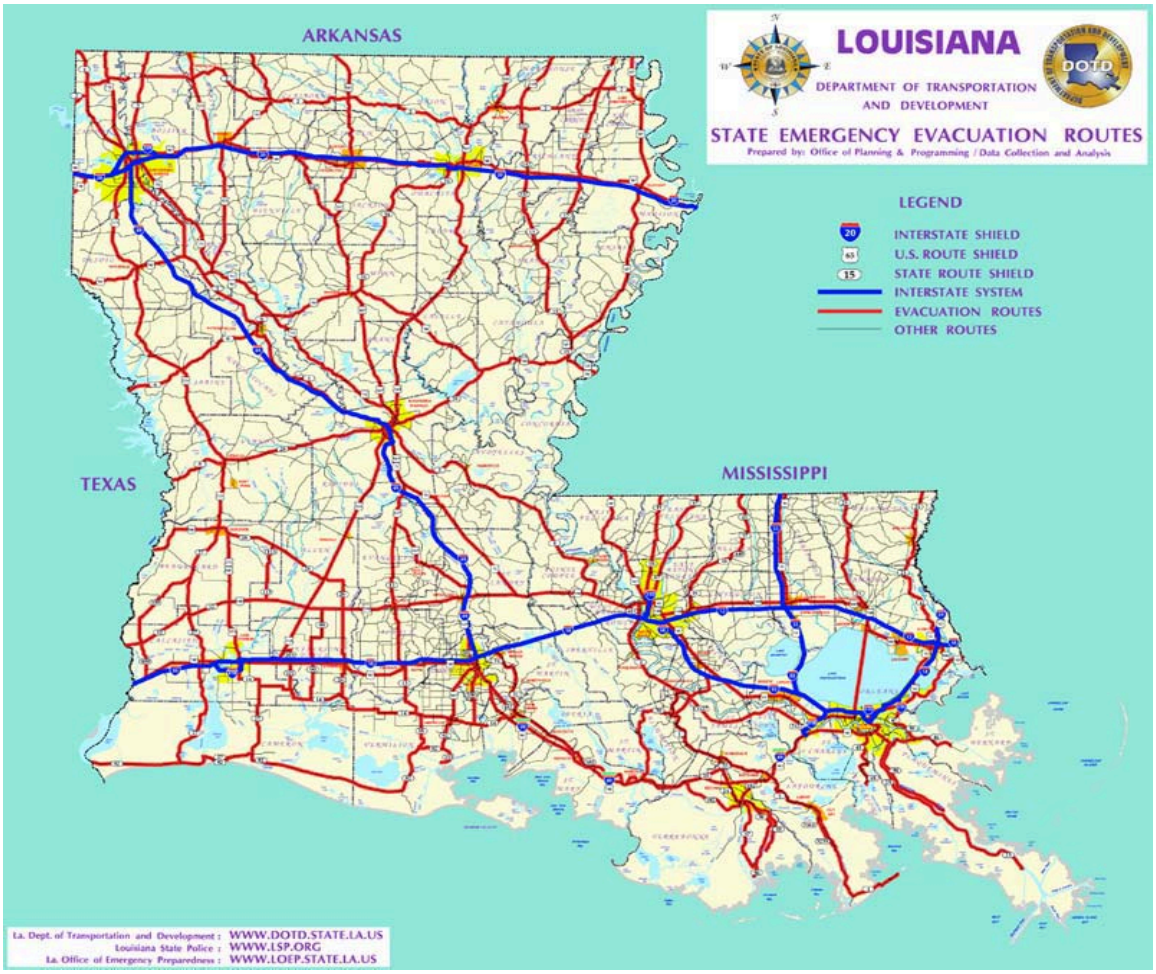

Figure 1-10 Louisiana Emergency Evacuation Route Map. Hurricane evacuation routes in red. *(Source: Louisiana State Department of Transportation and Development)*

The widespread subsidence of coastal wetland areas, in combination with hurricanes and storms, has resulted in potentially deadly circumstances. Dokka (2002) estimated that Highway 1 in Grand Isle sank about 1 - 2 feet (0.3 - 0.6 meters) due to subsidence. The loss of elevation in south Louisiana and the growth of open water conditions along the coast make future storms and hurricanes more likely to flood evacuation routes, coastal towns and ports, and stress flood protection levees each year (Challstrom 2002).

1.5.2.2.6.1 ***Hurricane Impacts on the Natural Environment***

Hurricanes and storms impact the natural environment resulting in vegetation losses and fish and wildlife losses (see also section 3.7 VEGETATION RESOURCES, section 3.8 WILDLIFE RESOURCES, and section 3.11 FISHERIES RESOURCES). The depletion of the barrier shorelines, which buffer storm impacts, is causing adverse effects to the coastal wetlands. Coast 2050 (LCWCRTF and WCRA 1998) reports that the coastal land loss in Louisiana represents 80 percent of the coastal wetland loss in the entire continental United States. Fresh and intermediate marsh, which includes floating marsh, makes up a substantial part of these wetlands (Chabreck and Linscombe 1978). Lovelace and McPherson (1998) reported that marshes suffered substantial damage caused by wind, tide, and wave action during Hurricane Andrew.

Damages to marsh habitat can be seen as compressed marsh, marsh balls (marsh piled, rolled, or deformed), and sediment deposition in thicknesses that can kill vegetation or sink floating marsh (Dunbar et al. 1992; Jackson et al. 1992). Other wetland damage includes erosion, vegetative scour (plant roots being torn from soil surface), and salt burning (saline water killing or damaging salt-sensitive species) (Dunbar et al. 1992; Jackson et al. 1992; Stone et al. 1993; Stone et al. 1997; Lovelace and McPherson 1998). Storms and hurricanes, depending on strength and intensity, can also blow over, defoliate, and/or cause major structural damage to trees well beyond the coastal zone (Lovelace 1998).

Guntenspergen (1998) reported that coastal wetlands are depleted at a faster rate when a hurricane or storm crosses over Louisiana. Estimates derived for this study indicated that between the years 1956-2000, about 1,900 sq mi (4,940 sq km) of coastal wetlands have been lost. Estimates derived by the USGS for the present study indicated that about 23 sq mi (59 sq km) of wetlands are lost annually (see appendix B Historic and Predicted Coastal Louisiana Land Changes: 1978-2050 of the Main Report).

Wildlife losses from hurricanes and storms reach from the Gulf of Mexico north to beyond the coastal zone of Louisiana. Freshwater fish are a major casualty due, primarily, to movement of water containing low dissolved oxygen concentrations and toxic hydrogen sulfide released from bottom sediments (Tilyou 1993, Lovelace and McPherson 1998). Saltwater fish can also incur great numbers of casualties due to suffocation, clogging of gills with sediment, or gas-bubble disease (Tilyou 1993). Other marine organisms are also affected. Oyster reefs can be smothered by deposition of sediment. After Hurricane Georges, the Chandeleur Barrier Islands lost over a quarter of their sea-grass beds (Turnipseed et al. 1998), which are the basis of the complex food chain. In addition, the Chandeleur Barrier Islands also provide wintering habitat for many birds including piping plover and brown pelican. Marsh losses would also affect wintering birds and ducks. Young wildlife species are especially at risk due to their extreme vulnerability to high winds and storm surges (Lovelace and McPherson 1998).

1.5.2.2.6.2 ***Hurricanes and Louisiana Barrier Shorelines/Islands***

The Louisiana barrier shoreline/island system, the first line of defense against hurricanes and storms, provides storm protection to estuaries, wetlands, and coastal populations. These islands take the initial impact of hurricanes and tropical storms. For example, between 1980 and 2002 Shell Island, which protects a portion of the Barataria Basin, lost approximately 101.5 feet per year (30.9 meters per year) (Conner et al. 2004) due to the effects of storm erosion, relative sea level rise, and a reduction in sediment supply. Sallenger (2000) reported that Hurricane Andrew stripped sand from 70 percent of the barrier islands, more than 70 km of dune habitat, leaving coastal marshes exposed to future storm events. If the erosion of Louisiana's barrier shoreline is not addressed, inland cities will become the front line of defense for a hurricanes high wind and storm surge. The depletion of the barrier shoreline is causing the adverse effects from storms and hurricanes to impact coastal wetlands, marshes and cities.

1.5.2.2.6.3 *Hurricane and Tropical Storms Damage*

Since 1965, Louisiana has been hit by 3 hurricanes ranging in intensity from category 3 to 5, as well as a number of minor hurricanes and tropical storms (**table 1-2**). Even tropical storms can have major impacts on the study area. Tropical Storm Isidore (September 25-26 2002), had winds up to 65 miles per hour (104 kilometers per hour). Lepore (2002) reported coastal storm surge flooding of 3 to 6 feet (0.9 to 1.8 meters) above normal tide levels with higher levels in bays. The total cost of damages was $105,000,000. In response to the storm events, which included tropical storm Lili, Louisiana was declared as a state of emergency.

Table 1-2
Costliest Hurricanes (National Ranking) that Impacted Louisiana from 1900-1996*

National Ranking	Hurricane	Year	Category	Damage
1	Andrew (SE FL/SE LA)	1992	4	$30,475,000,000
4	Betsy (FL/LA)	1965	3	$7,425,340,909
14	Juan (LA)	1985	1	$2,108,801,956
28	SE FL/LA/MS	1947	4	$810,897,436
30	Audrey (LA/ N TX)	1957	4	$802,325,581

**Source: Center for Business & Economic Research, University of Louisiana at Monroe*

1.5.2.2.7 *Climate Changes and Implications for Sea Level Change (Rise)*

Scientists working with the USEPA expect that increasing concentrations of greenhouse gases are likely to accelerate the global rate of climate change, although it is much less clear whether regional climate will become more variable. See: (http://yosemite.epa.gov/oar/globalwarming.nsf/content/climate.html).

Estimates that the average global surface temperature could rise 1-4.5^{o}F (0.6-2.55^{o}C) in the next 50 years have several implications. Scientists currently are unable to determine which parts of the U.S. will become wetter or drier, but there is likely an overall trend toward increased precipitation and evaporation, more intense rainstorms and drier soils. See: (http://yosemite.epa.gov/OAR/globalwarming.nsf/content/ClimateFutureClimate.html).

Considering factors such as warmer temperatures, melting glaciers, increased precipitation and snowfall, the Third Assessment Report of Working Group I of the Intergovernmental Panel on Climate Change estimate that sea level changes will rise 9 to 88 cm (3.5 to 34.3 inches) by year 2100. See: (http://yosemite.epa.gov/OAR/globalwarming.nsf/UniqueKeyLookup/SHSU5BWJE7/$File/wg1_science-sum.pdf).

1.5.2.3 Human Activities Influencing Coastal Land Loss

1.5.2.3.1 *General*

In many areas of the United States, wetland losses occur primarily because of direct causes: people drain or fill wetlands to improve their suitability for development, and those filling or draining the wetlands are clearly responsible for the wetland loss. While some direct losses occur in Louisiana (dredging of navigation channels, oil and gas canals, and borrow pits), the majority of losses in the state are caused indirectly. Indirect losses occur when human activities alter the process of land building and maintenance. To understand these indirect effects, it is important to understand the processes that built the landscape and which, under natural circumstances, maintain it.

Many human activities at the coast have interrupted or altered the natural processes. Some of these activities are widespread across the coast and can affect large areas. These include: construction and management of levees and flood control structures on the Mississippi River that alter sediment supply to wetlands and limit the building of new lands; construction of canals and associated side-cast material that disrupt the internal hydrology of the estuaries and wetlands; and increased boat traffic and construction of jetties and other structures to facilitate navigation. Other activities likely have localized effects, including the extraction of oil, gas, and groundwater and the introduction of nutria that graze extensively on wetland plants.

1.5.2.3.2 *Flood Control*

Following European settlement in coastal Louisiana, humans began to modify the Mississippi River. Levees were built and maintained to limit flooding of populated areas and agricultural areas, and to support interests such as navigation. Levees serve two general purposes: 1) contain river flows and 2) protect against storm surges. There are approximately 2,250 miles (3,622 kilometers) of levees that have been constructed in coastal Louisiana to contain the Mississippi River and its distributaries and to protect agricultural and urban areas from flooding. Numerous water control structures have been constructed related specifically to agricultural activities in the coastal zone as well resulting occasionally in impoundment of water. Several hurricane protection levee projects are in various stages of design and construction, including Morganza to the Gulf and Donaldsonville to the Gulf projects. These projects would upgrade or build new levees in the coastal area. An additional effect of these flood protection actions has been the facilitation of development throughout the coastal zone. Although the development of designated wetland areas are currently regulated this does not completely prohibited development. Perhaps more importantly, historically there was no prohibition for such development.

An unintended consequence of the construction of the levee system has been to accelerate coastal land loss and reduce the sustainability of the coastal ecosystem by reducing riverine influences to many of the coastal wetlands. In most instances, wetlands habitats have become isolated from the freshwater, sediment, and nutrients of the Mississippi River and its distributaries. With a reduced or absent hydrologic connection to the river, marine influences in the areas can predominate. In the short-term, this influence can result in greater habitat and wildlife diversity, as well as some land loss. In the long-term, coastal habitats can disappear without a renewed or enhanced connection to freshwater, sediment, and nutrients.

1.5.2.2.3 *Navigation*

There are 10 major navigation channels, both deep draft and shallow draft, within the Louisiana coastal area. While these channels support the local, regional, and National economies, they also serve as conduits for saltwater intrusion in some areas and barriers to the distribution of freshwater, sediment, and nutrients to wetland habitats in other areas. For example, jetties adjacent to the Empire Waterway, Belle Pass, Mermentau River Navigation Channel, and Calcasieu Ship Channel trap sediment on the east side creating an erosional shadow to the west due to disruption of the natural sediment transport system. The navigation channels, such as the GIWW, also subject inland areas to more dramatic tidal forces and wave action, thereby increasing erosion.

1.5.2.2.4 *Construction of Canals and Dredged Material Banks that Disrupt the Internal Hydrology of the Delta*

There have been large-scale changes in the hydrology of the coast due to the construction of canals, their associated side-cast material and the incidental impoundment, or hydrologic isolation, of extensive areas. By the end of the 20th century, over 9,300 miles (14,973 kilometers) of canals had been dredged in support of navigation, drainage, and oil-and-gas development. Canals alter natural hydrology in two main ways. First, canals that stretch from the Gulf of Mexico inland to freshwater areas allow saltwater to penetrate much further inland, particularly during droughts and storms, which has had severe effects on freshwater wetlands (e.g., Wang 1987 and 1988). Second, dredged material banks, which are much higher than the natural marsh surface, alter the flow of water across wetlands. This changes important biogeochemical and ecological processes, including chemical transformations, sediment transport, vegetation health, and migration of organisms. Because of the presence of dredged material banks, partially impounded areas have fewer, but longer periods of flooding and reduced water exchange when compared to unimpounded marshes (Swenson and Turner 1987; Boumans and Day 1994). This results in increased waterlogging and frequently plant death. Importantly, dredged material banks also block the movement of sediments resuspended in storms, which play a major role in sustaining land elevations (Reed et al. 1997). By altering salinity gradients and patterns of water and sediment flow through marshes, canal dredging, which mostly occurred between 1950 and 1980, not only directly changed land to open water, but also indirectly changed the processes essential to a healthy coastal ecosystem.

1.5.2.2.5 *Increased Vessel Traffic and the Construction of Jetties*

Wave erosion along exposed shorelines is a substantial factor contributing to coastal land loss, and in many areas this is an entirely natural process. Human activities that increase wave actions in coastal areas contribute to accelerated losses by erosion. These activities include construction of canals and navigation channels that widen rapidly due to the operation of vessels that generate wakes (Johnson and Gosselink 1982). At the barrier shoreline, jetties have been built around many tidal inlets to facilitate navigation from the gulf into rivers and navigation channels. The jetty rocks do have a beneficial effect in providing reef-like habitat for smaller organisms. However, these jetties alter the longshore drift of sediment along the shore that maintains barrier shorelines, and in many areas rapid erosion of beaches and shorelines has occurred on the 'down drift' side of the jetties (Penland et al. 1992).

1.5.2.2.6 *Oil and Gas Infrastructure*

With the discovery of oil and gas deposits in coastal Louisiana during the early 1920s, a vast network of canals, pipelines, and production facilities have been created to service the industry. Today, an estimated 9,300 miles (14,973 kilometers) of oil and gas pipelines crisscross the coastal wetlands of Louisiana. In addition, there are approximately 50,000 oil and gas production facilities located in the Louisiana coastal area. Canals that stretch from the Gulf of Mexico inland to freshwater areas allow saltwater to penetrate much farther inland, particularly during droughts and storms, which has had severe effects on freshwater wetlands (Wang 1987 and 1988).

Dredged material banks, which are much higher than the natural marsh surface, and the many smaller canals dredged for oil and gas exploration, alter the flow of water across wetlands. This hydrological alteration changes important hydrogeomorphic, biogeochemical, and ecological processes, including chemical transformations, sediment transport, vegetation health, and migration of organisms. Because of the presence of dredged material banks, partially-impounded areas have fewer but longer periods of flooding and reduced water exchange when compared to unimpounded marshes (Swenson and Turner 1987). This results in increased waterlogging and frequently in plant death. Importantly, dredged material banks also block the movement of sediment resuspended in storms, which play a major role in sustaining land elevations (Reed et al. 1997). By altering salinity gradients and patterns of water and sediment flow through marshes, canal dredging, which mostly occurred between 1950 and 1980, not only directly changed land to open water, but also indirectly changed the processes essential to a healthy coastal ecosystem. Elevated dredged material embankments may provide important wildlife refugia during storm events and valuable habitat for neotropical migratory birds, and the value of this habitat should be considered as restoration of these areas occurs.

1.5.2.3 Contributions to Land Loss

Direct losses (caused by an action and occur at the same time and place) can be quantified and attributed to specific causes with reasonable accuracy. Since the 1970s, direct losses have been dealt with through a permitting program required by Section 404 of the Clean Water Act as well as state laws. It is more difficult to assign specific causes to indirect land losses (caused by an action and are later in time or farther removed in distance). This is due to the natural variability of coastal processes and the complex way that human activities have altered these processes. Loss of coastal wetlands is most commonly caused by a number of factors, natural and human-induced, interacting to produce conditions at the local scale where wetland vegetation can no longer survive. For barrier shorelines, similarly complex interactions among storm events, longshore sediment supply, coastal structures and inlet dynamics, contribute to the erosion and migration of beaches, islands and cheniers.

Extensive coastal land loss in the mid-late 20th century occurred partially because human activities changed the processes essential to maintain the coastal ecosystem and limited the processes required to rebuild it. The magnitude and variety of these changes, and their interaction with natural landscape processes, means looking at any one of these factors in isolation would prevent a full understanding of the change in balance between land gain and land loss. While many studies have examined the individual factors contributing to land loss, few have attempted to isolate their individual contributions.

Various studies have attributed land loss to different causes. Turner (1997 and 2001a) claimed that the majority of the loss was due to canals and their direct and secondary impacts. Gagliano (1998) indicated that loss was mainly due to deep faulting caused by oil and gas extraction and would continue in the foreseeable future. Morton et al. (2002) claimed that some of the cause was faulting, but now that oil and gas extraction had slowed, faulting would slow. Penland et al. (2000a) made a detailed classification of the land loss that occurred between 1932 and 1990 within the Mississippi River Deltaic Plain. The loss was classified by 1) geomorphic form and 2) primary processes responsible for the loss. Geomorphic form is the physical place where loss occurs.

1.5.2.4 Geomorphic Form Classification Results

The results of the coastal land loss geomorphic classification (Penland et al. 2000a) show that of the 690,932 acres (279,824 ha) of land loss between 1932 and 1990, approximately 70 percent of loss was attributed to interior loss and 30 percent was attributed to shoreline loss. For the interior loss class, interior ponding accounted for approximately 57 percent followed by interior channels at 13 percent. For shoreline loss, the lake class at 9 percent, the gulf class at 5 percent, and the channel class at 5 percent followed the bay class at 11 percent.

Penland et al. (2000a) also identified three basic processes responsible for coastal land loss:

1. submergence (relative water level on the marsh increasing due to both human and natural causes);
2. erosion (loss due to wind and waves); and
3. direct removal (dredging of marsh for various reasons).

Altered hydrology resulting from the loss of riverine sediments, freshwater and nutrients, saltwater intrusion, interruption of sheet flow, and other causes accounted for a majority of land loss attributed to submergence. Natural waves and increased tidal forces accounted for a majority of the land loss attributed to erosion. Direct removal of land through the construction of various types of channels (e.g., for navigation and oil and gas extraction) contributed to coastal land loss.

1.5.2.5 Land Loss Measurement

1.5.2.5.1 *Overview*

A recent USGS study estimates that a total land loss of 674 sq mi (1,752 sq km) and a total land gain of 161 sq mi (418 sq km) will occur by 2050 (Barras et al. 2003). Sources of land gains considered in the estimate include the following: Coastal Wetlands Planning, Protection and Restoration Act (Public Law 101-646, title III) projects: 54 sq mi (111 sq km); Caernarvon Freshwater Diversion: 25 sq mi (65 sq km); Davis Pond Freshwater Diversion: 53 sq mi (137 sq km); Atchafalaya Delta building: 14 sq mi (36.4 sq mi); and Mississippi River Delta building: 15 sq mi (39 sq km). Note that these projected land gains for the Davis Pond and Caernarvon Freshwater Diversions include expected new land and reductions in land lost without the projects. Thus, the estimated projected net land loss was 513 sq mi (1,333 sq km) (see also appendix B HISTORIC AND PREDICTED COASTAL LOUISIANA LAND CHANGES: 1978-2050).

Summarized historic and projected land loss rates presented in this report for the Louisiana coastal area are:

- 1956-1978 = 39.4 sq mi/year (102.44 sq km/year)
- 1978-1990 = 34.9 sq mi/year (90.7 sq km/year)
- 1990-2000 = 23.9 sq mi/year (62.1 sq km/year)
- 2000-2050 = 10.3 to 13.5 sq mi/year (26.8 to 35.1 sq km/year)

There are several explanations for the reduced land loss rate projected between 2000 and 2050 and the rate of loss between 1990 and 2000. Actively managed areas in the coastal area were excluded in the future projection of land loss. These lands were included in the 1990-2000 rate of land loss calculation and accounted for 3 sq mi/year of the 23.9 sq mi/year (62.1 sq km/year) total for that time period. Also, total land in the coastal area has been reduced by 10 percent from 1978-2000; therefore, less land can be lost in the projections from 2000-2050. Further information regarding this subject can be found in the following pages and appendix B HISTORIC AND PREDICTED COASTAL LOUISIANA LAND CHANGES: 1978-2050 of the Main Report.

1.5.2.5.2 *Comparisons with Previous Land Loss Projections*

The projection of land-water conditions is presented in **table 1-3** using the same fundamental methodology as the projection included in the Coast 2050 Plan (LCWCRTF 1998). However, the projected magnitude of change by 2050 is the net loss of 513 sq mi (1,329 sq km), rather than the almost 1,000 sq mi (2,590 sq. km) that had been projected in 1998.

There are several reasons for this change in projection:

- The 1998 projection was based on land loss rates between 1974 and 1990. The base period for the current projection is 1978 to 2000, and thus the lower rates in the 1990s project lower rates into the future.

- The spatial patterns of land loss between 1974 and 1990 projected in the earlier analysis were based on data derived from aerial imagery, and the procedure used to develop the maps focused on land loss rather than land gain (Britsch and Dunbar 1993). Thus, the 1974 to 1990 data encompassed only "gross loss" and did not include any land gain occurring in the study area. The current analysis includes both loss and gain, and the net result of both processes is projected forward in a spatially explicit manner.

Table 1-3
Net Land Loss Trends by Province from 1978 to 2000

	1978-1990 Net loss (Mi^2)*	1990 - 2000 Net Loss (Mi^2)	1978 - 2000 Land Loss (Mi^2)	Net Loss 22 Years (Mi^2/Year)	% Total Loss by Area
Subprovince 1	52	48	100	4.5	15%
Subprovince 2	148	65	213	9.7	32%
Subprovince 3	134	72	206	9.4	31%
Subprovince 4	85	54	139	6.3	21%
Total	419	239	658	29.9	100%

**1978-1990 Net loss figures were based on Barras et al. 1994. The 1978 to 1990 basin level and coastwide trends used in this study were aggregated to reflect Louisiana coastal area subprovinces for comparison with the 1990-2000 data. The basin boundaries used in Barras et al. (1994) were based on older CWPPRA planning boundaries and are not directly comparable to the LCA Study area boundary used to summarize the 1990 to 2000 trend data. The 1990 to 2000 net loss figures include actively managed lands for comparison purposes with the 1978 to 1990 data.*

- The Britsch and Dunbar (1993) data set was based on analysis of aerial photography and was largely restricted to the nonforested areas of the coast. Little data were available for the upper basins, dominated by cypress-tupelo swamps and bottomland hardwoods. In the 1998 analysis, expert judgment was used to estimate the future loss in these areas and resulted in an estimate of over 360 sq mi (932 sq km) of swamp loss (out of the 1,000 sq mi [2,529 sq km]). This is now assumed to be an overestimate. In the current analysis, the Landsat TM (satellite databases) used for 1990 and 2000 covered the entire area. Therefore, using the same methodology, quantitative projections for the entire LCA Study area were possible.

- The loss shown in actively managed areas in the Britsch and Dunbar (1993) data was projected in the 1998 analysis. The current projection, however, excluded these areas because the LCA Land Change Study Group recognized that, at the time of the imagery, their classification as either land or water reflected the prevailing management regime rather than any trajectory of change in the coastal landscape.

The LCA Land Change Study Group, a part of the Project Delivery Team (PDT), considers that the net contribution of these four factors, and other minor differences in the projection methodology, account for the differences in the magnitude of the future loss projection. Most of these changes in the projection procedure represent a more thorough consideration of the factors contributing to coastal land change as a result of our increasing understanding of the coast and the use of improved technology. For more information on land loss see appendix B HISTORIC

AND PREDICTED COASTAL LOUISIANA LAND CHANGES: 1978-2050 of the Main Report.

1.5.2.5.3 *Patterns of Land Loss and Gain 1978–2000*

Across much of the Louisiana coast, wetland loss and shoreline erosion continue largely unabated. The rates of Louisiana's coastal land loss have varied over time (**figure 1-11**). For example, the conversion of numerous large areas [greater than 40 acres (16.1ha)] of interior marsh to open water, prevalent in the 1956 to 1978 period, continued to occur, to a lesser extent, in the 1978 to 1990 period and further decreased in the 1990 to 2000 period (**table 1-3**). Continued shoreline erosion and smaller interior marsh ponding are the primary loss patterns dominating the last decade. Interior ponds range in size from 2.5 to 5.0 acres (1 or 2 ha) to 125 acres (50 ha), with the majority of ponds occurring within the coastal fresh to intermediate marshes. Detectable shoreline erosion in larger lakes, bays, and ponds ranged from 165 to 1,000 feet (50 to 300 m).

1.5.2.6 **Projected 2000-2050 Land Change Summary**

According to the latest USGS information (see appendix B Historic and Predicted Coastal Louisiana Land Changes: 1978-2050), the projected 2000-2050 land changes, based on the analysis described previously, are a future land loss of 674 sq m (1,746 sq km) and a future land gain of 161 sq mi (417 sq km). These gains were from the following sources: CWPPRA projects, 54 sq mi (140 sq km); Caernarvon diversion, 25 sq mi (65 sq km); Davis Pond diversion, 53 sq mi (137 sq km); Atchafalaya Delta building, 14 sq mi (36 sq km); and Mississippi River Delta building, 15 sq mi (39 sq km). Land gains for Davis Pond and Caernarvon diversion reflect new land created and land projected to be saved from loss by the projects' operations over the next 50 years. Thus, the projected net land loss is 513 sq mi (1,329 sq km) (**table 1-4**). Land loss curves depicting land loss from 1956-2050 project gross loss (without projected gain) at 2,199 sq mi (5,695 sq km) and net loss (with projected gains) at 2,038 sq mi (5,278 sq km) over this 94-year period. Patterns of past and predicted land loss and gain are illustrated in **figure 1-11**.

Table 1-4
Projected Net Land Loss Trends by Subprovince from 2000 to 2050.
The projected total land gain is 161 sq mi.
The projected total loss is 674 sq mi.

	Land in 2000 sq mi	Projected Land in 2050 sq mi	Net Land Loss sq mi	% Land loss between 2050 and 2000	Land Loss sq mi/yr	% Total loss by area
Subprovince 1	1,331	1,270	61	4.61%	1.23	12%
Subprovince 2	1,114	928	186	16.68%	3.71	36%
Subprovince 3	1,975	1,746	229	11.59%	4.58	45%
Subprovince 4	1,431	1,394	37	2.59%	0.74	7%
Total sq mi sq km	5,851 15,154	5,338 13,825	513 1,329	8.77%	10.26 26.57	100%

Note that total percentage of land loss is the percentage of total net land loss (513 sq mi) in 2050 to the existing land (5,851 sq mi) in 2000.

1.5.2.7 Coastal Land Loss in the Future

The mid to late 20th century was clearly a period of massive human influence on the Louisiana coastal ecosystem and the resulting ecosystem degradation has been described above. However, the question must be asked as to whether these process changes will continue into the future. Much of the alteration of the coastal landscape associated with dredging of canals for oil and gas exploration and for navigation occurred between 1950 and 1980. Thus the direct effects of these extensive dredging activities are not expected to occur again. However, the indirect and ongoing effects of these activities on land loss, such as in alterations to marsh hydrology or basin-scale salinity gradients, are expected to continue in the future.

More chronic regional-scale problems such as subsidence and altered patterns of sediment delivery from the Mississippi River will also likely have the same effects in the future as in the past. Although recent data (Morton et al. 2002) suggest that extensive hydrocarbon extraction from subsurface reservoirs may have led to localized high rates of subsidence in previous decades, the greatest volumes of hydrocarbons were extracted in the 1960s and 1970s, at least in the fields examined by Morton et al. The extraction likely reactivated faults leading to the subsidence, but the timing of fault movement relative to mineral extraction has yet to be clearly identified. Thus, it is possible that localized high subsidence rates identified in recent decades may not continue in the future.

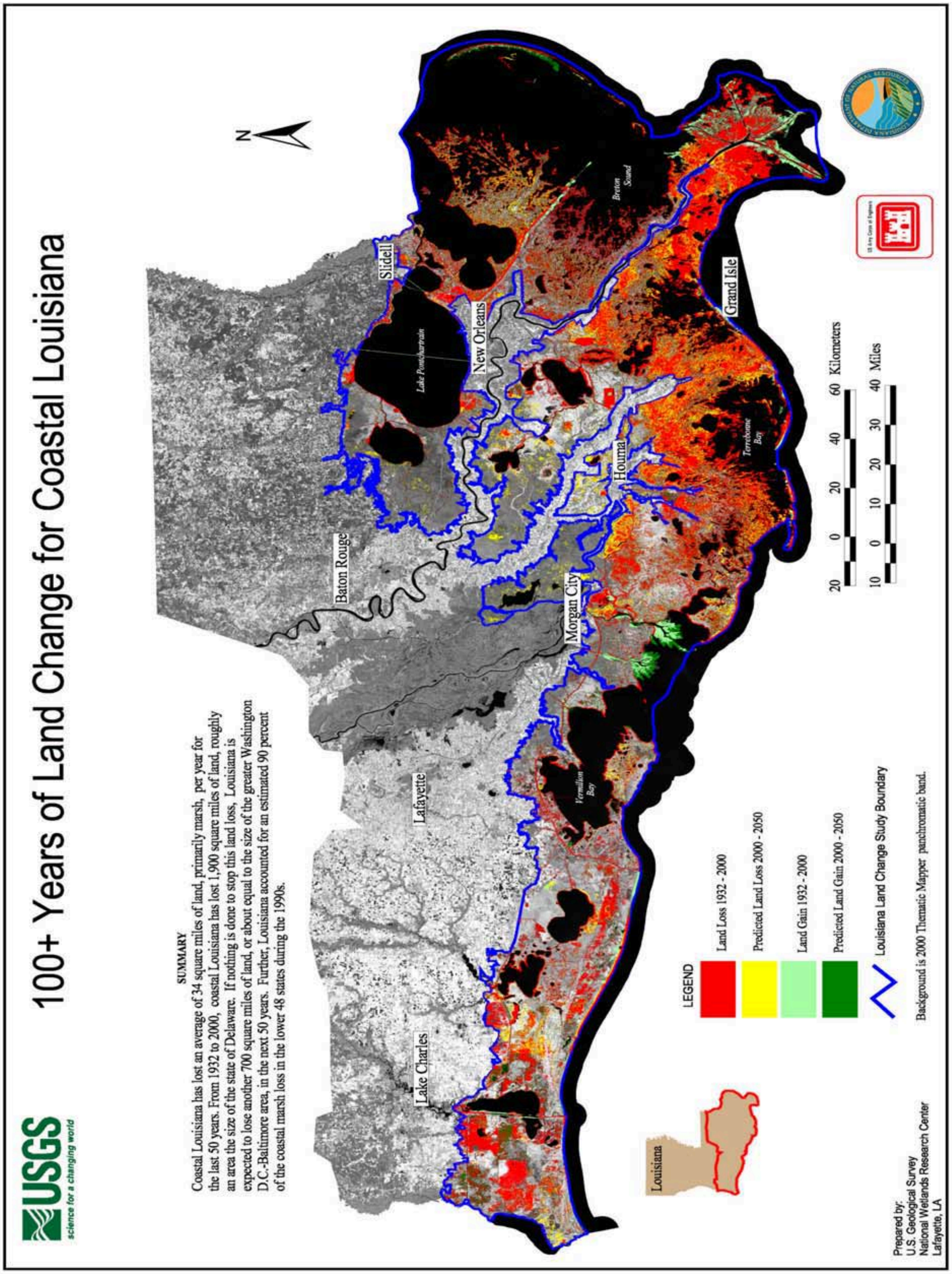

Figure 1-11. Past and projected land changes from 1932-2050.

The effects of future changes in climate and climate variability are difficult to predict. Some of these effects, such as changes in rates of sea-level rise are potentially important for future land loss. Louisiana coastal wetlands have been subjected to high rates of relative sea-level rise for centuries at least due to high subsidence rates associated with the compaction and dewatering of deltaic sediments. Some Louisiana marshes have adjusted to these high rates, and still survive in areas where measured rates from tide gauges are over 1 cm per year (cm/yr) (0.39 inch/yr), and others are experiencing stress which may in part be driven by the relative sea-level rise. Morris et al. (2002) recently predicted that salt marshes in areas of high sediment loading, such as those in Louisiana, the limiting rate of relative sea-level rise is at most 1.2 cm/yr (0.47 inch/yr). Future increases in eustatic sea level are projected to be approximately 20 cm (7.8 inches) by the year 2050 (Scavia et al. 2002) although there is much uncertainty associated with these predictions.

While this suggests that many Louisiana marshes may currently be at their limit with regard to relative sea-level rise and may deteriorate markedly under future sea level rise conditions, Morris et al. (2002) considered tidal flooding to be the primary determinant of sediment deposition. In Louisiana coastal marshes, it is well documented that high water events associated with frontal passages and tropical storms and hurricanes deliver most of the sediment that is currently deposited in coastal marshes (Reed 1989; Cahoon et al. 1995). These factors undoubtedly contribute to sustainability of existing Louisiana marshes and it is not known how marshes will accommodate future increases in relative sea level. Wetlands in coastal Louisiana can survive in areas of high relative sea level rise (RSLR) if rates of soil building due to mineral or organic matter deposition exceed the rate of RSLR. If sea level rise or subsidence increases RSLR to the point where a soil accretion deficit develops, these wetland areas would be susceptible to increased rates of land loss.

Clearly future land loss and degradation of the ecosystem depends on the interaction among many factors – some of which are unpredictable and many of which are expected to change in the future. The understanding of coastal land loss processes presented here, provides a sound foundation for minimizing future loss and reviving the ecosystem through restoration of those processes that naturally built and maintained the coast.

1.6 NEED FOR ACTION

The cumulative effect of human activities, both past and present, has been to tilt the balance between land building and land loss in the direction of net land loss. The reintroduction of riverine processes and resources, as well as the management of activities within the coastal area consistent with the objectives of wetland restoration, is needed to achieve a balanced and sustainable system. Consistency in operation and management of all existing and future measures and activities to optimize multiple system outputs would be required to ensure the success of any restoration program.

Critical needs in the study area include:

Prevent future land loss where predicted to occur

Addressing this need would create and sustain diverse coastal habitats, sustain wildlife and plant diversity, and sustain socio-economic resources. Effective measures to reverse coastal land loss should affect plant communities, in their root zone, in such a way as to promote healthy growth and reproduction, plant succession, or revegetation of denuded surfaces. Increasing nutrients and sediment in the estuarine area would increase the growth of marsh vegetation and slow the rate of land loss. Increased plant growth would result in greater production of organic detritus that is essential for a high rate of fisheries and wildlife production. Production of phytoplankton and zooplankton would increase in areas where turbidity is not limiting, and, as a result, the harvest of sport and commercial finfish and shellfish that depend on these microorganisms would increase.

Restore fundamentally impaired or mimic deltaic processes through river reintroductions

Addressing this need would reduce habitat deterioration by increasing nutrients and sediment delivered to the estuarine-marsh areas, which would increase marsh vegetation sustainability and improve fish and wildlife production. In addition, restoring riverine influences to coastal wetlands and creating wetlands would help address the need to reduce the nutrient loading into the northern gulf and to reduce the hypoxic zone. This need can be met by restoring or mimicking distributary flows, crevasses, and over-bank flow, as well as mechanical marsh creation with river sediment, if sustained by freshwater diversions.

Restore or preserve endangered critical geomorphic structures

Addressing this need would restore geomorphic structures, such as natural levee ridges, lake rims, land bridges, gulf shoreline barrier islands, barrier headlands, and chenier ridges. These features are essential to maintaining the integrity of coastal ecosystems because they are an integral part of the overall system and in many instances represent the first line of defense against marine influences and tropical storm events.

Protect vital local, regional, and national socio-economic resources

Addressing this need would reduce the increased risk of damage to cultures, communities, infrastructure, business and industry, and flood protection. Accelerated land loss and ecosystem degradation places over $100 billion of infrastructure at increased risk to damage as a result of storm events. This need could be met by increasing the marsh's capacity to buffer hurricane-induced flooding through wetland creation and sustenance and retention of barrier island systems.

1.7 OPPORTUNITIES

1.7.1 Saving Louisiana's Coastal Wetlands– Initial Phase

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 Louisiana's coastal wetlands and to restore and enhance their functionality.

1.7.1.1 Multi-Use Management Plan for South Central Louisiana

Awareness of Louisiana's coastal land loss problem resulted in part from the publication of the 1972 report *"Environmental Atlas and Multi-Use Management Plan for South-Central Louisiana"* (Gagliano et al. 1972). This report provided an initial assessment of the extent and magnitude of the land loss problem. Coastal resource management in Louisiana also 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 are accomplished with the greatest benefit and the least amount of environmental damage.

1.7.1.2 *Act 6, LA. R.S. 49:213* et seq.

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 established the Wetlands Conservation and Restoration Authority, the Louisiana Governor's Office of Coastal Activities, and the Coastal Restoration Division (CRD) within LDNR. With the creation of the CRD, Act 6 empowered the LDNR as the lead state agency for the development, implementation, operation, maintenance, and monitoring of coastal restoration projects. Chief among its many functions, the CRD has the lead for the development and implementation of state-sponsored coastal restoration projects. In addition, the CRD acts as the state's designated liaison for the Coastal Impact Assistance Fund (CIAF), which was authorized by Congress in 2001 to provide a one-time appropriation of $150 million to assist states in mitigating impacts from Outer Continental Shelf oil and gas production. In 2001, Louisiana received a one-time allocation from the CIAF of $26.4 million, which was 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.

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. Finally, 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.

1.7.1.3 Barataria-Terrebonne National Estuary Program

Another important Federal initiative in coastal Louisiana is the Barataria-Terrebonne National Estuary Program (BTNEP). Established in 1990 as part of the U.S. Environmental Protection Agency's (USEPA) National Estuary Program, the BTNEP is a partnership for the study of natural and man-made causes of environmental degradation in the Barataria-Terrebonne watershed and for protection of the watershed from further degradation.

1.7.1.4 Coastal Wetlands Planning, Protection, and Restoration Act

While the Federal government has been concerned with and involved in Louisiana's coastal land loss problem for decades, enactment of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) in 1990 marked the first Federal statutory mandate for restoration of Louisiana's coastal wetlands. The CWPPRA Task Force, composed of five Federal agencies (NMFS, NRCS, USACE, USEPA, and USFWS) and the State of Louisiana, prepared 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 also prepared and adopted an annual Project Priority List. As of January 2004, 13 priority lists have been approved; there are 127 active projects approved for implementation and 64 completed projects. These projects include gulf and inland shoreline protection, sediment and freshwater diversions, terracing, vegetative plantings, marsh creation, and barrier island restoration. CWPPRA provides $5 million annually for coastal restoration planning and roughly $50 million each year for the construction of coastal protection and restoration projects.

1.7.1.5 Coast 2050

While the coastal restoration programs and projects described above reduced coastal land loss and enhanced the health and functionality of portions of Louisiana's coastal ecosystem, Federal and state agencies, leading scientists, and other stakeholders realized that these efforts were not sufficient to address the magnitude of the land loss problem and to ensure a sustainable coastal ecosystem. In 1998, Federal and state agencies, local governments, academia, and numerous non-governmental groups and private citizens reached consensus on a conceptual plan for restoration of the Louisiana coast. Entitled *Coast 2050 – Toward a Sustainable Coastal Louisiana,* the plan presented a conceptual framework for achieving sustainability throughout coastal Louisiana. The plan integrates coastal management and coastal restoration approaches, and adopts a multiple-use approach to restoration planning. Among other contributions, the Coast 2050 Plan provides new quantitative techniques for projecting land loss patterns into the future, a coastwide assessment of subsidence rates and patterns, and a comprehensive consideration of changes in fish and wildlife populations. The Coast 2050 plan establishes regional and coastwide common strategies and programmatic recommendations.

The Coast 2050 Plan was a direct outgrowth of lessons learned from implementation of restoration projects through CWPPRA and reflected a growing recognition that a more comprehensive "systemic" approach was needed. The Coast 2050 Plan was the basis for the May 1999 report, entitled Section 905(b) (WRDA1986) Analysis Louisiana Coastal Area, Louisiana --Ecosystem Restoration. This reconnaissance level effort evaluated the Coast 2050 Plan as a whole and expressed a Federal interest in proceeding to the feasibility phase. This report was the precursor to the LCA Ecosystem Restoration Study.

1.7.1.6 Governor's Committee on the Future of Coastal Louisiana

In February 2002, the Governor's Committee on the Future of Coastal Louisiana (COFCL) prepared a report, "Saving Coastal Louisiana: Recommendations for Implementing an Expanded Coastal Restoration Program," which provided recommendations as a starting point for a renewed and expanded coastal restoration effort. The COFCL report characterizes Louisiana's land loss crisis as an emergency of untold cost to the state of Louisiana and the nation that must be confronted now, with all available resources. The devastation of the coastal land loss will, according to the COFCL report, directly affect our nation's security, navigation, energy consumption, and food supply. The COFCL report further elaborates that the potential loss of lives, infrastructure, industry, ecosystems and culture cannot be overstated.

1.7.1.7 Water Resources Development Act Restoration Actions

The Water Resources Development Acts (WRDA), authorize the Secretary of the Army and the USACE to study and/or implement various projects and programs for improvements to rivers and harbors of the United States and for other purposes. While not specifically environmental laws, a number of Water Resources Development Acts contain general environmental provisions pertinent to the Civil Works water resources development program or to the management of environmental resources. A number of sections from these Acts pertain to specific projects or studies for environmental purposes. The WRDA 1986 made numerous changes in the way potential new water resources projects are studied, evaluated, and funded. The major change is that the law now specifies greater non-Federal cost sharing for most USACE water resources projects. Caernarvon and Davis Pond are the two large scale freshwater diversion projects which divert Mississippi River water to counteract saltwater intrusion, to help offset marsh subsidence, and to enhance fish and wildlife. These projects are designed to benefit over 40,000 acres (16,200 ha) of wetland habitat.

Section 1135 (PL 99-662) of WRDA 1986 authorizes the USACE to review the operation of its existing water resources projects to determine the need for modifications in structures and operations for the purpose of improving the quality of the environment in the public interest. A maximum $25 million annual limit was authorized for this section with 25 percent of the cost of any modification to be paid by a non-Federal sponsor.

Section 204 (PL 102-580) of the WRDA 1992 authorized the Secretary of the Army to carry out projects for the protection, restoration, and creation, of aquatic and ecologically related habitats, including wetlands, in connection with dredging for construction, operation, or maintenance of an authorized Federal navigation project.

1.7.1.8 Louisiana State Restoration Projects

The state of Louisiana partners with private companies and agencies within the state, and the Federal government, to create, restore, and protect wetlands and shoreline from degradation. The types of projects include hydrologic restoration, beneficial use of dredged material, marsh management, marsh creation, shoreline protection, freshwater diversion, vegetation planting, sediment and nutrient trapping, sediment diversion, and barrier island restoration. These projects are scattered within the four subprovinces of the coastal zone of Louisiana. As of 2003, the total acreage created, restored, or protected for Subprovince 1 is 2,443 acres (989 ha), Subprovince 2 is 9,143 acres (3,703 ha), Subprovince 3 is 4,865 acres (1970 ha), and Subprovince 4 is 4,574 acres (1852 ha).

1.7.1.9 Vegetation Restoration Projects

The LDNR, NRCS, and Soil and Water Conservation Committee (SWCC) are the agencies involved with vegetative plantings in coastal Louisiana. Within the four subprovinces, there were 193 vegetation projects as of 2003. The total acreage benefited for each Subprovince is as follows: Subprovince 1 had 486 acres (197 ha), Subprovince 2 had 1,004 acres (407 ha), Subprovince 3 had 1,785 acres (723 ha), and Subprovince 4 had 1,973 acres (799 ha) created, restored, and/or protected. These plantings have rehabilitated fresh, brackish, intermediate, and saline marsh, swamp, and barrier islands.

1.7.1.10 Mitigation Banks in the Louisiana Coastal Zone

Currently, the District's Regulatory Branch database indicates that there are currently 21 mitigation banks in 10 parishes within the boundaries of the “coastal zone”. These mitigation banks hold a total about 9,000 acres (3,645 ha) of swamp and bottomland hardwood forests. The total credits used or total acres planted in these mitigation banks are about 4,908 acres (1,988 ha). There is more acreage available for sale and more opportunities for mitigation banks to be created.

1.7.1.11 Parish Coastal Wetlands Restoration Program

The Parish Coastal Wetlands Restoration Program (PCWRP), also known as the "Christmas Tree Program" is designed to encourage public involvement and participation in coastal restoration. The LDNR web site (http://www.savelawetlands.org/site/Xmas/xmas3.html) provides the following description of the PCWRP or Christmas Tree program. The Louisiana Christmas Tree Program originated from a similar erosion-control technique created in the Netherlands. In 1986, Louisiana State University scientists constructed brush fences using willow limbs and branches. Although this brush fence was effective, it required too much effort to build. In 1989, DNR/CRD constructed a prototype brush fence using Christmas trees at the La Branche Wetlands in St. Charles Parish. Twenty-three brush fences were built and filled with 8,000 used Christmas trees obtained from local citizens. This project was successful and set the stage for the DNR/CRD PCWRP. . The PCWRP expanded in 1990 to all coastal zone parishes through DNR/CRD and has now been in existence for eleven years. During this time over 40,000 linear feet (12,192 linear meters), or approximately 8 miles (12.9 kilometers), of brush fences have been built, with over 1,140,000 Christmas trees utilized. Jefferson Parish alone has used over 704,000 Christmas trees to fill brush fences and abandoned oil field canals.

1.7.1.12 Federal Emergency Management Agency

The Federal Emergency Management Agency (FEMA) provides aid to people and areas that have been adversely affected by presidentially declared natural disasters. Aid provided by FEMA includes vegetative plantings, beneficial use of dredged material, sand fences on barrier islands, repairing water control structures, and bank repair. As of 2003, FEMA assisted the state of Louisiana after several hurricanes, tropical storms, and flooding events with 8 projects, which benefited over 5,379 acres (2,178 ha).

1.7.1.13 Non-Governmental Organizations (NGOs)

Non-governmental organizations (NGOs) and other private interests include: private landowners, family estates, corporations, non-profit organizations, environmental organizations such as Ducks Unlimited, and academic institutions. Aside from the general recognition of a few conservation organizations' restoration efforts, a comprehensive accounting of the various NGO restoration activities in coastal Louisiana is lacking. Examples of public and private parties involved in wetlands preservation or restoration activities in coastal Louisiana include: Coastal America, Corporate Wetlands Restoration Partnership, Gulf Coast Joint Venture, Audubon Society, National Fish and Wildlife Foundation, The Nature Conservancy, National Wildlife Federation, the North American Wetlands Conservation Act (NAWCA), administered by the USFWS; and the Wisner Foundation, in a community-based partnership with the University of New Orleans, Morris P. Hebert, Incorporated, the Barataria-Terrebonne Estuary Program, Restore America's Estuaries Program, Chevron and the Federal government. A more detailed accounting of these restoration activities is presented in section 4.23.1 Federal, State, Local and Private Restoration Efforts.

1.7.2 Lessons Learned and Opportunities for the LCA Study

The resources of the Mississippi River system remain available to contribute to the restoration of the coastal Louisiana ecosystem. The Federal Government and State of Louisiana have been conducting ecosystem restoration efforts for the past 14 years under the CWPPRA. In addition, the scientific community in Louisiana is recognized internationally for their expertise in climate and wetland research. The lessons learned and extensive experience gained from past restoration and research efforts have been applied in the LCA Study and can continue to be applied in a systematic way to develop and implement a coast wide plan for addressing the land loss problem and critical needs facing coastal Louisiana. Opportunities for ecosystem restoration include:

- Freshwater reintroductions and outfall management - Diverting water from the Mississippi River into hydrologic basins can 1) nourish existing marshes to increase their productivity and build wetlands in areas of open water, 2) potentially reduce the extent of the hypoxic zone in the gulf, 3) help satisfy the need for maintaining salinity gradients that correspond to the diversity of vegetative habitat, and 4) reintroduce and distribute sediment and nutrients throughout the ecosystem;

- Barrier island restoration, through placement of sand from offshore sources or the Mississippi River, could sustain these geomorphic structures, which would provide additional protection from hurricane storm surges and protect the ecology of estuarine bays and marshes by reducing gulf influences, as well as protect Nationally important water bird nesting areas;
- Hydrologic modification, such as degrading excavated dredged material banks or re-establishing ridges or natural banks, can help restore salinity and marsh inundation patterns and provide fishery access in previously unavailable habitats; and
- The use of sediment material from dedicated dredging or maintenance dredging (e.g., beneficial use) to create a marsh platform can create large amounts of coastal habitat quickly.
- Many of the above techniques can be applied in combination to produce synergistic effects while minimizing disruptions to the surrounding ecology and economy (e.g., dedicated dredging in conjunction with a small river diversion to increase the sustainability of the created marsh).

By applying ecologically sound principles and restoration methods developed in recent years, and through improved understanding of coastal system processes and ecosystem responses to restoration projects, there is an opportunity available for Louisiana and the Nation to reverse the current trend of land loss and move the Louisiana coastal area ecosystem toward a sustainable future.

1.7.2.1 Freshwater and Sediment Diversions

There is an opportunity to use riverine resources, such as freshwater, sediment, and nutrients, transported down the Mississippi River and its distributaries to reverse coastal land loss, restore hydrologic connectivity, and improve ecosystem function. Controlled diversions into marshes with water depths averaging about 5 feet (1.5 meters) or less would require relatively less sediment for each acre (hectare) of new land and would likely be more effective in counteracting land loss than the building of sub-deltas in relatively deep water. Mimicking crevasses through reintroductions into waters with depths of approximately 12 feet (3.7 meters) may be a practical and effective means of creating land in bays and sounds adjacent to the Mississippi River, but would require substantially more sediment for each acre (hectare) of marsh created.

In creating new land, it is not desirable to completely fill the receiving water bodies. Rather, it would be more desirable to transform large lakes and bays into a series of interconnecting ponds with shallow water depths. Judicious spacing of the sub-delta lobes would substantially increase the land/water interface, which is more attractive to marsh and estuarine life forms. The introduction of sediment should be carried out periodically. This would allow plants and animals to enter and establish themselves in the newly made areas shortly after the land is formed.

In addition to freshwater diversions, hydrologic restoration can also be accomplished through salinity control management in areas where riverine sources are less abundant, such as in the Chenier Plain.

1.7.2.2 Beneficial Use of Dredged Materials

The beneficial use of dredged material can also reduce land loss. The U.S. Army Corps of Engineers-Mississippi Valley, New Orleans District (District) excavates an average of 70 million cubic yards (mcy) of material annually in maintenance dredging of navigation channels. A major portion of this volume is either re-suspension or hopper dredged material, however, and is therefore not available for beneficial placement. The District, along with other Federal and state local cost sharers, has beneficially placed dredged material to create over 18,000 acres (7,200 ha) of land between 1976 and 2003. To provide perspective, placing 60 million cubic yards of material in water bodies up to 3 feet (0.9 meter) in depth, and allowing for losses due to compaction, subsidence, and erosion, could result in the creation of 4,300 acres (1,742 ha) of marsh per year. This is approximately 28 percent of the current annual net rate of land loss.

Sediment will be tested as appropriate on a project specific basis. Furthermore, the Clean Water Act 404 (b)(1) Guidelines (40 CFR 230) are the environmental criteria for evaluating the proposed discharges of dredged or fill material into waters of the U.S. Compliance with these guidelines is the controlling factor used by the USACE to determine the environmental acceptability of disposal alternatives. The USACE must demonstrate through completion of a 404 (b)(1) evaluation that any proposed discharge of dredged material is in compliance with the Guidelines.

1.7.2.3 Nearshore and Offshore Sand Resources

Barataria offshore sand resources

Identification of sand resources to support the coast wide restoration of Louisiana's barrier islands and back-barrier marshes requires finding large volumes of high-quality sand and developing cost-effective delivery systems to move these materials. The recent cooperative study by the USGS, the University of New Orleans, and USACE (Kindinger et al. 2001) as part of the Barataria Feasibility Study provides such information for the offshore Barataria Basin area.

Seismic and sonar interpretations, verified by geologic core samples, confirm that there are several nearshore sand bodies within the Barataria offshore area that meet or exceed the minimum criteria for potential mining sites. These sand bodies potentially contain between 396 and 532 mcy (303 to 407 million cubic meters) of sand and can be characterized into surficial and buried sites. However, while these potential sand sources consist primarily of fine sand, a full 90 percent of the sand body areas will need almost 570 mcy (436 million cubic meters) of overburden removed if the entire resource is mined. Kindinger et al. (2001) recommend using the sand for barrier island shoreface restoration and the overburden to build back-barrier platforms for marsh restoration. The researchers also recommend consideration of Ship Shoal as an alternative resource.

Terrebonne/Timbalier offshore sand resources (Ship Shoal)

Ship Shoal, the largest submerged shoal off Louisiana, is a sand body located on the south-central Louisiana inner shelf about 9.5 miles (15.3 kilometers) seaward of the Isles Dernieres. Ship Shoal is approximately 31 miles (50 kilometers) long and 3 to7.5 miles (4.8 to 12.1 kilometers) in width, with relief of up to 12 feet (3.6 meters). Water depth ranges from 23 to 30 feet (7 to 9 meters) on the eastern side of the shoal to approximately 10 feet (3 meters) over the western reaches (Penland et al. 1986). It is composed primarily of well-sorted quartz sand, a benthic substrate not commonly found on the Louisiana inner shelf (Stone 2000) and, as the name implies, may have significant historical sites associated both within and on its surface. The Minerals Management Service (MMS) recently completed an environmental assessment on proposed dredging of sand from Ship Shoal for coastal and barrier island restoration projects and for flood levee construction. This analysis determined that the proposed action to dredge and emplace sand from Ship Shoal would not significantly affect the quality of the human environment.

1.7.2.4 Availability of Coastal Wetlands to Remove Nutrients

In January 2001, the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force issued the *Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico* (Action Plan). According to the Action Plan, restoring and enhancing de-nitrification and nitrogen retention in the Mississippi River Basin, including the Deltaic Plain in southeastern Louisiana, are the primary approaches for reducing gulf hypoxia. Mitsch et al. (2001) also identify Mississippi River diversions as a tool for reducing gulf hypoxia, and estimate that potential nitrate reduction using diversions "is probably limited to less than 10 percent to 15 percent of total flux in the river."

Preliminary results of earlier coastal area water quality modeling efforts (see appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING) along with existing literature on the subject (Mitsch et al. 2001) suggest that large-scale river diversions may contribute significantly to the National effort to reduce hypoxia in the northern Gulf of Mexico. Because some river diversion features evaluated during plan formulation are relatively small, implementation of such projects would likely result in nutrient reductions that are small in comparison to total nutrient inputs from the Mississippi River to the gulf. Implementation of a LCA Plan would, however, provide an excellent opportunity to add to our understanding of the effectiveness of river diversions in reducing nutrient inputs from the Mississippi River to the Gulf of Mexico, while also further studying any potential adverse effects of such projects. In this way, the lessons learned from implementation of the river diversion features could facilitate large-scale river diversion projects in the future, along with the potentially significant nutrient reductions such projects might provide.

1.8 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REQUIREMENTS

In compliance with NEPA, this report documents the programmatic approach of the LCA Study. In an effort to reduce paperwork, integrate NEPA requirements with other environmental review and consultation requirements, and combine environmental documents with other documents, this report utilizes some concepts established by the CEQ -- adoption, incorporation by reference, and tiering.

Adoption is discussed in 40 CFR Section 1506.3. "*An agency may adopt a Federal draft or final environmental impact statement or portion thereof provided that the statement or portion thereof meets the standards for an adequate statement under these regulations."* This report adopts in its entirety or portions thereof previous NEPA documents to take advantage of lessons learned from previous Louisiana coastal wetlands restoration efforts. The document and/or portions being adopted include:

Coast 2050: Toward a Sustainable Coastal Louisiana;
Coast 2050: Toward a Sustainable Coastal Louisiana, An Executive Summary;
Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices;
(source: http://www.coast2050.gov)

Tiering is discussed in 40 CFR Section 1508.28. *"Tiering refers to coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basin-wide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. . . from an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe."* This statement will serve as a programmatic analysis for restoration efforts that will concentrate on coastwide, province-wide, and basin-wide issues. This statement will provide the foundation for more site-specific environmental analysis as needed at later dates.

1.9 PRIOR STUDIES, REPORTS AND EXISTING WATER RESOURCES PROJECTS

A number of studies and reports on water resources development in the study area have been prepared by the USACE, other Federal, state, and local agencies, research institutes, and individuals. Previous studies established an extensive database for the LCA Study. Historical trends and existing conditions were identified to provide insight into future conditions, help isolate the problems, and identify the most critical areas. The following studies, reports, and projects in the coastal area are the most relevant to ecosystem restoration. A more thorough listing of prior studies, reports, and water resources projects can be found in attachment 2 to this report.

1.9.1 The Mississippi River and Tributaries (MR&T) Project

The Mississippi River and Tributaries (MR&T) Project is a comprehensive project for flood control on the lower Mississippi River below Cape Girardeau, Missouri. The project was authorized as a result of the 1927 flood of the lower Mississippi River, which resulted in the failure of existing levees and extensive flooding of populated areas. The four major elements of the MR&T Project are: 1) levees for containing flood flows; 2) floodways for the passage of excess flows past critical reaches of the Mississippi River; 3) channel improvement and stabilization to provide an efficient navigation alignment, increase the flood carrying capacity of the river, and protect the levee system; and 4) tributary basin improvements for major drainage and for flood control, such as dams and reservoirs, pumping plants, auxiliary channels, etc. (**figure 1-12**). The MR&T system controls and confines the river system before it reaches the coastal area. Several major outlets to the main stem of the river, which are described below, exist for the purposes of flood control during flood stages. The effects of channel and backwater storage are not accounted for in the flow volumes through the Atchafalaya Floodway and Atchafalaya River presented in **figure 1-12**.

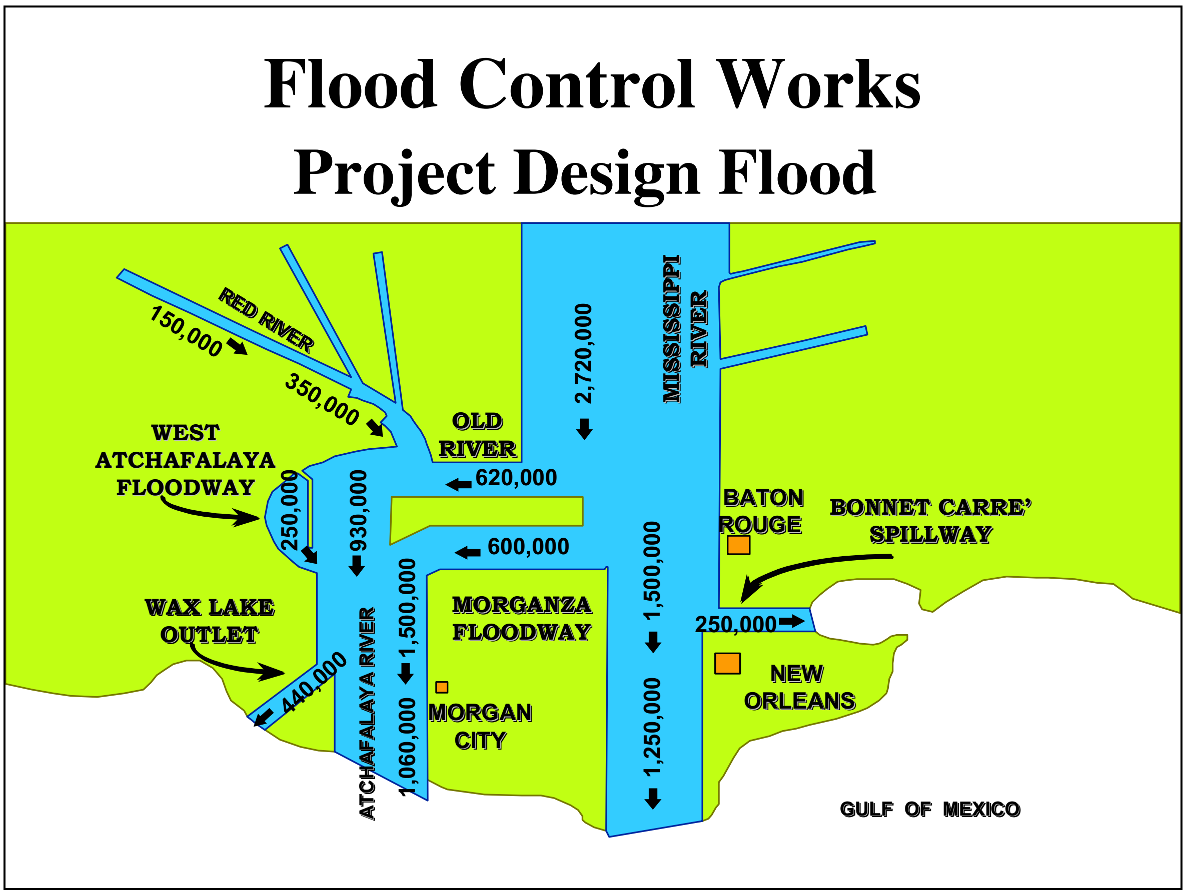

Figure 1–12. MR&T Scenario During Maximum Flood Projected Flood Conditions.

1.9.2 The Atchafalaya Basin

At the latitude of the Old River Control Complex, the MR&T Project flood totals 3 million cubic feet per second (cfs) (90,000 cubic meters per second [cms]) consisting of the sum of the Red River and Mississippi River flood flows. The Atchafalaya Basin is designed to convey up to one half of the project flood flows or 1.5 million cfs (45,000 cms). During daily operations, the Old River Control structures are regulated to maintain a 70/30 distribution between the Mississippi/Atchafalaya Rivers. In authorizing the Old River Control Complex (Flood Control Act of 1954), Congress directed that the system distribution should be maintained at the same distribution that existed in 1950 which was 70/30. During a project flood, the Old River Control Complex would divert up to 620,000 cfs (18,600 cms) from the Mississippi River to the Atchafalaya from the Morganza and West Atchafalaya Floodways.

The Morganza Floodway (located to the east of the Atchafalaya River) and the West Atchafalaya Floodway (located to the west of the river) are two floodways that can convey flood waters into the Atchafalaya Basin during severe floods. The West Atchafalaya Floodway is controlled by a fuse plug levee at the Red River, which would overtop or be blown in the event of the project flood, thereby allowing an additional 250,000 cfs (7,500 cms) to enter the basin. The Morganza Floodway is controlled by a structure at the Mississippi River that can allow another 600,000 cfs (18,000 cms) to enter the basin in the event of the project flood.

The basin has two outlets at the southern end, which empty into Atchafalaya Bay and then the Gulf of Mexico. One outlet is the Lower Atchafalaya River, a natural outlet, while the other is a manmade outlet, the Wax Lake Outlet, which was constructed in 1941 to facilitate better conveyance of flood flows.

1.9.3 Bonnet Carré Spillway

The Bonnet Carré Spillway is located at the site of an old crevasse, and contains a control structure at the Mississippi River. The facility is designed to convey a maximum of 250,000 cfs (7,500 cms) of floodwater to Lake Pontchartrain to relieve flood conditions downstream,

1.9.4 Caernarvon and Davis Pond Freshwater Diversion Projects

The "Freshwater Diversion to the Barataria and Breton Sound Basins" report (USACE, 1983), and subsequent technical appendices (USACE 1984), recommended diverting Mississippi River water into Breton Sound Basin near Caernarvon and into Barataria Basin near Davis Pond to increase habitat quality and improve fish and wildlife resources. The Caernarvon Freshwater Diversion was completed in 1991 with a design discharge of 8,000 cfs (240 cms). Since its construction, the Caernarvon structure has been operated as a salinity control measure, with freshwater introductions ranging between 1,000 cfs (30 cms) to 10,000 cfs (300 cms). The Davis Pond Freshwater Diversion was completed in 2002 with a maximum design capacity of 10,650 cfs (319 cms). It is noted that a third freshwater diversion project with a maximum capacity of 30,000 cfs (900 cms) at Bonnet Carré was included in the 1983 report, but the project has not been constructed due to environmental concerns by non-Federal interests.

1.9.5 The Gulf Intracoastal Waterway (GIWW)

The GIWW was authorized and construction was begun in the 1920s. It traces the U.S. coast along the Gulf of Mexico from Apalachee Bay near St. Marks, Florida to the Mexican border at Brownsville, Texas. From its intersection with the Mississippi River, the waterway extends eastward for approximately 376 miles (605 kilometers) and westward for approximately 690 miles (1,111 kilometers). In addition to the main stem, the GIWW includes a major alternate channel, 64 miles (103 kilometers) long, which connects Morgan City, Louisiana, to Port Allen, Louisiana. Project dimensions for the main stem channel and the alternate route are 12 feet (3.7 meters) deep and 125 feet (38.1 meters) wide, except for the reach between the Mississippi River and Mobile Bay, which is 150 feet (45.7 meters) wide. Today, portions of the GIWW are deeper and wider than the original construction dimensions. Numerous side channels and tributaries intersect both the eastern and western main stem channel, providing access to inland areas, coastal harbors, and the Gulf of Mexico.

1.9.6 Mississippi River Gulf Outlet (MRGO)

The Rivers and Harbors Act of 1956 (PL 84-455) authorized construction of the Mississippi River - Gulf Outlet (MRGO), a deep draft navigation channel that was completed and put into service in the 1960s. The MRGO provides deep draft navigation access to the New Orleans tidewater port area located along the upper reaches of the MRGO and the Inner Harbor Navigation Canal (IHNC), close to the junction of the GIWW with the Mississippi River. Today, the surface dimensions of the channel have increased beyond those of the original construction, and in some areas, the width of the channel has appreciably widened as a result of erosion. The authorized channel width for the project is 500 feet (152 meters), but the channel is more than 2,000 feet (610 meters) wide at some locations.

The USACE is currently investigating the feasibility of continued operation of the MRGO Navigation Project because of the increased cost of channel maintenance and decreased channel use at maximum depths. The reevaluation study is tentatively scheduled for completion in FY 2005.

1.9.7 Morganza to the Gulf

In March 2002, a feasibility report and programmatic environmental impact statement (PEIS) entitled “Mississippi River & Tributaries - Morganza, Louisiana to the Gulf of Mexico -- Hurricane Protection” was prepared by the USACE (USACE 2002). It is noted that there is an addendum 1 to the report dated April 2003 and an addendum 2 dated March 2004. It is further noted that the Chief's Report (which the proposed authorizing language references) is dated August 9, 2002. The Chief's report was also supplemented in 2003. The recommended plan proposed a series of flood protection measures and included the following:

- The construction of approximately 72 miles (116 kilometers) of levee south of Houma;
- The construction of nine gated structures in various waterways and three floodgates in the GIWW;
- The construction of a lock structure and floodgate complex for the Houma Navigation Canal (HNC); and
- The construction and operation of new and replacement fish and wildlife structures in selected locations to maintain tidal exchange.

The area to be protected by the levee system is a former major delta from a previous course of the Mississippi River. As in other locations in south Louisiana, urban and agricultural development has occurred along the banks of the remnant ridges of the delta. Therefore, conveyance of freshwater via the Mississippi River through these remnant channels is not practical. However, the close proximity of the area to the Atchafalaya Basin offers other options of freshwater distribution. The GIWW is linked to the Atchafalaya Basin and conveys water eastward to the area. The HNC intercepts these flows before they reach the area of need and conveys them efficiently to the Gulf of Mexico. If authorized, and with the levee system and water control structures in place, the Atchafalaya River flows can be managed and distributed across the area. The proposed Morganza to the Gulf levees and water control structures would convey Atchafalaya River water eastward and would support the efforts proposed within the LCA Plan, thus helping solve the saltwater intrusion problem in the Houma area.

1.9.8 Donaldsonville, Louisiana to the Gulf of Mexico Feasibility Study

In February 2002 the USACE, New Orleans District signed a Feasibility Cost Sharing Agreement with the Lafourche Basin Levee District and the Louisiana Department of Transportation and Development. This agreement continued investigations under the authority of a U.S. House of Representatives Transportation and Infrastructure Committee resolution adopted May 6, 1998. The focus for initial action is within the jurisdictional boundaries of the Lafourche Basin Levee District, which covers portions of the parishes of Ascension, Assumption, Lafourche, St. Charles, St. James, and St. John the Baptist. The study area has been declared a Federal Disaster Area four times since 1985 after flooding events. The basin is subject to heavy rainfall, tidal surges from the Gulf of Mexico, and hurricane flooding.

The purpose of the study is to investigate the feasibility of constructing a hurricane protection levee from Larose, Louisiana, that connects to the authorized West Bank Hurricane Protection Levee Project to investigate possible solutions to improve interior drainage within the Lac des Allemands drainage basin and to investigate restoring and/or protecting the natural and human environment to create a sustainable ecosystem in the Lac des Allemands drainage basin. The investigations are ongoing and scheduled for completion of the feasibility phase in June 2006.

1.9.9 Third Delta

In June 1999, a report entitled The Third Delta Conveyance Channel Project was completed by S. M. Gagliano and J. L. van Beek. The primary concept of the "Third Delta Conveyance Channel" is to reestablish the natural processes of Mississippi River land building on a large scale as a fundamental approach to achieving sustainable restoration in coastal Louisiana. The report discusses reintroduction of Mississippi River water and sediment in a manner that mimics natural processes. The implementation of a Third Delta would likely target wetlands in western Barataria Basin and eastern Terrebonne Basin. The LDNR is currently undertaking a reconnaissance-level study to evaluate the feasibility of constructing the Third Delta as proposed, and also to define and evaluate alternatives to the original concept that may also achieve the desired results. This study is projected to be completed by the end of FY 2005.

1.9.10 Cooperative River Basin Studies

Cooperative River Basin Studies have also been published by NRCS. These contain current and historic descriptions of basins and provide detailed management alternatives of hydrologic units within these basins. The published coastal reports include:

- Lafourche-Terrebonne, 1986
- East Central Barataria, 1989
- Calcasieu-Sabine, 1994
- Mermentau, 1997
- Teche-Vermilion, 1999

1.9.11 Watershed Reports

Watershed Reports have also been published by NRCS. These contain current and historic descriptions of watershed and provide even detailed management alternatives of hydrologic units within these watersheds. The completed coastal projects include:

- Bayou Folse Watershed, Lafourche Parish, completed 1977
- Bell City Watershed, Calcasieu, Cameron and Jefferson Davis Parishes, completed 1994
- Cameron Creole Watershed, Cameron Parish, completed 1994
- English Bayou Watershed, Calcasieu and Jefferson Davis Parishes, completed 1974
- Lake Verret Watershed, Iberville, Ascension and Assumption Parishes, completed 1994
- Seventh Ward Canal Watershed, Vermilion Parish, completed 1971
- West Fork of Bayou Lacassine Watershed, Jefferson Davis and Calcasieu Parishes, completed 1977
- Watershed reports authorized but not yet complete in coastal areas include:
- Bayou Penchant-Lake Penchant, approved 1987
- West Fork Bayou L'Ours, approved 1987
- Bayou Tigre Watershed, Iberia and Vermilion Parishes, planning authorized 2002
- Hebert Canal Watershed, Vermilion Parish, planning authorized 2002
- Sabine-Black Bayou Watershed, planning authorized 1995

CHAPTER 2 ALTERNATIVES

This is a programmatic effort for creating a coastal restoration program that addresses the ecological and human restoration needs of coastal Louisiana. Conceptual programmatic restoration opportunities (alternatives) were developed to address the critical ecological and human needs criteria identified through the scoping process and other forums. This chapter includes presentation of planning constraints, plan formulation rationale, alternative formulation phases, comparison of the potential impacts for each restoration feature, the recommended LCA Plan, and plan implementation. Detailed discussions of the plan formulation phases are contained in the Main Report. For the sake of clarity, the following sections reiterate some of the information contained in the Main Report about the plan formulation phases. A detailed listing of coast wide plans and corresponding features is presented.

GENERAL

In order to ensure that sound decisions are made with respect to development of alternatives and ultimately plan selection, the plan formulation process requires a systematic and repeatable approach. The Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (P&G) describes the USACE study process and requirements and provides guidance for the systematic development of alternative plans that contribute to the Federal objective. Alternatives should be formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies.

The first phase of the plan formulation process is the initial problem identification. The second phase is a thorough evaluation of the resources within the study area and an assessment of what currently exists within the area compared to estimates of the change in those resources over time. This evaluation, or inventorying phase, accounts for the level or amount of a particular resource that currently exists within the study, i.e., the "Existing Conditions." The phase also involves forecasting to predict what change(s) will occur to resources throughout the period of analysis, assuming no actions are taken to address the problems of marsh/land loss in Coastal Louisiana, i.e. the "Future Without-Project Conditions." Comparison of these two conditions of the study area measures the "Problems" resulting from the change in resources over time and identifies the

"Needs" that must addressed as a result of the problems. Study area "Problems" and resulting "Needs" should be quantified based on this predicted change in resources. This second phase also results in the delineation of "Opportunities" that fully or partially address the "Problems and Needs" of the study area. An "Opportunity" is a resource, action, or policy that, if acted upon, may alter the conditions related to an identified problem. An example "Opportunity" is the utilization of the river for sediment delivery by diversion or dredge disposal.

The third phase is to then assess potential "Opportunities" to generate alternative solutions. Alternative plans are then formulated across a range of potential scales to demonstrate the relative effectiveness of various approaches at varying scales.

In the fourth phase, after alternative plans are developed, they must be "Evaluated" for their potential results in addressing the specific problems, needs, and objectives of the study. The measure of output is expressed by the difference in amount or effect of a resource between the "Future Without-Project" (No Action) conditions and those predicted to occur with each alternative in place (future with-project conditions). This difference is referred to as the benefits of the alternative. The LCA Study focus was on ecosystem restoration benefits, which are measured in metrics that reflect the area, productivity, and value of wetlands that are rehabilitated, restored, or maintained to the extent practicable.

The plan formulation process continues with the fifth phase, comparison of alternative plans to each other utilizing the benefit outputs and costs of the alternatives. A relationship between costs and varying levels of ecosystem restoration outputs across a full range of scales is compared.

The final phase in the process is selection of the plan that best meets the study objectives and the P&G's four criteria: completeness, effectiveness, efficiency, and acceptability.

Using the six-phase formulation process, the LCA Plan that best meets NER objectives was developed.

2.1 PROGRAMMATIC CONSTRAINTS

The development and evaluation of restoration alternatives within coastal Louisiana was constrained by several factors. Foremost among these factors was the fundamental premise that restoration of deltaic processes would be accomplished in part, through reintroductions of riverine flows, but that natural and historical "channel switching" of the Mississippi River would not be allowed to occur. The availability of freshwater, primarily water transported down the Mississippi River, was considered a planning constraint because minimum levels or water flows are required to maintain navigation, flood control, and public water supply, and limit saltwater intrusion. The availability of sediment for restoration efforts was also considered a planning constraint for this study because there is not an unlimited, easily accessible, and low-cost source for restoration efforts.

Another major category of constraints is the scientific and technological uncertainties inherent in large-scale aquatic ecosystem restoration projects. While many of these were known as the plan formulation process began, others became more evident as the formulation process was completed. A summary of the key scientific uncertainties and technological challenges as they are currently understood, along with proposed strategies to address these uncertainties and challenges, is presented below.

2.1.1 Scientific and Technological Uncertainties

Scientists have documented the importance of the Louisiana coastal area for fish and wildlife habitat (Coalition to Restore Coastal Louisiana 1989; Keithly 1991; Herke 1993; Michot 1993; Olsen and Noble 1976), estuarine productivity (Morris et al., 1990), and ecological sensitivity to human activity (Templet and Meyer-Arendt 1988; McKee and Mendelssohn 1989; Reed 1989). This recognition has resulted in considerable efforts to investigate and understand the complex physical (Morris et al. 1990), chemical (Mendelssohn et al. 1981; Morris 1991), and ecological (Montague et al. 1987) processes that drive the system, providing Louisiana with a rich history of scientific studies. Studies on understanding relationships between different habitats and different aquatic species (Minello and Zimmerman1991) have been conducted due to the importance of the Louisiana coast's support to numerous estuarine dependent fish and its ability to provide important nursery habitat for diverse fish communities. The coastal areas have also been important for wintering waterfowl with several studies conducted to understand relationships between waterfowl use and habitat conditions. Oil and gas exploration and production have prompted numerous studies on subsurface geologic conditions. Additional geologic conditions have been investigated to aid in understanding deltaic processes that have shaped the Louisiana coast (Fisk 1944; Kolb and Van Lopik 1958; Frazier 1967; May 1984; Smith et al. 1986; Penland et al. 1988a, 1988b, 1988c; Dunbar et al. 1994; 1995). Studies on the Atchafalaya River and delta have also contributed to our understanding of deltaic processes (USACE 1951; Fisk 1952; Shlemon 1972). In addition, numerous studies performed in other ecosystems are applicable in understanding the ecology and function of the Louisiana coastal area. The results of these investigations provide considerable understanding of the physical, chemical, and biological processes that formed and sustain the Louisiana coast. The numerous state-sponsored studies generated from CWPPRA have developed basic trend information over the past 14 years. Studies funded by the National Science Foundation and others have aided in an understanding of impacts and have provided recommendations for improved operations for some existing diversion projects.

The LCA Study builds upon the best available science and engineering knowledge, which has resulted in part from the work described above. However, many of the studies conducted in the Louisiana coastal area have been limited in geographic extent or technical scope. Therefore, while previous research efforts have contributed to a strong understanding of the processes affecting the Louisiana coastal area, scientific and technical uncertainties still remain. Additional investigations to further reduce the scientific and technical uncertainties and to enhance the likelihood that restoration projects will successfully meet restoration goals would be necessary during LCA Plan implementation. The use of newer techniques like geospatial technology (e.g., GIS and remote sensing) should be investigated to determine their capabilities in answering areas of uncertainty. It is expected that geospatial technologies will be able to answer many of the uncertainties associated with the LCA Study. The LCA Project Delivery Team (PDT) reviewed annual Adaptive Management reports prepared to assess previously constructed CWPPRA projects. These efforts are an extension of the existing monitoring program used to identify "lessons learned" from the many CWPPRA projects, past and future, and will also serve as a valuable assessment of "what worked" and "why it worked" on projects that have been built long enough to provide useful data. Identification of the reasons why other projects did not meet initial project goals is also essential to reduce uncertainties.

This discussion on scientific and technological uncertainties is intended to illustrate that considerable information has been developed from prior studies, but that data gaps still exist and considerable scientific and engineering uncertainties remain. The PDT recognized the uncertainties and conducted plan formulation and evaluation with this recognition. The discussion that follows details the different broad types of uncertainties, with appropriate actions to resolve them during LCA Plan implementation.

Identification of the reasons why other projects did not meet initial project goals is also essential to reduce uncertainties.

The Main Report presents a more detailed discussion on scientific and technological uncertainties that is intended to illustrate the considerable information that has been developed from prior studies, but that data gaps still exist and considerable scientific and engineering uncertainties remain. There are numerous types of uncertainties that need to be addressed to support and improve LCA Study restoration efforts. Each uncertainty requires a different resolution strategy, based on the effects of the uncertainty on the program, degree of uncertainty, cost of addressing the uncertainty, and importance of reducing the uncertainty. The Main Report also discusses the strategies to resolve the four uncertainty types:

- Type 1 - Uncertainties about physical, chemical, geological, and biological baseline conditions
- Type 2 - Uncertainties about engineering concepts and operational methods
- Type 3 - Uncertainties about ecological processes, analytical tools, and ecosystem response
- Type 4 - Uncertainties associated with socioeconomic/political conditions and responses

2.2 PLAN FORMULATION RATIONALE

2.2.1 Coordination to Complete Plan Formulation

The plan formulation effort was conducted as a coordinated and collaborative effort involving a host of Federal and state agencies, the Louisiana academic community, and experts across the Nation. The broad geographic scope of the Louisiana coastal area and the complexity of aquatic ecosystem restoration efforts in general provided the rationale for convening a number of multi-disciplinary teams to provide technical expertise and expedite review and decision-making within the plan formulation process. The teams generally fell into one of three categories: coordination, project execution, and special. The role of each team is described in the following sections.

2.2.1.1 Coordination Teams

Federal Principals Group - A Federal Principals Group (FPG) was established to provide Washington, D.C. level collaboration among Federal agencies for the LCA Study. The FPG for the LCA Study includes regional representatives from the following:

- U.S. Environmental Protection Agency (USEPA), Headquarters;
- Department of Interior - Fish and Wildlife Service (USFWS);
- Department of Interior - Minerals Management Service (MMS);
- Department of Commerce - National Marine Fisheries Service (NMFS);
- Department of Interior - Geological Service (USGS);
- Department of Agriculture - Natural Resources Conservation Service (NRCS);
- Department of Energy (DOE);
- Department of Transportation - Maritime Administration; and
- Department of Homeland Defense - Federal Emergency Management Agency (FEMA).

Regional Working Group **-** A Regional Working Group (RWG) was formed to support the Washington-level Federal Principal's Group and facilitate regional level collaboration and coordination on the LCA Study. The RWG membership mirrors the composition of the FPG.

Executive Team - An Executive Team was formed to provide executive-level guidance and support for the LCA Study. In addition, the Executive Team worked with the District Engineer on various issues throughout the LCA Study and plan formulation. The Executive Team consisted of the following members:

- District Engineer, New Orleans District, USACE
- Deputy District Engineer for Project management, New Orleans District, USCAE
- Secretary of the Louisiana DNR
- Deputy Secretary of the Louisiana DNR

Governor's Advisory Commission on Coastal Restoration and Conservation - By statute, the State of Louisiana recently established a Governor's Advisory Commission on Coastal Restoration and Conservation. The primary purpose of the Advisory Commission is to advise the governor and state legislature on the overall status and direction of the state's coastal restoration program.

Framework Development Team **-** A Framework Development Team (FDT) was formed to provide a forum for Federal interagency representatives, environmental non-governmental groups (NGOs), and State of Louisiana resource agencies to discuss LCA Study activities and technical issues.

2.2.1.2 Project execution teams

Vertical Team - The Vertical Team (VT) was formed for the purpose of ensuring communication and coordinating activities within the USACE at the district, division, and headquarters levels.

The VT has also provided guidance regarding the level of detail and overall approach for completing the LCA Study.

Project Delivery Team (PDT) - Execution of the LCA Study and PEIS rested primarily with the PDT. The PDT was comprised of professional personnel representing several Federal and state agencies, many of whom were "collocated" at the District office. Member agencies included the District, LDNR, USEPA, NRCS, USGS, USFWS, and NOAA.

The PDT also included researchers affiliated with Louisiana State University (LSU), the University of New Orleans (UNO), Southeastern Louisiana University (SLU), and the University of Louisiana at Lafayette (ULL), as well as various contractors.

The PDT was organized into various teams to support key elements of the planning process. The team organization was as follows:

- Public Outreach Work Group
- Goals and Objectives Work Group
- Numerical Modeling Work Group
- Desktop Modeling and Verification Work Group
- Benefits Protocol Work Group
- Environmental Impact Statement Work Group
- Institute of Water Resources (IWR) Plan Assessment Work Group
- Economics Work Group
- Real Estate Work Group
- Engineering Work Group
- Cultural/Recreational Work Group

2.2.1.3 Special teams

National Technical Review Committee – The District formed a National Technical Review Committee (NTRC) to provide external, independent technical review of the LCA Study. The purpose of the NTRC was to ensure quality and credibility of the results of the planning process. The first seven meetings of the NTRC focused on ongoing review, comment study formulation, and plan development efforts. The NTRC held its eighth meeting to complete the review and provide comments on the LCA Study and plan development on 16–17 August 2004. Members of the NTRC included representatives from academia, the oil and gas industry, the Smithsonian Institution, and the USACE Institute for Water Resources. Each person was selected for their technical expertise in coastal geomorphology, river engineering, wetland ecology, socioeconomics, and planning.

Independent Technical Review Team - In coordination with the USACE Office of the Chief of Engineers Value Engineering Study Team (USACE-OVEST) and the Division, a Value Engineering/Independent Technical Review (VE/ITR) Team was established to perform an independent review of the plan formulation process and to perform an evaluation of the conclusions and recommendations of this report. Members of the VE/ITR included employees from the Jacksonville, Mobile, and Wilmington Districts.

Office of the Chief of Engineers Value Engineering Study Team – USACE-OVEST is a organization of the USACE that optimizes the value of programs/projects/processes by the employment of Value Engineering. The team consists of technically skilled people with a cross section of experience in construction, design, operations and maintenance (O&M), and project management. The team is also augmented with resources from throughout USACE. The VE methodology was applied at an early point in the LCA Study to assure the optimization of the scoping effort and subsequent study investigations. The VE study duration, team composition, and study outputs were adjusted to the LCA Study to produce optimum plan formulation results.

2.2.1 Objectives and Principles for Plan Formulation

In conjunction with the study constraints, two sets of strategic level principles guided the LCA Plan formulation process. The first was the USACE-adopted Environmental Operating Principles (EOPs). The second was the Study Guiding Principles for Plan Formulation (Guiding Principles). While the EOPs direct a general, strategic "way of doing business" for all USACE efforts, the Guiding Principles, developed during the first plan formulation scoping process, provide a "way of doing business" to address system-wide problems, needs, and opportunities associated with the Louisiana coastal area. At the tactical level, specific Planning Objectives were necessary to focus formulation of a plan intended to achieve specific outcomes contributing to the attainment of the overarching goal of reversing the current trend of ecosystem degradation and ultimate loss of function in the Louisiana coastal area (as indicated by points, A, B, and C in **figure 2-1** below). This graph demonstrates that multiple outcomes representing restoration of combined ecosystem functions are possible. The planning objectives further describe the elemental system functions that the PDT viewed as essential to reflecting successful restoration.

2.2.2 Planning Objectives

In an effort to guide plan formulation, two tiers of tactical planning objectives were established - hydrogeomorphic and ecosystem. Concepts and features considered in this study, including freshwater diversions, sediment diversions, dedicated dredging/marsh creation, and barrier island protection, may effectively accomplish these planning objectives.

Hydrogeomorphic Objectives:

1. Establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing (fluctuation related to normal daily and seasonal tidal action or exchange).
2. Increase sediment input from sources outside estuarine basins, and manage existing sediment resources within estuarine basins, to sustain and rejuvenate existing wetlands and rebuild marsh substrate.
3. Maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function.

Ecosystem Objectives**:**

1. Sustain productive and diverse fish and wildlife habitats.
2. Reduce nutrient delivery to the Continental shelf by routing Mississippi River waters through estuarine basins while minimizing potential adverse effects.

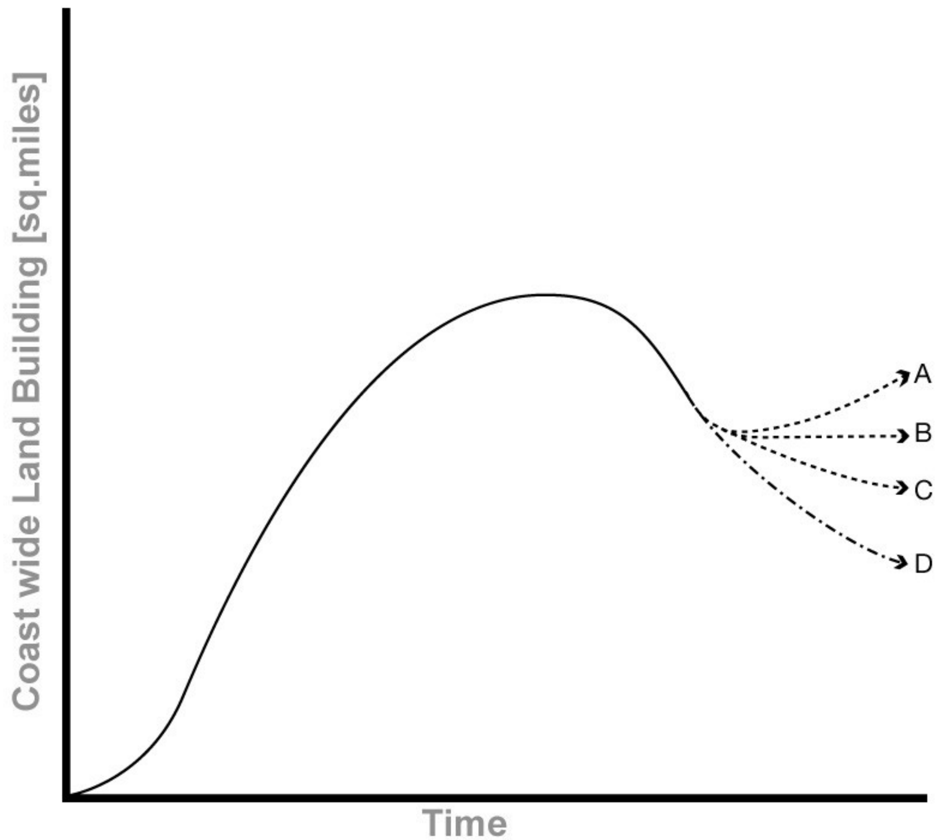

Figure 2-1. Ecosystem Degradation Trend Over Time. *The arrows represent conceptual outcomes for restoration (A, B, C) and the predicted future without-project (D).* ***(Not to scale.)***

2.2.2.1 Environmental operating principles

In 2002, the USACE reaffirmed its long-standing commitment to the environment by formalizing a set of EOPs applicable to decision-making in all programs. The principles are consistent with NEPA; the Department of the Army's Environmental Strategy with its four pillars of prevention, compliance, restoration, and conservation; and other environmental statutes and WRDAs that govern USACE activities. The EOPs have informed the plan formulation process and are integrated into all proposed program and project management processes. The EOPs are:

1. Strive to achieve environmental sustainability, and recognize that an environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.
2. Recognize the interdependence of life and the physical environment, and proactively consider environmental consequences of USACE programs and act accordingly in all appropriate circumstances.
3. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
4. 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.
5. Seek ways and means to assess and mitigate cumulative impacts to the environment and bring systems approaches to the full life cycle of our processes and work.
6. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.
7. 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 innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

2.2.2.2 Guiding principles

The PDT compiled the Guiding Principles for Plan Formulation in coordination with key stakeholder groups and with public comments provided during the scoping process.

1. It is evident that management of Louisiana's coast is at a point of decision. Only a concerted effort now will stem this on-going degradation, and thus alternatives must include features which can be implemented in the near-term and provide some immediate benefits to the ecosystem, as well as those which require further development and refinement of techniques and approaches.
2. Appreciation of the natural dynamism of the coastal system must be integral to planning and the selection of preferred alternatives. This should include assessing the risks associated with tropical storms, river floods, and droughts.
3. Alternatives that mimic natural processes and rely on natural cycles and processes for their operation and maintenance will be preferred.
4. Limited sediment availability is one of the constraints on system rehabilitation. Therefore, plan elements including mechanical sediment retrieval and placement may be considered where landscape objectives cannot be met using natural processes. Because sediment mining can contribute to ecosystem degradation in the source area, such alternatives should, to the extent practicable, maximize use of sediment sources outside the coastal ecosystem (e.g., from the Mississippi River or the Gulf of Mexico).
5. Plans will seek to achieve ecosystem sustainability and diversity while providing interchange and linkages among habitats.
6. Future rising sea levels and other global changes must be acknowledged and incorporated into planning and the selection of preferred alternatives.

7. Displacement and dislocation of resources, infrastructure, and possibly communities may be unavoidable under some scenarios. In the course of restoring a sustainable balance to the coastal ecosystem, sensitivity and fairness must be shown to those whose homes, lands, livelihoods, and ways of life may be adversely affected by the implementation of any selected alternatives. Any restoration-induced impacts will be consistent with NEPA in that actions will be taken to avoid, minimize, rectify, reduce, and then, only if necessary, compensate for project-induced impacts.
8. The rehabilitation of the Louisiana coastal ecosystem will be an ongoing and evolving process. The selected plan should include an effective monitoring and evaluation process that reduces scientific uncertainty, assesses the success of the plan, and supports adaptive management of plan implementation.
9. Recognizing that disturbed and degraded ecosystems can be vulnerable to invasive species, implementation needs to be coordinated with other state and Federal programs addressing such invasions, and project designs will promote conditions conducive to native species by incorporating features, where appropriate, to protect against invasion to the extent possible without diminishing project effectiveness.
10. Net nutrient uptake within the coastal ecosystem is maximized through increased residence time and the development of organic substrates, and thus project design should promote conditions that route riverine waters through estuarine basins and minimize nutrient export to shelf waters.

2.2.5 Planning Objectives

In an effort to guide plan formulation, two tiers of tactical planning objectives were established - hydrogeomorphic and ecosystem. Concepts and features considered in this study, including freshwater diversions, sediment diversions, dedicated dredging/marsh creation, and barrier island protection, may effectively accomplish these planning objectives.

Hydrogeomorphic Objectives:

1. Establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing (fluctuation related to normal daily and seasonal tidal action or exchange).
2. Increase sediment input from sources outside estuarine basins, and manage existing sediment resources within estuarine basins, to sustain and rejuvenate existing wetlands and rebuild marsh substrate.
3. Maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function.

Ecosystem Objectives**:**

1. Sustain productive and diverse fish and wildlife habitats.
2. Reduce nutrient delivery to the Continental shelf by routing Mississippi River waters through estuarine basins while minimizing potential adverse effects.

2.3 PLAN FORMULATION

This section summarizes the six phases of plan formulation. Each phase of the plan formulation process provided distinct results that were then used to initiate the next phase. A more detailed description of the entire plan formulation effort is available at the District upon request.

The LCA Study planning process used by the PDT evolved over two years, ultimately resulting in selection of a recommended near-term course of action. During this time, the PDT used an iterative planning process to identify and evaluate the merits of individual restoration features, the effects of combining these features into different coast wide frameworks, and ultimately the ability of these frameworks to address the most critical needs. **Table 2-1** highlights the purpose, decision criteria, and results of the major iterations.

Near the completion of the fifth phase of the plan formulation effort on going review of the study effort by the Vertical Team and PDT identified specific long-range uncertainties regarding the dynamic nature of the coastal ecosystem, science and technology (S&T) for implementation and model predictive capability. The Vertical Team and PDT, with guidance in the form of the Fiscal Year 2005 Federal budget, redirected the plan formulation effort towards the identification of a plan that focused on the critical restoration needs in the near-term, the next 5 to 10 years, along with investigative initiatives to provide better certainty on appropriate long-range restoration needs and activities. The PDT determined that an LCA Plan would best meet the overall study objectives through inclusion of several complementary plan components that differ in scale and time.

2.3.1 Phase I - Establish Planning Objectives and Planning Scales

In Phase I, the PDT developed the tactical Study Planning Objectives and planning scales for the study. The Planning Objectives were developed based on professional knowledge and extensive experience in coastal Louisiana restoration. The PDT also created planning scales to facilitate the development of different alternatives to meet the planning objectives. For the purposes of this report, the term “scale” does not refer to a specific state of the landscape. Rather, it reflects the degree to which fundamental environmental processes would be restored or reestablished, and the resulting ecosystem and landscape changes that would be expected over the next 50 years. The planning scales were developed in consideration of the tactical planning objectives and the strategic principles and established a minimum range of alternative restoration output necessary for plan formulation in each subprovince.

The PDT determined that the highest, most ambitious scale would be an annual net increase in ecosystem function. This uppermost scale, affecting an approximate 50 percent increase over no net loss, is referred to as “*Increase.*” The PDT determined that no net loss of ecosystem function would be an appropriate intermediate scale. This scale is referred to as “*Maintain.*” Reducing the projected rate of loss of function was judged to be another appropriate intermediate scale, as it is sufficiently different from the other scales and would offer an option that could provide substantial benefits over no action. This scale, achieving an approximate 50 percent reduction in the current loss rate, is referred to as “*Reduce.*” The lowest possible scale was no further action above and beyond existing projects and programs, such as CWPPRA. This scale was the basis for the No Action Alternative.

Table 2-1. Major Iterations of Plan Formulation.

	Iteration We started with:	Purpose Our intent was to:	Criteria We made decisions based on:	Result The iteration ended with:
Phase 1	EOPs and Guiding Principles	Develop Planning Objectives and Planning Scales	• Professional judgment • Extensive CWPPRA experience • Scoping Comments	Planning Objectives Planning Scales
Phase 2	Coast 2050 Plan Section 905(b) Report	Assess broad scale strategies in 2050 Plan to identify Core Strategies for LCA Study effort	• Existing resources available in each of the four Subprovinces	LCA Core Strategies
Phase 3	LCA Core Strategies	Develop restoration features that would support LCA Core Strategies	• Planning Objectives • Creating features that would meet various Planning Scales • Developing features for all LCA Core Strategies	Restoration Features
Phase 4	Restoration Features	Combine Restoration Features into Subprovince Alternative Frameworks	• Need to combine Restoration Features into Alternative Frameworks that achieve different Planning Scales • Need to develop significantly different Restoration Features for all LCA Core Strategies	Subprovince Frameworks
	Subprovince Frameworks	Create, assess, and select Coast Wide Restoration Frameworks	• Cost effectiveness (CE) • Incremental Cost Analysis (ICA)	Tentative Final Array of Coast Wide Restoration Frameworks
Phase 5	Tentative Final Array of Coast Wide Restoration Frameworks	Address completeness of Coast Wide Restoration Frameworks in Tentative Final Array	• Public meeting and stakeholder comments • Re-verification of CE/ICA	Final Array
Phase 6	Final Array	Identify highly cost-effective Restoration Features within the Final Array that address most critical needs	• Critical need sorting criteria • Critical need assessment criteria	LCA Plan

2.3.2 Phase II - Assess Restoration Strategies from the Coast 2050 Plan

The PDT, in conjunction with the Vertical Team and FDT, reviewed the Coast 2050 Plan and the LCA Section 905(b) reconnaissance report (for which the Coast 2050 Plan was the basis). These plans are described in Attachment 2, Prior Studies, Reports and Existing Water Projects. These reports identified problems in both the current and future coastal landscape and laid out 93 broad-scale strategies for addressing ecosystem restoration. Strategies in the context of the

Coast 2050 and 905(b) reports often translate directly to restoration projects. However, since many of the 93 strategies in these documents represented common restoration methods, the strategies captured for incorporation in the LCA plan formulation effort represent those most common or "core" restoration methodologies identified both coast wide and in each subprovince.

Overall, the strategies would describe methods to accomplish:

- Creation and sustenance of wetlands through input and accumulation of sediment;
- Maintenance of estuarine and wetland salinity gradients for habitat diversity; and
- Maintenance of ecosystem linkages for the exchange of organisms and system energy.

Because these accomplishments were very similar to the tactical planning objectives developed in Phase I, the PDT assessed the 93 broad-scale strategies to determine common methodologies for effecting restoration of wetland and system functions. As part of this study, the PDT identified a smaller subset of core strategies for coastal restoration efforts in the four subprovinces.

For Subprovince 1, the core restoration strategies included basin-wide freshwater reintroduction and salinity control. Reintroductions were selected because of the readily available freshwater resource, the Mississippi River. Because of its function as a conveyance of saline water into the central portion of the subprovince, the closure or constriction of the existing MRGO navigation project was identified as a potentially major component of the salinity control strategy.

For Subprovince 2, the core restoration strategies included: sustaining barrier islands, headlands, and shorelines; managing the available sediment of the Mississippi River; freshwater introduction; Mississippi River water and sediment introduction via the formation of a new delta; and preserving land bridges within the Barataria Basin.

For Subprovince 3, the core restoration strategies included: restoring Terrebonne / Timbalier barrier islands; rebuilding land in eastern Terrebonne Basin; modifying the Old River Control Complex operation scheme to increase sediment input to the Atchafalaya River; Mississippi River water and sediment introduction via the formation of a new delta; and management of Atchafalaya River freshwater, sediment, and nutrients.

In the Chenier Plain (Subprovince 4), there are no excess riverine resources available to promote land building and to control salinities in the estuarine system. As such, the core strategy for this subprovince is the control of estuarine salinities through the management of rainfall and runoff inputs to the system and the management of existing hydrologic structures and geomorphic features.

2.3.3 Phase III - Develop and Evaluate Restoration Features

In Phase III, the PDT developed 166 potential restoration features that would support the restoration strategies identified for each of the subprovinces in Phase II and that would achieve some level of the planning scales identified in Phase I. The term feature is used to describe any specific restoration project or defined collection of structural and non-structural elements combined to affect a wetland restoration action. Features represent the specific solutions for which costs were developed and from which restoration plans, or "frameworks", would be created. The term framework will be used to describe an assemblage of features developed to produce a discreet, cohesive, logical plan for achieving systemic restoration within a definable hydrologic or ecologic area.

The intent of this effort was to provide an initial identification of the most effective frameworks for meeting the overarching study objectives in concert with key strategies in each subprovince. Within this context, in addition to the programmatic nature of the NEPA documentation, the potential restoration features are intended to be representative of the most promising restoration actions and plan combinations for planning purposes. These features provide a basis for estimating costs and potential benefits and provide a starting point for identifying the most efficient framework combinations, most effective steps for addressing critical ecosystem needs, and estimating the overall cost of the ultimate implementation effort. The final refinement of feature scale and location is intended to be addressed in decision documents subsequent to the approval of this report. In developing the restoration features, the PDT took advantage of the extensive experience gained from other coastal restoration efforts, such as CWPPRA.

Preliminary costs and estimates regarding the potential for each feature to modify ecosystem functioning were based on experience and insight gained through the execution of the CWPPRA program, along with professional judgment and the best available information. The fourteen years of effort in project development and design under the CWPPRA program, along with design work completed under other Federal and state programs, provided an extensive base of design information to build on with basic component costs developed in the CWPPRA Engineer Work Group. Detailed documentation of the design assumptions, feature level of detail, and the development of the cost estimates are available at the District. The result of this phase was a "tool box" of restoration features for each subprovince, including features that addressed freshwater reintroduction (diversion), sediment diversion, hydrologic restoration, hydrologic modification, land acquisition, interior shoreline protection, barrier island and barrier headland restoration, and marsh creation and restoration. **Table 2-2** lists the number of features for each subprovince and categorizes them by feature type.

In addition, the PDT developed features whose implementation would result in varying levels of ecosystem function restoration. This exercise provided the PDT with similar features in some of the subprovinces, particularly in Subprovinces 1 and 2, that would address the reduce, maintain, and increase planning scales. For example, of the 21 freshwater reintroduction features identified for Subprovince 1, the PDT developed small, medium, and large freshwater diversion features to influence the same geographic area. Each of the diversions would result in a different level of ecosystem function restoration, and thus each would be more or less appropriate to satisfy a particular planning scale (i.e., a small freshwater diversion may or may not achieve the "increase" planning scale, whereas a large freshwater diversion in the same area would be more likely to achieve the "increase" scale).

The composition of restoration features (e.g., beneficial use of dredged materials, sediment diversion, etc.) developed for each subprovince was largely guided by the need to implement the restoration strategies previously identified in Phase II. For example, in Subprovinces 1 and 2, freshwater reintroduction was a restoration strategy. As such, the composition of restoration features for those subprovinces weighs heavily in favor of freshwater reintroductions because of the presence of an available resource, the Mississippi River. Careful examination of the distribution of restoration features developed in each subprovince can identify the nature of the ecosystem function in the area. Areas with or adjacent to abundant freshwater resources present ample diversion opportunities (i.e., Deltaic Plain) while areas with limited riverine resources (i.e., Chenier Plain) tend to provide more focus on preservation and management.

Table 2-2. Types of Restoration Features by Subprovince.

Restoration Feature	Subprovince 1	Subprovince 2	Subprovince 3	Subprovince 4
Freshwater Reintroduction (Diversion)	21	30	1	
Sediment Diversion	21	18	1	
Dedicated Dredging and Beneficial Use / Marsh Creation and Restoration	12	4	1	1
Salinity Control	1		2	16
Structure Modification (Hydrologic Restoration)	4	1		
Hydrologic Modification (Hydrologic Restoration)	1		12	4
Land Acquisition	1			
Barrier Island, Barrier Headland, and Interior Shoreline Protection and Restoration	1	1	10	2
Subprovince Totals	62	54	27	23
Total Number of Restoration Features for All Subprovinces	166			

As a final step in Phase III, the PDT made initial assessments of the positive, negative, or neutral fit of the features to address the planning objectives established for the study. This positive, negative, or neutral assessment was also made for each feature against a broad range of resources. These assessments were used to identify strengths and weaknesses of features and as a basis for including them in appropriate subprovince frameworks in Phase IV.

2.3.4 Phase IV - Develop and Evaluate Subprovince Frameworks

2.3.4.1 Development of subprovince frameworks

In Phase IV, the PDT created multiple frameworks, for each subprovince. It then evaluated the outputs and benefits of each subprovince framework using hydrodynamic and ecological models and benefit assessment protocols described in this section.

Since the resolution level and other capabilities of the available hydrodynamic and ecologic modeling system precluded adequate assessments of the effects of individual features in discreet increments, the analysis focused on combinations of features. This approach provided a basis for identifying the features that are the most likely to be effective and therefore should be included in the LCA ecosystem restoration plan. More detailed evaluations of individual features can be performed to support decisions to implement each of the features.

The combinations of restoration features in subprovince frameworks were guided by two requirements: 1) the need to combine restoration features to achieve various levels of planning scales in the subprovince, and 2) the need to develop appreciably different frameworks in each subprovince that would provide alternative planning approaches.

The PDT accomplished the second requirement with the use of restoration "approaches" that it created for each subprovince. By using different approaches to achieving restoration inside a subprovince, the PDT was able to develop appreciably different combinations of restoration features, and, in turn, an appreciably different set of frameworks. . For example, in Subprovince 1, the PDT identified "minimize salinity change" and "continuous [freshwater] reintroduction" as two different restoration approaches. The mix of restoration features in a framework to accomplish the "minimize salinity change" restoration approach would likely be one with few freshwater reintroduction features and/or where freshwater reintroduction features would be relatively small to medium. On the other hand, a mix of restoration features in a framework to accomplish the "continuous [freshwater] reintroduction" restoration approach would likely be one that relied heavily on freshwater reintroduction features, including features that would be relatively large. Restoration approaches for each subprovince are listed below:

Subprovinces 1 and 2
- Minimize Salinity Changes
- Continuous Reintroduction (w/Stage Variation)
- Mimic Historic Hydrology

Subprovince 3
- Rehabilitation/maintenance of geomorphic features
- Land Building by Delta Development
- Maximize Mississippi and Atchafalaya Flows

Subprovince 4
- Large-scale Salinity Control
- Perimeter Salinity Control
- Freshwater Introduction Salinity Control

To prevent the analysis of alternative frameworks from becoming overly complex, a maximum of nine frameworks were developed for each subprovince, with three frameworks for each planning scale (increase, maintain, and reduce). Around each planning scale a framework was developed based on the restoration approaches for that sub-province. Subprovince 1, for example, contained 3 frameworks designed to increase ecosystem function based on minimizing salinity changes (E1), continuous reintroduction of freshwater (E2), and mimicking historic hydrology (E3). Of the 166 available restoration features in the toolbox, only 111 were found necessary to meet the criteria stated above in formulating the subprovince frameworks.

During Phase V of plan formulation, the PDT developed a reasonable, "supplemental" framework for each subprovince, the process and rationale of which is presented in the Phase V summary. To ensure that this Phase IV summary identifies all subprovince frameworks that were evaluated in this study, the supplemental framework for each subprovince is included in the total count of subprovince frameworks, described below. A total of 32 subprovince frameworks were developed and evaluated in this study in addition to the no-action alternative for each Subprovince. The individual features that make up each subprovince framework are identified in **tables 2-3** through **2-6.** Full detailed descriptions of subprovince frameworks are available upon request through the New Orleans District office.

Subprovince Frameworks
Subprovince 1 = 10 Frameworks
Subprovince 2 = 10 Frameworks
Subprovince 3 = 5 Frameworks
Subprovince 4 = 7 Frameworks

For Subprovince 1, there were a total of ten frameworks: three "reduce" (R); three "maintain" (M); and three "increase" (E); and the supplemental framework (N) (**table 2-3**). For Subprovince 2, there were a total of ten frameworks: three "reduce" (R); three "maintain" (M); three "increase" (E); and the supplemental framework (N) (**table 2-4**). For Subprovince 3, there were a total of five frameworks: three "reduce" (R); one "maintain" (M); and the supplemental framework (N) (**table 2-5**). For Subprovince 4, there were a total of seven frameworks: three "maintain" (M); three "increase" (E); and the supplemental framework (N) (**table 2-6**).

Table 2-3. Subprovince 1 Frameworks.

Restoration Features	R1	R2	R3	M1	M2	M3	E1	E2	E3	N1
15,000 cfs diversion at American/California Bay				x			x	x		
110,000 cfs diversion (div.) at American/California Bay with sediment enrichment			x		x					x
250,000 cfs div. at American/California Bay with sediment enrichment						x			x	
12,000 cfs div. at Bayou Lamoque		x	x		x	x		x	x	x
5,000 cfs div. at Bonnet Carré Spillway	x	x		x						
10,000 cfs div. at Bonnet Carré Spillway						x	x	x	x	
200,000 cfs div. at Caernarvon w/ sediment enrichment								x		
1,000 cfs div. at Convent/Blind River			x			x			x	
5,000 cfs div. at Convent/Blind River		x			x		x			x
10,000 cfs div. at Convent/Blind River								x		
15,000 cfs div. at Fort St. Philip			x	x			x			
26,000 cfs div. at Fort St. Philip w/ sediment enrichment						x				
52,000 cfs div. at Fort St. Philip w/ sediment enrichment									x	
1,000 cfs div. at Hope Canal	x	x	x	x	x	x			x	x
1,000 cfs div at Reserve Relief Canal									x	
6,000 cfs div at White's Ditch							x			
10,000 cfs div. at White's Ditch		x	x		x	x			x	x
Sediment delivery by pipeline at American/California Bays				x			x		x	
Sediment delivery via pipeline at Central Wetlands	x			x			x			
Sediment delivery via pipeline at Fort St. Philip				x			x			
Sediment delivery via pipeline at Golden Triangle							x			
Sediment delivery via pipeline at La Branche	x			x			x			x
Sediment delivery via pipeline at Quarantine Bay	x						x			
Authorized opportunistic use of the Bonnet Carré Spillway										x
Increase Amite River Diversion Canal influence by gapping banks										x
Marsh nourishment on the New Orleans East land bridge										x
Mississippi River Delta Management Study										x
Mississippi River Gulf Outlet Environmental Restoration Features					x		x			x
Modification of operation of the Caernarvon freshwater diversion. (optimize for marsh creation)										x
Rehabilitate Violet Siphon and post authorization for the diversion of water through Inner Harbor Navigation Canal for increased influence into Central Wetlands										x

Note: R = Reduce; M = Maintain; E = Increase; N = Supplemental; Approaches: 1 = Minimize salinity change; 2 = Continuous reintroduction; 3 = Mimic historic hydrology.

Table 2-4. Subprovince 2 Frameworks.

Restoration Features	R1	R2	R3	M1	M2	M3	E1	E2	E3	N1
5,000 cfs diversion (div.) at Bastian Bay/Buras			x							
130,000 cfs div. at Bastian Bay/Buras		x								
120,000 cfs div. near Bayou Lafourche									x	
60,000 cfs div. at Boothville w/ sediment enrichment.										x
1,000 cfs div. at Donaldsonville		x	x		x	x				x
5,000 cfs div. at Donaldsonville w/ sediment enrichment								x		
1,000 cfs div. at Edgard		x	x		x	x				x
5,000 cfs div. at Edgard w/ sediment enrichment	x							x		
5,000 cfs div. at Empire			x							
90,000 cfs div. at Empire								x		
5,000 cfs div. at Fort Jackson			x							
60,000 cfs div. at Fort Jackson	x			x						
60,000 cfs div. at Fort Jackson w/ sediment enrichment						x	x	x		
90,000 cfs div. at Fort Jackson w/ sediment enrichment									x	
150,000 cfs div. at Fort Jackson w/ sediment enrichment					x					
1,000 cfs div. at Lac Des Allemands		x			x	x				x
5,000 cfs div. at Lac Des Allemands w/ sediment enrichment				x			x	x	x	
5,000 cfs div. at Myrtle Grove	x		x	x			x			x
15,000 cfs div. at Myrtle Grove		x								
38,000 cfs div. at Myrtle Grove w/ sediment enrichment					x					
75,000 cfs div. at Myrtle Grove w/ sediment enrichment						x				
150,000 cfs div. at Myrtle Grove w/ sediment enrichment								x		
5,000 cfs div at Oakville			x							
1,000 cfs div. at Pikes Peak		x	x		x	x				x
5,000 cfs div. at Pikes Peak w/ sediment enrichment								x		
5,000 cfs div. at Port Sulphur			x							
Barataria Basin barrier shoreline restoration	x	x	x	x	x	x	x	x	x	x
Implement the LCA Barataria Basin Wetland Creation and Restoration Study	x			x			x		x	x
Mississippi River Delta Management Study							x		x	x
Modification of operation of Davis Pond diversion										x
Sediment delivery via pipeline at Bastian Bay				x			x			
Sediment delivery via pipeline at Empire			x	x			x			
Sediment delivery via pipeline at Head of Passes				x			x			
Sediment delivery via pipeline at Myrtle Grove	x			x			x			x
Third Delta (120,000 cfs diversion)										x

Note: R = Reduce; M = Maintain; E = Increase; N = Supplemental; Approaches: 1 = Minimize salinity change; 2 = Continuous reintroduction; 3 = Mimic historic hydrology.

Table 2-5. Subprovince 3 Frameworks.

Restoration Features	R1	R2	R3	M1						N1
Backfill pipeline canals			x	x						
Bayou Lafourche 1,000 cfs pump	x	x		x						x
Convey Atchafalaya River water to northern Terrebonne marshes	x		x	x						x
Freshwater introduction south of Lake De Cade	x	x		x						
Freshwater introduction via Blue Hammock Bayou	x	x		x						x
Increase sediment transport down Wax Lake Outlet	x	x		x						x
Maintain land bridge between Bayous du Large and Grand Caillou	x		x	x						x
Maintain land bridge between Caillou Lake and Gulf of Mexico.			x	x						x
Maintain northern shore of East Cote Blanche Bay at Pt. Marone			x	x						x
Maintain Timbalier land bridge			x	x						
Multipurpose operation of the Houma Navigation Canal (HNC) Lock.	x	x	x	x						x
Optimize flows and Atchafalaya River influence in Penchant Basin	x	x	x	x						x
Rebuild historic reefs –Rebuild historic barrier between Point Au Fer and Eugene Island	x	x	x	x						
Rebuild historic reefs – Construct segmented reef/breakwater/jetty along the historic Point Au Fer barrier reef from Eugene Island extending towards Marsh Island to the west	x	x	x	x						
Acadiana Bays Estuarine Restoration			x	x						x
Rehabilitate northern shorelines of Terrebonne/Timbalier Bays			x	x						
Relocate the Atchafalaya navigation channel	x	x		x						x
Restore Terrebonne barrier islands.			x	x						x
Stabilize banks of Southwest Pass			x	x						
Stabilize gulf shoreline of Point Au Fer Island			x	x						x
Alternative operational schemes of the Old River Control Structure (ORCS) operational scheme	x	x		x						x
Third Delta (120,000 cfs diversion)		x		x						

Note: R = Reduce; M = Maintain; N = Supplemental; Approaches: 1 = Rehabilitation/maintenance of geomorphic features; 2 = Land-building by delta development; 3 = Maximize Mississippi and Atchafalaya flows.

Table 2-6. Subprovince 4 Frameworks.

Restoration Features				M1	M2	M3	E1	E2	E3	N1
Black Bayou bypass culverts										x
Calcasieu Pass lock				x			x			
Calcasieu Ship Channel beneficial use				x	x	x	x	x	x	x
Chenier Plain freshwater and sediment management and allocation reassessment.										x
Dedicated dredging for marsh restoration					x	x		x	x	
East Sabine Lake hydrologic restoration					x			x		x
Freshwater introduction at Highway 82				x	x	x	x	x	x	x
Freshwater introduction at Little Pecan Bayou				x	x	x	x	x	x	x
Freshwater introduction at Pecan Island				x	x	x	x	x	x	x
Freshwater introduction at Rollover Bayou				x	x	x	x	x	x	x
Freshwater introduction at South Grand Chenier				x	x	x	x	x	x	x
Freshwater introduction via Calcasieu lock and Black Bayou culverts						x			x	
Gulf shoreline stabilization					x		x	x	x	x
Modify existing Cameron-Creole watershed control structures					x			x		x
New lock at the GIWW					x			x		
Sabine Pass lock				x			x			
Salinity control at Alkali Ditch					x			x		x
Salinity control at Black Bayou					x			x		x
Salinity control at Black Lake Bayou					x			x		x
Salinity control at Highway 82 Causeway					x	x		x	x	x
Salinity control at Long Point Bayou.					x			x		x
Salinity control at Oyster Bayou					x			x		x

Note: M = Maintain; E = Increase; N = Supplemental; Approaches: 1 = Large-scale salinity control; 2 = Perimeter salinity control; 3 = Freshwater introduction salinity control.

2.3.4.2 Evaluation of subprovince frameworks

The four subprovinces in the LCA represent the appropriate area for evaluating and comparing specific hydrodynamic and ecologic functions. In order to evaluate the outputs and benefits of a particular subprovince framework, the PDT employed hydrodynamic and ecological models, benefit protocols, and agency and academic expertise to generate baseline information about the effects of the combinations of restoration features. Outputs and benefits evaluated by the PDT included measures of ecosystem function and response such as: land building, habitat switching, primary productivity of land and water, removal of nitrogen from Mississippi River water; and habitat use of wetlands by 12 coastal species. The outputs/benefits covered an array of ecosystem attributes and functions, and they provided a means of comparing complex patterns, both in space and time, of ecosystem change. All benefits were expressed relative to the No Action Alternative. A detailed description of the use of hydrodynamic and ecologic models, as well as the benefit protocols, to evaluate subprovince frameworks can be found in appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING.

Land Building - This benefit assessment protocol measured the achievement of the subprovince framework in creating and preserving land (e.g., wetlands, barrier islands, and ridges) after 50 years. The measurement for land building was expressed in acres.

Habitat Switching - This benefit assessment protocol measured ecosystem response after 50 years by determining the conversion of wetland habitats from one type into another type, including open water. For example, freshwater reintroductions in a subprovince may result in the wetland habitat composition for the subprovince to switch to a composition where there was a greater percentage of freshwater marsh after 50 years. The measurement for habitat switching was expressed as change of habitat type in acres.

Primary Productivity of Land and Water - This benefit assessment protocol measured the change in primary productivity of land and water after 50 years. The PDT used the results from this benefit protocol and the Habitat Use benefit protocol, described below, to gauge the quality of the wetland habitats after 50 years. The measurement for primary productivity of land and water was expressed in terms of an index of composite plant productivity across the range of habitat types in the system.

Removal of Nitrogen from the Mississippi River - This benefit assessment protocol assessed the amount of nitrogen removed from the Mississippi River by the subprovince framework in tons per year. This assessment provided the PDT with information on how well a particular subprovince alternative would help address the hypoxia problem in the gulf. The measurement for removal of Nitrogen from the Mississippi River was expressed as a percentage of nutrients removed.

Habitat Use - This benefit assessment protocol measured the fish and wildlife habitat value for each marsh habitat type after 50 years. The PDT assessed habitat use for 12 coastal species, including: white shrimp, brown shrimp, oyster, gulf menhaden, spotted seatrout, Atlantic croaker, largemouth bass, American alligator, muskrat, mink, otter, and dabbling ducks. The 12 species were chosen because they provide the best representation of the ecologically diverse productivity of the coastal system. This assessment provided the PDT with information on the relative abundance of preferred habitats for the 12 coastal species in response to implementation of a subprovince framework. The measurement for habitat use was expressed in habitat units (HU).

The benefits were calculated for each of the subprovince frameworks and the end result was costs and benefits associated with each framework.

2.3.5 Phase V - Select a Final Array of Coast Wide Frameworks that Bests Meets the Planning Objectives

The subprovince frameworks developed by the PDT and evaluated through the ecologic models provided the basis for developing larger coast wide restoration frameworks. The creation of these coast wide frameworks was based on identifying the optimal combinations of the subprovince frameworks. Due to the fact that Subprovinces 1 through 3 share many of the same restoration resources, the PDT determined that these subprovince frameworks would need to be combined in a manner that determine the best allocation of resources while achieving the largest environmental benefits. Within the Deltaic Plain (Subprovinces 1 to 3), the availability of river water and sediment served to limit the number of possible combinations. There were no such limiting factors for the Chenier Plain, therefore any of the Subprovince 4 frameworks could be combined with any combination of the Subprovinces 1 to 3 frameworks. In addition a key difference in basic system function between the deltaic and Chenier Plains required that different benefit metrics be used. This allowed some simplification of the coast wide framework development process since the Subprovince 4 frameworks could be independently optimized. Therefore, combinations of frameworks in Subprovinces 1 to 3 were developed independently from the Chenier Plain frameworks.

The PDT used the IWR-Plan computer program (Version 3.3, USACE) to create and compare coast wide frameworks, which were composed of a framework from each subprovince. This automated program grouped the 32 subprovince frameworks and no-action alternatives into thousands of different combinations. The program then performed a cost effectiveness and incremental cost analysis (CE/ICA) using the outputs/benefits and the estimated costs that had been previously developed in the initial plan formulation phases.

2.3.5.1 Cost effectiveness/incremental cost analysis

The Study developed and evaluated alternative coast wide frameworks formulated to preserve coastal habitat and functions. The benefits of the various frameworks were defined in non-monetary units, as previously described. Benefits for most of the study area were evaluated using a qualitative and quantitative metric that assessed each alternative's contribution to the stock of natural resources. In the Chenier Plain portion of the study area, benefits were measured more simply in acres of land preserved or restored. Since these feature outputs were not readily translatable to dollar terms, traditional monetary benefit-cost analysis could not be performed. Consequently, the use of the CE/ICA method was selected for the comparison of ecologic output benefits versus costs.

In the cost effective analysis, the combined weighted ecologic outputs, provided by the ecologic models and benefit assessment protocols described in the previous section, were documented for each coast wide framework. The combined weighted outputs and costs for each framework were also displayed and ordered by level of benefit. The primary factors of interest were ecological benefit versus cost. Detailed discussion of this portion of the analysis is available upon request through the New Orleans District office.

The coast wide frameworks were then assessed according to their ability to produce benefits for a given cost level. The result was a listing of coast wide frameworks that would achieve each benefit level at the lowest cost. A theoretical line, or an "efficient frontier", was developed to show those restoration frameworks with the lowest cost to benefit ratios. Restated, alternative frameworks screened in this manner met these two criteria: (1) no other solution produces the same level of benefit for less cost, and (2) no other framework provides more benefit for the same or less cost.

The cost-effectiveness assessment and identification of the efficient frontier was followed by an incremental cost analysis. Incremental cost is the additional cost for each increase in the level of output. Changes in incremental costs, combined with other selection criteria discussed below, facilitated a process of evaluating the desirability of implementing the remaining plans in the absence of a strict guideline for determining the best outcome (such as maximizing net benefits, as is done in NED analysis

2.3.5.2 Development of the tentative final array for the Deltaic Plain

Following an initial CE/ICA analysis, the alternative framework selection process continued by applying three additional criteria to cost-effective coast wide frameworks. These criteria were developed to aid in identifying the point along the efficient frontier where coast wide frameworks could be anticipated to produce broad enough systemic benefits as to provide qualitative certainty of completeness. The three criteria were:

1. Alternative frameworks were limited to those that reduced land loss by at least one half of the current rate (based on 1990 to 2000 land loss data) of -24 mi^2/yr to -10 mi^2/yr. Reducing land loss by this amount would greatly contribute to the reduction of land loss as a result of ongoing restoration efforts.
2. Alternative frameworks were evaluated for their potential to provide storm surge protection across the coast (i.e., in all subprovinces), as well as for their potential to impact the navigation industry.
3. Alternative frameworks were assessed for their potential to add environmentally important features, such as barrier islands or a Third Delta feature, in subsequent implementation phases.

The first criteria simply assured that the frameworks identified would exceed the beneficial level that could be attained through current restoration programs. These programs have been identified as being capable of achieving only a fraction of the necessary restoration outputs. The second criteria sought to assure an adequate distribution of restoration measures by qualitatively identifying the relative damage risk to damage reduction potential. The comparison of spatially fixed investment versus potential wetland restoration effect allowed a qualified judgment of wetland restoration completeness versus relative use. The third criteria simply assessed and assured that important system needs or restoration opportunities were not being systematically overlooked as an artifact of the subprovince framework assemblages.

During this stage of the framework selection process, the PDT evaluated the frameworks that formed the cost-efficient frontier based on the above criteria and eliminated several of the frameworks from further consideration. Some cost-effective frameworks were eliminated because they did not provide comprehensive potential for coast wide restoration. Those cost-effective alternative frameworks that met the criteria occurred at approximately the point in the cost-effective curve at which the cost per unit benefit begins to rise rapidly. The CE/ICA software generates a numbered labeling to specifically identify the analyzed framework combinations these numbers will be used throughout the remainder of the report to refer to the cost effective or tentatively selected coast wide frameworks. Frameworks 5110, 7002, 7410, and 7610 represent those cost effective combinations that define the upper limit of the cost effective frontier. Framework 7002 represented the terminal point of the cost-efficient frontier shown in **figure 2-2**. However, upon review of these frameworks, the PDT identified several environmentally important features that were not included in or addressed by any of the cost-effective frameworks on the curve.

It was determined that additional frameworks near the cost-effective curve, particularly near the point of rapidly increasing unit cost, could fall within the limits of confidence, and as such could be considered in the final array. These additional frameworks would provide more completeness to a final array of restoration solutions. Beginning at the previously identified location on the cost-effective curve, the PDT began investigating other frameworks adjacent to the cost-efficient frontier that included important features not in the cost-effective framework combinations. A number of additional frameworks were identified that addressed the identified important features such as the barrier islands in Subprovince 3. These additional frameworks (5410 and 5610) were grouped with the remaining cost-effective frameworks to form a tentative final array. The six frameworks in the tentative final array for the Deltaic Plain were 5110, 5410, 5610, 7002, 7410, 7610 and 7002. As indicated above framework 7002 is the terminal, or maximum output framework. This framework has been included in the tentative final array as a representation of the required incremental level of investment necessary to achieve the maximum level of beneficial output. **Figure 2-3** graphically displays the Plan Formulation Process from Phase III through the initial CE/ICA analysis.

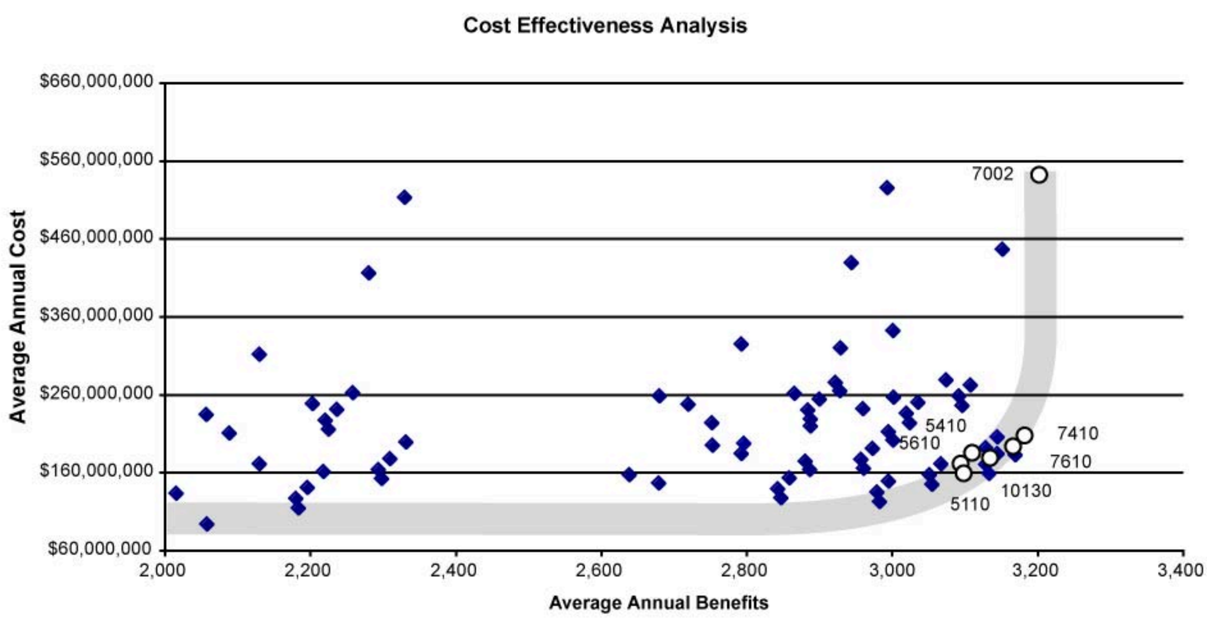

Figure 2-2. Preliminary Average Annual Costs and Average Annual Benefits for the Final Array of Alternative Frameworks for Subprovinces 1 to 3. *Note: the gray line denotes the cost efficient frontier.*

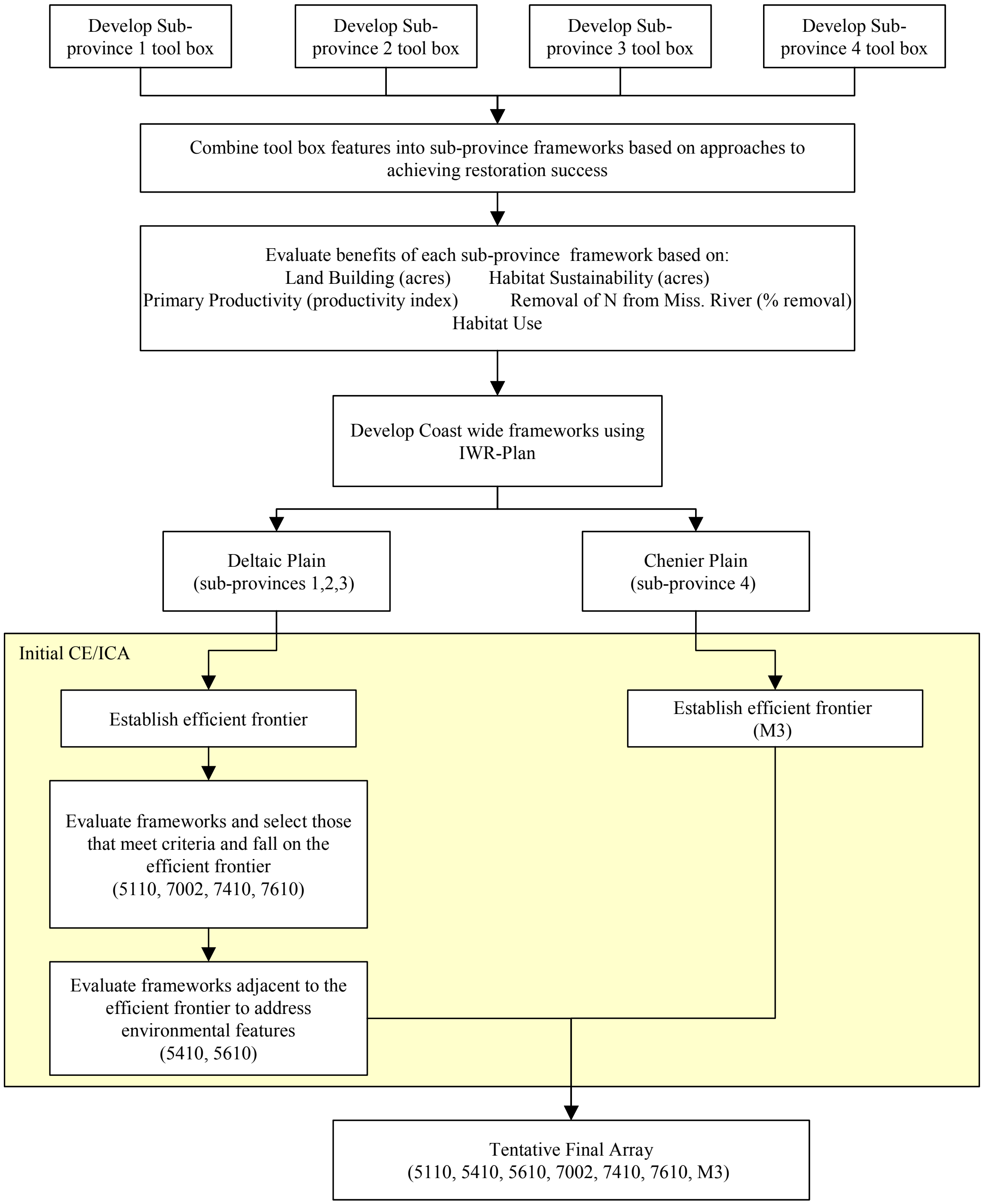

Figure 2-3. Plan formulation and framework selection process: Phase III through initial CE/ICA analysis

2.3.5.3 Development of supplemental frameworks to address completeness of final array for the Deltaic Plain

The vertical team, executive team, and individual members of the framework development team, reviewed the cost-effectiveness analysis and the PDT effort in developing the tentative final array. Following this review, the executive team directed the PDT to develop two supplemental frameworks to attempt to further address the criteria of incorporating environmentally important features. A second framework was desired to further assess the viability of incorporating large-scale features and the possibility of producing additional frameworks to redefine the upper limit of the efficient frontier. These frameworks were also intended to address the completeness of the final array since the tentative frameworks identified by the initial analysis omitted a number of larger-scale features that were viewed as potentially critical to long-range success. The output from the ecological modeling and the experience gained from that effort provided valuable insight regarding plan effectiveness. The results of that effort were reviewed to determine what specific restoration features might be introduced to create a more complete and effective framework.

The PDT reviewed the features, model outputs, and framework components for each subprovince. At the conclusion of this effort, the PDT assembled the two supplemental frameworks (N1 and N2), which were predominantly based on framework 5610. These two supplemental frameworks were identical, except that the second supplemental framework (N2) contained the large-scale Third Delta feature. Once the features of the supplemental frameworks were identified, preliminary costs and benefits were developed for the supplemental frameworks in a manner consistent with the previously analyzed coast wide frameworks. The data were incorporated into the IWR-Plan database. A second iteration of the CE/ICA was run to determine the position of the two supplemental frameworks relative to the existing cost-efficient frontier.

The CE/ICA analysis revealed that supplemental framework N1 created fewer benefits at similar cost than those in the efficient frontier. The second supplemental framework, N2, created slightly more output, but at a greater increased incremental cost than the tentative final array of frameworks. Neither framework plotted within the optimal range of the existing tentative final array of frameworks. In addition a review of the features included in the second supplemental framework revealed that several of the diversion features included in the framework could be redundant and potentially not compatible with the inclusion of the Third Delta feature. Framework 7002 also included the best available estimates for several of the features identified as elements of large-scale long-range concepts and included in supplemental framework N2. As a result, it was determined that the appropriate action would be to continue to develop supplemental framework N1 and include it along with framework 7002 in the final array. The inclusion of framework 7002 in the tentative final framework provides a gauge of the level of incremental cost required to achieve the maximum ecosystem benefits beyond those provided by frameworks identified as optimal in the cost effective analysis. This also provides some insight into the relative beneficial return for extremely large-scale long-range restoration features.

To further determine whether the combinable components of the supplemental framework had any specific strengths or weaknesses, another iteration of cost-effectiveness was executed for each subprovince. The study executive team reviewed this information and was able to identify an existing framework in Subprovince 2 that in combination with the N1 supplemental framework components in Subprovinces 1 and 3 could produce a modified supplemental framework that would be more complete and cost-effective. The data for the modified supplemental framework, which was labeled 10130 (based on the IWR-Plan system of numbering solution scales), was added to the IWR-Plan database. An additional iteration of the cost-effectiveness analysis revealed the new framework to be on the cost-effective curve and consistent with the position and criteria for the final array. Therefore, the seven frameworks in the tentative final array of frameworks for the Deltaic Plain were 5110, 5410, 5610, 7002, 7410, 7610, and 10130.

The final array of frameworks are all fairly close to the efficient frontier, and, given limitations of both the benefit and cost data, are within the margin of error for the efficient frontier. That is, given the level of accuracy in the model's prediction of benefits and limitations on our ability to estimate costs, it is not possible to state with certainty that the supplemental framework 10130 is less efficient than those on the efficient frontier. The exception, since the framework that produces the maximum possible output is always a component of the efficient frontier, is framework 7002, which has costs far in excess of frameworks which produce only slightly lower benefit levels, as illustrated in **figure 2-2**. Therefore, any of the frameworks, with the exception of 7002, could suffice as a cost-effective framework for the Deltaic Plain. **Figure 2-4** graphically represents the development and evaluation of the supplemental frameworks.

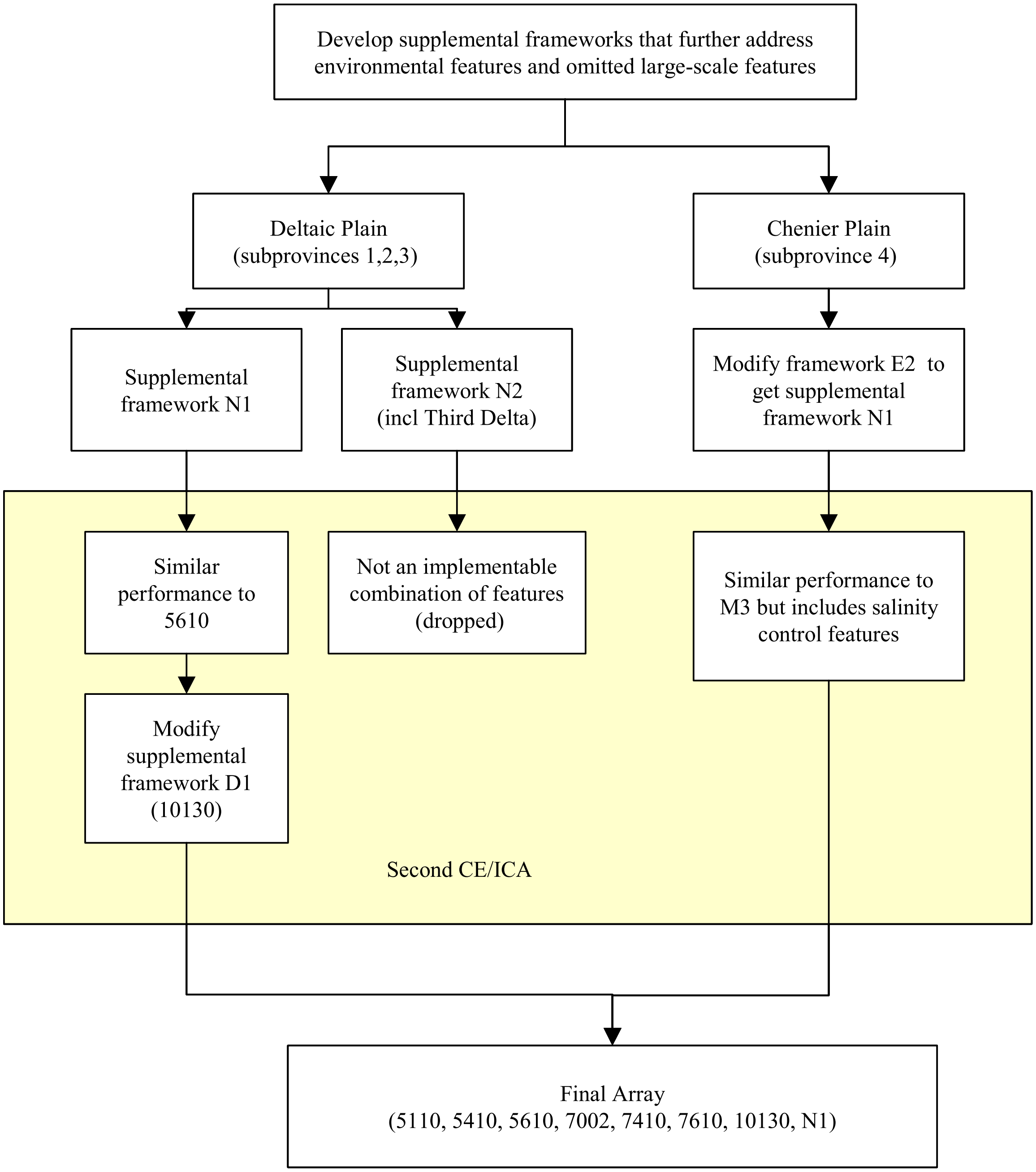

Figure 2-4. Plan formulation and framework selection process: development of supplemental frameworks and second CE/ICA analysis

2.3.5.4 Development of the final array for the Chenier Plain

Because habitats in the Chenier Plain were created by processes that did not include periodic overflows of the river to build and maintain land, the frameworks for Subprovince 4 were not constrained by the amount of water and sediment available in the Mississippi River and the resources used for restoration on Subprovinces 1 through 3. Consequently, the PDT evaluated Subprovince 4 separately from the other three subprovinces, which comprised the Deltaic Plain.

Because there is no nitrogen removal issue in the Chenier Plain and the habitat created in this area is expected to remain fairly uniform in quality, evaluation of Subprovince 4 frameworks was solely based on land creation. Any of the outcomes here could be combined with any of the seven frameworks in the final array for the Deltaic Plain.

The cost-effective analysis produced a cost-effective curve consisting of only one cost-effective framework, M3. The PDT reviewed the cost-effectiveness analysis results and recognized that framework M3 failed to appreciably address the core restoration strategy for the Chenier Plain of controlling estuarine salinities. In addition, the PDT suggested that the "Increase" planning scale be adopted as the minimum restoration level in this subprovince due to the relatively low rate of loss. Again, the Plan Formulation process from Phase III through the initial CE/ICA analysis is graphically depicted in **figure 2-3**.

2.3.5.5 Development of supplemental framework for final array for the Chenier Plain

The executive team, as well as the vertical team and members of the framework development team, again reviewed the cost-effectiveness analysis and the PDT effort in identifying the cost-effective frameworks for the Chenier Plain. The executive team directed the PDT to develop a supplemental framework to better address the core strategy. While not cost-effective, the relative ability of framework E2 to better address the core restoration strategy (i.e., salinity control) was suggested as a starting point to develop the supplemental framework. During a two-day meeting of the executive team and PDT, the PDT assembled the supplemental framework, which was based on the framework E2. The criteria concerning the identification and inclusion of any environmentally important features applied in the Deltaic Plain also applied to this subprovince.

Once the features of the supplemental alternative framework were identified, costs and benefits were developed for the framework in a manner consistent with the previously analyzed alternative frameworks. This data was incorporated into the IWR-Plan database. A second iteration of the CE/ICA was run to determine the position of the supplemental alternative framework relative to the efficient frontier. Once again, the supplemental framework was intended to add to the completeness of the final array.

Eight subprovince frameworks, including the supplemental framework and the No Action Alternative, were evaluated for the Chenier Plain (**figure 2-5**). As stated previously, the Chenier Plain was analyzed separately and thus frameworks that are not combinable were analyzed independently.

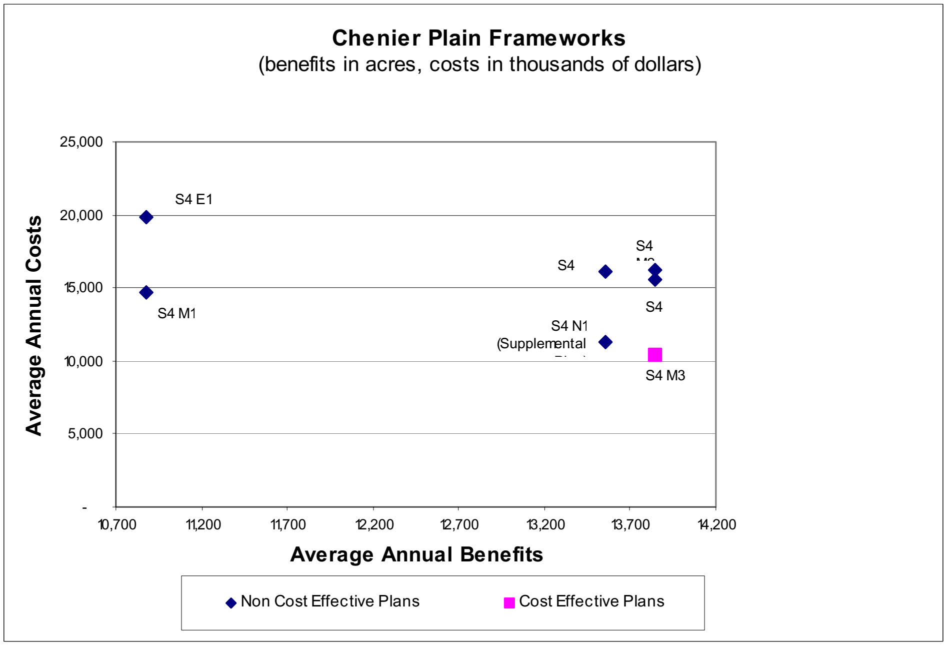

Figure 2-5. Costs and Benefits (acres) for all Chenier Plain Frameworks.

A second iteration once again resulted in the identification of only one cost-effective framework, M3. However, the added supplemental framework (N1) was similar in average annual cost but produced slightly fewer average annual benefits. The features in framework M3 failed to appreciably address the core restoration strategy for Subprovince 4, as previously identified by the PDT. Framework N1 included the major features of framework M3 in addition to features to address salinity control. As a result, framework M3 was dropped from the final array. The final array focuses on framework N1, the supplemental framework that was developed by modifying framework E2. Again, the Plan Formulation process from supplemental framework development through the second CE/ICA analysis is graphically presented in **figure 2-4**.

2.3.5.6 Details of the final array of coast wide system frameworks

As stated previously, the Chenier Plain framework can be added to any of the seven Deltaic Plain frameworks to construct coast wide frameworks, resulting in seven coast wide frameworks. **Table 2-7** identifies the subprovince framework components of each of the system frameworks identified in the final array. The subprovince frameworks considered, and the features included in them, can be found in **tables 2-3** through **2-6**. The final array of coast wide system frameworks identified a relatively tight grouping of possible alternatives. In comparing these alternatives, the PDT observed numerous cases of common features between the frameworks. The differences in restoration features between the frameworks, however, typically resulted in an observable difference in the make up of their beneficial outputs (i.e., the balance of marsh type and resultant species usage). The end result was that any of the frameworks in the final array could be a justifiable plan depending on the nuances applied in developing a single output value for their comparison.

In addition, the PDT recognized that the relative uncertainty of quantifying ecologic performance and sustainability versus the somewhat more certain quantification of implementation cost caused a variable effect on certainty across the range of features considered in the system wide frameworks. Particularly, larger-scale, longer range restoration features compared poorly in a comparative analysis. As a result, for the longer-range features included in the various frameworks, there were lower confidence limits that have implications for the overall timing of their implementation. Conversely, features that could be implemented and produce environmental outputs in the near-term resulted in a higher degree of confidence.

Table 2-7. Overview of Final Array of Coast wide Restoration Frameworks.

	Framework Identification						
	5110	**5610**	**5410**	**7610**	**7410**	**7002**	**10130**
Subprovince 1							
M2	**X**	**X**	**X**				
E1				**X**	**X**	**X**	
N1 (Modified M2)							**X**
Subprovince 2							
R1	**X**						
M1			**X**		**X**		
M3		**X**		**X**			
E3						**X**	
N1 (Modified R1)							**X**
Subprovince 3							
R1	**X**	**X**	**X**	**X**	**X**		
M1						**X**	
N1 (Modified R1)							**X**
Subprovince 4							
N1 (Modified E2)	**X**	**X**	**X**	**X**	**X**	**X**	**X**

Of the 111 features listed in **tables 2-3** through **2-6**, 79 features are contained in the final array of coast wide frameworks identified in **table 2-7**. Descriptions of the 79 features are found in section 3.3.6.1.

2.3.6 Phase VI - Development of Alternative LCA Restoration Plans

Upon the completion of Phase V efforts, with attention to the dynamic nature of the coastal ecosystem, the science and technology (S&T) uncertainties and model uncertainties, the Vertical Team and PDT redirected the plan formulation effort towards the identification of a plan that focused on critical restoration effort needs in the near-term, the next 5 to 10 years. The PDT determined that a LCA Plan would best meet the overall study objectives through inclusion of several complementary plan components that differ in scale and time. These would include:

- Near-term, highly certain feature concepts for development and implementation;
- Identified, feature-related uncertainties and potential methods or features to resolve them; and
- Large-scale and long-range feature concepts to be more fully developed.

Having identified the most efficient, effective, and complete combinations, of features within the final array of coast wide frameworks it was decided to not abandon the work that produced and screened those coast wide alternatives. The PDT believed that the formulation of frameworks and the identification and assessment of beneficial outputs accurately reflected the relative effectiveness and efficiency of the coast wide frameworks to meet the study planning objectives and affect coastal restoration. In meeting the set objectives and benefit parameters, in addition to being effective and efficient, the most critical restoration features should have been captured in these frameworks as well. The PDT determined that a resorting of the features included in the final alternative coast wide frameworks would provide a representative plan of those most promising critical restoration features.

The seven final coast wide frameworks were used as the starting point for the identification of alternative LCA near-term plans. The 79 restoration features that were combined into the coast wide frameworks of the final array primarily addressed areas of critical wetland loss, opportunities for the reestablishment of deltaic processes, and the protection and restoration of geomorphic features. The 79 features were the building blocks for alternative LCA Plans in Phase VI.

2.3.6.1 Description of the restoration features identified in the final array of coast wide frameworks

The PDT initially determined that the follow-on feasibility study process would analyze and optimize specific locations and dimensions for any restoration feature that would ultimately become a component of the LCA Plan that best met the objectives. Instead, general details about restoration features were included as part of this plan formulation process. For example, diversions were referred to as either small, medium, or large, where small equates to 1,000 to 5,000 cfs (30 to 150 cms) to diversions, medium to 5,000 to 15,000 cfs (150 to 450 cms) diversions, and large to greater than 15,000 cfs diversions. Additionally for features involving the use of dredged sediments borrow locations are typically not specified, however, consistent with guiding principle number 4, the use of sediment sources both renewable and external to the functional coastal system are expected to be identified in final decision and NEPA documents. More detailed cost information regarding the features is available at the District upon request. The features are shown on **figures 2-6** through **2-9**.

2.3.6.1.1 *Subprovince 1 feature descriptions*

Medium diversion at American/California Bays

This restoration feature provides for a medium non-structural, uncontrolled diversion from the Mississippi River at American/California Bays. The diversion feature would consist of an armored crevasse through the existing un-leveed riverbank into the fringe marsh and open water of the bay system. The objective of this feature is to increase sediment introduction into American/California Bays. The introduction of additional sediment would facilitate organic and mineral sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Medium to large sediment diversion at American/California Bays

This restoration feature involves a large non-structural, uncontrolled sediment diversion from the Mississippi River with sediment enrichment at American/California Bays. The diversion feature would consist of an armored crevasse through the existing un-leveed riverbank into the fringe marsh and open water of the bay system. The objective of this feature is to maximize sediment inputs and spur large-scale land building in American/California Bays. This area was historically an outflow area of the Mississippi River, which received river discharges during flooding events. The creation and restoration of wetlands in American/California Bays would have the added benefit of stabilizing the Breton Sound marshes to the north by reducing marine influences from the Gulf of Mexico.

Rehabilitate Bayou Lamoque structure as a medium diversion

This feature provides for the refurbishment and operation of a pair of diversion structures, regulating the flow of Mississippi River water into Bayou Lamoque, a former distributary of the Mississippi River. The existing Bayou Lamoque diversion structures require mechanical rehabilitation and operational security modifications. The remote location of these structures and the frequent occurrence of vandalism have resulted in an inability to ensure consistent and reliable operation. The objective of this feature is to increase and maintain riverine inflows into Bayou Lamoque. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse.

Medium diversion at Bonnet Carré Spillway

This restoration feature would be located at the existing Bonnet Carré Spillway and involve a reevaluation of the existing authorized project. The spillway is currently operated to remove excess water from the Mississippi River during flooding events and pass the water through the Bonnet Carré Spillway into Lake Pontchartrain. The restoration feature consists of a medium diversion with east and west branches into the La Branche wetlands and Manchac land bridge - diverted through a modified segment of the existing flood control structure and redirected through the guide levees into adjacent wetlands. The objective of the project is to decrease salinities in Lake Pontchartrain and the surrounding marshes, especially the La Branche Wetlands, and to add nutrients and some sediment to these marshes and swamps. This feature is located in the vicinity of a historic crevasse.

Small diversion at Convent/Blind River

This restoration feature involves a small diversion from the Mississippi River into Blind River through a new control structure. The objective of this feature is to introduce sediment and nutrients into the southeast portion of Maurepas Swamp. This feature is intended to operate in conjunction with the Hope Canal diversion to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

Medium diversion at Fort St. Philip

This restoration feature provides for a medium diversion from the Mississippi River into marshes northeast of Fort St. Philip, between the Mississippi River and Breton Sound. Objectives of this feature are to reduce wetland loss and facilitate riverine influences to these marshes. The diversion would facilitate organic deposition in and biological productivity of the marshes by increasing freshwater circulation and providing sediment and nutrients to the system.

Small diversion at Hope Canal

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Hope Canal. The objective is to introduce sediment and nutrients into Maurepas Swamp south of Lake Maurepas. The introduction of additional freshwater via the diversion would facilitate organic deposition, improve biological productivity, and prevent further deterioration of the swamp. Work for this feature has been initiated in engineering and design and NEPA compliance under CWPPRA.

Medium diversion at White's Ditch

This restoration feature, located at White's Ditch, downstream of the existing Caernarvon diversion structure, provides for a medium diversion from the Mississippi River into the central River aux Chenes area using a controlled structure. The objective of the feature is to provide additional freshwater, nutrients, and fine sediment to the area between the Mississippi River and River aux Chenes ridges. This area is currently isolated from the beneficial effects of the Caernarvon freshwater diversion. The introduction of additional freshwater would facilitate organic sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse. Follow-up feasibility-level analysis will determine the ultimate size of the diversion.

Sediment delivery via pipeline at American/California Bays

This restoration feature provides for sediment delivery via pipeline through programmatic sediment mining from the Mississippi River. The moderately deep (6 to 10 feet [1.8 to 3 meters]) open water in this bay system requires a large volume of sediment to create wetlands. The objective of this feature is to create wetlands in the American/California Bays.

Sediment delivery via pipeline at Central Wetlands

This restoration feature provides for placement of sediment mined from the Mississippi River into the Central Wetlands adjacent to the MRGO and Violet canal, via pipeline. The objective of this feature is to create wetlands by placing dredged sediment in the shallow (1 to 2 feet [0.3 to 0.6 meters]) open waters of the marshes. Placement of this dredged material would counteract marsh breakup by providing sediment and nutrients to renourish the area. This feature is located in the vicinity of a historic crevasse.

Sediment delivery via pipeline at Fort St. Philip

This feature provides for sediment delivery at Fort St. Philip via programmatic sediment mining from the Mississippi River. The objective of the feature is to create and/or restore marsh habitat by depositing sediment in appropriate moderately shallow (3 to 5 feet [0.9 to 1.5 meters]) open water areas in the vicinity of Fort St. Philip. Increasing the area and improving the function of these marshes would facilitate biological productivity of the marshes and reduce wetland loss.

Sediment delivery via pipeline at Golden Triangle

This restoration feature provides for sediment delivery via sediment mined from the Mississippi River and placed in the area formed by the confluence of the MRGO, GIWW, and Lake Borgne. The objective of the feature is to create and/or restore marsh habitat by depositing sediment in appropriate shallow (1 to 2 feet [0.3 to 0.6 meters]) open water in the area adjacent to these three water bodies. Increasing the area and improving the function of these marshes would facilitate biological productivity of the marshes and reduce wetland loss.

Sediment delivery via pipeline at La Branche Wetlands

The proposed restoration feature includes the dedicated dredging of sediment from the Mississippi River, which would be delivered via pipeline to shallow (1 to 2 feet [0.3 to 0.6 meters]) open waters within the La Branche Wetlands in the southwest corner of Lake Pontchartrain. The creation and restoration of these marshes would facilitate improved biological productivity and reduce wetland loss. This feature is located in the vicinity of a historic crevasse.

Sediment delivery via pipeline at Quarantine Bay

This restoration feature provides for sediment delivery to Quarantine Bay via programmatic sediment mining from the Mississippi River. The objective of the feature would be to create wetland habitat through the placement of dredge sediment in the moderately shallow (3 to 5 feet [0.9 to 1.5 meters]) open waters of Quarantine Bay.

Opportunistic use of Bonnet Carré Spillway

This restoration feature involves freshwater introductions from the Mississippi River via the opportunistic use of the existing flood control structure at the Bonnet Carré Spillway. The spillway is currently operated to remove excess water from the Mississippi River during flooding events and pass the water through the Bonnet Carré Spillway into Lake Pontchartrain. This feature would allow for freshwater introductions to be delivered to Lake Pontchartrain and the adjacent La Branche wetlands during times of high river water levels. Thus, the river introductions would help reduce salinities in the southwest corner of Lake Pontchartrain and nourish the intermediate and brackish marshes in La Branche with sediment and nutrients. This feature is located in the vicinity of a historic crevasse.

Increase Amite River Diversion Canal influence by gapping banks

This restoration feature involves the construction of gaps in the existing dredged material banks of the Amite River Diversion Canal. The objective of this feature is to allow floodwaters to introduce additional nutrients and sediment into western Maurepas Swamp. The exchange of flow would occur during flood events on the river and from the runoff of localized rainfall events. This feature would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

Marsh nourishment on New Orleans East land bridge

This restoration feature involves wetland creation through the dedicated dredging of sediment from lake bottom sources. The objective of this feature is to create wetlands by placing dredged sediment in the shallow open waters within the land bridge separating Lakes Pontchartrain and Borgne. This area has experienced wetland deterioration and loss due to erosion from wave energies in Lake Borgne. Reinforcing the land bridge between the two lakes would help maintain the salinity gradients in Lake Pontchartrain and ensure the long-term sustainability of the wetland ecosystems in the area.

Mississippi River Delta Management Study

This restoration concept requires detailed investigations to address the maximization of river resources, such as excess freshwater and sediment, for wetland restoration. The objective of this concept is to greatly increase the deposition of Mississippi River sediment on the shallow continental shelf, while ensuring navigation interests. Sediment, nutrients, and freshwater would be re-directed to restore the quality and sustainability of the Mississippi River Deltaic Plain, its coastal wetland complex, and the Gulf of Mexico. The study would investigate potential modifications to existing navigation channel alignments and maintenance procedures and requirements.

Mississippi River Gulf Outlet (MRGO) environmental restoration features

This restoration opportunity involves the implementation of the environmental restoration features considered in the MRGO Reevaluation Study. In response to public concerns, adverse environmental effects, and national economic development considerations, an ongoing study is reevaluating the viability of operation and maintenance of this authorized navigation channel. Since the construction of the MRGO, saltwater intrusion and ship wake erosion have degraded large expanses of fresh and intermediate marshes and accelerated habitat switching from freshwater marshes to brackish and intermediate marshes in the Biloxi marshes, the Central Wetlands, and the Golden Triangle wetlands. This environmental restoration study would evaluate the stabilization of the MRGO banks and various environmental restoration projects, including evaluation of freshwater reintroductions into the Central Wetlands, possible channel depth modification, and other ecosystem restoration measures. Implementation of this feature would preserve estuarine wetlands and important structural features of the lake and marsh landscape.

Modification of Caernarvon diversion

The Caernarvon diversion structure, constructed on the Mississippi River in 1992 near the Breton Sound marshes, has a maximum operating capacity of 8,000 cfs (286 cms). The structure has been operated as a salinity management feature, with freshwater introductions ranging between 1,000 cfs to 6,000 cfs (36 cms to 214 cms), but in general averaging less than half of the structure's capacity. The primary purpose of the existing Caernarvon project has been to maintain salinity gradients in the central portion of Breton Sound. This operation, in effect, partially restored the historic functions of marsh nourishment (e.g., freshwater inflow, providing nutrients and sediment to the marsh, and countering the effects of subsidence). The proposed restoration feature study would assess changes in the operation of the Caernarvon project to increase wetland creation and restoration outputs for this structure. Modified operation of this structure would allow an increase in the freshwater introduction rate, perhaps 5,000 cfs (178 cms) on average, to accommodate the wetland building function of the system. This study would identify any changes to this feature's operation that would increase restoration outputs. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse. Any proposed change in purpose that would require modification of the existing authorization for this structure would be submitted for Congressional approval.

Rehabilitate Violet Siphon for increased freshwater influence to Central Wetlands

This restoration feature involves the rehabilitation of the existing Violet Siphon water control structure, which is located between the Mississippi River and the MRGO, in the Central Wetlands. The objectives of this feature are to improve the operation of the Violet Siphon and enhance freshwater flows into the Central Wetlands. This action would increase freshwater in the wetlands and nourish the remaining swamp and intermediate marshes. The restoration of wetlands and improvement in ecosystem function produced by this feature would be increased by the freshwater introductions via the IHNC lock feature. This feature is located in the vicinity of a historic crevasse.

Post authorization change for the diversion of water through Inner Harbor Navigation Canal for increased freshwater influence into Central Wetlands

This restoration feature calls for a post-authorization modification of the IHNC lock. Modifications would incorporate culverts and controls to divert freshwater from the Mississippi River through the IHNC to the Central Wetlands. The objectives of this feature are to introduce freshwater and nutrients into the intermediate and brackish marshes of the Central Wetlands, boost plant productivity, and reduce elevated salinities. This restoration feature could also increase the benefits produced by the Violet Siphon structure rehabilitation restoration feature.

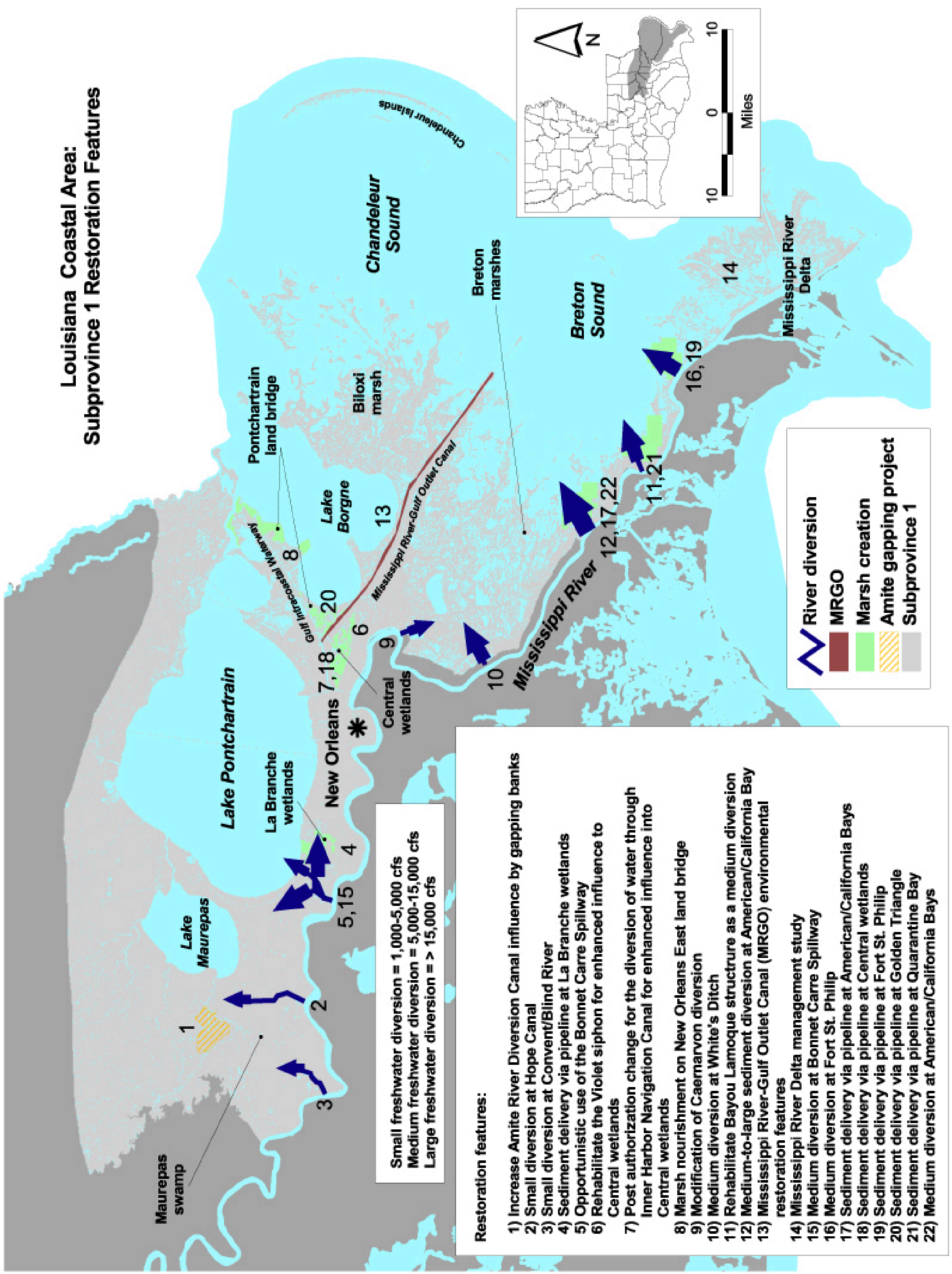

Figure 2-6. Subprovince 1 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

2.3.6.1.2 *Subprovince 2 Feature Descriptions*

Large diversion at Boothville with sediment enrichment

This restoration feature provides for a large nonstructural, uncontrolled sediment diversion from the Mississippi River near Boothville into the Yellow Cotton/Hospital Bays area. The objective of this feature is to create wetlands by diverting sediment in the moderately deep (6 to 10 feet [1.8 to 3 feet]) open waters of Yellow Cotton / Hospital Bays. The freshwater and nutrients would also increase vegetative stability in the fringing marshes and along the Bayou Grand Liard ridge. Ultimately, sediment would reach and supplement the barrier shoreline between Red Pass and the Empire to the gulf waterway. Sediment enrichment assumes use of 20-inch (51 centimeter) dredge at capacity for three months yielding 1,468,000 cubic yards (1,120,000 cubic meters) each year. The diversion would maximize sediment and nutrient inputs and spur large-scale land building in the extreme southeastern portion of Barataria Bay.

Small diversion at Donaldsonville

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Donaldsonville. The objective is to introduce freshwater, sediment, and nutrients into upper Bayou Verret, which is located to the northwest of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood forests. This feature is intended to operate in conjunction with three other small diversions in the area.

Small diversion at Edgard

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Edgard. The objective is to introduce freshwater, sediment, and nutrients into Bayou Fortier, which is located to the northeast of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood forest. This feature is intended to operate in conjunction with three other small diversions in the area.

Medium diversion at Edgard with sediment enrichment

This restoration feature involves a medium diversion from the Mississippi River through a new control structure at Edgard. The objective is to introduce freshwater, sediment, and nutrients into Bayou Fortier, which is located to the northeast of Lac des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood forest. Sediment enrichment would involve use of 12-inch (31 centimeter) dredge for three months. Discharge of effluent upstream of the diversion intake would allow the capture of silts and very fine sands only.

Medium diversion at Fort Jackson - Alternative to Boothville diversion

This restoration feature provides for a medium non-structural, uncontrolled sediment diversion from the Mississippi River near Fort Jackson into the Yellow Cotton/Hospital Bays area. The objective of this feature is to create wetlands by diverting sediment in the moderately deep (6 to 10 feet [1.8 to 3 feet]) open waters of Yellow Cotton/Hospital Bays. The associated freshwater and nutrients would also increase vegetative stability in the fringing marshes and along the Bayou Grand Liard ridge. The diversion would maximize sediment and nutrient inputs and spur land building in the extreme southeastern portion of Barataria Bay.

Large diversion at Fort Jackson with sediment enrichment - Alternative to Boothville diversion

This restoration feature provides for a large (50,000 to 100,000 cfs [1,800 to 3,600 cms]) non-structural, uncontrolled sediment diversion from the Mississippi River near Fort Jackson into the Yellow Cotton/Hospital Bays area. The objective of this feature is to create wetlands by diverting sediment in the moderately deep (6 to 10 feet [1.8 to 3 feet]) open waters of Yellow Cotton / Hospital Bays. The associated freshwater and nutrients would also increase vegetative stability in the fringing marshes and along the Bayou Grand Liard ridge. Sediment enrichment assumes use of 20-inch (51 centimeter) dredge at capacity for three months yielding 1,468,000 cubic yards (1,120,000 cubic meters) each year. Ultimately, sediment would reach and supplement the barrier shoreline between Red Pass and the Empire to the gulf waterway. The diversion would maximize sediment and nutrient inputs and spur large-scale land building in the extreme southeastern portion of Barataria Bay.

Small diversion at Lac des Allemands

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Lac des Allemands. The objective is to introduce freshwater, sediment, and nutrients into Bayou Becnel, which is located to the north of Lac des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in Bayou Becnel and surrounding Lac des Allemands area is classified as wetland forest, consisting primarily of bottomland hardwood forest. This feature is intended to operate in conjunction with three other small diversions in the area.

Medium diversion at Lac des Allemands with sediment enrichment

This restoration feature involves a medium diversion from the Mississippi River through a new control structure at Lac des Allemands. The objective is to introduce freshwater, sediment, and nutrients into Bayou Becnel, which is located to the north of Lac des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in Bayou Becnel and surrounding Lac des Allemands area is classified as wetland forest, consisting primarily of bottomland hardwood forest. Sediment enrichment would involve use of 12-inch (31 centimeter) dredge for three months. Discharge of effluent upstream of the diversion intake would allow the capture of silts and very fine sands only. This feature is intended to operate in conjunction with three small diversions in the area.

Medium diversion with dedicated dredging at Myrtle Grove

This restoration feature involves a medium diversion of the Mississippi River near Myrtle Grove through a new control structure. The diversion would provide additional sediment and nutrients to nourish highly degraded existing fresh to brackish wetlands in shallow open water areas. This reintroduction would ensure the long-term sustainability of these marshes by increasing plant productivity, thereby preventing future loss. The introduction of sediment to this area would also promote the infilling of shallow open water areas both through deposition and marsh expansion. Dedicated dredging of sediment mined from the Mississippi River would complement this feature. This feature is located in the vicinity of a historic crevasse. Work has been initiated on engineering and design and NEPA compliance under CWPPRA.

Large diversion at Myrtle Grove with sediment enrichment

This restoration feature involves a large sediment diversion from the Mississippi River near Myrtle Grove through a new control structure. The diversion would provide additional sediment and nutrients to nourish highly degraded existing fresh to brackish wetlands in shallow open water areas throughout the central Barataria basin. This reintroduction would allow the creation of new wetland in expansive open water and bay areas and ensure the long-term sustainability of currently degraded marshes by increasing plant productivity, thereby preventing future loss. The additional introduction of sediment by enrichment assumes use of 30-inch dredge at capacity for three months yielding 6,293,000 cubic yards [4,810,000 cubic meters] each year. This feature is located in the vicinity of a historic crevasse.

Small diversion at Pikes Peak

This restoration feature involves a small diversion from the Mississippi River through a new control structure at Pikes Peak. The objective is to introduce freshwater, sediment and nutrients into Bayou Chevreuil, which is located to the north of Lac Des Allemands, to improve water quality and promote plant productivity. The wetland ecosystem in the area is classified as wetland forest, consisting primarily of bottomland hardwood wetlands. This feature is intended to operate in conjunction with three other small diversions in the area.

Barataria Basin barrier shoreline restoration

This restoration feature involves mining of offshore sediment sources to reestablish sustainable barrier islands. The feature is based on designs developed in the LCA Barataria Barrier Island Restoration study and assumes a 3,000-foot [914 meter] wide island footprint. This feature originally considered restoration elements for all the major reaches of the Barataria barrier-shoreline chain. However, for inclusion in the near-term plan some consideration to the most critically needed elements of the chain. The most critical areas of this chain, however, include the Caminada-Moreau Headland (an area between Belle Pass and Caminada Pass) and Shell Island (a barrier island in the Plaquemines barrier island system). These barrier shoreline segments are critical components of the Barataria shoreline. The Shell Island segment has been nearly lost and failure to take restorative action could result in the loss of any future options for restoration. This would result in permanent modification of the tidal hydrology of the Barataria

Basin. The Caminada-Moreau Headland protects the highest concentration of near-gulf oil and gas infrastructure in the coastal area. This reach of the Barataria shoreline also supports the only land-based access to the barrier shoreline in the Deltaic Plain. These critical endpoints in the Barataria chain also serve as sources of material for the littoral system delivering sediment to the remainder of the chain.

Implement the LCA Barataria Basin Wetland Creation and Restoration Study

This feature involves implementation of components of the LCA Barataria Basin Wetland Creation and Restoration Study. The wetlands in the lower Barataria Basin have experienced wetland deterioration due to subsidence, a lack of circulation, saltwater intrusion, and a paucity of sediment and nutrients. Sediment dredged from offshore borrow sites would be placed at specific sites near Bayou Lafourche in the Caminada Headland to create and restore marsh and ridge habitat in the area.

Modification of Davis Pond diversion

The Davis Pond diversion structure, constructed in 2002 in upper Barataria Basin, has a maximum operating capacity of 10,600 cfs [378 cms]. The structure has been operated as a salinity management feature, with freshwater introductions from the Mississippi River ranging from 1,000 cfs up to 5,000 cfs [36 cms to 178 cms] averaging, to this point in time, considerably less than half of the structure's capacity. The primary purpose of the existing Davis Pond project has been to maintain salinity gradients in the central portion of Barataria Basin. This operation, in effect, partially restored the historic functions of marsh nourishment (e.g., freshwater inflow, providing nutrients and sediment to the marsh, and countering the effects of subsidence). This restoration feature study would assess changes in the operation of the Davis Pond project to increase wetland creation and restoration outputs. Modified operation of this structure could potentially result in an increase in the freshwater introduction rate, perhaps 5,000 cfs [178 cms] on average, to accommodate the wetland building function of the system. This study would identify changes to feature's operation that would increase restoration outputs. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. This feature is located in the vicinity of a historic crevasse. Any proposed change in purpose that would require modification of the existing project authorization would be submitted for Congressional approval.

Sediment delivery via pipeline at Bastian Bay/Buras

This restoration feature provides for sediment delivery via pipeline through programmatic sediment mining from the Mississippi River. The moderately deep (6 to 10 feet [1.8 to 3 feet]) open water in this bay system requires a large volume of sediment to create wetlands. The objective of this feature is to create wetlands in the highly degraded Bastian Bay and Buras area.

Sediment delivery via pipeline at Empire

This restoration feature provides for sediment delivery via pipeline through programmatic sediment mining from the Mississippi River. The moderately deep (6 to 10 feet [1.8 to 3 feet]) open water in Bay Adams and Barataria Bay requires a large volume of sediment to create wetlands. The objective of this feature is to create wetlands in the highly degraded areas south and west of Empire.

Sediment delivery via pipeline at Main Pass (Head of Passes)

This feature provides for sediment delivery via programmatic sediment mining from the Mississippi River utilizing a sediment trap above the Head of Passes. The estimated annual yield of dredge material from the sediment trap is 9 million cubic yards [6.9 million cubic meters]. The objective of this feature is to create wetlands in the degraded areas in the east and west portions of the Mississippi River Delta south of Venice.

Third Delta (Subprovinces 2 & 3)

This feature provides for a large diversion from the Mississippi River through a new control structure in the vicinity of Donaldsonville. This feature provides for an approximately 240,000 cfs diversion at maximum river stage. Flows would be diverted into a newly constructed conveyance channel (parallel to Bayou Lafourche) extending approximately 55 miles [88 kilometers] from the initial point of diversion to the eventual point of discharge. Diverted flow would be divided equally at a point north of the GIWW to enable the creation of a deltaic wetlands complex in each of the Barataria and Terrebonne Basins. A possible alternative configuration would involve a 120,000 cfs [4300 cms] diversion at maximum river stage into the Barataria Basin only. Enrichment of this diversion would also be considered and assumes use of 30-inch [77 cm] dredge at capacity for three months yielding 6,293,000 cubic yards [4,810,000 cubic meters] each year. The study requires detailed investigations of flood control, drainage, and navigation impacts in addition to environmental and design efforts because it would require construction either through wetlands or prime farmland.

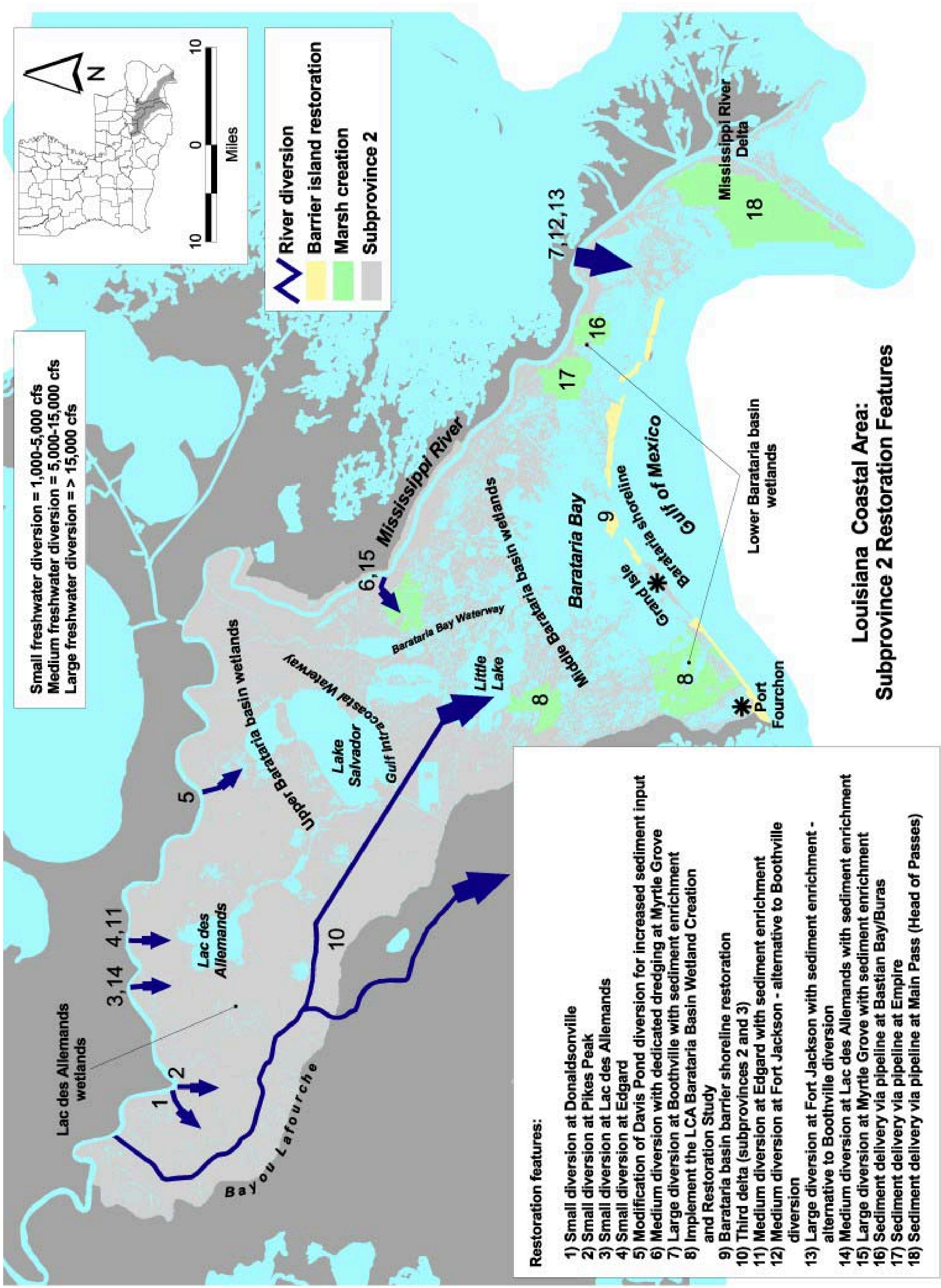

Figure 2-7. Subprovince 2 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

2.3.6.1.3 Subprovince 3 feature descriptions

Backfill pipeline canals

This restoration feature provides for the backfilling of pipeline canals south of Catfish Lake. The Twin Pipeline canals in this area are crossed by numerous oilfield canals, which have greatly altered natural water circulation patterns. The 63,300 feet [19,300 meters] of pipeline canals would be filled at strategic locations to restore primary water circulation through Grand Bayou Blue. The retention time of Atchafalaya and Bayou Lafourche (pumped) flows would be increased to benefit affected wetlands.

Small Bayou Lafourche reintroduction

This restoration feature would reintroduce flow from the Mississippi River into Bayou Lafourche. The piped flow would be continuous and would freshen and reduce loss rates for the wetlands between Bayous Lafourche and Terrebonne, south of the GIWW.

Convey Atchafalaya River water to Northern Terrebonne marshes - via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, and enlarging constrictions in the GIWW below Gibson and in Houma, and Grand Bayou conveyance channel construction/enlargement

This restoration feature would increase existing Atchafalaya River influence to central (Lake Boudreaux) and eastern (Grand Bayou) Terrebonne marshes via the GIWW by introducing flow into the Grand Bayou basin by enlarging the connecting channel (Bayou L'Eau Bleu) to capture as much of the surplus flow (max. 2000 to 4000 cfs [70 to 140 cms]) that would otherwise leave the Terrebonne Basin. Several alternatives would be evaluated through hydrologic models; however in all cases, gated control structures would be installed to restrict channel cross-section to prevent increased saltwater intrusion during the late summer and fall when riverine influence is typically low. Some alternatives may include auxiliary freshwater distribution structures. This feature also includes increasing freshwater supply through repairing banks along the GIWW, enlarging constrictions in the GIWW, and diverting additional Atchafalaya River freshwater through the Avoca Island Levee and into Bayou Chene/GIWW system.

Freshwater introduction south of Lake De Cade

This restoration feature is intended to improve Atchafalaya flows to Terrebonne wetlands between Lake De Cade, Bayou du Large, and Lake Mechant by constructing three small conveyance channels along the south shore of Lake De Cade to the Small Bayou La Pointe area. Channel flows would be controlled by structures that could be actively operated. Lowering salinities and increasing nutrient inputs would reduce intermediate marsh losses.

Freshwater introduction via Blue Hammock Bayou

This restoration feature would increase flow from the Atchafalaya River to the southwest Terrebonne wetlands by increasing the cross-section of Blue Hammock Bayou. This would increase the distribution of Atchafalaya flows from Four League Bay to the Lake Mechant wetlands. Grand Pass and Buckskin Bayou, outlets of Lake Mechant, would be reduced in cross section to increase the retention and benefits of Atchafalaya nutrients, sediment, and freshwater in these estuarine wetlands. Additional marsh would also be created with dredged material.

Increase sediment transport down Wax Lake Outlet

This restoration feature would increase sediment transport down Wax Lake Outlet by extending the outlet northward through Cypress Island to connect to the Atchafalaya Main Channel. Currently, the Wax Lake Outlet flows passes over the relatively shallow Six Mile Lake before entering the outlet. This restoration feature would connect the deep outlet directly to the deep Atchafalaya Main Channel thereby increasing bed load sediment transported to the Wax Lake Outlet Delta.

Maintain land bridge between Caillou Lake and Gulf of Mexico

This restoration feature would maintain the land bridge between the gulf and Caillou Lake by placing shore protection in Grand Bayou du Large to minimize saltwater intrusion. This feature would involve rock armoring or marsh creation to plug/fill broken marsh areas on the west bank of lower Grand Bayou du Large, to prevent a new channel from breaching the bayou bank and allowing a new connection with Caillou Lake. Some gulf shore armoring would be needed to protect these features from erosion on the gulf shoreline. Gulf shoreline armoring might be required where shoreline retreat and loss of shoreline oyster reefs has allowed increased water exchange between the gulf and the interior water bodies (between Bay Junop and Caillou Lake). Some newly opened channels would be closed to restore historic cross-sections of exchange points. By reducing marine influences in these interior areas, this feature would allow increased freshwater influence from Four League Bay to benefit area marshes.

Maintain land bridge between Bayous du Large and Grand Caillou

This restoration feature provides for construction of a land bridge between Bayous du Large and Grand Caillou south of Falgout Canal and northeast of Caillou Lake. A grid of numerous trenasses, a small human-made channel for navigation, has artificially increased the hydrologic connection between interior marshes with Caillou Lake and adjoining water bodies. This problem would be addressed by depositing hydraulically dredged material to close the trenasses and areas of broken marsh to create a continuous berm of "high marsh" in the area. This berm would separate the higher, healthy brackish/saline marshes bordering the northeast end of Caillou Lake from the deteriorating inland intermediate/brackish marshes. It would also allow the freshwater flowing down the HNC and Bayou Grand Caillou to have a greater influence on interior marshes through existing water exchange points along Bayou Grand Caillou, north of the proposed land bridge.

Maintain northern shore of East Cote Blanche Bay at Point Marone

This restoration feature would protect the north shore of East Cote Blanche Bay from Point Marone to Jackson Bayou. Bay shoreline would be stabilized to protect the interior wetland water circulation patterns in the Cote Blanche Wetlands CWPPRA project. The feature was designed to increase the retention time of the Atchafalaya flows moving from the GIWW to East Cote Blanche Bay.

Maintain Timbalier land bridge

This restoration feature provides for maintaining the Timbalier land bridge in the upper salt marsh zone. A 2,000-foot-wide (610 meter), 21-mile-long (34 kilometer), segmented marsh and low ridge land form (roughly 5,000 acres [2000 ha]) would be constructed from the east bank of Bayou Terrebonne near Bush Canal to the west bank of Bayou Lafourche near the southern terminus of the hurricane protection levee. This landform would be constructed by depositing hydraulically dredged material and could resemble the long, linear, segmented dredge material disposal islands in Atchafalaya Bay. The nine major bayous, which connect the upper subbasin to the downstream lakes and bays, would remain open; among others, they include Grand Bayou Blue and Bayous Pointe Au Chien, Jean La Croix, Barre, and Tambour. The proposed land bridge alignment is in the upper salt Marsh zone, minimizes impacts to existing oyster leases, and avoids most of the oil and gas fields in the Timbalier Subbasin.

Multi-purpose operation of Houma Navigation Canal (HNC) Lock

The restoration feature involves the multi-purpose operation of the proposed HNC Lock, located at the southern end of the HNC. The Morganza to the Gulf Hurricane Protection Study includes construction of the lock, but does not include the multi-purpose operation of the lock. The objective of this feature is to make more efficient use of Atchafalaya River waters and sediment flow, as well as maintain salinity regimes favorable for area wetlands. The proposed structure would be operated to restrict saltwater intrusion and distribute freshwater and sediment during times of high Atchafalaya River flow. The current project is designed to limit saltwater intrusion, but with a minor modification would provide additional benefits to the wetlands by increasing retention time of Atchafalaya River water in the Terrebonne Basin wetlands. An increased retention time would provide additional sediment and nutrients to nourish the wetlands and would benefit the forested wetlands, and fresh, intermediate, and brackish marshes adjacent to the lock and canal; the Lake Boudreaux wetlands to the north; the Lake Mechant wetlands to the west; and the Grand Bayou wetlands to the east.

Penchant Basin Restoration

This restoration feature involves the implementation of the Penchant Basin Plan. This would increase the efficiency of Bayou Penchant to convey flows from the area wetlands as Atchafalaya River stages fall after spring floods, and reduce excessive water levels in the upper Penchant Subbasin. Increased outlet capacities would utilize flow, increasing circulation and retention in tidal wetlands below the large fresh floating marsh area.

Rebuild Historic Reefs - rebuild historic barrier between Point Au Fer and Eugene Island and construct segmented reef/breakwater/jetty along the historic Point Au Fer Barrier Reef from Eugene Island extending towards Marsh Island to the west

This restoration feature would increase the rate of Atchafalaya Delta growth and would increase the Atchafalaya River influence in Atchafalaya Bay, Point Au Fer Island, and Four League Bay by rebuilding the historic barrier between Point Au Fer and Eugene Island. This barrier would separate these areas from the gulf following the historic Point Au Fer reef alignment. The barrier could be a reef, a barrier island, an intertidal spit, or a segmented breakwater. The barrier would increase delta development by reducing the erosive wave effects. Atchafalaya River freshwater influence would be increased in the interior areas of the Atchafalaya Basin. Constructing a segmented reef/breakwater/jetty along the historic Point Au Fer barrier reef from Eugene Island extending towards Marsh Island to the west would produce similar beneficial effects in the western portion of Atchafalaya Bay. The barrier would join the Bayou Sale natural levee feature.

Acadiana Bays Estuarine Restoration

This restoration feature provides for rebuilding historic Point Chevreuil Reef toward Marsh Island, and rehabilitating the Bayou Sale natural levee between Point Chevreuil and the gulf. The natural levee would be rebuilt in the form of a shallow sub-aqueous platform, small islands, and/or reefs. The historic shell reefs were removed by shell dredging. This feature was designed to help restore historic hydrologic conditions in the Teche/Vermilion Basin.

Rehabilitate northern shorelines of Terrebonne/Timbalier Bays

This feature provides for the rehabilitation of the northern shorelines of Terrebonne/Timbalier Bays with a segmented breakwater from the Seabreeze area to the Little Lake area. This feature would rebuild and maintain the historic shoreline integrity around Terrebonne and Timbalier Bays by constructing segmented barriers along the west side of Terrebonne Bay, across the historic shoreline alignment along the northern sides of both bays, and along the eastern side of Timbalier Bay.

Relocate the Atchafalaya Navigation Channel

This restoration feature consists of relocating the Atchafalaya Navigation Channel. The navigation channel route through the delta has been identified as the greatest impediment to the delta's growth. By rerouting the channel between the delta lobes, and by using a passive hydraulic structure at the point of departure in the Lower Atchafalaya River, river sediment would be used more efficiently in the growing delta.

Terrebonne Basin barrier shoreline restoration

This feature originally considered restoration elements for all the major reaches of the Terrebonne barrier-shoreline chain. However, for inclusion in the near-term plan some consideration to the most critically needed elements of the chain. This restoration feature provides for the restoration of the Timbalier and Isles Dernieres barrier island chains. This would simulate historical conditions by reducing the current number of breaches, enlarging (width and dune crest) of the Isles Dernieres (East Island, Trinity Island, and Whiskey Island), Timbalier Island, and East Timbalier Island.

Stabilize banks of Southwest Pass

This restoration feature would maintain the integrity of Southwest Pass channel connecting southwestern Vermilion Bay with the Gulf of Mexico by protecting its bay and gulf shorelines. This feature would involve the construction of a dike and armoring of the banks of the pass to maintain the existing pass dimensions.

Gulf shoreline stabilization at Point Au Fer Island

This feature provides for stabilizing of the gulf shoreline of Point Au Fer Island. The purpose is to prevent direct connections from forming between the gulf and interior water bodies as the barrier island is eroded. In addition to gulf shoreline protection, this feature would prevent the fresher bay side water circulation patterns from being influenced directly by the gulf, thus protecting the estuarine habitat, which has higher quality wetland habitats, from conversion to marine habitat.

Alternative operational schemes of Old River Control Structure (ORCS)

This feature would evaluate alternative ORCS operational schemes with a goal of increasing the sediment load transported by the Atchafalaya River for the purpose of benefiting coastal wetlands. Detailed studies of this feature would determine: impacts (beneficial and adverse) to the interior of the Atchafalaya Basin; the degree to which flow and sediment redistributions would be required; and the increased costs of maintaining the flood control, navigation, and environmental features along the Lower Mississippi, Red, and Atchafalaya Rivers.

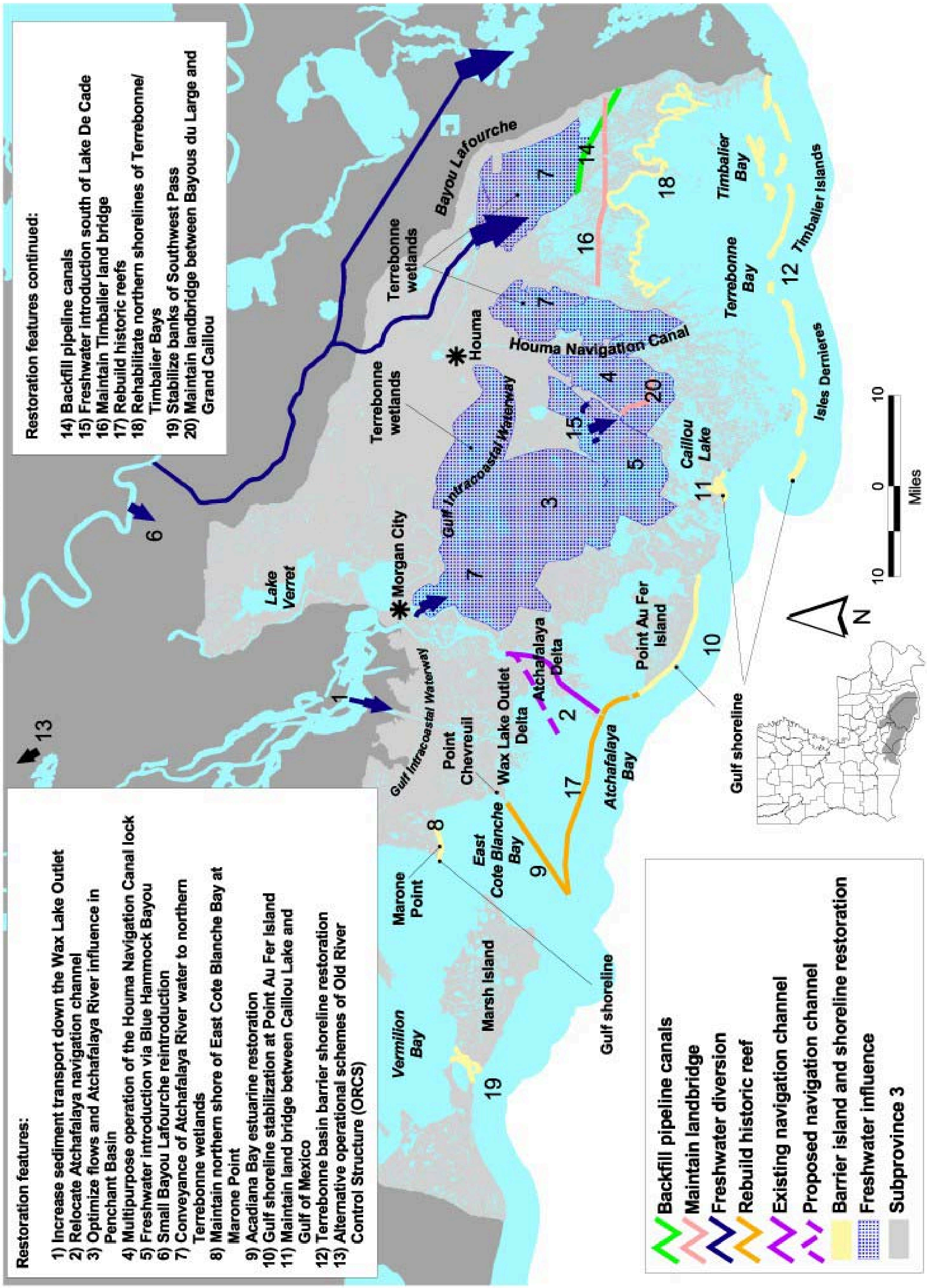

Figure 2-8. Subprovince 3 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

2.3.6.1.4 *Subprovince 4 feature descriptions*

Black Bayou bypass culverts

This restoration feature involves the replacement of the Calcasieu Lock in the GIWW west of the Hwy 384 Bridge and uses the old lock for freshwater introduction to the upper Calcasieu estuary from the Mermentau Basin. This feature also incorporates freshwater introduction via the Black Bayou Culverts feature at the intersection of Black Bayou and Hwy 384.

Calcasieu Ship Channel Beneficial Use

This feature capitalizes on the existing navigation maintenance activity by expanding beneficial use of dredged material from the Calcasieu Ship Channel. It accomplishes this by extending the application of material dredged from the channel for routine maintenance beyond the normal standard. Average annual maintenance dredging volume is approximately 4 million cubic yards (3.1 million cubic meters). The expanded use of this material would result in wetland creation over 50 years of application.

Chenier Plain freshwater management and allocation reassessment

This restoration opportunity requires detailed investigations involving water allocation needs and trade-off analysis in the eastern Chenier Plain, including the Teche/Vermilion Basin, to provide for wetland restoration and support continued agriculture and navigation in the region. A series of navigation and salinity control structures are currently authorized and operated in the eastern portion of the Chenier Plain. These structures maintain a freshwater source for agricultural applications and prevention of salinity intrusion in the area. Tidal stages have predominantly exceeded stages within the managed area creating a ponding issue for the fresh and intermediate marshes in the area. In addition, the natural ridges that define this area continue to be impacted by erosion, further threatening the ability for continued management and sustainability of the interior marshes. The study would address water management and allocation issues including salinity control, drainage, and fisheries accessibility.

Dedicated dredging for marsh restoration

This restoration feature would apply dredged material from offshore sources beneficially to restore subsided wetlands on Sabine National Wildlife Refuge (NWR) and adjacent properties. Locations for marsh restoration would be north and northwest of Browns Lake on Sabine NWR. Average open water depth is 1.5 to 2 feet (0.4 to 0.6 meters) deep.

East Sabine Lake hydrologic restoration

This restoration feature involves restoration of East Sabine Lake between Sabine Lake and Sabine NWR Pool 3. This feature would include salinity control structures at Willow Bayou, Three Bayou, Greens Bayou, and Right Prong of Black Bayou. Sediment terracing would also be used in shallow open water areas along with shoreline protection along Sabine Lake and some smaller structures.

Freshwater introduction at Highway 82

This restoration feature provides for drainage of "excess" freshwater from the Mermentau Basin Lakes Subbasin across Hwy 82 to the Chenier Subbasin at the Highway 82 area between Rollover Bayou and Superior Canal to the eastern portion of Rockefeller Refuge. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater introduction at Little Pecan Bayou

This restoration feature provides for drainage of "excess" freshwater from the Mermentau Basin Lake Subbasin across Hwy 82 to the Chenier Subbasin west of Rockefeller Refuge at the Thibodeaux Bridge. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater introduction at Pecan Island

This restoration feature provides for drainage of "excess" freshwater from the Mermentau Basin Lake Subbasin across Hwy 82 near Pecan Island to the Chenier Subbasin. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater introduction at Rollover Bayou

This restoration feature provides for drainage of "excess" freshwater from the Mermentau Basin Lake Subbasin across Hwy 82 at Rollover Bayou to the Chenier Subbasin. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Freshwater Introduction at South Grand Chenier

This restoration feature provides for drainage of "excess" freshwater from the Mermentau Basin Lakes Subbasin from the Mermentau River across Hwy 82 to the Chenier Subbasin Hog Bayou watershed. This introduction would involve the replacement or modification of culverts under Hwy 82. The objective of this feature is to relieve elevated stages in the northern area and provide freshwater input to the brackish and intermediate marshes to the south. This feature is intended to work in concert with four other restoration feature located along the Hwy 82 alignment.

Stabilize Gulf shoreline near Rockefeller Refuge

This restoration feature provides for gulf shoreline stabilization from Mermentau Ship Channel to near Rollover Bayou east of Rockefeller Refuge. Stabilization methods include rock foreshore dikes, offshore reefs, or segmented breakwaters, similar to Holly Beach breakwaters, placed closer to shore and with narrower gaps. The objective of this feature is the prevention of shoreline breaching into the landward brackish and intermediate marshes.

Modify existing Cameron-Creole watershed structures

The Cameron-Creole watershed feature, constructed in 1989, consists of 5 large concrete water control structures and a 16 mile-long levee along the shoreline of Calcasieu Lake. Three of the five structures (Grand Bayou, Bois Connine Bayou, and Lambert Bayou) are adjustable structures with slide gates and the remaining two (Mangrove Bayou and No Name Bayou) are fixed crest weir structures. The fixed crest weir sill heights may be set too high. This higher setting could be contributing to the impoundment problem within Cameron-Creole marshes adjacent to those structures. If the weir sills for these two structures could be modified to lower weir crests, reduced impoundment, greater water flow, and increased fisheries access (above that afforded by the vertical fish slots already present in the structures) would occur independent of salinity control at Calcasieu Pass.

New Lock at the GIWW

This feature consists of a new lock at the GIWW east of Alkali Ditch with dimensions of 75 to 110 feet (23 to 34 meters) wide by 15 feet (4.6 meters) deep. This restoration feature would limit the exchange of water between the Sabine River and the GIWW eastward to the Calcasieu River. The existing circulation pattern provides a mechanism for the intrusion of higher salinity waters transmitted by the deeper navigation channels in each of the rivers to reach the interior marshes. The objective of the feature is the reduction of circulation of higher salinity water through the Calcasieu-Sabine sub-basin, thereby reducing future wetlands loss.

Salinity control at Alkali Ditch

This restoration feature provides salinity control at the Alkali Ditch, northwest of Hackberry at the GIWW, with a gated structure or rock weir with barge bay. The existing dimensions of the feature are approximately 150 to 200 feet (45 to 60 meters) wide by 8 to10 feet (2.4 to 3 meters) deep; the structure or weir with approximate dimensions 70 feet wide (21 meters) by 8 feet (2.4 meters) deep. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Black Bayou

This restoration feature calls for a salinity control structure with boat bay at the mouth of Black Bayou (either a gated structure or a rock weir), located at the intersection of Black Bayou and the northeastern shoreline of Sabine Lake. The existing bayou dimensions are 150 to 200 feet (45 to 60 meters) wide by 10 feet (3 meters) deep. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Black Lake Bayou

This restoration feature calls for salinity control in Long Point Bayou with a gated structure or rock weir located in Long Point Bayou north of Sabine NWR near Hwy 27, west of the Calcasieu Ship Channel. The existing dimensions are 40 feet wide (12 meters) by 5 feet (1.5 meters) deep. The structure's approximate dimensions are 10 to 15 feet (3 to 4.5 meters) wide by 4 feet (1.2 meters) deep boat bay. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Highway 82 Causeway

This restoration feature provides for a rock weir at Hwy 82 Causeway located in the southern portion of Sabine Lake north of Sabine Pass and the Sabine-Neches Waterway. Existing dimensions of the facility equal approximately 3,400 feet wide by approximately 4 feet deep, except at the approximate 10 feet (3 meters) deep center channel. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Long Point Bayou

This restoration feature provides for salinity control in Long Point Bayou with a gated structure or rock weir located in Long Point Bayou north of Sabine NWR near Hwy 27, west of the Calcasieu Ship Channel. The existing dimensions are 40 feet wide by 5 feet deep. The structure's approximate dimensions are 10 to 15 feet (3 to 4.5 meters) wide by 4 feet (1.2 meters) deep boat bay. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

Salinity control at Oyster Bayou

This restoration feature provides for salinity control in Oyster Bayou with a gated structure or rock weir. The location in Oyster Bayou is about 1 mile west of the Calcasieu Ship Channel, which is 100 to 150 feet wide by 10 feet deep; with an approximately 15 to 20 foot (4.5 to 6 meters) wide by 4 foot (1.2 meters) deep boat bay. The objective of this feature is to regulate saltwater intrusion in order to stabilize the brackish and intermediate marshes in the area and reduce future loss.

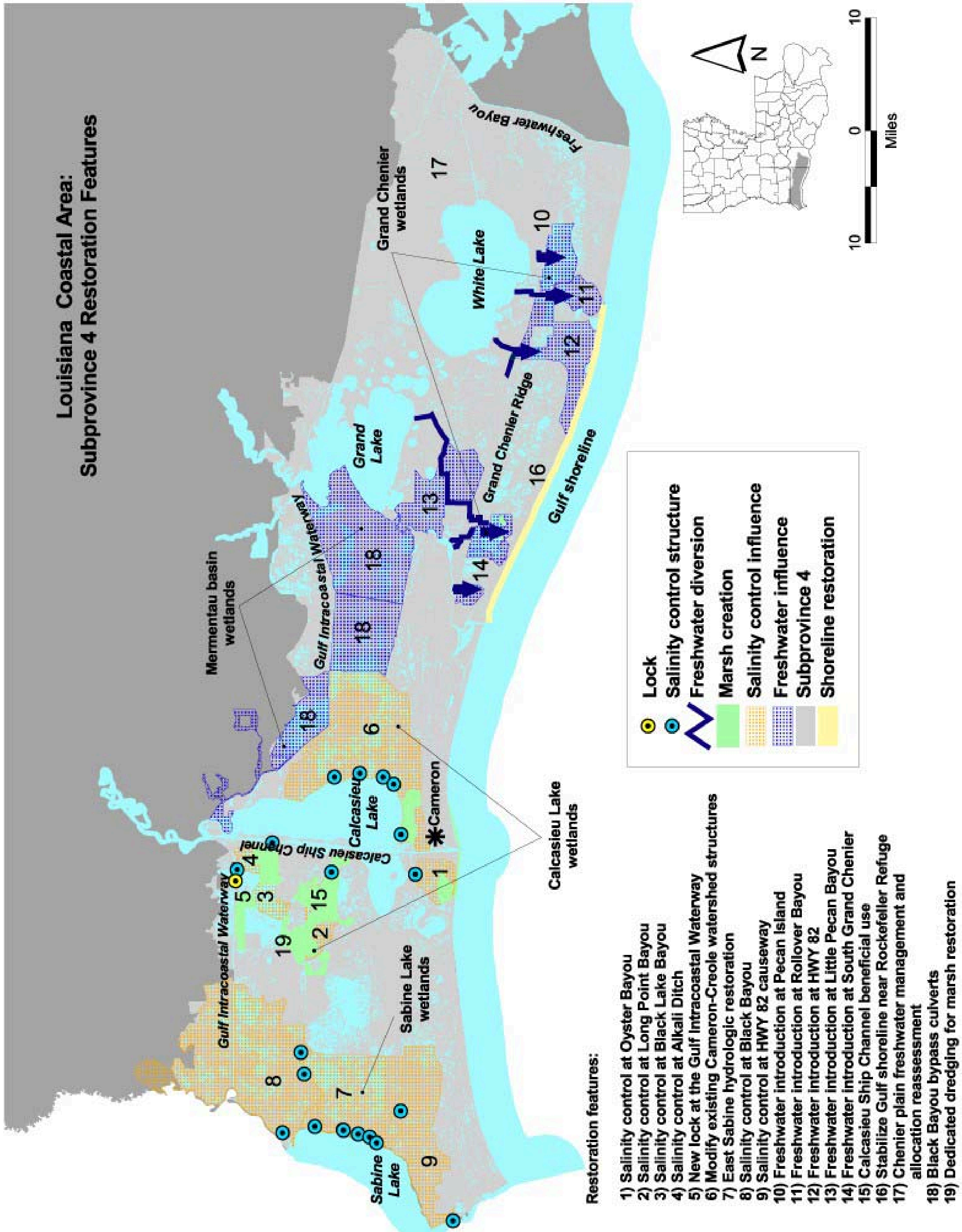

Figure 2-9. Subprovince 4 Restoration Features Identified in the Final Array of Coast Wide Frameworks.

2.3.7 Development of Sorting and Critical Needs Criteria

The PDT determined that use of initial sorting criteria and follow-on critical needs criteria-based evaluations was an appropriate method to determine which of the 79 features would best meet near-term requirements. Criteria were developed to identify which restoration features would be placed into the various component categories described in Section 3.3.6. In addition, the criteria helped identify the ability of each restoration feature to address critical needs.

The initial step in identifying these criteria was the gathering of input by the PDT. The Vertical Team, Framework Development Team, and the PDT developed a methodology to: 1) sort the restoration features into the component categories of the alternative LCA Plans; and 2) identify the relative value of a restoration feature in addressing critical ecologic needs in the coastal landscape. The criteria were designated as either "sorting" or "critical needs" criteria. The PDT designated three sorting criteria, and four critical needs criteria.

2.3.7.1 Sorting criteria

2.3.7.1.1 *Sorting Criterion #1 - Engineering and design complete and construction started within 5 to 10 years*

A restoration feature would meet this criterion if, over the next 5 to 10 years:

- Required feasibility-level decision documents could be completed;
- Necessary NEPA documentation could be completed;
- Pre-construction engineering & design (PED) could be completed; and
- Construction authorization could be obtained and construction could be initiated.

If a restoration feature did not meet this criterion, it was not viewed as a potential near-term restoration opportunity, but rather a potential candidate for large-scale and long-range study.

2.3.7.1.2 *Sorting Criterion #2 - Based upon sufficient scientific and engineering understanding of processes*

A restoration feature would successfully meet this criterion if it contained:

- Opportunities for which there is currently a sound understanding based in science and technology; and
- Science and engineering principles that have been applied within Louisiana and successfully achieved a beneficial ecosystem response.

Features that did not meet this criterion were not considered as potential near-term restoration opportunities. Instead, the scientific and/or engineering uncertainties associated with these restoration features provided a basis for the feature to be a potential candidate for a demonstration project.

2.3.7.1.3 *Sorting Criterion #3 - Implementation is independent; does not require another restoration feature to be implemented first*

If a feature was not deemed to be independent, other features that potentially had overlapping or duplicative effects were identified, and the interdependent features were combined. This combination of features was then reassessed to determine if, as a composite, the group of features met the initial two sorting criteria and classified appropriately. The intent of this criterion was to ensure that those features with overlapping hydrologic or ecologic influence area were considered simultaneously in their design development. This criterion was meant to apply specifically to, but not be limited to, those features that would be implemented in the near-term restoration effort. The realization of individual feature benefits is not dependent on implementation of all features. Once they have been synergistically designed, each feature will be of an appropriate scale to operate independently without being redundant with other features within the influence area.

The sorting criteria were applied sequentially. In other words, if a feature failed to meet criterion #2, then it was not reviewed to assess whether it met criterion #3. The process of applying these sorting criteria is represented in the flow diagram in **figure 2-10**.

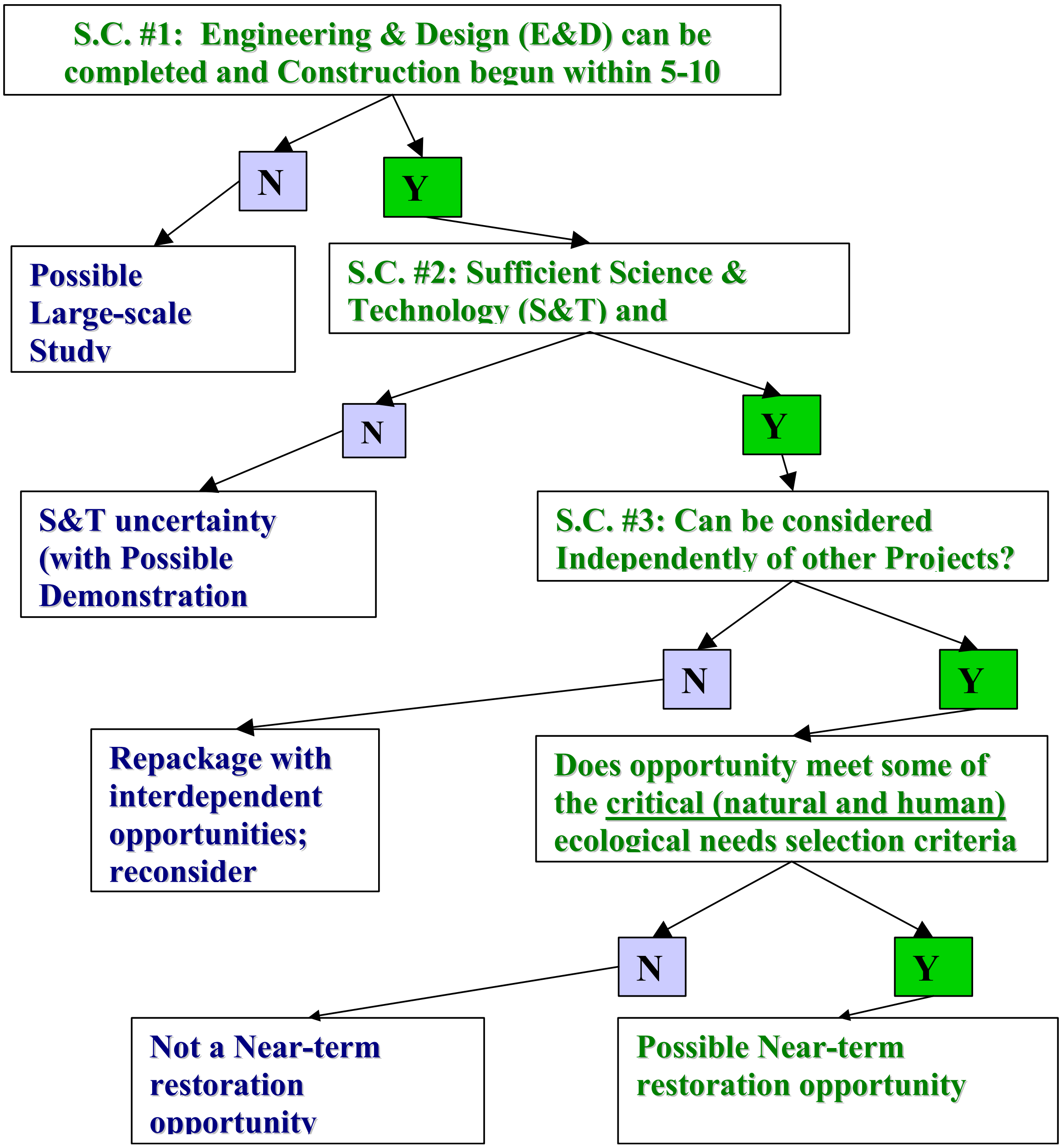

Figure 2-10. LCA Sorting Process Flow Diagram.

2.3.7.2 <u>Critical needs criteria</u>

If a restoration feature met all of the sorting criteria, it was then assessed against the critical needs criteria. The application of the criteria was done in an annotated manner so that the reasoning for applicability of each feature versus the criteria could be readily assessed. This approach allowed the PDT to make relative comparisons of different features based on common criteria and fine tune the overall value of features in addressing the critical ecologic and human needs of the system. The following criteria were applied to potential near-term course of action features as defined.

2.3.7.2.1 *Critical Needs Criterion #1 - Prevents future land loss where predicted to occur*

One of the most fundamental drivers of ecosystem degradation in coastal Louisiana has been the conversion of land (mostly emergent vegetated wetland habitat) to open water. One of the most fundamental critical needs is to stem this loss. Thus, the projection of the future condition of the ecosystem must be based upon the determination of future patterns of land and water. Future patterns of land loss were based on the USGS open file report 03-334 “Historical and Predicted Coastal Louisiana Land Changes: 1978-2050” (appendix B HISTORIC AND PROJECTED COASTAL LOUISIANA LAND CHANGES: 1978-2050). This also applies to future predicted conversion of cypress swamp in areas with existing fragmenting marsh.

2.3.7.2.2 *Critical Needs Criterion #2 - (Sustainability) Restores fundamentally impaired (or mimics) deltaic function through river reintroductions*

This criterion refers to opportunities that would restore or mimic natural connections between the river and the basins (or estuaries), including distributary flows, crevasses, and over-bank flow. Mechanical marsh creation with river sediment was also viewed as mimicking the deltaic function of sediment introduction if supported by sustainable freshwater and nutrient reintroduction.

2.3.7.2.3 *Critical Needs Criterion #3 - (Sustainability) Restores or preserves endangered critical geomorphic structure*

This criterion identifies opportunities that would restore or maintain natural geomorphic structures such as barrier islands, distributary ridges, cheniers, land bridges, and beach and lake rims. These geomorphic structures are essential to maintaining the integrity of coastal ecosystems. Those structures that are endangered or “nearly lost” in the near-term are especially critical.

2.3.7.2.4 *Critical Needs Criterion #4 - Protects vital socioeconomic resources*

This criterion identifies proposed opportunities that would potentially protect vital local, regional, and national social, economic, and cultural resources. These resources include cultures, community, infrastructure, business and industry, and flood protection.

2.3.7.3 Application of the criteria

Following the identification of these restoration criteria and the method for their application, the PDT made an initial assessment of the 79 restoration features. This assessment indicated that the methodology could be applied effectively to identify potential alternative plans (**figure 2-10**).

During the week of April 19 to 23, 2004, a series of public scoping meetings were held across the LCA Study area. These meetings provided the public and stakeholder groups an opportunity to comment on the modification of the study and the specific criteria for identifying alternative LCA Plans. The participants were provided with an overview of the criteria and methodology, the written definition of each criterion's application, and a list of the 79 features. This information was also made available on the study's web site along with additional feature details. The meeting participants were encouraged to comment on and/or modify the criteria and methodology developed by the PDT, as well as to provide input on additional criteria that they considered appropriate. Finally, attendees were encouraged to take materials to other interested parties who were not able to attend or direct them to the study's web site to submit their comments.

The public input was compiled and used to make adjustments to the criteria or to the criteria's application to individual features. In addition, public input allowed the PDT to make final assessments of the appropriate components of the alternative LCA Plans.

2.4 SORTING CRITERIA APPLICATION RESULTS

During Phase VI, each of the 79 restoration features was analyzed through the three Sorting Criteria (**figure 2-10**) and four Critical Needs Criteria. These criteria were designed to determine whether or not a restoration feature should be incorporated as a near-term component in one or more of the LCA alternative plans. In addition, if it was determined that a feature was to be included in the near-term course of action, the criteria helped determine in which component category it would best fit. For example a restoration feature could represent a potential near-term critical restoration feature or a potential large-scale study for a promising restoration concept. Alternatively, an overarching scientific or technological uncertainty could be associated with a restoration feature that would first require the development and implementation of an appropriately scaled demonstration project prior to the implementation of the feature.

2.4.1 Results of Applying Sorting Criterion #1: Engineering and Design (E&D) can be Completed and Construction Started Within 5 to 10 Years

Application of Sorting Criterion #1 winnowed down the number of potential restoration features from 79 to 61. Those restoration features deemed too complex to have feasibility-level decision documents complete and construction begun within the next 5 to 10 years of plan implementation did not successfully pass through this sorting criterion and were instead considered for inclusion in the LCA Plan alternatives as potential large-scale studies. **Table 2-8** lists those restoration features that did not meet Sorting Criterion #1 and were, therefore eliminated from further consideration as near-term plan restoration features.

Table 2-8. Restoration Features Eliminated Using Sorting Criterion #1: Features Whose E&D Could Not be Completed and Construction Started Within the Next 5 to 10 Years.

Subprovince 1
- Medium diversion at Bonnet Carré Spillway
- Post authorization for the diversion of water through Inner Harbor Navigation Canal for increased influence into Central Wetlands
- Medium to large sediment diversion at American/California Bays
- Mississippi River Delta Management Study (Subprovinces 1 & 2)

Subprovince 2
- Medium diversion at Edgard with sediment enrichment
- Large diversion at Boothville with sediment enrichment
- Medium diversion at Fort Jackson - Alternative to Boothville diversion
- Large diversion at Fort Jackson with sediment enrichment - Alternative to Boothville diversion
- Medium diversion at Lac des Allemands with sediment enrichment
- Large diversion at Myrtle Grove with sediment enrichment
- Third Delta (Subprovinces 2 & 3)

Subprovince 3
- Relocate the Atchafalaya Navigation Channel
- Increase sediment transport down Wax Lake Outlet
- Alternative operational scheme of the Old River Control Structure (ORCS)
- Acadiana Bays Estuarine Restoration
- Rebuild historic reefs - Rebuild historic barrier between Point Au Fer and Eugene Island and construct segmented reef/breakwater/jetty along the historic Point Au Fer barrier reef from Eugene Island extending towards Marsh Island to the west

Subprovince 4
- Chenier Plain freshwater management and allocation reassessment*
    - Freshwater introduction at South Grand Chenier
    - Freshwater introduction at Pecan Island
    - Freshwater introduction at Rollover Bayou
    - Freshwater introduction at Highway 82
    - Freshwater introduction at Little Pecan Bayou
- New lock at the GIWW

** These features did not pass Sorting Criterion #3, were repackaged and are considered as a potential large-scale study within the Chenier Plain Freshwater Management and Allocation Study*

2.4.2 Results of Applying Sorting Criterion #2: Sufficient S&T and Engineering Understanding of Processes

Of the 61 features that met Sorting Criterion #1, 28 did not successfully meet Sorting Criterion #2 because they contained some form of scientific or technical uncertainty that would require resolution prior to their implementation. The various types of uncertainties are described in section 3.1 PLANNING CONSTRAINTS. These uncertainties may be resolved by the development and implementation of an appropriately scaled demonstration project (the specific features may suggest demonstration project locations). **Table 2-9** lists features that did not meet Sorting Criterion #2 and were, therefore eliminated from further consideration as near-term course of action restoration features.

Table 2-9. Restoration Features Eliminated Using Sorting Criterion #2: Features Having Major Uncertainties About Science and Technology and Engineering Understanding of Processes.

Subprovince 1

- Marsh nourishment on New Orleans East land bridge
- Sediment delivery via pipeline at La Branche wetlands
- Sediment delivery via pipeline at American/California Bays
- Sediment delivery via pipeline at Central Wetlands
- Sediment delivery via pipeline at Ft. St. Philip
- Sediment delivery via pipeline at Golden Triangle
- Sediment delivery via pipeline at Quarantine Bay
- Opportunistic use of Bonnet Carré Spillway

Subprovince 2

- Implement the LCA Barataria Basin Wetland Creation and Restoration Study
- Sediment delivery via pipeline at Bastian Bay/Buras
- Sediment delivery via pipeline at Empire
- Sediment delivery via pipeline at Main Pass (Head of Passes)

Subprovince 3

- Maintain land bridge between Bayous du Large and Grand Caillou
- Maintain Timbalier land bridge
- Backfill pipeline canals
- Freshwater introduction south of Lake De Cade
- Freshwater Introduction via Blue Hammock Bayou

Subprovince 4

- Salinity control at Alkali Ditch
- Salinity control at Highway 82 Causeway
- Salinity control at Oyster Bayou
- Salinity control at Long Point Bayou
- Salinity control at Black Lake Bayou
- Black Bayou Bypass culverts
- Dedicated dredging for marsh restoration
- Stabilize Gulf shoreline near Rockefeller Refuge
- Modify existing Cameron-Creole watershed structures
- East Sabine Lake hydrologic restoration
- Salinity control at Black Bayou

2.4.3 Results of Applying Sorting Criterion #3: Implementation is Independent; Does not Require Other Restoration Feature to be Implemented First

The remaining 33 features were next subjected to Sorting Criterion #3 to determine their independence from other restoration features. When running these remaining features through Sorting Criterion #3, 12 features were deemed to be independent (received a “Yes” for this criterion). These 12 features then proceeded to the Critical Needs Criteria evaluation. The 21 features that were determined to be interdependent (received a “No” for this criterion) were combined with other dependent features(s), as appropriate, to create “restoration opportunities”. The combined restoration opportunities were evaluated again using Sorting Criteria 1, 2, and 3. One of the restoration opportunities, Freshwater Reintroductions into Subprovince 4, (consisting of five features) failed to pass Sorting Criterion #1 and was reserved as a potential concept for large-scale studies and eliminated from consideration as a near-term restoration opportunity. The remaining 6 restoration opportunities (consisting of 16 features) passed both criteria 1 and 2 and were included for further consideration as near-term restoration opportunities. **Table 2-10** identifies the 12 restoration features and 6 combined restoration opportunities (made up of 16 restoration features) that were further evaluated using the Critical Needs Criteria. **Figure 2-11** provides a graphic representation of the Sorting Criteria Evaluation Process.

Table 2-10. Restoration Features and Restoration Opportunities that Passed Sorting Criteria 1 to 3.

Subprovince 1

- MRGO Environmental Restoration Features
- Maurepas Swamp Reintroductions Restoration Opportunity
  This restoration opportunity includes the following features:
  - Small diversion at Hope Canal
  - Small diversion at Convent / Blind River
  - Increase Amite River Diversion Canal influence by gapping banks
- Upper Breton Sound Reintroductions Restoration Opportunity
  This restoration opportunity includes the following features:
  - Modification of Caernarvon diversion
  - Medium diversion at White's Ditch
- Lower Breton Sound Reintroductions Restoration Opportunity
  This restoration opportunity includes the following features:
  - Rehabilitate Bayou Lamoque structure as a medium diversion
  - Medium diversion at American / California Bays
- Rehabilitate Violet Siphon for increased influence to Central Wetlands
- Medium diversion at Fort St. Philip

Subprovince 2

- Barataria Basin barrier shoreline restoration
- Mid-Barataria Basin Reintroductions Restoration Opportunity
  This restoration opportunity includes the following features:
  - Modification of Davis Pond diversion for increased sediment input
  - Medium diversion with dedicated dredging at Myrtle Grove
- Lac Des Allemands Area Reintroductions Restoration Opportunity
  This restoration opportunity includes the following features:
  - Small diversion at Lac Des Allemands
  - Small diversion at Donaldsonville
  - Small diversion at Pikes Peak
  - Small diversion at Edgard

Subprovince 3

- Small Bayou Lafourche reintroduction
- Terrebonne Marsh Restoration Opportunity
  This restoration opportunity includes the following features:
  - Optimize flows and Atchafalaya River influence in Penchant Basin
  - Multi-purpose operation of Houma Navigation Canal (HNC) Lock
  - Convey Atchafalaya River water to Terrebonne Marshes via a small diversion in the Avoca Island Levee, repairing eroding banks of the GIWW, and enlarging constrictions in the GIWW below Gibson and in Houma, and Grand Bayou conveyance channel construction / enlargement
- Terrebonne Basin barrier shoreline restoration
- Maintain land bridge between Caillou Lake and Gulf of Mexico
- Gulf shoreline stabilization at Point Au Fer Island
- Maintain northern shore of East Cote Blanche Bay at Point Marone
- Rehabilitate Northern Shorelines of Terrebonne / Timbalier Bays
- Stabilize banks of Southwest Pass

Subprovince 4

- Calcasieu Ship Channel Beneficial Use

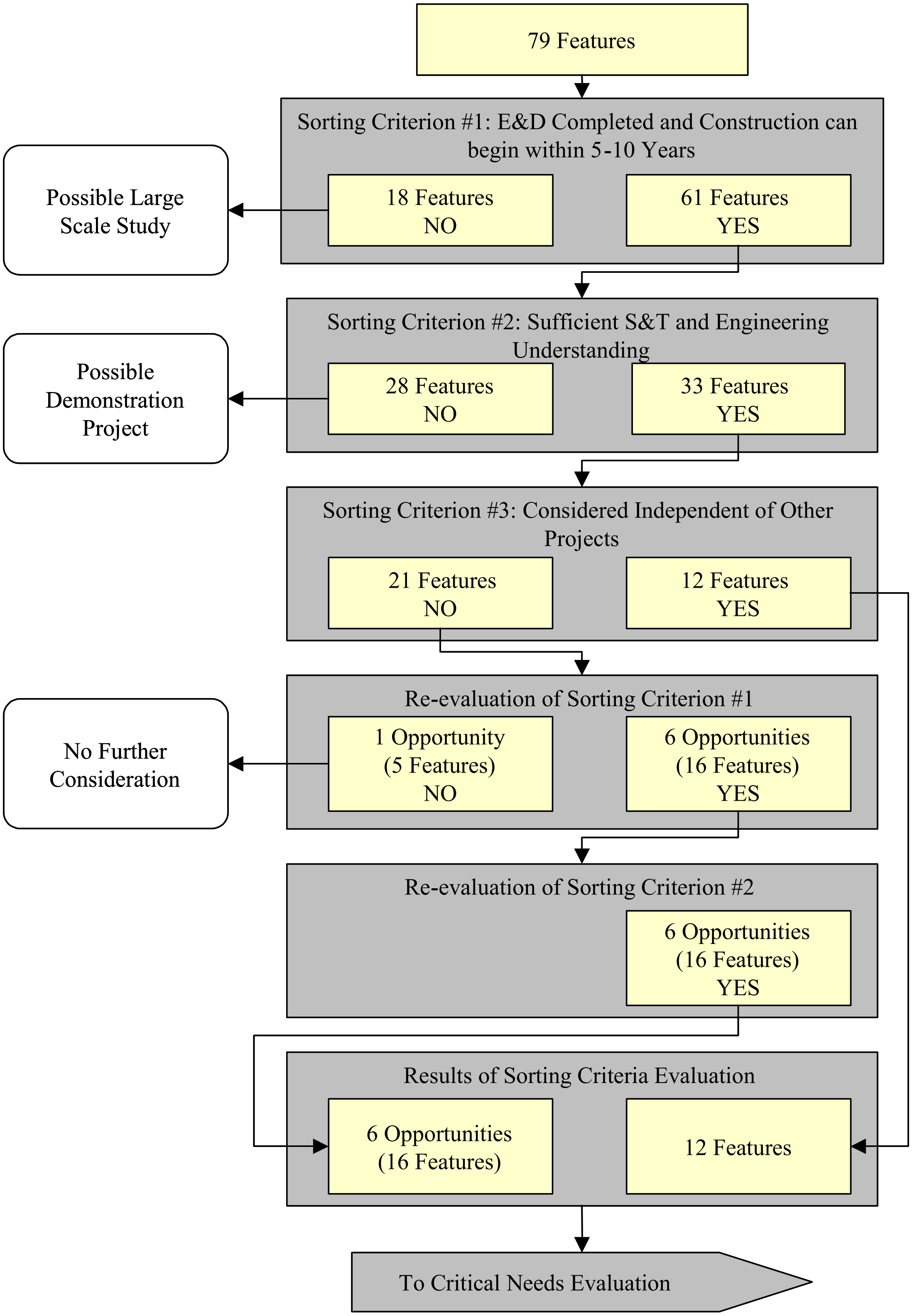

Figure 2-11. Application of Sorting Criteria to Restoration Features and Opportunities.

2.5 CRITICAL NEEDS CRITERIA APPLICATION RESULTS

Following the application of Sorting Criteria, the 12 restoration features and 6 restoration opportunities (made up of 16 restoration features) were further evaluated using the Critical Needs Criteria. Annotated comments were developed for each feature and opportunity to identify the particular Critical Need Criteria that a component met (or did not meet), as well as the relative ability of the feature or opportunity to address them. After evaluating the 12 features and 6 restoration opportunities using the Critical Needs Criteria, seven features and five restoration opportunities (made up of 14 restoration features) were determined to meet the Critical Needs Criteria. These features and opportunities were used to form the basis of the alternative near-term courses of action. Alternately, five features and one restoration opportunity (made up of two restoration features) did not meet the Critical Needs Criteria, and were not considered for inclusion in the near-term course of action. Below are the annotated comments of the results of the assessment of individual features and restoration opportunities following application of the four Critical Needs Criteria.

2.5.1 Features Having Major "Critical Needs Criteria" Value

2.5.1.1 Subprovince 1

MRGO Environmental Restoration Features

These features address Critical Needs Criteria 1, 3, and 4. Specifically, these features have the potential to: prevent predicted future land loss and restore previously degraded wetlands; stabilize and restore the endangered, critical lake rim geomorphic structure; and protect vital socioeconomic resources, such as developments located adjacent to the MRGO.

Maurepas Swamp Reintroductions Opportunity

The Maurepas Swamp Reintroduction Opportunity includes the following features:

- Small diversion at Hope Canal
- Small diversion at Convent / Blind River
- Increase Amite River Diversion Canal influence by gapping banks

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent future cypress swamp degradation and transition currently predicted to occur; restore the deltaic process impaired by levee and dredged material bank construction; and protect vital socioeconomic and public resources, such as the growing eco-tourism industry resident in the Maurepas Swamp and the Maurepas Wildlife Management Area.

Upper Breton Sound Reintroductions Opportunity

The Upper Breton Sound Reintroduction Opportunity includes the following features:

- Modification of Caernarvon diversion
- Medium diversion at White's Ditch

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 2 and 4. Specifically, this opportunity has the potential to restore the deltaic process impaired by levee construction at locations where historic crevassing has occurred and protect vital socioeconomic resources located in areas along the east bank of the Mississippi River in Plaquemines Parish within hurricane flood protection levees. This opportunity also includes features that capitalize on existing structures, such as the Caernarvon diversion.

2.5.1.2 Subprovince 2

Barataria Basin Barrier Shoreline Restoration

This restoration feature has multiple components, some of which have potential to address Critical Needs Criteria 1, 3, and 4. This near-term critical feature has been defined as restoration of the Caminada Headland and Shell Island reaches. These elements of the Barataria barrier-shoreline directly meet specific critical need criteria internal and external to the feature footprint. The feature has the potential to: preventing future land loss where currently predicted to occur; restoring immediately endangered, critical geomorphic structure at the gulfward boundary of the Barataria system; and providing immediate protection of vital socioeconomic resources, such as oil and gas infrastructure located on the leeward side of these islands. In addition the elements of this feature are related to the support and function of all the other elements of the Barataria barrier-shoreline chain. All other elements of this barrier-shoreline are currently being considered for restoration action under other programs. However, this feature does entail some aspects of technical uncertainty in the availability and quality of source material, delivery material by pipeline, and durability.

Mid-Barataria Basin Reintroductions Opportunity

The Mid-Barataria Basin Reintroduction Opportunity includes the following features:

- Modification of Davis Pond diversion
- Medium diversion with dedicated dredging at Myrtle Grove

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent future land loss where currently predicted to occur; restore the deltaic process impaired by the construction of levees at locations where historic crevassing has occurred, as well as improve water quality; and protect vital socioeconomic resources located in the central and upper portions of the Barataria Basin. This opportunity would also capitalize on the existing Davis Pond diversion structure.

Lac des Allemands Area Reintroductions Opportunity

The Lac des Allemands Area Reintroductions Opportunity includes the following features:

- Small diversion at Lac Des Allemands
- Small diversion at Donaldsonville
- Small diversion at Pikes Peak
- Small diversion at Edgard

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent greater future land loss where currently predicted to occur; restore the deltaic process impaired by levee construction in areas where historic crevassing has occurred, prevent swamp degradation and stagnation; and protect vital socioeconomic resources such as the eco-tourism industry and residents in the upper Barataria Basin.

2.5.1.3 Subprovince 3

Small Bayou Lafourche Reintroduction

This feature would reintroduce flow from the Mississippi River into Bayou Lafourche and addresses Critical Needs Criteria 1, 2, and 4. Specifically, this feature has the potential to: prevent future land loss where predicted to occur; restore a fundamentally impaired deltaic process by reintroducing water to a historic distributary of the Mississippi; and protect vital community and socioeconomic resources by supplementing channel flow and stabilizing water quality.

Terrebonne Basin Barrier Shoreline Restoration

This near-term critical feature has been defined as restoration of the Isle Dernieres and East Timbalier reaches of the Terrebonne barrier-shoreline chain. All other elements of this barrier-shoreline are currently being considered for restoration action under other programs. This restoration feature has multiple components, some of which have potential to address Critical Needs Criteria 1, 3, and 4. Specifically, this feature has the potential to: prevent future barrier island losses where predicted to occur; restore endangered, critical geomorphic structure; and protect vital socioeconomic resources such as oil and gas infrastructure and fisheries. However, this feature entails some aspects of technical uncertainty in the availability and quality of source material, delivery of material by pipeline, and durability.

Maintain Land Bridge Between Caillou Lake and Gulf of Mexico

This restoration feature addresses Critical Needs Criteria 1 and 3. This feature would stem shoreline retreat and prevent further breaches that have allowed increased water exchange between the gulf and the interior water bodies (between Bay Junop and Caillou Lake). Prevention of increased marine influence would reduce interior wetland loss as well as preserve the potential for long-range restoration. Closure of newly opened channels would restore historic cross-sections of exchange points, would reduce marine influences in interior areas, and allow increased freshwater influence from Four League Bay to benefit area marshes.

Gulf Shoreline Stabilization at Point Au Fer Island

This feature addresses Critical Needs Criteria 1, 3, and 4. Specifically, this feature has the potential to: prevent future shoreline retreat, where predicted to occur; restore endangered, critical geomorphic structure by stabilizing the island shoreline; and protect vital community and socioeconomic resources.

Terrebonne Marsh Restoration Opportunity

The Terrebonne Marsh Restoration Opportunity includes the following features:

- Optimize flows and Atchafalaya River influence in Penchant Basin
- Multi-purpose operation of Houma Navigation Canal (HNC) Lock
- Convey Atchafalaya River water to Terrebonne Marshes via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, and enlarging constrictions in the GIWW below Gibson and in Houma, and Grand Bayou conveyance channel construction/enlargement

This near-term restoration opportunity evaluates several features that have the potential to address Critical Needs Criteria 1, 2, and 4. Specifically, this opportunity has the potential to: prevent future land loss where predicted to occur; restore fundamentally impaired deltaic processes through the re-introduction of Atchafalaya River water; and protect vital community and socioeconomic resources in the area, such as waterborne commerce and oil and gas infrastructure.

2.5.1.4 Subprovince 4

Calcasieu Ship Channel Beneficial Use

This feature addresses Critical Needs Criteria 1 and 4. Specifically, this feature has the potential to prevent future land loss where predicted to occur and protect vital community and socioeconomic resources of agricultural land use and oil and gas infrastructure. It also capitalizes on the existing navigation maintenance activity.

2.5.2 Features and Opportunities Having Limited or No "Critical Needs Criteria" Value

2.5.2.1 Subprovince 1

Lower Breton Sound Reintroductions Opportunity

The Lower Breton Sound Reintroductions Opportunity includes the following features:

- Rehabilitate Bayou Lamoque structure as a medium diversion
- Medium diversion at American/California Bays

This near-term restoration opportunity evaluates two features that have the potential to address Critical Needs Criteria 2 and 4. This opportunity also includes features that capitalize on existing structures, such as the Bayou Lamoque diversion. While this opportunity has some limited potential to restore the deltaic process in locations where historic crevassing has occurred, the proposed scale does not afford an appreciable influence on the critical need in the area. As a result, this opportunity was not included in any alternative plans.

Rehabilitate Violet Siphon for Increased Influence into Central Wetlands

This feature has some effectiveness meeting Critical Needs Criteria 1 and 2. However, the existing structure has currently been rehabilitated and is operating to capacity on a regulated schedule. Therefore, this feature was not included in any alternative plans.

Medium Diversion at Fort St. Philip

This feature has limited impact meeting Critical Needs Criterion #2. Specifically, this feature appears to have some limited potential to restore deltaic process in the area. However, the major ecologic need in the area is the introduction of large volumes of sediment. The assessment of this feature was that it fell low in the priority of possible critical near-term actions and was therefore not included in any alternative plans.

2.5.2.2 Subprovince 3

Maintain Northern Shore of East Cote Blanche Bay at Point Marone

This feature addresses Critical Needs Criteria 1 and 3 to a minor extent. Specifically, this feature has the potential to prevent some limited future shoreline retreat where predicted to occur and restore some geomorphic structure by stabilizing a small portion of this bay shoreline. The assessment of this feature was that it fell low in the priority of possible critical near-term actions and was therefore not included in any alternative plans.

Rehabilitate Northern Shorelines of Terrebonne/Timbalier Bays

This feature addresses Critical Needs Criteria 1 and 4. Specifically, this feature has the potential to prevent future shoreline retreat where predicted to occur and protect vital community and socioeconomic resources. This feature potentially duplicates the effects of the Terrebonne Basin Barrier-shoreline Restoration feature. The assessment of this feature is that in the near-term the immediate stabilization of the existing barrier-shoreline features is a more effective option. While this feature could be investigated in conjunction with the barrier-shoreline feature, it was not included in any alternative plans.

Stabilize Banks of Southwest Pass

Consideration of critical near-term criteria applied to assess the extent to which critical ecologic needs in the coast would be addressed, this feature was deemed less effective. While qualifying, with some effect relative to critical needs criteria, this feature does not appear to produce appreciable enough changes in the ecosystem to include in any alternative plans. The feature may be further investigated in conjunction with the large-scale Acadiana Bays Estuarine Restoration Study.

2.6 ALTERNATIVE PLAN EVALUATION RESULTS

As detailed previously, application of the three sorting criteria and four critical needs criteria was the basis for development of alternative plans composed of near-term critical features, candidate large-scale studies, and candidate science and technology demonstration projects. The sorting criteria application that determined what were the possible near-term critical features among the 79 initial features was considered fixed. The best opportunity to develop alternative plans resided in the application of the critical needs criteria to determine the near-term critical features. While each of the critical needs criteria were supporting and complimentary, it was possible to discern alternative combinations of near-term critical features by applying the criteria individually or in varying combinations.

Alternative plans, which include differing restoration features and restoration opportunities, were developed for evaluation based on the ability of the alternative to meet one or more of the Critical Needs Criteria. Alternatives represent combinations of specific features or actions that are capable of achieving the identified planning objectives through appreciably different ecologic modifications or technical methods and thereby represent clearly different options for achieving restoration. **Table 2-11** presents the 15 Alternative Plans (plus the No Action Alternative), provides the corresponding plan name (represented by the letters A – O), and identifies which Critical Needs Criterion/Criteria each specific alternative strived to meet. For example, Alternative Plans A, B, D, and H all focus on meeting one of the Critical Needs Criteria (1 through 4 respectively). The remaining 11 Alternative Plans were formulated to include all remaining possible mathematical combinations of the 4 Critical Needs Criteria.

Table 2-11. Possible Alternative Plan Combinations Based on the Critical Needs Criteria.

Alternative Plan	Criterion 1 (Prevent Future Land Loss)	Criterion 2 (Riverine Reintroductions)	Criterion 3 (Restore Geomorphic Structure)	Criterion 4 (Protects Vital community & socioeconomic resources)
A	X			
B		X		
C	X	X		
D			X	
E	X		X	
F	X	X	X	
G		X	X	
H				X
I	X			X
J		X		X
K	X	X		X
L	X		X	X
M			X	X
N	X	X	X	X
O		X	X	X
P (No Action)				

Using the annotated comments that resulted from the Critical Needs Criteria evaluation process, specifically the consensus opinion on which Critical Needs Criteria a restoration feature or opportunity best addresses, the PDT populated each of the 15 alternative plans with the restoration features and opportunities that successfully passed through both Screening and Critical Needs Criteria. For example, Alternative A includes all viable restoration features and opportunities that address Critical Needs Criteria 1 (preventing future land loss). Continuing the example, Alternative C is comprised of all viable restoration features and opportunities that address both Critical Needs Criteria 1 and 2 (prevent future land loss and utilizing riverine reintroductions). A summary of the restoration features and restoration opportunities included in each of the 15 alternative plans is detailed in **table 2-12**.

Table 2-12. Alternative Plan Make-up.

		Alternative Plans														
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**
Restoration Feature or Opportunity	MRGO Environmental Restoration Features	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Maurepas Swamp Reintroduction Opportunities	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Barataria Basin Barrier Shoreline Restoration	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Small Bayou Lafourche Reintroduction	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Mid-Barataria Basin Reintroduction Opportunity	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Upper Breton Sound Reintroduction Opportunity		X	X			X	X	X	X	X	X	X	X	X	X
	Calcasieu Ship Channel Beneficial Use	X		X	X	X	X	X		X		X	X	X	X	X
	Terrebonne Marsh Restoration Opportunity	X	X	X		X	X	X	X	X	X	X	X	X	X	X
	Terrebonne Basin Barrier Shoreline Restoration	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Maintain Land Bridge Between Caillou Lake and Gulf of Mexico	X		X	X	X	X	X		X		X	X	X	X	X
	Gulf Shoreline Stabilization at Point Au Fer Island	X		X	X	X	X	X	X	X	X	X	X	X	X	X
	Las des Allemands Area Reintroductions Opportunity	X	X	X		X	X	X		X	X	X	X		X	X

Evaluation of the 15 alternatives was based on the identification of appreciably different alternative plans to meet the study objectives and Critical Needs Criteria. As **table 2-12** clearly shows, all of the restoration features and measures available to make up the suite of alternative plans were found in more than one Alternative Plan. This is due to the fact that all available restoration features and measures met multiple Critical Needs Criteria. For example, the MRGO Environmental Restoration Feature met Critical Needs Criteria 1, 3, and 4. Because of this, the process of identifying and delineating appreciably different alternative plans was one in which the 15 alternative plans underwent intense scrutiny. A discussion of the composition of, and similarities and differences between, alternative plans follows.

2.6.1 Alternative Plans Designed to Meet Only 1 Critical Needs Criterion

Alternative A (the independent application of Critical Needs Criterion #1 (*prevention of predicted land* loss), resulted in a plan combination that excluded diversions in the Breton Sound Basin, but was inclusive of all other potential near-term features and opportunities. As such, Alternative A was grouped into the numerous alternative plans that sought to meet multiple Critical Needs Criteria.

Alternative B (the independent application of Critical Needs Criterion #2 (*sustainability through restored deltaic function*), also produced broad inclusion of potential features and opportunities, but uniformly excluded all barrier shoreline and marsh creation through dredged material use features. Alternative B also excluded any near-term opportunities in the Chenier Plain. However, this alternative was appreciably different from the other 15 alternatives, and was carried forward for further evaluation.

Alternative D (the independent application of Critical Needs Criterion #3 (*sustainability through restoration of geomorphic structure*), produced a combination of features and opportunities focused on barrier shoreline restoration and direct land building focused on maintaining a protective structure. However, this alternative was appreciably different from the other 15 alternatives, and was carried forward for further evaluation.

Alternative H (the independent application of Critical Needs Criterion #4 (*protection of vital socioeconomic resources*), resulted in a diverse combination of features and opportunities that excluded restoration features and opportunities that did not directly benefit infrastructure or property. However, inclusion of Critical Needs Criterion #4 with any other criteria also provided a minor supplemental effect to most other possible alternative combinations. The absence of Critical Needs Criterion #4, in combination with any other criteria, results in only 2 to 3 feature or opportunity exclusions in any of those plans. In addition, Critical Needs Criterion #4, while defining a critical outcome of coastal restoration, could be more appropriately viewed as a synergistic factor in comparison to the critical needs for direct physical restoration of the landscape. As a result, it was determined that the independent application of criterion #4 did not produce a viable alternative plan. Therefore, Alternative H was not considered as a viable alternative plan.

2.6.2 Alternative Plans Designed to Meet Multiple Critical Needs Criteria

Alternative plans seeking to meet multiple Critical Needs Criteria, particularly those that included Critical Needs Criterion #2, quickly reached full inclusion of all or nearly all the potential restoration features and opportunities. Three of the Alternative Plans (Alternatives E, J, and M), while intending to focus on meeting different Critical Needs Criteria, were comprised of almost the same restoration features and opportunities (+/- 4 features/opportunities). Likewise, eight of the Alternative Plans (Alternatives C, F, G, I, K, L, N, and O) had the exact same make-up i.e., they included all potential restoration features and opportunities. These 11 alternative plans were therefore grouped because, due to their similarity, they did not provide a true alternative choice (they were not appreciably different). For the purpose of continued alternative plan evaluation, these 11 alternatives, and Alternative A described previously, were grouped and represented by Alternative Plan N because its inclusion of all potential restoration features and opportunities was an outcome of its design to meet all four Critical Needs Criteria.

2.6.3 Comparison of Alternative Plans

Summarizing the analysis results detailed above, three appreciably different alternatives (Alternative Plans B, D, and N) arose. A comparison of the restoration features and construction costs estimates for these three alternative plans is provided in **table 2-13**.

Table 2-13. Comparison of Alternative Plan Feature Combinations and Construction Costs.

Potential Near-term Features	Alternative Near-term Plans		
	B	D	N
Mississippi River Gulf Outlet Environmental Environmental Restoration Features		$80,000,000	$80,000,000
Maurepas Swamp Reintroductions --			
Small Diversion at Convent / Blind River	$28,564,000		$28,564,000
Small Diversion at Hope Canal	$33,029,000		$33,029,000
Amite River Diversion (spoil bank gapping)	$2,855,000		$2,855,000
Barataria Basin Barrier Shoreline Restoration -- Caminada Headland, Shell Island		$181,000,000	$181,000,000
Small Bayou Lafourche Reintroduction	$90,000,000		$90,000,000
Medium Diversion with Dedicated Dredging at Myrtle Grove	$146,700,000		$146,700,000
Calcasieu Ship Channel Beneficial Use of Dredged Material		$100,000,000	$100,000,000
Modifcation of Caernarvon Diversion for Marsh Creation	$1,800,000		$1,800,000
Modifcation Davis Pond Diversion for Marsh Creation	$1,800,000		$1,800,000
Terrebonne Marsh Restoration Opportunities --			
Optimize Flows & Atchafalaya River Influence in Penchant Baisn	$9,720,000		$9,720,000
Multi-purpose Operation of the Houma Navigation Canal (HNC) Lock	$0		$0
Convey Atchafalaya River Water to Northern Terrebonne Marshes	$132,200,000		$132,200,000
Terrebonne barrier shoreline restoration -- Isle Derniere, E. Timbalier		$84,850,000	$84,850,000
Maintain Land Bridge between Caillou Lake and Gulf of Mexico.		$41,000,000	$41,000,000
Medium Freshwater Diversion at White's Ditch	$35,200,000		$35,200,000
Stabilize Gulf Shoreline at Point Au Fer Island		$32,000,000	$32,000,000
Lac des Allemands area Reintroductions --			
Small Diversion at Lac des Allemands	$17,330,000		$17,330,000
Small Diversion at Donaldsonville	$16,670,000		$16,670,000
Small Diversion at Pikes Peak	$12,940,000		$12,940,000
Small Diversion at Edgard	$13,100,000		$13,100,000
Total Near-term Plan Construction Cost	**$541,908,000**	**$518,850,000**	**$1,060,758,000**

Alternative Plan B focused on restoration of deltaic processes (Critical Needs Criterion #2), and included 15 restoration near-term features and opportunities, all with combinations of river diversion features (**figure 2-12**). Alternative Plan B exhibits some shortcomings because it does not address critical geomorphic structures. Alternative Plan D focused on restoration of geomorphic structure (Critical Needs Criterion #3), and included 11 restoration features and opportunities including shoreline protection, barrier island restoration, and marsh creation (**figure 2-13**). Alternative Plan D exhibits some shortcomings because it does not address the river reintroductions. The body of knowledge concerning application of coastal restoration strategies in Louisiana suggests that while Alternative Plans B and D would have appreciable environmental benefits, they each exhibit some weaknesses in addressing the complete range of study planning objectives and Critical Needs Criteria.

Conversely, Alternative Plan N encompasses all four Critical Needs Criteria and exhibits potential for long-term sustainability because it contains the geomorphic structures, which serve to protect and buffer the diversion feature influence areas from erosive coastal wave action and storm surge. Additionally, the river diversion features contained in Alternative Plan N are more sustainable than other types of restoration features because they receive continuous sediment and nutrient nourishment from the river. **Figure 2-14** provides a graphical representation of this discussion.

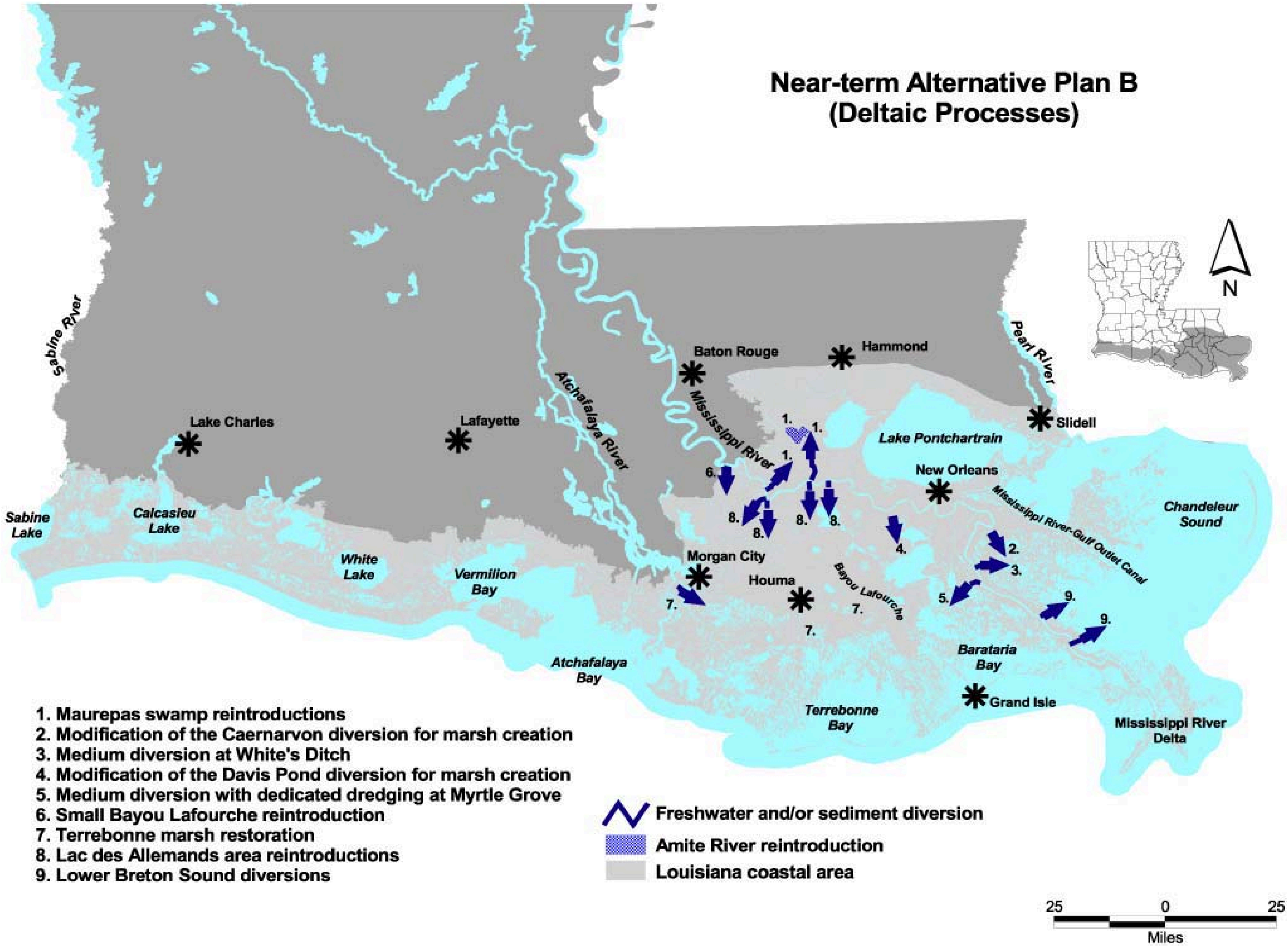

Figure 2-12. Near-Term Alternative Plan B (Deltaic Processes).

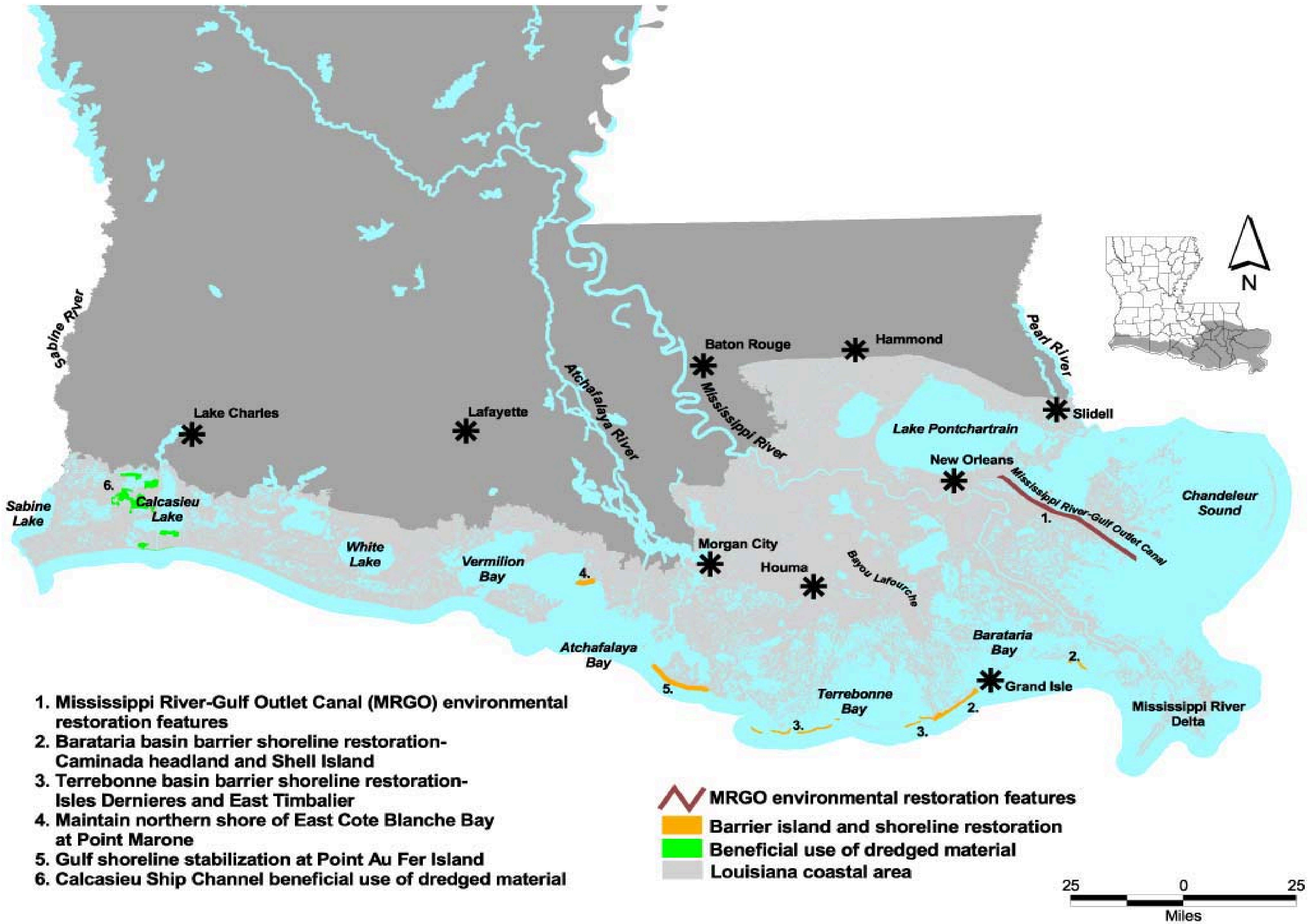

Figure 2-13. Near-Term Alternative Plan D (Geomorphic Structure).

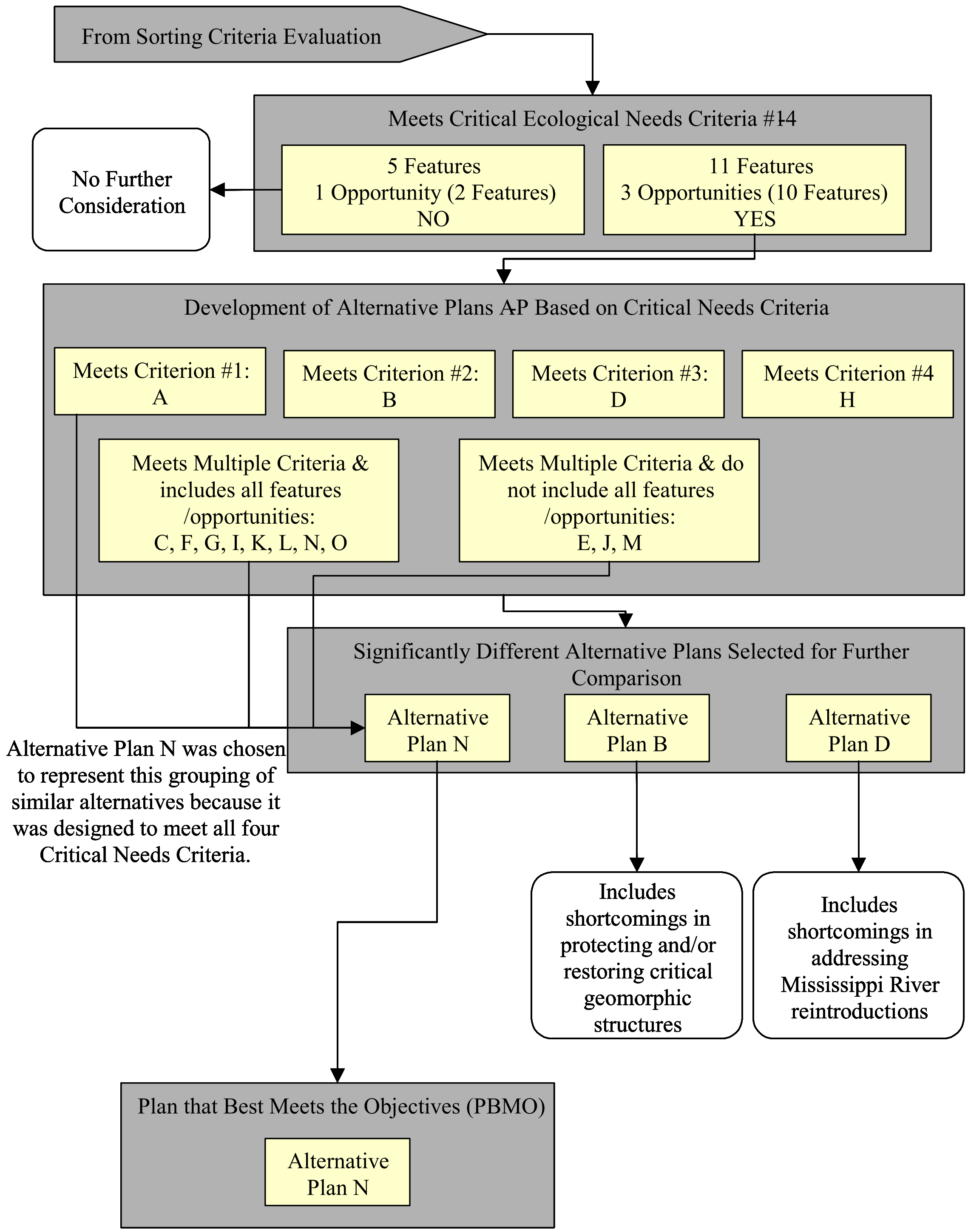

Figure 2-14: Alternative Plan Development and Selection Based on Critical Needs

2.7 PLAN FORMULATION RESULTS

As discussed in section 3.2 PLAN FORMULATION RATIONALE and section 3.3 PLAN FORMULATION, the purpose of the LCA Study was to meet study objectives and thus identify a plan that is effective in addressing the most critical needs within the Louisiana coastal area. The most critical needs are located in those areas of the coast that, without attention, would experience a permanent or severely impaired loss of system stability and function. As such, the development and evaluation of alternative plans focused on identifying combinations of restoration features that best addressed these critical need areas.

The alternative plan that best meets the planning objectives (PBMO) is Alternative Plan N. Of the three alternative plans selected for further comparison, Alternative Plan N best meets the planning objectives and the Critical Needs Criteria.

In addressing the most critical ecologic needs of the Louisiana coast, this plan is also effective in meeting the defined study objectives. As presented previously in this report, the study objectives are as follows:

Hydrogeomorphic Objectives

1. Establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing (tidal action or exchange).
2. Increase sediment input from sources outside estuarine basins, and manage existing sediment resources within estuarine basins, to sustain and rejuvenate existing wetlands and rebuild marsh substrate.
3. Maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function.

Ecosystem Objectives

1. Sustain productive and diverse fish and wildlife habitats.
2. Reduce nutrient delivery to the Continental shelf by routing Mississippi River waters through estuarine basins while minimizing potential adverse effects.

2.7.2 Effectiveness of the Plan in Meeting the Study Objectives

The PBMO addresses the most immediate and critical needs of the ecosystem in attaining the study objectives. The rehabilitation of the coastal ecosystem by promoting the distribution of riverine freshwater, nutrients, and sediment using natural processes and ensuring the structural integrity of the estuarine basins is key to this sustainable solution. A sustainable ecosystem would support Nationally important living resources, provide a sustainable and diverse array of fish and wildlife habitats, reduce nitrogen delivery to offshore gulf waters, and provide infrastructure protection and a sustainable resource base necessary to support NER goals.

The PBMO accomplishes the stated Hydrogeomorphic Objective 1. In the Deltaic Plain, the PBMO identifies reintroductions of freshwater from the Mississippi River in multiple locations from small to moderate scales.

The PBMO also addresses Hydrogeomorphic Objective 2 as the recommended actions for the Deltaic Plain are founded primarily on the introduction of Mississippi River water, nutrients, and suspended sediment. The PBMO identifies one restoration feature and three restoration opportunities (composed of seven features) for the introduction of Mississippi River water and recommendations for the investigation of rehabilitation or modification of two existing diversion structures in the Deltaic Plain. In addition, the PBMO identifies two restoration features capitalizing on the direct introduction of Mississippi River sediment. The PBMO directs attention to many areas where the prevention of wetland loss is critical to maintaining the ability to provide sustainable coastal restoration in the future. In the Chenier Plain, the PBMO focuses on providing continued stability to preserve the viability of future restoration actions.

Major components of the PBMO in the Deltaic Plain are directed at meeting Hydrogeomorphic Objective 3. The conservation and restoration of barrier islands and shorelines are large components of protecting the coastline from storm damage. Restoration features of the PBMO include a critical headland area and a critical land bridge in the deltaic plain. Proposed features and opportunities, located across the entire coast, assure that landscape features are restored and maintained to provide additional potential protection from storm damage.

Ecosystem Objective 1 is addressed by the PBMO, which contributes to the increased introduction of Mississippi River water, nutrients, and suspended sediment, the improved management of Atchafalaya River water, nutrients, and suspended sediment in the Deltaic Plain, and the expansion of beneficial use of dredged material in the Chenier Plain. The features recommended in the Deltaic Plain provide major improvements in connectivity and material exchange.

While the overall quantity of wetland area is projected to increase with the execution of the proposed restoration effort, the cumulative quantities of suitable habitat are projected to decline for some species in localized areas of the coast. However, it was estimated that the overall useable amounts of the various habitat types would remain relatively plentiful throughout the 50-year period analyzed. Based on earlier ecological model analysis, certain saline species are anticipated to experience the most notable change in habitat levels. For most species across the coast, suitable habitat levels are expected to remain at or slightly below current levels. It is expected that many freshwater-associated species should see increases in levels of suitable habitat. These trade-offs are consistent with the reintroduction of deltaic land building processes. Even with the anticipated changes in cumulative habitat suitability, overall diversity is expected to remain relatively high and close to current conditions in keeping with the ecosystem objective.

The effectiveness of the PBMO in achieving Ecosystem Objective 2 has also been taken into account. The Action Plan for Reducing, Mitigating and Controlling Hypoxia in the Northern Gulf of Mexico states that the best current science indicates that efforts to reduce nutrient loadings in the Mississippi River Basin should be aimed at achieving a 30 percent reduction (from the average discharge in the 1980-1996 time frame) in nitrogen discharges to the Gulf (on a 5-year running average) to be consistent with the coastal goal for reducing the aerial extent of hypoxia in the Gulf. Based on an average annual loading of 1.6 million metric tons, a 30 percent reduction would be 480,000 tons annually (CENR 2000). The PBMO would make a small contribution towards meeting this goal. However, the knowledge gained from implementation of the projects in the PBMO and from the large-scale studies could greatly facilitate the implementation of larger reintroduction projects, which could provide greater benefits in terms of reducing Gulf hypoxia.

2.7.2.1 Environmental operating principles/achieving sustainability

Striving to achieve environmental sustainability is a core objective both for the development and for the implementation of an NER plan. Although the result of the LCA Study effort does not identify the final NER plan, the PBMO is focused on producing economic and environmental outcomes that will support and reinforce one another over both the near and long-term. The recognition of the interdependence of biological resources and the physical and human environment has driven the development of many of the guiding principals and tools applied in this study. As a result, the restoration features and opportunities that make up the PBMO produce balance and synergy between human development activities and natural systems.

The restoration features and opportunities in the PBMO that point toward additional investigations are intended to continue to shape activities and decisions currently under the authority of the USACE in order to increase the continued viability of the natural systems within which they occur. The PBMO is also intended to provide a mechanism to continue to assess and address cumulative impacts to the environment, and to achieve consistency by applying a systems approach to the full life cycle of all related water resources activities in the Louisiana coastal area.

2.7.2.2 Components of the Plan that Best Meets the Objectives (PBMO)

The PBMO consists of the components addressed below. These combined components represent the best near-term approach for addressing coastal wetlands loss in Louisiana. The features and opportunities addressed below are viewed as representative of the most likely anticipated action and provide an optimal starting points for the detailed investigations that will lead to project justification and implementation. The projects that are ultimately authorized for construction would be optimized for location, scale, and beneficial output to be documented in a decision document supporting final NEPA compliance prior to implementation.

2.7.2.2.1 *Near-term critical restoration features and opportunities*

The first principal component of the PBMO is the group of features and opportunities identified to meet the critical near-term ecosystem needs of the Louisiana coastal wetlands. The restoration features and opportunities representing solutions to the Critical Needs included in the PBMO are:

- MRGO environmental restoration features
- Maurepas Swamp Reintroductions:

    - Small diversion at Hope Canal
    - Small diversion at Convent/Blind River
    - Increase Amite River Diversion Canal influence by gapping banks
- Barataria Basin barrier shoreline restoration
- Small Bayou Lafourche reintroduction
- Medium diversion with dedicated dredging at Myrtle Grove
- Calcasieu Ship Channel Beneficial Use
- Modification of Caernarvon diversion
- Modification of Davis Pond diversion
- Terrebonne marsh restoration opportunities:
    - Optimize flows and Atchafalaya River influence in Penchant Basin
    - Multi-purpose operation of Houma Navigation Canal (HNC) Lock
    - Convey Atchafalaya River water to Northern Terrebonne marshes via a small diversion in the Avoca Island levee, repairing eroding banks of the GIWW, enlarging constrictions in the GIWW below Gibson and in Houma and Grand Bayou conveyance channel construction/enlargement
- Terrebonne Basin barrier shoreline restoration
- Maintain land bridge between Caillou Lake and Gulf of Mexico
- Medium diversion at White's Ditch
- Gulf shoreline stabilization at Point Au Fer Island
- Lac des Allemands area reintroductions:
    - Small diversion at Lac des Allemands
    - Small diversion at Donaldsonville
    - Small diversion at Pikes Peak
    - Small diversion at Edgard

2.7.2.2.2 Large-scale and long-term concepts requiring detailed study

The second principal component of the PBMO is the identification of large-scale, long-range studies of long-term restoration concepts. These long-range initiatives typically define fundamental changes to the hydrogeomorphic or ecologic structure, function, or management of the Louisiana coast. These concepts, which represent major opportunities for coastal restoration, require detailed study and development to determine the probable impacts (beneficial and adverse) of such features in order to determine if these projects are desirable and can be integrated into the plan for coastal restoration. These concepts also include some levels of uncertainty, which are typically so extensive in scale that resolution through a demonstration project is impractical. As a general rule, large-scale diversions (flow greater than 15,001 cfs [54 cms]) were deemed impractical in the near-term because of their being mutually exclusive with important concepts such as Third Delta. River resource hydrodynamic studies would necessarily evaluate these larger scale diversions in concert. The large-scale and long-term concepts identified in the PBMO include:

- Mississippi River Hydrodynamic Study
- Mississippi River Delta Management Study
- Third Delta Study

- Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study
- Acadiana Bays Estuarine Restoration Feasibility Study
- Upper Atchafalaya Basin Study (This study would include evaluation of alternative operational schemes of Old River Control Structure and will be funded under MR&T)

2.7.2.2.3 *Science and Technology (S&T) Program and potential demonstration projects*

The third principal component of the PBMO is the establishment of a S&T Program to address both near and long-term uncertainties in the implementation and execution of the plan. A portion of this component would include the execution of focused demonstration projects to resolve specific uncertainties and provide insight to the programmatic short and long-range implementation of the PBMO. **Figure 2-15** illustrates the PBMO.

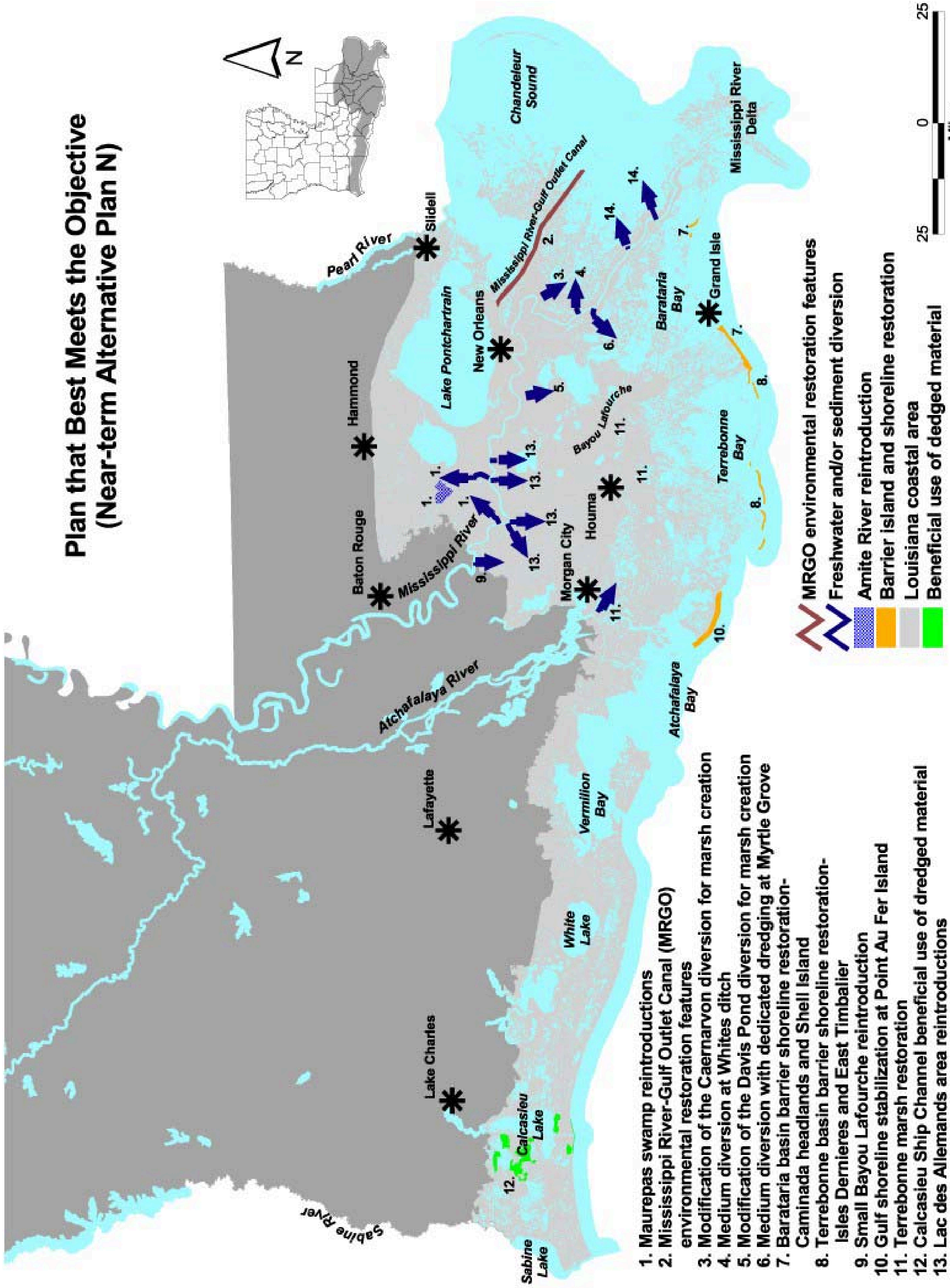

Figure 2-15. Plan That Best Meets the Objectives (PBMO).

2.8 PLAN IMPLEMENTATION

Within plan implementation, there are several key individuals and organizations that are introduced and discussed in detail. For clarity, the following abbreviated terms apply:

- Assistant Secretary of the Army for Civil Works: the Assistant Secretary
- U.S. Army Corps of Engineers, Headquarters: Headquarters
- U.S. Army Corps of Engineers, Mississippi Valley Division: the Division
- U.S. Army Corps of Engineers-Mississippi Valley Division, New Orleans District: the District
- Coastal Louisiana Ecosystem Protection and Restoration Task Force: the Task Force
- State of Louisiana: the state

The State of Louisiana, acting through the LDNR, is the non-Federal cost share sponsor.

2.8.1 Evaluation of PBMO Implementation

Sequencing and scheduling of the alternative plan that bests meets objectives (PBMO) was required to determine an implementation plan. This implementation plan evaluation is based on the ability to meet the near-term (5 to 10 years) and critical needs. While these criteria identified the features that would comprise the most appropriate near-term restoration effort, the sequencing of the PBMO features needed to consider implementation parameters and constraints and identify the most effective means of executing the plan. The features of the PBMO were sequenced based on the highest capability for achieving construction approval first and then scheduled according to resource requirements and capabilities. Representatives of the cost share partners from the District and the LDNR, representing the state, established a set of assumptions and rules to sequence and schedule implementation of all components of the plan. The results of this evaluation are discussed in greater detail in a later part of this section.

2.8.1.2 Assumptions and Rules

There were five major assumptions made in the preparation of the implementation schedule prepared for this report. They are related to project authorizations, large-scale and long-term studies, demonstration projects, and funding and manpower resources. These are described in the following bullets. A set of sequencing rules was also developed to guide development of the implementation schedule. These rules are also described in more detail in the following bullets.

Assumptions

- Near-term critical restoration feature feasibility-level decision documents and feasibility studies could begin in October 2004 based upon existing authority;
- Large-scale and long-term studies could begin in October 2004 based upon existing authority;
- Feasibility-level decision document preparation for demonstration projects could begin in January 2005 based upon successful completion of the Chief's Report in December 2004 and future WRDA authorization;

- The annual cost shared execution capability of the District and non-Federal sponsor would be approximately $200 million per year on average; and
- All components should have construction initiated within the next 10 years.

Sequencing Rules

- Near-term critical restoration features that exhibit high degree of design development and have initiated NEPA compliance documentation (EIS)
- Near-term critical restoration features that if delayed, could result in “Loss of Opportunity” to restore a critical needs area;
- Modifications to existing structures already identified as major opportunities for contribution to LCA objectives; and
- Qualitative valuations that resulted in determining the features resident in the PBMO also allow for a prioritized ordering of the remaining features.

2.8.1.3 Implementation Scheduling Evaluation

Once the implementation sequence for the PBMO components had been determined, the Federal and State cost share partners began development of the 10-year implementation schedule. Based on the assumptions and rules for scheduling of plan components, all PBMO projects could not be implemented simultaneously. In addition, discussions with the non-Federal sponsor led to the conclusion that the total annual project expenditures would be limited to approximately $200 million per year on average (attachment 3 NON-FEDERAL SPONSOR FINANCIAL CAPABILITY). The inclusion of all plan components would force the implementation schedule to either exceed the average available funding limitation, or would result in initial construction of some features in the PBMO being delayed beyond the 10-year planning period.

To facilitate the initial efforts in sequencing the near-term critical features, a number of those features that had been grouped were considered separately to identify if they met the specific sequencing rules. The intent of grouping features was to indicate that those features required common consideration and analysis during the decision document phase. The assumption in considering implementation of grouped features separately is that the initial feature sequenced in any group would need to consider and reconcile the combined effects of the specific group. The ultimate implementation sequence of grouped features is not a dependent function if they have been properly assessed and scaled from the outset.

The critical near-term features of the PBMO were also reviewed in consideration of the 10-year timeframe to identify any additional conflicts or efficiencies in implementing the PBMO not captured by the established assumptions and sequencing rules. This review revealed that the Penchant Basin Restoration feature could be implemented more effectively by allowing the feature to proceed to approval under the CWPPRA program. The sequencing for this feature was identified as being beyond year 5 in the near-term plan. Construction approval and funding through the CWPPRA program could potentially be achieved for this feature in 2 to 3 years. As noted above, it is assumed that consideration of this feature, in conjunction with other hydrologic modification features with which it was grouped, would be performed prior to the implementation of the any of these features.

The review also revealed a consistent potential near-term conflict between the Lac Des Allemands Reintroduction features and the large-scale, long-range Third Delta study. The potential for hydrologic conflicts, or possibly more effective means of achieving the benefits through the larger feature, indicated that these near-term features should not be initiated until after completion of the large-scale study.

Considering this information, it was deemed reasonable to consider these features last in the sequencing. As a result, the Penchant Basin Restoration, and Lac Des Allemands were placed last in the sequencing and resulted in the inability to execute these features within the 10-year near-term timeframe.

Because beneficial use has been added as a program-wide component for this restoration technique, the beneficial use of dredged material from the Calcasieu Ship Channel would be evaluated for implementation as part of the larger beneficial use program. Evaluation of the Calcasieu River project, as part of the overall beneficial use program, would ensure that the most effective and feasible projects would be implemented more quickly.

Utilizing the sequencing rules, and the considerations discussed above the elements of the PBMO were sequenced as shown in **table 2-14**

Table 2-14. Sequenced PBMO Components.

Near-term Critical Restoration Features

- MRGO Environmental Restoration features
- Small Diversion at Hope Canal
- Barataria Basin Barrier Shoreline Restoration
- Small Bayou Lafourche Reintroduction
- Medium Diversion with dedicated dredging at Myrtle Grove
- Multi-purpose operation of Houma Navigation Canal Lock
- Terrebonne Basin Barrier Shoreline Restoration
- Maintain Land Bridge between Caillou Lake and Gulf of Mexico
- Small Diversion at Convent / Blind River
- Increase Amite River Diversion Canal Influence by gapping banks
- Medium Diversion at White's Ditch
- Stabilize Gulf Shoreline at Point Au Fer Island
- Convey Atchafalaya River water to Northern Terrebonne Marshes
- Modification of Caernarvon Diversion
- Modification of Davis Pond Diversion
- Penchant Basin Restoration
- Lac Des Allemands Reintroductions
- Calcasieu River Beneficial Use

The result of the scheduling evaluation effort was the identification of the set of near-term critical features that met sorting and critical need criteria, and could be implemented within the time and funding parameters identified for the near-term effort. This subset of the PBMO, along with other long-term and programmatic elements, was designated as the LCA Plan in the draft report prepared for public review and now represents the major features of the near-term critical restoration effort identified in the LCA Plan. A list of the near-term critical features contained in this subset is shown in **table 2-15**, following the discussion of authorization process considerations.

2.8.1.4 Project Authorization Process Analysis

After identifying the subset of near-term critical features to be included in the LCA Plan the Federal and state cost-share partners evaluated alternative implementation scenarios for all the components of the LCA Plan using two different authorization procedures:

(1) Specific Congressional authorization for all critical features with implementation subject to approval of feasibility-level decision documents by the Secretary of the Army (a process hereinafter referred to as “conditional authorization” elsewhere in the report;

(2) Future Congressional construction authorization for all critical features (i.e., the typical WRDA authorization process used for authorization of water resources projects, in which investigations are performed to complete feasibility reports and, upon completion, submitted for construction authorization under future WRDAs).

These two authorization processes have in common the requirement, which applies to all components of the LCA Plan, for completion and approval of detailed decision and NEPA compliance documents prior to the initiation of construction. In the case of the conditional authorization, the necessary Congressional authorization to proceed would be provided conditional to the approval of the required documents by the Secretary of the Army. For future Congressional construction authorization, approval of all required documents by the Secretary of the Army would be completed prior to submission to Congress, which then would provide final approval and authorization for construction at one time.

In this first scheduling iteration, the comparison of the implementation schedule results indicate that the major difference between the authorization scenarios was in the execution capability within the first five years. Both scenarios indicate execution at an annual capability averaging approximately $200 million beyond year 5.

Another iteration was conducted to investigate the effects of conditional authorization for only the five most highly critical features that met the first sequencing rule. Substantial design development and NEPA compliance efforts have been undertaken for these projects. Based on these considerations, the Federal and state cost share partners determined that these features could be ready for construction approval prior to the next opportunity for authorization. This scheduling iteration identified that conditional authorization for only the top five restoration features, with future Congressional construction authorization for the remaining 10 features, provided the same increased execution capability as the conditional authorization for all 15 restoration features. It became apparent that annual funding limitations, as well as the typical process of seeking construction approval under WRDA authorization, limited the plan’s execution. The implementation scenario supported by conditional authorization for the top five restoration features is optimal for expediting implementation of features that address the most urgent needs of the coastal area. This scenario would facilitate the most effective and efficient implementation leading to the identification of the LCA plan. Without conditional authority, both the approval to proceed, and ability to budget for implementation, would setback the construction and operation of these critical restoration features.

Table 2-15 shows the LCA Plan near-term critical features recommended for conditional authorization and approval with future Congressional authorization.

Table 2-15. Scheduled LCA Plan Components.

Recommended for Conditional Authorization
Near-term Critical Restoration Features • MRGO Environmental Restoration features • Small Diversion at Hope Canal • Barataria Basin Barrier Shoreline Restoration, Caminada Headland, Shell Island • Small Bayou Lafourche reintroduction • Medium diversion with dedicated dredging at Myrtle Grove
Recommended for Approval With Future Congressional Construction Authorization
Other Near-term Critical Restoration Features • Multi-purpose operation of Houma Navigation Canal Lock • Terrebonne Basin Barrier Shoreline Restoration • Maintain land bridge between Caillou Lake and Gulf of Mexico • Small Diversion at Convent / Blind River • Increase Amite River Diversion Canal Influence by gapping banks • Medium diversion at White's Ditch • Stabilize Gulf Shoreline at Point Au Fer Island • Convey Atchafalaya River water to Northern Terrebonne Marshes • Modification of Caernarvon Diversion • Modification of Davis Pond Diversion

2.8.2 Summary of the LCA Plan Components and Implementation Schedule

2.8.2.1 Description of the LCA Plan

As stated in section 3.1 PLANNING CONSTRAINTS, the resolution of S&T uncertainties requires continued science and technology development supported by demonstration projects. In addition, there is coastwide beneficial use of dredged material, as well as potential modifications of existing water resource projects that may offer the opportunities to advance restoration. To better achieve completeness and effectiveness, the PDT incorporated these two additional plan components for programmatic authorization. This resultant multi-component LCA Plan represents the best near-term approach for addressing ecosystem degradation in Louisiana. The LCA program relies on Congressional approval of the LCA Plan as a framework for conditional and future Congressional construction authorization actions. Components of the LCA Plan are:

- Conditional authorization for implementation of five near-term critical restoration features for which construction can begin within 5 to 10 years, subject to approval of feasibility-level decision documents by the Secretary of the Army;
- Programmatic Authorization of a Science and Technology (S&T) Program;
- Programmatic Authorization of Science and Technology Program Demonstration Projects;
- Programmatic Authorization for the Beneficial Use of Dredged Material;
- Programmatic Authorization for Investigations of Modification of Existing Structures;
- Approval of 10 additional near-term critical restoration features and authorization for investigations to prepare necessary feasibility-level reports to be used to present recommendations for potential future Congressional authorizations (hereinafter referred to as “Congressional authorization”); and
- Approval of investigations for assessing six potentially promising large-scale and long-term restoration concepts.

Figure 2-16 and **tables 2-16a** and **2-16b** list the components of the LCA Plan.

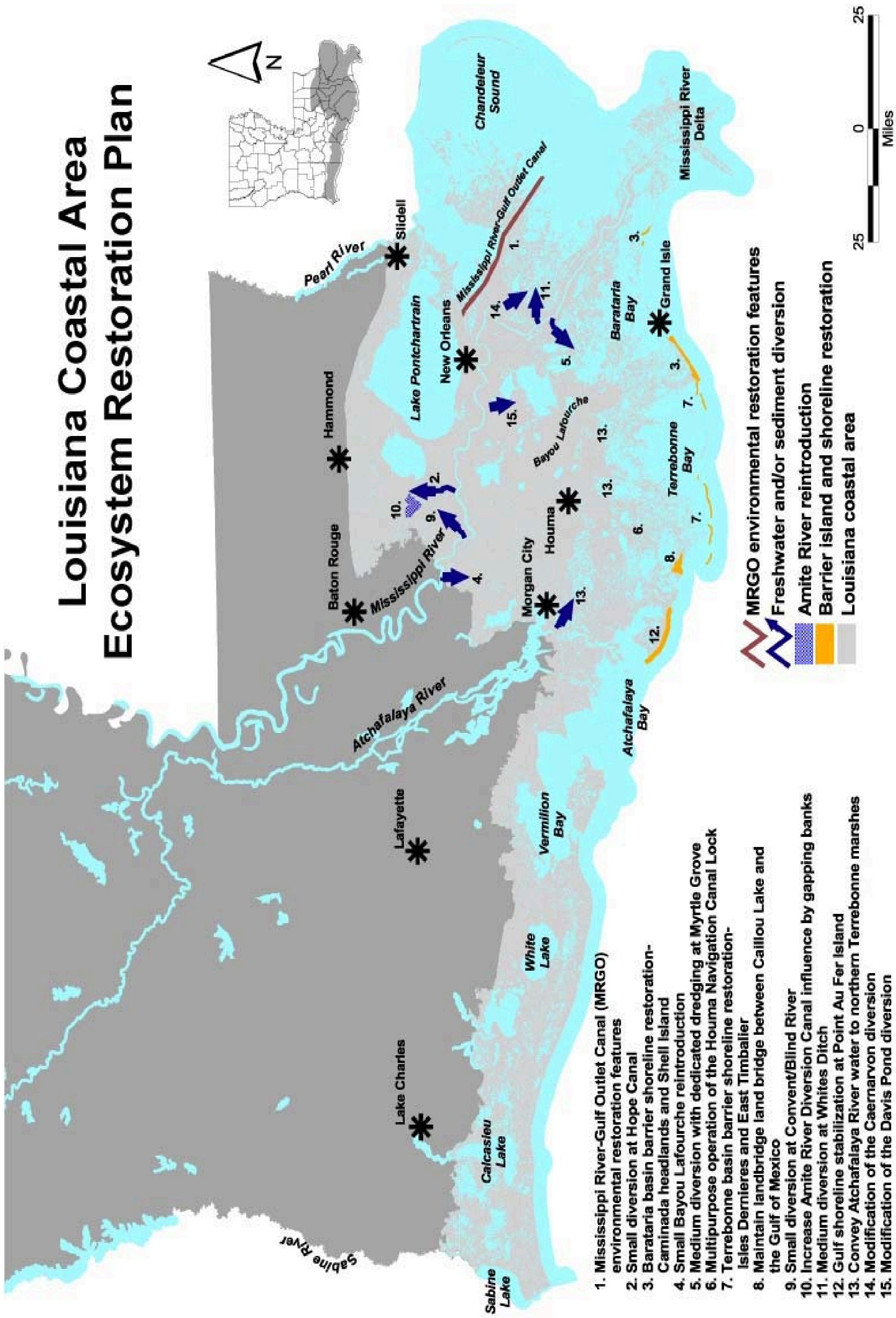

Figure 2-16. Near-Term Critical Restoration Features of the LCA Plan.

Table 2-16a. Components of the LCA Plan.

Recommended for Conditional or Programmatic Authorization
1. Conditional Authorization of Near-term Critical Restoration Features • MRGO Environmental Restoration Features • Small Diversion at Hope Canal • Barataria Basin Barrier Shoreline Restoration • Small Bayou Lafourche Reintroduction • Medium Diversion with Dedicated Dredging at Myrtle Grove 2. Programmatic Authorization of the S&T Program 3. Programmatic Authorization of Demonstration Projects 4. Programmatic Authorization for the Beneficial Use of Dredged Material 5. Programmatic Authorization to Initiate Investigations of Modifications of Existing Water Control Structures

Table 2-16b. Components of the LCA Plan.

Recommended for Approval With Future Congressional Construction Authorization
6. Other Near-term Critical Restoration Features • Multi-purpose operation of Houma Navigation Canal Lock • Terrebonne Basin Barrier Shoreline Restoration • Maintain land bridge between Caillou Lake and Gulf of Mexico • Small Diversion at Convent / Blind River • Increase Amite River Diversion Canal Influence by gapping banks • Medium diversion at White's Ditch • Stabilize Gulf Shoreline at Point Au Fer Island • Convey Atchafalaya River water to Northern Terrebonne Marshes • Modification of Caernarvon Diversion • Modification of Davis Pond Diversion 7. Large-scale and Long-term Concepts Requiring Detailed Study • Mississippi River Hydrodynamic Study • Mississippi River Delta Management Study • Third Delta Study • Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study • Acadiana Bays Estuarine Restoration Study • Upper Atchafalaya Basin Study

2.8.2.2 Sequencing of the LCA Plan

Tables 2-17a-d show the implementation schedule for the LCA Plan, developed with conditional authorization for five critical features, programmatic authorization features, and future Congressional construction authorization for the other 10 near-term critical features.

Table 2-17a. The LCA Plan Implementation Schedule

Project:	101204
Time Now:	10/01/04
Start:	10/01/04
Finish:	09/29/23
Run:	10/15/04

The LCA Plan Implementation Schedule

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Planned / Critical / Milestone △ / Progress

ID	Activity Desc.	Duration	Early Start	Early Finish
A01A	MRGO Environmental Restoration Features (SP1) DD	390d	01/10/05	07/07/06
A01B	MRGO Environmental Restoration Features (SP1) PED	520d	07/10/06	07/04/08
A01C	MRGO Enviro. Rest. Construction	1430d	07/07/08	12/27/13
A01C2	MRGO Enviro. Rest. E&D, S&A	1430d	07/07/08	12/27/13
A01C3	MRGO Enviro. Rest. RE	1430d	07/09/07	12/28/12
A01C4	MRGO Enviro. Rest. Monitoring	1300d	12/30/13	12/21/18
B02A	Small Diversion at Hope Canal (SP1) DD	650d	04/04/05	09/28/07
B02B	Small Diversion at Hope Canal -PED	520d	10/01/07	09/25/09
B02C	Div. at Hope Canal Construction	1300d	09/28/09	09/19/14
B02C2	Div. at Hope Canal E&D, S&A	1300d	09/28/09	09/19/14
B02C3	Div. at Hope Canal RE	1300d	09/29/08	09/20/13
B02C4	Div. at Hope Canal Monitoring	1300d	09/22/14	09/13/19
C03A	Barataria Basin Barrier Shore Rest. -Caminada ,Shell Is. SP2	1415d	05/01/00	09/30/05
C03B	Barat Basin Barrier Shore Rest. Cam., Shell-DD	390d	04/04/05	09/29/06
C03BA	Barat. Basin Barrier Shore Rest. Cam., Shell-PED	520d	10/02/06	09/26/08
C03C	Barat Basin Barrier Shore. Rest. Cam, Shell Is Const	1040d	09/29/08	09/21/12
C03C2	Barat Basin Barrier Shore. Rest. Cam, Shell Is E&D, S&A	1040d	09/29/08	09/21/12
C03C3	Barat Basin Barrier Shore. Rest. Cam, Shell Is RE	1040d	10/01/07	09/23/11
C03C4	Barat Basin Barrier Shore. Rest.Cam,Shell Monitoring	1300d	09/24/12	09/15/17
D06A	Small Bayou LaFourche Reintroduction (SP3)-DD	780d	01/10/05	01/04/08
D06B	Small Bayou LaFouche Reintroduction (SP3)-PED	520d	01/07/08	01/01/10
D06C	Small Bayou La Fourche Reintro Construction	1820d	01/04/10	12/23/16
D06C2	Small Bayou La Fourche Reintro E&D, S&A	1820d	01/04/10	12/23/16
D06C3	Small Bayou La Fourche Reintro RE	1820d	01/05/09	12/25/15
D06C4	Small Bayou LaFouche Reintro Monitoring	1300d	12/26/16	12/17/21
E07A	Medium Diversion w/ Dedicated Dredging at Myrtle Grove- DD	780d	04/04/05	03/28/08
E07B	Medium Diversion W/ Dedicated Dredging at Myrtle Grove-PED	520d	03/31/08	03/26/10
E07C	Medium Diversion at Myrtle Grove Construction	1560d	03/29/10	03/18/16
E07C2	Medium Diversion at Myrtle Grove E&D, S&A	1560d	03/29/10	03/18/16
E07C3	Medium Diversion at Myrtle Grove RE	1560d	03/30/09	03/20/15
E07C4	Medium Diversion at Myrtle Grove Monitoring	1300d	03/21/16	03/12/21
FST01	Science & Tech Program FY05-FY15	2537d	01/10/05	09/30/14

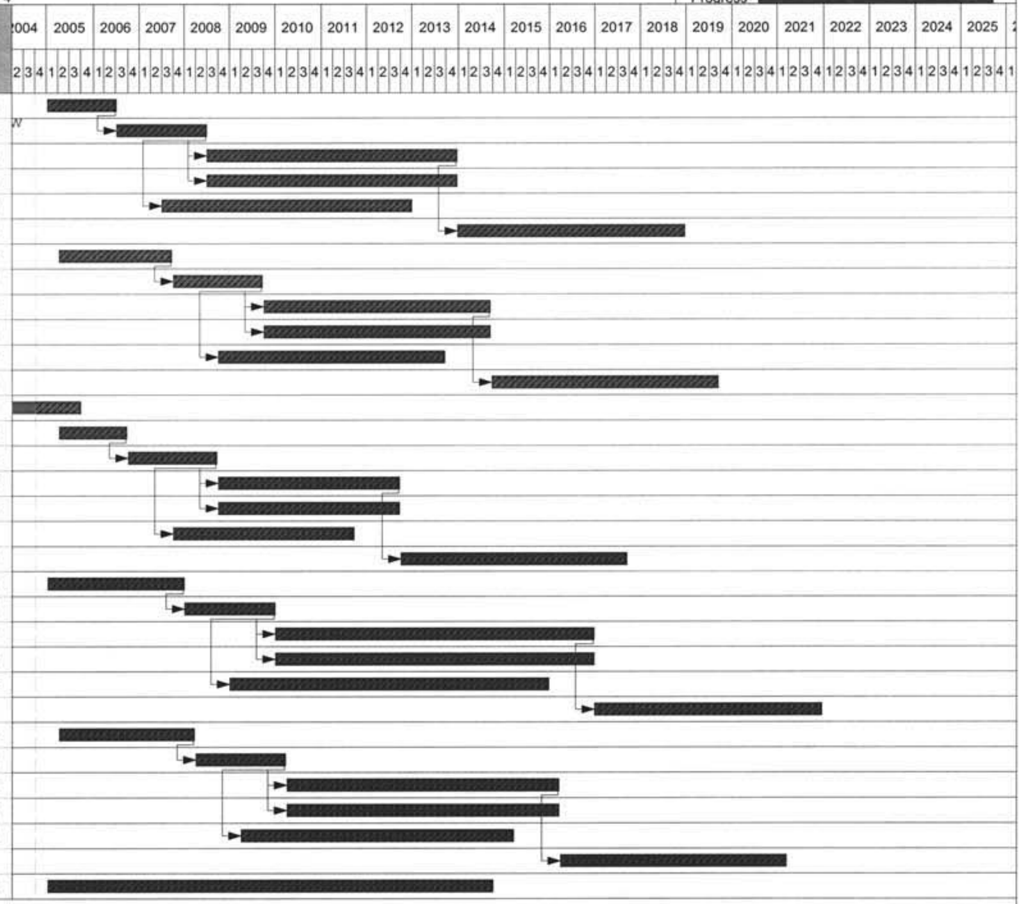

Table 2-17b. The LCA Plan Implementation Schedule

Project: 101204
Time Now: 10/01/04
Start: 10/01/04
Finish: 09/29/23
Run: 10/15/04

The LCA Plan Implementation Schedule

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ID	Activity Desc.	Duration	Early Start	Early Finish
GDEMO5C	Demo Projects-DD	1695d	04/04/05	09/30/11
GDEMO5D	Demo Projects-PED	1565d	10/02/06	09/28/12
GDEMO5E	Demo Projects-RE	1827d	10/01/07	09/30/14
GDEMO5F	Demo Projects-CONSTRUCTION	2350d	09/29/08	09/29/17
GDEMO5G	Demo Projects-MONITORING	3135d	09/27/10	09/30/22
GDEMO5H	Demo Projects-E&D	2350d	09/29/08	09/29/17
GDEMO5I	Demo Projects-S&A	2350d	09/29/08	09/29/17
GDEMO5J	Demo Projects-MONITORING RPT	3138d	09/21/11	09/29/23
HPGMA	Prog. Auth. for Beneficial Use of Dredged Mtrl.-DD	2738d	04/04/05	09/30/15
HPGMB	Prog. Auth. for Beneficial Use Construction	2340d	04/03/07	03/21/16
HPGMB2	Prog. Auth. for Beneficial Use RE	2340d	04/03/06	03/20/15
IMODA	Investigation of Mod to Existing Structures-Other Opportun.	2410d	07/05/05	09/29/14
J08A	Multi-Purpose Ops of Houma Nav. Canal (HNC) Lock-DD	390d	07/06/11	01/01/13
J08B	Multi-Purpose Ops of Houma Nav. Canal (HNC) Lock PED	260d	01/02/13	12/31/13
J08B2	Multi-Purpose Ops of Houma Nav. Canal (HNC) Lock RE	520d	01/02/13	12/30/14
J08B3	Multi-Purpose Ops of Houma Nav Canal Lock E&D S&A	520d	01/01/14	12/29/15
J08B4	Multi-Purpose Ops of Houma Nav. Canal Lock-Monitoring	1300d	12/30/15	12/22/20
K09A	Terr. Basin Barrier Shore. Restoration -DD	520d	10/01/10	09/27/12
K09B	Terr. Basin Barrier Shore. Restoration PED	520d	09/28/12	09/25/14
K09C	Terr. Basin Barrier Shore. Restoration Construction	726d	09/26/14	07/07/17
K09C2	Terr. Basin Barrier Shore. Restoration E&D, S&A	726d	09/26/14	07/07/17
K09C3	Terr. Basin Barrier Shore. Restoration RE	726d	09/27/13	07/08/16
K09C4	Terr. Basin Barrier Shore. Rest. Monitoring	1300d	07/10/17	07/01/22
L10A	Maintain Land Bridge b/t Caillou Lk. and Gulf of Mexico-DD	520d	10/01/09	09/28/11
L10B	Maintain Land Bridge b/t Caillou Lake and Gulf of Mexico-PED	520d	09/29/11	09/25/13
L10C	Maintain Land Bridge b/t Caillou Lake & Gulf Construction	520d	09/26/13	09/23/15
L10C2	Maintain Land Bridge b/t Caillou Lake & Gulf E&D, S&A	520d	09/26/13	09/23/15
L10C3	Maintain Land Bridge b/t Caillou Lake & Gulf RE	520d	09/27/12	09/24/14
L10C4	Maintain Land Bridge b/t Caillou Lk & Gulf Monitoring	1300d	09/24/15	09/16/20
M11A	Small Diversion at Convent / Blind River DD	780d	10/01/07	09/24/10
M11B	Small Diversion at Convent/Blind River PED	520d	09/27/10	09/21/12
M11C	Small Diversion at Convent/Blind River Construction	1300d	09/24/12	09/15/17

Table 2-17c. The LCA Plan Implementation Schedule

Project:	101204
Time Now:	10/01/04
Start:	10/01/04
Finish:	09/29/23
Run:	10/15/04

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ID	Activity Desc.	Duration	Early Start	Early Finish
M11C2	Small Diversion at Convent/Blind River E&D, S&A	1300d	09/24/12	09/15/17
M11C3	Small Diversion at Convent/Blind River RE	1300d	09/26/11	09/16/16
M11C4	Small Diversion at Convent/Blind River Monitoring	1300d	09/18/17	09/09/22
N12A	Increase Amite River Influence by Gapping Bank (SP1)	390d	10/01/07	03/27/09
N12B	Increase Amite River Influence PED	390d	03/30/09	09/24/10
N12C	Increase Amite River Influence Construction	390d	09/27/10	03/23/12
N12C2	Increase Amite River Influence E&D, S&A	390d	09/27/10	03/23/12
N12C3	Increase Amite River Influence RE	390d	09/28/09	03/25/11
N12C4	Increase Amite River Influence Monitoring	1300d	03/26/12	03/17/17
O13A	Medium Diversion at Whites Ditch (SP1)	780d	10/01/08	09/27/11
O13B	Medium Diversion at Whites Ditch PED	520d	09/28/11	09/24/13
O13C	Medium Diversion at Whites Ditch Construction	1300d	09/25/13	09/18/18
O13C2	Medium Diversion at Whites Ditch E&D, S&A	1300d	09/25/13	09/18/18
O13C3	Medium Diversion at Whites Ditch RE	1300d	09/26/12	09/19/17
O13C4	Medium Diversion at Whites Ditch Monitoring	1300d	09/19/18	09/12/23
P14A	Gulf Shore. Stabilization at Pt. Au Fer Island (SP3)	484d	10/01/09	08/09/11
P14B	Gulf Shore. Stabilization at Pt. Au Fer Island-PED	780d	08/10/11	08/05/14
P14C	Gulf Shore. Stabilization at Pt. Au Fer Is. Construction	352d	08/06/14	12/10/15
P14C2	Gulf Shore. Stabilization at Pt. Au Fer Is. E&D, S&A	352d	08/06/14	12/10/15
P14C3	Gulf Shore. Stabilization at Pt. Au Fer Is. RE	352d	08/07/13	12/11/14
P14C4	Gulf Shore. Stabilization at Pt. Au Fer Is. Monitoring	1300d	12/11/15	12/03/20
Q15A	Convey Atch. River to Terrebonne Marsh via Small Div.	630d	10/01/07	02/26/10
Q15B	Convey Atch. River to Terrebonne Marsh-PED	520d	03/01/10	02/24/12
Q15C	Convey Atch. River to Terrebonne Marsh-Construction	1560d	02/27/12	02/16/18
Q15C2	Convey Atch. River to Terrebonne Marsh-E&D S&A	1672d	02/27/12	07/24/18
Q15C3	Convey Atch. River to Terrebonne Marsh-RE	1672d	02/28/11	07/25/17
Q15C4	Convey Atch. River to Terr. Marsh Monitoring	1300d	02/19/18	02/10/23
R04A	Modification to Caernarvon Div (SP1) DD	520d	10/03/05	09/28/07
R04B	Modification to Caernarvon PED	520d	10/01/07	09/25/09
R04C	Modification to Caernarvon Div Construction	1040d	09/28/09	09/20/13
R04C2	Modification to Caernarvon Div E&D, S&A	1040d	09/28/09	09/20/13
R04C3	Modification to Caernarvon Div RE	1040d	09/29/08	09/21/12

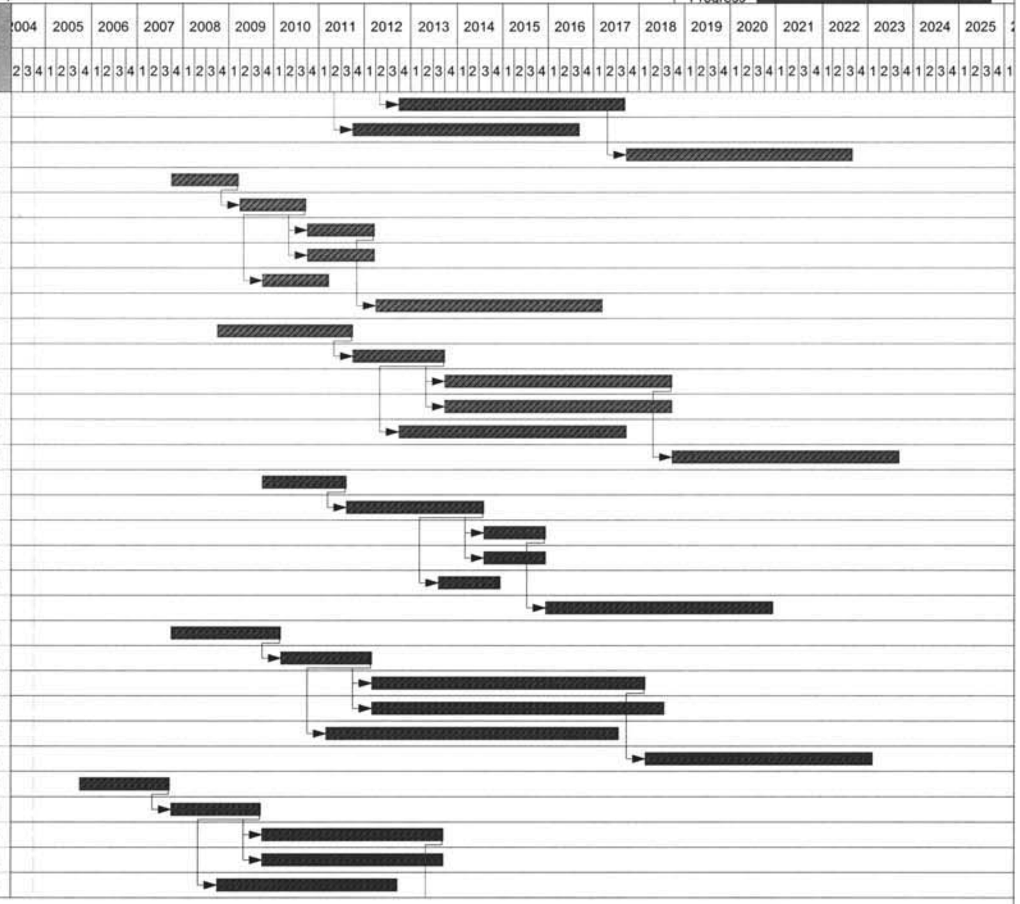

Table 2-17d. The LCA Plan Implementation Schedule

Project:	101204
Time Now:	10/01/04
Start:	10/01/04
Finish:	09/29/23
Run:	10/15/04

The LCA Plan Implementation Schedule

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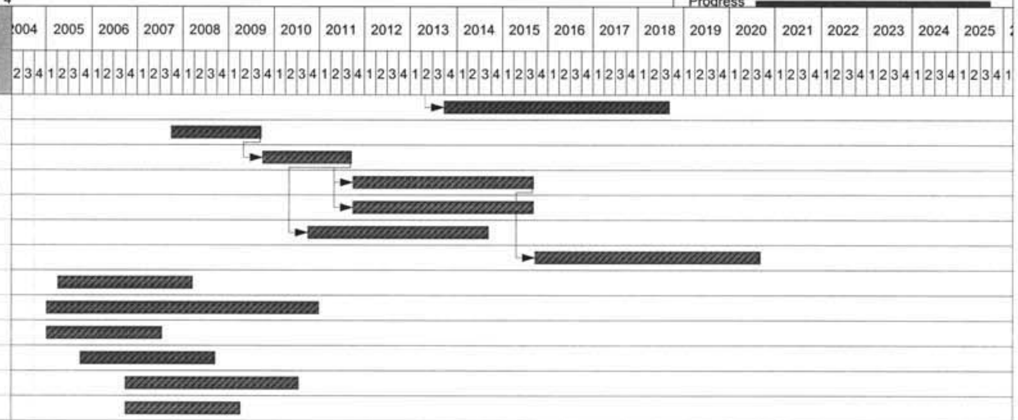
ID	Activity Desc.	Duration	Early Start	Early Finish
R04C4	Modification to Caernarvon Div Monitoring	1300d	09/23/13	09/14/18
S05A	Mod. to Davis Pond Div. for Increased Sed.SP2 DD	520d	10/01/07	09/25/09
S05B	Mod. to Davis Pond Div. for Increase Sed. PED	520d	09/28/09	09/23/11
S05C	Modification to Davis Pond Diversion Construction	1040d	09/26/11	09/18/15
S05C2	Modification to Davis Pond Diversion E&D, S&A	1040d	09/26/11	09/18/15
S05C3	Modification to Davis Pond Diversion RE	1040d	09/27/10	09/19/14
S05C4	Modivication to Davis Pond Div. Monitoring	1300d	09/21/15	09/11/20
TLS1	Mississippi River Hydrodynamic Study	780d	04/04/05	03/28/08
TLS2	Third Delta (SP2 and 3)	1560d	01/10/05	12/31/10
TLS3	Upper Atchafalaya Basin Study w/Mod Old Riv Cont Struct Scm	660d	01/10/05	07/20/07
TLS4	Chenier Plain Freshwater Mgt. and Allocation Reassess. (SP4)	780d	10/03/05	09/26/08
TLS5	Miss. River Delta Mgt. Study (SP1 & 2)	990d	10/02/06	07/16/10
TLS6	Acadiana Bay Estuarine Restoration (SP3)	660d	10/02/06	04/10/09



2.8.3. Near-Term Critical Restoration Features

2.8.3.1 Cost Effectiveness of the Near-term Critical Component of the LCA Plan

Following the identification of the critical near-term features to be implemented in the near-term restoration effort the ecologic models were run in each subprovince. The specific purpose of this modeling effort was to enable the cost effectiveness of the near-term critical features of the LCA Plan to be comparatively assessed relative to the larger frame works from which they had been developed. With the existing cost information and the benefit output for the LCA Plan in each subprovince a comparison of the cost effectiveness of the LCA Plan versus the previously analyzed coast wide frameworks was made. The overlaying of the LCA Plan on the identified cost effective frontier indicates that three coast wide frameworks previously deemed to be cost effective would be eliminated from the frontier. The comparison of the LCA Plan versus these frameworks is provided in **table 2-18**. The effected coastwide frameworks are shaded in the table.

Table 2-18.
LCA Plan versus Final Array of Coast Wide Frameworks Forming the Cost Effective Frontier

Plan	Subprovince Framework Codes	Average Annual Benefits*	Average Annual Costs
0000	No Action	0	$ -
1000	S1R1	219	22,910,914
2000	S1R2	1074	24,350,598
5000	S1M2	1873	32,838,902
7000	S1E1	1945	55,021,432
5010	S1M2, S3R1	1987	70,438,353
7010	S1E1, S3R1	2059	92,620,883
2100	S1R2, S2R1	2185	113,555,259
LCA Plan		**2865**	**55,921,000**
5100	S1M2, S2R1	2984	122,043,563
7100	S1E1, S2R1	3056	144,226,093
5110	S1M2, S2R1, S3R1	3098	159,643,014
10130	S1-3 N3*	3134	179,073,919
7110	S1E1, S2R1, S3R1	3170	181,825,544
7410	S1E1, S2M1, S3R1	3182	207,599,025
7002	S1E1, S2E3, S3M1	3202	542,511,742

**Based on a composite of land building, habitat suitability, and nitrogen removal.*

A comparison of the cost effectiveness of the LCA Plan versus the final array of coast wide frameworks from which the LCA Plan was derived shows that the LCA Plan produces a lesser magnitude of output. However, the efficiency of the LCA Plan is comparable to that of the larger plans in the final array. The comparison of the LCA Plan and the final array of coast wide frameworks is presented in **table 2-19** and **figure 2-17.**

Table 2-19.
LCA Plan and Final Array of Coast Wide Frameworks

Plan	Subprovince Framework Codes	Average Annual Benefits ([1])	Average Annual Costs
LCA Plan		**2865**	**$ 55,921,000**
5610	S1M2, S2M3, S3R1	3094	171,479,754
5110	S1M2, S2R1, S3R1	3098	159,643,014
5410	S1M2, S2M1, S3R1	3110	185,416,495
10130	S1-3 N3*	3134	179,073,919
7610	S1E1, S2M3, S3R1	3166	193,662,284
7410	S1E1, S2M1, S3R1	3182	207,599,025
7002	S1E1, S2E3, S3M1	3202	542,511,742

*Note: Plan developed by modification of plan 5110.
([1]) **Based on a composite of land building, habitat suitability, and nitrogen removal.*

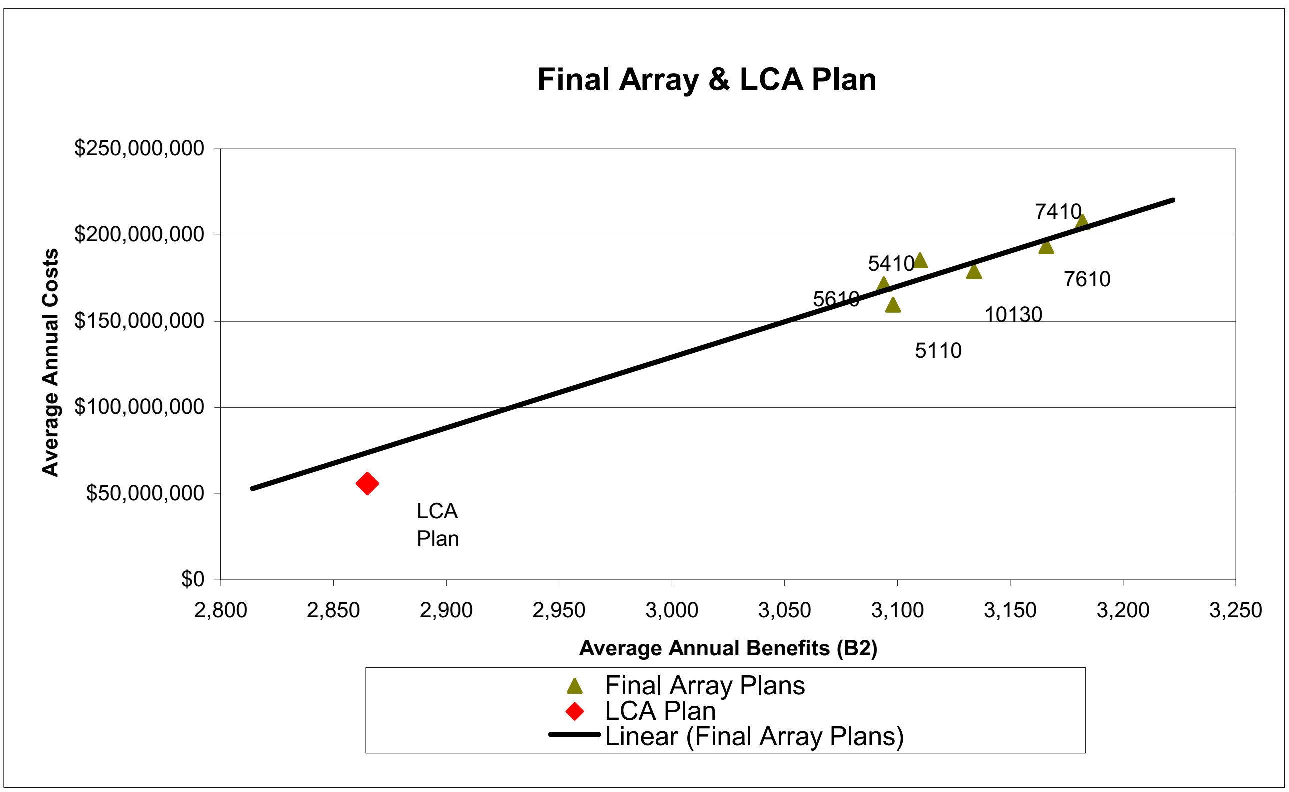


Figure 2-17. Effectiveness of the LCA Plan Relative to the Final Array of Coast Wide Frameworks

The ecologic model output for land building estimates that the plan would offset approximately 62.5 percent of the 462,000 acres projected to be lost within the coast under the no action alternative. The estimated land building for Subprovince 1 exceed projected no action losses. In Subprovinces 2 & 3 the models estimated that the LCA Plan prevented almost 50 percent of the expected losses in each basin. These estimates do not include any projects in Subprovince 4.

A comparison of the habitat suitability projected by the ecologic model for the LCA Plan indicates that increases in overall suitability in habitat for lower and moderate salinity species should generally occur in the Deltaic Plain subprovinces relative to no action. Subprovince 1 is an exception where lower salinity species are estimated to experience a slight decline in habitat with the LCA Plan, which is a reversal in trend as compared to the coast wide framework effects. This reversal is also apparent for moderate salinity species in Subprovince 1 with a negative habitat trend being reflected by the coast wide frameworks. In Subprovince 2, the coast wide frameworks project a slightly higher improvement for lower salinity species than with the LCA Plan. In Subprovince 3, there is no difference in projected trends from the LCA Plan to the coast wide frameworks.

For higher salinity species, the projected trends for all three subprovinces indicate slight to moderate decline in habitat suitability. The comparison of the effect of the LCA Plan versus the coast wide frameworks indicates that the habitat decline would be somewhat reduced for the LCA Plan. The models estimate that the largest effects would occur in these saline habitats. The potential declines of approximately 35 percent in these habitat types are heavily influenced by oyster habitat suitability factors.

The ecologic model also estimates the capability of restoration plans for nitrogen removal from Mississippi River flows. A target for this effectiveness is expressed as a fraction of 30 percent of the annual nitrogen load transported by the river. In relation to the coast wide frameworks, the potential of the LCA Plan to meet this objective is reduced due to the exclusion of larger-scale diversions from the near-term restoration plan.

Although the model results indicate that the LCA Plan would offset roughly 62.5 percent of the projected land loss in the future, significant need still exists to offset the past loss of approximately 1.2 million acres and subsequent reduction in overall ecosystem quality.

2.8.3.2 Conditional authority for implementation of certain near-term critical restoration features

Feasibility-level decision documents would be developed for each of the initial five near-term critical restoration features. These feasibility-level decision documents would document planning; engineering and design; real estate analyses; and supplemental requirements under the NEPA. It is recommended that Congress authorize implementation of the five near-term restoration features described below, subject to review and approval of the feasibility-level decision documents by the Secretary of the Army.

The feature descriptions below explain the justification for the requested conditional authorization for the initial five near-term critical restoration features. All of these features have a basis in cost effectiveness and in their value in addressing critical natural and human ecological needs. These five critical near-term features present a range of effects essential for success in restoring the Louisiana coast. The benefits provided by these features include the sustainable reintroduction of riverine resources, rebuilding of wetlands in areas at high risk for future loss, the preservation and maintenance of critical coastal geomorphic structure, and perhaps most importantly, the preservation of critical areas within the coastal ecosystem, and the opportunity to begin to identify and evaluate potential long-term solutions.

Based on a body of work both preceding and including this study effort, the PDT produced an estimate of average annual costs and benefits for these five features. Benefits were estimated during previous investigations of these features using a community based Habitat Evaluation Procedure (HEP) model developed by the USFWS specifically for the CWPPRA program. This model was entitled the Wetland Value Assessment (WVA) and was geared toward optimal species common parameters over a range of habitats. The model is driven by input based on multi-user professional judgment supported by available habitat data and user observation. The users must specifically prescribe the area and level of expected effect. This model expands upon professional judgment by formalizing a consensus, and standardizing methodology. The model does not mathematically extrapolate biologic response over the defined spatial extent of the project area in the manner of the desktop or a numeric model. In this regard, the WVA has some limitation in projecting beneficial output. While the desktop model is capable of capturing far reaching secondary effects related to altered hydrology or riverine input transported through a larger system, the WVA can be limited by the user defined areas, and estimated levels, of effect.

Composite information based on WVA output for these features shows that average annual environmental output for this conditionally authorized feature package would be on the order of 22,000 habitat units (HU) at an average annualized cost of $2,700 per unit provided. Summaries of the five near-term critical features presented for conditional authorization are presented on the following pages. Detailed descriptions and background information for these five features is provided in attachment 4 to the Main Report.

2.8.3.2.1 *Mississippi River Gulf Outlet (MRGO) environmental restoration features*

The Lake Borgne estuarine complex is deteriorating and recent analysis indicates that the rate of wetland loss in the area is accelerating. Rapid action is required to protect the integrity of the southern Lake Borgne shoreline and to prevent continued erosion of the Mississippi River Gulf Outlet (MRGO) channel banks from ocean going vessel wakes. Additional ecosystem restoration features are required to address serious ecological problems developing in the surrounding parts of the estuary. Without action, critical landscape components that make up the Lake Borgne estuary would be lost and future efforts to restore other parts of the ecosystem would be much more difficult and expensive if not impossible.

Construction and maintenance of the MRGO caused widespread wetland loss and damage to estuarine habitats from the outer barrier islands in the lower Chandeleur chain up to cypress forests and tidal fresh marshes in the western reaches of the Lake Borgne Basin. During construction of the MRGO, dredging and filling destroyed more than 19,000 acres of wetlands, and an important hydrologic boundary was breached when the channel cut through the ridge at Bayou La Loutre.

After the MRGO was completed, significant habitat shifts occurred because the impacted area converted to a higher salinity system with the influx of saltwater through ridges and marsh systems that were severed or destroyed during channel construction. Continued operation of the MRGO results in high rates of shoreline erosion from ship wakes, which destroy wetlands and threatens the integrity of the Lake Borgne shoreline and adjacent communities, infrastructure, and cultural resources. In addition, severe erosion of the MRGO channel continues to facilitate the transition of the upper Pontchartrain Basin estuary toward a more saline system.

Annual erosion rates in excess of 35 feet along the north bank of the MRGO result in the direct loss of approximately 100 acres of shoreline brackish marsh every year and additional losses of interior wetlands and shallow ponds as a result of high tidal ranges and rapid water exchange through the modified watercourse system. These vegetated habitats and shallow waters are important for estuarine biological resources and serve as critical habitat for the threatened Gulf sturgeon.

Erosion and saltwater intrusion are also impacting ridge habitat that is important for mammals, reptiles, and birds. The highest rates of erosion in the area occur along the north bank of the MRGO channel. The southern shoreline of Lake Borgne is eroding at approximately 15 feet per year resulting in the loss of 27 acres (10.9 ha) of wetlands per year. Continuing erosion along the channel and the shoreline of Lake Borgne is threatening to breach the lake/marsh rim, which would result in the coalescence of the two water bodies. A breach would accelerate marsh loss.

This near-term restoration feature involves the construction of shoreline protection measures, such as rock breakwaters, along the north bank of the MRGO and along important segments of the southern shoreline of Lake Borgne, as well as the investigation of various environmental restoration strategies requested in response to public concerns over the proposed plan to stabilize the MRGO navigation channel. The natural ridges along these selected shoreline segments are in danger of breaching in the very near future because of ship wakes along the channel and erosion from wind-driven waves along the lakeshore. Once these ridges are breached, the wetlands protected by these ridges become vulnerable to natural and man-made erosive forces that will quickly work to degrade the wetlands. Strategic placement of similar protective breakwaters has been effectively used along the MRGO in other locations to prevent bankline retreat and to protect large areas of estuarine wetlands from further erosion and degradation. The breakwaters may also facilitate future wetland creation using dedicated dredging and/or beneficial use of dredged material by serving as containment and protection for the restored wetlands. Additional ecosystem restoration features including marsh creation, freshwater introduction, barrier island restoration, and channel modification will be investigated to develop a suite of measures to stabilize and maintain important estuarine components.

The specific features proposed as part of the near-term MRGO environmental restoration plan include:

- Construct 23 miles (37 km) of shoreline protection using rock breakwaters to prevent high rates of erosion that are occurring along the north bank of the MRGO.

- Construct 15 miles (24.2 km) of rock breakwaters to protect critical points along the southern shoreline of Lake Borgne that are in peril of breaching in the near future.

These features would prevent the loss of 6,350 acres (2,572 ha) of marsh over the next 50 years. The estimated cost for designing and constructing critical rock breakwaters along the MRGO and selected sections of the southern Lake Borgne shoreline is $108.27 million (including monitoring). Details of this cost estimate are provided in the **tables 2-21** and **2-22**:

Table 2-20. Summary of Costs for MRGO Environmental Restoration Features (June 2004 Price Level)

Lands and Damages	$	4,214,000
Elements:		
Bank Stabilization	$	80,000,000
Monitoring	$	842,000
First Cost	$	85,056,000
Feasibility-Level Decision Document	$	5,400,000
Preconstruction Engineering and Design (PED)	$	3,600,000
Engineering and Design (E&D)	$	4,614,000
Supervision and Administration (S&A)	$	9,600,000
Total Cost	**$**	**108,270,000**

Table 2-21. MRGO Environmental Restoration Features
FEDERAL AND NON-FEDERAL COST BREAKDOWN
(June 2004 Price Level)

Item	Federal	Non-Federal	Total
Decision Document (50%Fed-50%NFS)	$ 2,700,000	$ 2,700,000	$ 5,400,000
PED (65%Fed-35%NFS)	$ 2,340,000	$ 1,260,000	$ 3,600,000
LERR&D (100% NFS)	$ -	$ 4,214,000	$ 4,214,000
Ecosystem Restoration (65%Fed-35%NFS)	$ 54,739,100	$ 25,260,900	$ 80,000,000
Engineering and Design (E&D) (65%Fed-35%NFS)	$ 2,999,100	$ 1,614,900	$ 4,614,000
Supervision and Administration (S&A) (65%Fed-35%NFS)	$ 6,240,000	$ 3,360,000	$ 9,600,000
Monitoring (65%Fed-35%NFS)	$ 547,300	$ 294,700	$ 842,000
Total Construction	**$ 66,865,500**	**$ 36,004,500**	**$ 102,870,000**
TOTAL COST	**$ 69,565,500**	**$ 38,704,500**	**$ 108,270,000**
Cash Contribution	*$ 69,565,500*	*$ 31,790,500*	

In addition to these specific construction items, details of additional ecosystem restoration features would be developed during a study phase for purposes of estimating costs and benefits and for selecting the best set of projects to attain the ecosystem restoration goals for the area. This study effort would be conducted under the modification of the existing structures portion of the LCA proposed authorization. Under this approach, the MRGO channel is considered a structure for purposes of evaluating potential modifications to improve the environment.

Under this plan, large amounts of estuarine marshes would be protected from further shoreline erosion and other areas would be improved for the long-term benefit of the environment. In addition, other restoration features will be investigated that produce environmental benefits following the sequence established in the Coast 2050 plan to preserve wetlands and maintain the estuarine gradients established by the surrounding marshes. These habitats are significant for commercial and recreational fisheries as well as wildlife, and these areas serve as critical habitat for the threatened Gulf sturgeon.

The most important area of uncertainty associated with the near-term proposal is the future of the MRGO navigation channel as a deep draft-shipping route. A study is currently underway to reevaluate the economic benefits to the Nation of maintaining the channel. The scope of the reevaluation study covers a number of different alternative depth modifications and implementation timeframes for channel authorization changes. The outcome of that study has not been determined and, thus, the future status of the channel is unknown at this time. The possibility exists that some time in the future the status of the channel could be changed through a USACE study recommendation and a Congressional action to deauthorize the shipping canal. However, while some of the ecosystem losses occurring in the area are directly associated with the operation of the navigation channel, the need for shoreline protection on Lake Borgne and the channel will remain regardless of the future status of the channel. The need will remain because the background factors in Louisiana wetland losses will continue and some shallow draft navigation will likely continue to use the area waterways.

2.8.3.2.2 *Small diversion at Hope Canal*

The cypress-tupelo swamps south of Lake Maurepas represent an accumulation of decades of plant production and associated ecological complexity. Much (arguably, relatively more than even most other coastal ecosystems in Louisiana) will be lost if this ecosystem is degraded beyond the ability to restore it. Given the temporal considerations associated with replacing long-lived tree species, preventing the loss of such trees is preferable from both economic and ecological standpoints.

The ongoing degradation of the Maurepas Swamp can be attributed to two types of factors: the first being the relatively constant stress associated with the lack of riverine input and prolonged inundation, and the second being the effects of stochastic events, most notably increased salinities. A qualitative estimate of the ecosystem losses that could be prevented by contingent authorization must consider both types of these factors.

The ongoing, constant deterioration of the Maurepas Swamp results in reduced tree productivity and health, increased tree mortality, decreased soil integrity, and increased relative subsidence. At this same time, stochastic events (particularly salinity increases) have the potential to dramatically increase tree mortality, while further stressing the remaining trees. Delaying project implementation would result in a continuation of the constant ecosystem decline, while also exposing the existing ecosystem to the additional risks associated with increased salinities and other difficult to predict events. Therefore, under any scenario, expediting implementation of the Hope Canal project would prevent a range of potential adverse effects. Again, because the higher end of this range would represent unpredictable events, it would not be possible to accurately predict the full possible extent of such losses.

The potential adverse effects discussed above would include decreased habitat for important avian species (most notably the bald eagle) and could also adversely affect the populations of a variety of indigenous species, such as crawfish, alligator snapping turtles, blue crab, and channel catfish. Additionally, such losses would also contribute to an overall decline in swamp health, as measured by soil integrity, substrate elevation, and vegetative health and resilience.

The effectiveness of the Hope Canal project depends in large part upon enhancing the health and productivity of the existing trees, which would play a major role in restoring soil integrity and counteracting subsidence. As discussed above, delaying action on the Hope Canal project would result in increased tree mortality and decreased health in the remaining trees. It is very difficult to quantify the number of individual trees that would die or become severely stressed, but it is certain that the system as a whole will suffer without action. A delay would, therefore, most likely reduce the effectiveness of this restoration effort and/or require increased restoration inputs to achieve the same level of benefits.

Contingent authorization of the Hope Canal project is an appropriate and necessary way to meet the critical needs discussed above. Specifically, expediting the authorization process for this project has the potential to reduce tree mortality and decline in the overall health of the swamp; minimize exposure to stochastic risks, particularly increased salinities; reduce potential impacts to populations of indigenous fish and wildlife species; and minimize restoration costs and maintain restoration effectiveness.

The specific features proposed as part of the near-term Hope Canal Reintroduction plan include:

- Construct 2 10-foot x 10-foot box culverts in the Mississippi River levee with the invert set at an elevation to assure capability of essentially year-round water diversion.
- Build a receiving pond/settling basin with 100-foot x 100-foot dimensions, reinforced with 20 inches of riprap at the outfall of the culverts to slow velocities and remove heavy sand.
- Excavate a new leveed channel from the existing southern terminus of Hope Canal to the proposed reintroduction structure in the Mississippi River levee.
- Enlarge the cross section of Hope Canal to a width of 50 feet to accommodate the reintroduced river water. This channel would be a total of 27,500 feet long and run from the river to I-10.
- Implement outfall management measures to insure the water gets into the swamp.
- Install navigable constrictions in Hope Canal and gap an abandoned railroad embankment along Hope Canal north of I-10.

The Hope Canal project would restore approximately 36,000 acres (14,580 ha) of swamp. The estimated cost for designing and constructing the Hope Canal Reintroduction feature is $70.513 million (including monitoring). Details of this cost estimate are provided in the **tables 2-22** and **2-23**:

Table 2-22 Summary of Costs for the Small Diversion at Hope Canal (June 2004 Price Level)

Lands and Damages	$	26,383,000
Elements:		
Relocations	$	22,384,000
Channels and Canals	$	4,125,000
Diversion Structures	$	6,520,000
Monitoring	$	594,000
First Cost	$	60,006,000
Feasibility-Level Decision Document	$	3,568,000
Preconstruction Engineering and Design (PED)	$	2,182,000
Engineering and Design (E&D)	$	1,189,000
Supervision and Administration (S&A)	$	3,568,000
Total Cost	**$**	**70,513,000**

Table 2-23. Small Diversion at Hope Canal FEDERAL AND NON-FEDERAL COST BREAKDOWN (June 2004 Price Level)

Item	Federal	Non-Federal	Total
Decision Document (50%Fed-50%NFS)	$ 1,784,000	$ 1,784,000	$ 3,568,000
PED (65%Fed-35%NFS)	$ 2,182,000	$ -	$ 2,182,000
LERR&D (100% NFS)*	$ -	$ 48,767,000	$ 48,767,000
Ecosystem Restoration (65%Fed-35%NFS)	$ 10,645,000	$ (25,336,250)	$ 10,645,000
Engineering and Design (E&D) (65%Fed-35%NFS)	$ 1,189,000	$ -	$ 1,189,000
Supervision and Administration (S&A) (65%Fed-35%NFS)	$ 3,568,000	$ -	$ 3,568,000
Monitoring (65%Fed-35%NFS)	$ 594,000	$ -	$ 594,000
Total Construction	**$ 18,178,000**	**$ 23,430,750**	**$ 66,945,000**
TOTAL COST	**$ 19,962,000**	**$ 25,214,750**	**$ 70,513,000**
Cash Contribution	*$ 47,082,250*	*$ (25,336,250)*	

*For the conditionally authorized feature, Small Diversion at Hope Canal, LERR&D exceeded 35% of the total project cost by $25,336,250, which is reimbursed to the non-federal sponsor.

To preserve swamps in the long-term, conditions must be reestablished that both allow survival of existing cypress and tupelo trees and allow at least periodic reproduction and recruitment of seedlings. In the Maurepas Swamp, non-stagnant water, accretion, and freshening are all needed to achieve these goals. From the perspective of sustainable ecosystem management, it is believed that implementation of a reintroduction project of appropriate size into the Maurepas Swamp is essential for bringing the area back toward environmental sustainability. Implementation of the proposed reintroduction would greatly increase flow through the project area, which would provide constant renewal of oxygen- and nutrient-rich waters to the swamps. (It is important to note that the proposed alternative would be operated such that reintroductions are reduced or stopped when climate and soil conditions are conducive to tree regeneration).

Benefits of the Hope Canal project would include measurable increases in productivity, which would help build swamp substrate and balance subsidence, as well as increases in growth of trees, reduced mortality, and an increase in soil bulk density. As accretion improves, there also is expected to be an increase in recruitment of new cypress and tupelo trees, required for long-term sustainability of the swamp. Anticipated sediment benefits to the swamp include direct contribution to accretion, as well as contribution to biological productivity through the introduction of sediment-associated nutrients, which also contributes to production of substrate. The sediment loading to the target swamps from the Hope Canal reintroduction is conservatively estimated to be >1,000 $g/m^2/yr$, or about twice the estimated quantity needed to keep up with subsidence.

The Hope Canal project has already been the subject of interagency review, numerous planning processes, considerable public review, and a range of environmental and engineering analyses. This review process has helped identify and address a number of potential questions/concerns, such as whether river reintroduction could cause flooding. While more information and evaluation will be needed to fully answer such questions, the information available to date indicates that such issues will either not occur or, if they could occur, are manageable and do not render the project infeasible or too risky. With respect to flooding in particular, the increased channel capacity in Hope Canal should provide greater ability to remove storm water from the existing drainage system, and the operation plan for the reintroduction project would be developed to accommodate such a use.

The Hope Canal project would offer an excellent opportunity to capitalize on existing environmental and engineering information to provide near-term environmental benefits to an area of critical need. Accordingly, it should be included in the contingent authorization category for the LCA Study.

2.8.3.2.3 *Barataria Basin barrier shoreline restoration*

The Louisiana barrier islands and shorelines are almost entirely uninhabited but are an essential ecosystem to the Louisiana coastal area since they include wetland habitats, essential fish habitat, and have high fish and wildlife value. The Louisiana barrier islands also protect interior coastal wetlands, which also have high fish and wildlife value within the Louisiana coast area.

The accelerated loss of Louisiana's coastal wetlands has been ongoing since at least the early 1900s with commensurate deleterious effects on the ecosystem and possible future negative impacts to the economy of the region and the Nation (USACE 2004 – Main Report). Contributing to these deleterious effects is the collapse of the Louisiana barrier islands and gulf coast shorelines. This Louisiana coastal area restoration feature is to restore or re-build the natural ecological function of the two coastal barrier shorelines, known as the Caminada Headland and Shell Island reaches.

The average rate of long-term (greater than 100 years) shoreline change along the Louisiana coast is a retreat of 19.9 ft/yr. The average short-term (less than 30 years) rate of shoreline change is a retreat of 30.9 ft/yr (USACE 2004 – Appendix D.3). Of the 505 miles of Louisiana gulf shoreline, 484 miles (96 percent) are eroding. The Barataria Basin Barrier Shoreline Restoration Project is one of three barrier island projects in the LCA Plan. All three of these barrier island projects are important; however, the Barataria Barrier Shoreline Restoration is considered critical due to the greatly degraded state of this shoreline and its key role in protecting and preserving larger inland wetland areas and bays. If this fragile area is not addressed quickly, restoration would be far more difficult and costly.

The Barataria Basin Barrier Island Restoration feature addresses critical ecological needs and would sustain essential geomorphic features for the protection of Louisiana's coastal wetlands and coastal infrastructure. The project is synergistic with future restoration by maintaining or restoring the integrity of Louisiana's coastline, upon which all future coastal restoration is dependent. The design and operation of the feature would maintain the opportunity for and support the development of large-scale, long-range comprehensive coastal restoration. The feature would also support the opportunity for resolution of scientific and technical uncertainties through incorporation of demonstration features and/or adaptive management.

The specific features proposed as part of the near-term Barataria Basin Barrier Island Restoration plan include:

<u>Caminada Headland</u>

- Dredge and place 9 to 10 million cubic yards of sand from Ship Shoal along 13 miles of shoreline to create a dune approximately 6 feet high and a 1,000-foot wide shoreward berm. Plant the dune with native varieties of bitter panicum and sea oats for stabilization.
- Remove thirteen existing breakwaters that are failing.
- Approximately 2 million cubic yards of sand would be placed about every 10 years to periodically restore the dune and berm.
- Dredge and place about 6 million cubic yards of material to create a marsh area about 5 miles long and up to 1,200 feet wide. The created marsh would be planted with native vegetation, such as smooth cordgrass.
- Nourish existing eroding marsh in the area with a thin layer of dredged material.

Shell Island (west)

- Dredge and place 3.4 million cubic yards of material to create 139 acres of dune and berm and 74 acres of marsh.
- Plant the dune with native varieties of bitter panicum and sea oats for stabilization.
- Plant the marsh with smooth cordgrass, also a native variety.

Shell Island (east)

- Dredge and place 6.6 million cubic yards of material to create 223 acres of dune and berm and 191 acres of marsh. Contain material with geotubes on the gulf side and earthen dike on the bay side.
- Plant the dune with native varieties of bitter panicum and sea oats for stabilization.
- Plant the marsh with smooth cordgrass, also a native variety.

The Caminada Headland component would preserve 640 acres of dune and berm over the next 50 years and 1,780 acres of saline marsh. The Shell Island component would preserve 147 acres of barrier island habitat over the next 50 years. The estimated cost for designing and constructing these barrier shoreline restoration features is $247.204 million (including monitoring). Details of this cost estimate are provided in the **tables 2-24** and **2-25**:

Table 2-24. Summary of Costs for Barataria Basin Barrier Shoreline Restoration (June 2004 Price Level)

Lands and Damages	$	15,558,000
Elements:		
Beach Replenishment	$	181,000,000
Monitoring	$	1,966,000
First Cost	$	198,524,000
Feasibility-Level Decision Document	$	10,200,000
Preconstruction Engineering and Design (PED)	$	6,800,000
Engineering and Design (E&D)	$	9,960,000
Supervision and Administration (S&A)	$	21,720,000
Total Cost	**$**	**247,204,000**

Table 2-25. Barataria Basin Barrier Shoreline Restoration
FEDERAL AND NON-FEDERAL COST BREAKDOWN
(June 2004 Price Level)

Item	Federal	Non-Federal	Total
Decision Document (50%Fed-50%NFS)	$ 5,100,000	$ 5,100,000	$ 10,200,000
PED (65%Fed-35%NFS)	$ 4,420,000	$ 2,380,000	$ 6,800,000
LERR&D (100% NFS)	$ -	$ 15,558,000	$ 15,558,000
Ecosystem Restoration (65%Fed-35%NFS)	$ 127,762,700	$ 53,237,300	$ 181,000,000
Engineering and Design (E&D) (65%Fed-35%NFS)	$ 6,474,000	$ 3,486,000	$ 9,960,000
Supervision and Administration (S&A) (65%Fed-35%NFS)	$ 14,118,000	$ 7,602,000	$ 21,720,000
Monitoring (65%Fed-35%NFS)	$ 1,277,900	$ 688,100	$ 1,966,000
Total Construction	**$ 154,052,600**	**$ 82,951,400**	**$ 237,004,000**
TOTAL COST	**$ 159,152,600**	**$ 88,051,400**	**$ 247,204,000**
Cash Contribution	*$ 159,152,600*	*$ 67,393,400*	

The Caminada Headland component of the Barataria Basin Barrier Shoreline Restoration should be constructed at the earliest possible date and include ecosystem restoration of the dune and berm as well as marsh creation. The overall goal of this feature is to maintain this headland reach, which would sustain significant and unique coastal habitats, help preserve endangered and threatened species, continue to transport sand to Grand Isle, and protect Port Fourchon and the only hurricane evacuation route available to the region.

The Shell Island component of the Barataria Basin Barrier Shoreline Restoration should be constructed at the earliest possible date and include beach restoration by use of containment to rebuild a vital link in the Louisiana barrier shoreline system. The overall goal is to prevent the intrusion of the Gulf of Mexico into the interior bays and marshes, which threatens fisheries and the regional ecology. The project would also help restore natural sand transport along this reach of the coast supporting the adjacent regional shorelines and various shoreline habitats. Numerous infrastructure elements such as highways, levees, ports, and oil and gas facilities located along the rim of the inland bays would incidentally benefit from this ecologic restoration.

The coastal resources at risk for the Barataria Basin Barrier Shoreline Restoration feature and the level of investigation in this area undertaken to date provides a high level of certainty in the appropriateness of the restoration feature and the range of alternative configurations that should be addressed in a final decision document. This project must be undertaken with a strong adaptive management approach due to the uncertainties of coastal processes and response to restoration. Monitoring- based project management would largely offset technical uncertainties. The current status of analyses and NEPA documentation also provides a high degree of confidence that the design and documentation for this restoration feature can be completed for approval and implementation on an expedited schedule.

2.8.3.2.4 *Small Bayou Lafourche reintroduction*

Bayou Lafourche occupies a central location in Louisiana's Deltaic Plain, between Terrebonne and Barataria Bays. This valuable estuarine complex is also Louisiana's most endangered, due in large part to the disruption of natural deltaic processes. Once a major distributary of the Mississippi River, Bayou Lafourche was a critical conduit for freshwater, nutrients, and sediment, which helped build and nourish marshes in the Barataria-Terrebonne estuary complex. Although flows down Bayou Lafourche declined as the river switched its course 800 to 1,000 years ago, the bayou continued to provide important riverine inputs until it was dammed in 1904 to alleviate flooding problems. While a limited amount of river flow (currently around 200 cfs) was subsequently restored to the bayou, there is an opportunity to use this natural distributary to increase freshwater, nutrient, and sediment inputs to coastal areas with critical restoration needs.

Approximately 2,000 years ago, the course of the Mississippi River began to occupy what is now Bayou Lafourche. This channel remained a primary distributary of the Mississippi River until about 800 to 1,000 years ago, when it was gradually replaced by the modern course of the river. While it was active, the Bayou Lafourche distributary built a large natural levee, with elevation ranging from over 20 feet NGVD near Donaldsonville, to approximately 1 foot near the mouth of the bayou.

In 1851 and 1858, discharge in Bayou Lafourche was measured at 6,000 to 11,000 cfs during high river stages. Thus, despite the shift in the river, Bayou Lafourche remained a major conduit by which freshwater, nutrients, and sediment were transported to coastal wetlands. During this time, the bayou was also extensively used for navigation.

Flows continued to decrease during the 19th century and, by 1887, a bar had developed at the head of the bayou, which restricted flow and navigation. This led to annual dredging by the USACE. Additionally, the natural levee along the bayou was not sufficient to protect settled areas from flooding, and plantation owners gradually built up levees along most of the length of the bayou. Despite these levees, flood problems along Bayou Lafourche began to overshadow the usefulness of the channel for navigation. In 1902, Federal approval was given to construct a temporary dam across the head of the bayou. The dam was completed in 1904. The intent was to replace this dam with a lock, to allow for navigation. However, the dam was subsequently replaced by the Mississippi River flood control levee.

In 1906, a new problem arose: salt-water intrusion was recorded at Bush Grove Plantation just south of Lafourche Crossing. Agricultural, industrial, and domestic users recognized that fresh water would be necessary for their communities to continue to thrive. Also, damming the bayou contributed to dramatic salinity increases in the Barataria-Terrebonne estuary system. Anecdotal information gives evidence of the dramatic changes that resulted from the increased salinities. By 1910, for example, oysters were found growing in areas around Leeville, and where orange orchards and rice fields had once flourished, saltwater seeped into the land, killing the oak groves and making the soil unsuitable for farming.

Responding to expanding industrial and residential demands, the Louisiana Legislature created the Bayou Lafourche Freshwater District in the 1950s. In 1955, a pump/siphon system with a capacity to reintroduce approximately 340 cfs was installed on the levee at Donaldsonville. No Federal funds were spent on that project. Because of channel constraints, this existing pump/siphon currently provides approximately 200 cfs of river water into the bayou. Approximately 80 percent of the current volume of water reintroduced to the bayou flows through the system, with approximately 20 percent being used for water supply (of which a relatively small amount is used for irrigation).

Today the bayou supplies fresh water to over 300,000 residents in four parishes: Ascension, Assumption, Lafourche and Terrebonne. In addition to residents and land-based businesses, Bayou Lafourche also provides potable water through Port Fourchon to offshore oil and gas facilities in the Gulf of Mexico. The bayou also provides aesthetic, recreation, drainage and navigation benefits to the numerous communities that have developed along its banks.

From 2000 to 2050, this estuary complex is predicted to lose approximately 231,000 acres of wetlands. This is 50 percent of the predicted loss in the entire state. In addition, approximately 465,000 acres have been lost in this complex over the past 50 years. The continued loss will further weaken an already stressed ecosystem that supports a wide range of resident and migratory animals. The highly diverse and numerous fish and shellfish populations in the complex would dramatically decline as land loss continues. In the future, there would be decreased habitat for neo-tropical migratory birds, furbearers, waterfowl, and threatened species such as the bald eagle.

Proposals to reconnect Bayou Lafourche as a restoration feature date back to at least 1992. At that time, coastal researchers from Louisiana State University's Center for Coastal Energy and Environmental Resources (CCEER; Currently LSU School of the Coast and the Environment) crafted a report that included reconnection of the former distributary as an innovative alternative to help address the land loss crisis in the Louisiana coastal zone. In the November 1993 Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Main Report and Environmental Impact Statement (EIS) submitted to the U.S. Congress by the Task Force, reintroduction of Mississippi River water via Bayou Lafourche was listed as a major strategy for both the Terrebonne and Barataria basins.

The specific features proposed as part of the near-term Bayou Lafourche Reintroduction plan include:

- Upgrading existing pump/siphon facility to operate at the full 340 cfs capacity and constructing a 660 cfs new pump/siphon facility.
- Improving channel capacity to 1,000 cfs by eliminating the existing fixed weir at Thibodeaux, dredging of 6.7 million cubic yards of material over about 55 miles of the channel within its existing banks. If the dredged sediments are clean, they will be

made available for local use and land application or sale. Any contaminated sediment will require special placement.

- Providing bank stability over three miles of the channel. The improved channel and bank stabilization would prevent flooding of bayou-side residents.
- Operating five monitoring stations to provide continuous information on water levels and other bayou conditions.
- Installing two adjustable weirs, one at Thibodeaux and another at Donaldsonville, to control water levels as necessary to eliminate current causes of bank instability, and to facilitate passage of storm runoff.
- Constructing a sediment trap at Donaldsonville to control siltation of the main channel and insure that flows are not impeded. This trap would be cleaned as needed.

As part of the CWPPRA process, the wetland benefits of the Bayou Lafourche project, with regard to providing habitat for a variety of fish and wildlife species, were calculated using Wetland Value Assessment (WVA) methodology. The benefit areas encompass 85,094 acres (nearly 49,000 acres of wetlands and 36,000 acres of water). Wetland benefits were determined primarily in terms of the projected reduction in marsh loss expected to occur as a result of the project. The mechanisms through which the diversion was expected to impact marsh loss in the seven areas were: (1) the reduction of salinity stress due to increased freshwater flows, and (2) the stimulation of organic production in emergent marshes as a result of the introduction of clay sediment and nutrients. Based on the 1998 WVA, it is estimated that at the end of 50 years there would be approximately 2,500 more acres of marsh than if the project had not been built. The WVA also credited this project with increasing submerged aquatic vegetation (SAV) that improves habitat for fish and waterfowl.

The estimated cost for designing and constructing the Bayou Lafourche Reintroduction is $144.116 million (including monitoring). Details of this cost estimate are provided in **tables 2-26** and **2-27**:

Table 2-26. Summary of Costs for
Small Bayou Lafourche Reintroduction
(June 2004 Price Level)

Lands and Damages	$	12,590,000
Elements:		
Relocations	$	14,720,000
Channels and Canals	$	52,156,000
Pumping Plants	$	16,230,000
Bank Stabilization	$	6,894,000
Monitoring	$	1,026,000
First Cost	$	103,616,000
Feasibility-Level Decision Document	$	13,500,000
Preconstruction Engineering and Design (PED)	$	9,000,000
Engineering and Design (E&D)	$	5,040,000
Supervision and Administration (S&A)	$	12,960,000
Total Cost	**$**	**144,116,000**

Table 2-27. Small Bayou Lafourche reintroduction
FEDERAL AND NON-FEDERAL COST BREAKDOWN
(June 2004 Price Level)

Item	Federal	Non-Federal	Total
Decision Document (50%Fed-50%NFS)	$ 6,750,000	$ 6,750,000	$ 13,500,000
PED (65%Fed-35%NFS)	$ 5,850,000	$ 3,150,000	$ 9,000,000
LERR&D (100% NFS)	$ -	$ 27,310,000	$ 27,310,000
Ecosystem Restoration (65%Fed-35%NFS)	$ 66,683,500	$ 8,596,500	$ 75,280,000
Engineering and Design (E&D) (65%Fed-35%NFS)	$ 3,276,000	$ 1,764,000	$ 5,040,000
Supervision and Administration (S&A) (65%Fed-35%NFS)	$ 8,424,000	$ 4,536,000	$ 12,960,000
Monitoring (65%Fed-35%NFS)	$ 666,900	$ 359,100	$ 1,026,000
Total Construction	**$ 84,900,400**	**$ 45,715,600**	**$ 130,616,000**
TOTAL COST	**$ 91,650,400**	**$ 52,465,600**	**$ 144,116,000**
Cash Contribution	*$ 91,650,400*	*$ 18,405,600*	

The wetlands being lost in the Barataria-Terrebonne estuary complex are of vast ecological importance. It has been estimated that nearly one fifth of the Nation's estuarine-dependent fisheries rely on the diverse habitats of Barataria-Terrebonne. Annual commercial fisheries landings have been estimated at more than $220 million, including oysters, shrimp, crabs, and various finfish. The wetlands and other habitats of the Barataria-Terrebonne estuary complex are also important for a wide range of resident and migratory birds. It is estimated that 353 species of birds are known to have occurred in Barataria-Terrebonne, of which 185 species are annual returning migrants. In total, approximately 735 species of birds, finfish, shellfish, reptiles, amphibians, and mammals spend all or part of their life cycle in the estuary.

By increasing the connection of the river to the bayou, the Bayou Lafourche project would nourish marshes, contribute to soil building through mineral sediment accretion and organic matter production, and combat saltwater intrusion during droughts or prolonged southerly winds. The associated increased vegetative health and vertical accumulation of the marsh surface would counterbalance subsidence and reduce future wetland loss in the area.

Although the WVA many attributes of estuaries that fish and wildlife rely upon, there would be unquantifiable benefits over the 49,000 acres of wetlands and 36,000 acres of estuarine waters, especially with a project such as this that is synergistic with other projects. It is possible that the acres preserved are underestimated. There would be benefits to threatened species such as the bald eagle and higher quality Essential Fish Habitat would be preserved. Waterfowl habitat would be improved.

Having undergone years of interagency and public review, the Bayou Lafourche project is well suited for conditional authorization within the LCA Plan. Since being selected by the CWPPRA Task Force in 1996, the Bayou Lafourche project has undergone considerable environmental and engineering review, including hydraulic modeling and environmental benefits assessment. Most recently, engineering and design and the National Environmental Policy Act process have been initiated as part of the ongoing CWPPRA process. The existing information provides greater certainty with respect to costs and environmental outcomes, and will help expedite completion of both the feasibility study and EIS.

2.8.3.2.5 *Medium diversion with dedicated dredging at Myrtle Grove*

Approximately 1,000 years ago, the Plaquemines Delta began to deposit sediment in the Myrtle Grove study area. Shallow water areas were filled with interdistributary and marsh deposits. The Mississippi River has been in its present location for the past 1,000 years, and the study area continued to receive fresh water and sediment from the Mississippi River and its distributaries.

With the development of the Mississippi River levee system over the last century, once frequent introductions of sediment and nutrients were disrupted. These introductions helped the area accrete sediment and detritus, and the marshes kept pace with subsidence. Another major factor was the dredging of oil and gas and navigation canals that allowed salt water to encroach far inland, resulting in a shift from intermediate marshes to slower-growing brackish marshes. The high subsidence rate combined with these factors resulted in a rapid degradation of the marshes in the area.

The project area is currently a sediment-starved system with little freshwater input. These factors have magnified the high subsidence in the area, resulting in massive land loss. To counteract this loss, the project area needs inputs of both sediment and water. The Davis Pond diversion provides freshwater input into the basin to the north, but local marshes are too far removed from the diversion structure to benefit directly from the introduction of nutrients, and the salinity regime would be more controllable with a freshwater input closer to the area of need.

The Medium Diversion with Dedicated Dredging at Myrtle Grove critical near-term feature addresses both the need to preserve long-term restoration opportunities and to bring significant reversal of the wetland loss trend. In preserving long-range restoration opportunities, implementation of this feature also supports several possible outcomes of proposed large-scale studies. The immediate restoration impact of the implementation of the Myrtle Grove feature is significant in addressing predicted future wetland loss in an ecologically critical zone of habitat transition in one of the most productive estuaries in the Nation. In addition, commercial and private development at the perimeter of this basin, located to take advantage of its productivity and to support local, regional, and National economic interests, would receive benefits from the restoration of these wetlands. These benefits would include continued sustainable biologic productivity in the estuary as well as the indirect benefit of reduction of storm-driven tidal stages.

The key components of the proposed feature include:

- A gated diversion structure with a capacity of approximately 5,000 cfs
- Inflow and outflow channels totaling approximately 16,000 feet
- Associated channel guide levees and infrastructure relocation
- Creating at least 6,500 acres of new marsh through dedicated dredging

This project is predicted to create/preserve 6,563 acres over the next 50 years. The estimated cost for designing and constructing the Myrtle Grove Diversion and Dedicated Dredging feature is $293.962 million (including monitoring). Details of this cost estimate are provided in **tables 2-28** and **2-29**:

Table 2-28. Summary of Costs for the Medium Diversion with Dedicated Dredging at Myrtle Grove (June 2004 Price Level)

Lands and Damages	$	78,990,000
Elements:		
Relocations	$	3,780,000
Ecosystem Restoration	$	96,970,000
Channels and Canals	$	24,150,000
Diversion Structures	$	21,800,000
First Cost	$	225,690,000
Feasibility-Level Decision Document	$	22,005,000
Preconstruction Engineering and Design (PED)	$	14,670,000
Engineering and Design (E&D)	$	8,215,000
Supervision and Administration (S&A)	$	21,125,000
Monitoring	$	2,257,000
Total Cost	**$**	**293,962,000**

Table 2-29. Medium Diversion with Dedicated Dredging at Myrtle Grove FEDERAL AND NON-FEDERAL COST BREAKDOWN (June 2004 Price Level)

Item	Federal	Non-Federal	Total
Decision Document (50%Fed-50%NFS)	$ 11,002,500	$ 11,002,500	$ 22,005,000
PED (65%Fed-35%NFS)	$ 9,535,500	$ 5,134,500	$ 14,670,000
LERR&D (100% NFS)	$ -	$ 82,770,000	$ 82,770,000
Ecosystem Restoration (65%Fed-35%NFS)	$ 142,920,000	$ -	$ 142,920,000
Engineering and Design (E&D) (65%Fed-35%NFS)	$ 6,339,750	$ 1,875,250	$ 8,215,000
Supervision and Administration (S&A) (65%Fed-35%NFS)	$ 16,509,750	$ 4,615,250	$ 21,125,000
Monitoring (65%Fed-35%NFS)	$ 1,467,050	$ 789,950	$ 2,257,000
Total Construction	**$ 176,772,050**	**$ 95,184,950**	**$ 271,957,000**
TOTAL COST	**$ 187,774,550**	**$ 106,187,450**	**$ 293,962,000**
Cash Contribution	*$ 187,774,550*	*$ 12,414,950*	

Currently authorized Federal environmental projects (in this specific case, the Davis Pond Freshwater Diversion project) have been designed to sustain and stabilize the present basin wide salinity regime. This outcome falls short of the broader restoration objectives, but existing projects can and will be incorporated or modified in the implementation of this and other future restoration efforts. In this manner, the proposed restoration feature would also support adaptive management and learning goals and provide a platform for additional learning through add-on demonstration projects.

The proposed restoration feature considers a diversion ranging from 2,500 to 15,000 cfs coupled with dedicated dredging for the creation of up to 19,700 acres of new wetlands. This combination would allow for rapid creation of wetland acreage and long-term sustainability. The diversion will allow the reintroduction of freshwater, sediment, and nutrients into the critically effected area of the basin in a manner similar to the rise and fall of the river's hydrologic cycle. The rate of reintroduction would be optimized according to the overall planning objectives of the LCA restoration effort to maintain hydro-geomorphic diversity and connectivity, as well as habitat diversity. The dedicated dredging component of the Myrtle Grove feature would allow immediate recovery of former wetland areas already converted to open water. The combination is also expected to maximize the amount of acreage created per yard of sediment placed by capitalizing on incremental accretion of diverted sediment.

A diversion from the Mississippi River would provide both resources, and would provide a relatively cost-effective way to recreate land in the project area. Nevertheless, the land accretion process is slow, and an introduction of material through dedicated dredging would provide for a marsh platform immediately. To balance the need for wetland acreage in the near-term with the ability to sustain the marshes over the long-term, various combinations of marsh creation through dedicated dredging and freshwater introductions through a river diversion would be examined.

The proposed restoration feature has the potential to prevent significant future land loss where currently predicted to occur in the central portion of the Barataria Basin. Ecologic modeling indicates that, in the next 50 years, all saline and brackish marsh and approximately 40 percent of the intermediate marsh in the Barataria Basin will be lost. This can be attributed to lack of sediment input, and continued soil subsidence. In addition to directly resulting in wetland loss, these factors are compounded by the low success of saline vegetation reestablishing on the highly organic soils established in fresh marshes. These combined factors, along with the projected hydraulic and ecologic trends in, and current make up of the area in the vicinity of Myrtle Grove, indicates that it is at particularly high risk.

The restoration of wetlands in this area would also protect and support socio-economic interests located in the central and upper portions of the Barataria Basin to capitalize on the fisheries productivity of the estuary. The communities of Lafitte and Barataria represent the southernmost development in the interior of the Barataria Basin and are located outside of any existing hurricane protection works. Loss of the existing wetland structure would have an immediate impact on the sustainability of these communities. In addition, industries located along the Mississippi River in the vicinity of Myrtle Grove would also become threatened with the loss of interior wetlands in this area. Currently, there is no Federal hurricane protection levee parallel to the river in this area. The absence of this protection is due, in part, to the historic presence of the wetlands.

The Medium Diversion with Dedicated Dredging at Myrtle Grove restoration feature addresses critical ecological needs in a sensitive area of the most highly productive estuarine systems in the Nation. The components of the feature create a synergy that would result in highly productive and sustainable outputs. The design and operation of the feature would maintain the opportunity for and support the development of large-scale, long-range comprehensive coastal restoration. The feature would also support opportunity for resolution of scientific and technical uncertainties through incorporation of demonstration projects and/or adaptive management.

2.8.3.2 Future Congressional Authorization for implementation of critical restoration features

The near term critical restoration features within the LCA Plan that are not conditionally authorized would be submitted to Congress for consideration of authorization in future WRDAs. Based on an analysis of the current LCA Plan schedule, components would have feasibility-level decision documents or Feasibility Reports completed and ready to submit to Congress through FY 2013, with construction starting no later than FY 2014.

2.8.4 Large-Scale and Long-Term Concepts Requiring Detailed Study

During plan formulation, the PDT identified several candidate large-scale and long-term concepts for potential incorporation into the LCA Plan. These restoration concepts exhibited a greater potential to contribute to achieving restoration objectives in 1) the subprovince within which they would be located, 2) adjacent subprovince(s), and/or 3) substantial portions of Louisiana's coastal ecosystem. Accordingly, the corresponding benefits and costs for these potential plan features should be further analyzed and confirmed to determine how best to incorporate them, if at all, with other plan features. Upon completion of detailed feasibility studies, recommendations for action would be documented in the manner specified for features that would be proposed for Congressional authorization, and would be subject to the standard review and authorization process for USACE water resources projects. Short descriptions of the large-scale, long-term concepts are included below.

2.8.4.1 Acadiana Bays Estuarine Restoration Study

The primary goal of this study is to evaluate the potential for reestablishing historic water quality conditions and viable estuarine fisheries in the Acadiana Bays system while maintaining a growing delta system in Atchafalaya Bay. The Acadiana Bays area of Louisiana consists of those bays in the central part of coastal Louisiana including from east to west, Four League, Atchafalaya, East Cote Blanche, West Cote Blanche, Weeks, and Vermilion Bays (**figure 2-18**).

During the last half of the 20th century, this estuary has experienced a freshening trend and increased turbidity. As a result, submerged aquatic vegetation densities and the viability of estuarine fisheries have declined. Several factors have led to these problems. In 1900, the Atchafalaya Basin received about 5 percent of the total of the Red River and Mississippi Rivers. By the 1950s, the Atchafalaya share had grown to 30 percent and has remained at that distribution with the construction of the Old River Control Structures in the early 1960s. Even though the flow distribution down the Atchafalaya has been stabilized, the basin has experienced significant changes in the twentieth century, resulting in greater efficiency to convey water and sediment to the estuary. Also, at one time, the bay complex reportedly contained the largest concentration of oyster reefs in the United States. The remnant reefs had limited wave action and storm impacts in the Acadiana Bays by providing a physical barrier to exchange; however these were largely destroyed by shell dredging prior to the mid-1980s. Removing this reef complex eliminated natural baffles between the Gulf of Mexico and Atchafalaya Bay, as well as Atchafalaya and West Cote Blanche Bays.

Figure 2-18. The Acadiana Bays, Louisiana.

The State of Louisiana has conducted initial engineering studies for restoration of the Acadiana Bays estuary. The large-scale study would expand on this effort by improving existing hydrodynamic models, using existing and new data to evaluate the salinity and turbidity levels in the Acadiana Bays system and ultimately determining the best course of action for restoration and maintenance of this estuarine system.

Several potential alternatives that have been proposed including construction of a rock jetty or a series of staggered reefs from Pt. Chevreuil to Marsh Island to impede the western flow of fresh water and sediment from Atchafalaya Bay, and shoreline stabilization and/or gap closures on the GIWW and the eastern shoreline of Freshwater Bayou Canal to minimize freshwater flow into the Acadiana Bays system.

The Acadiana Bays Estuarine Restoration Study would ultimately aid in defining the restoration plans of this ecologically important region of coastal Louisiana. This study has an anticipated start date of FY06 and an anticipated finish date of FY09, with an approximate cost of $7,110,000.

2.8.4.2 Upper Atchafalaya Basin Study

The study purpose is to conduct a system-wide comprehensive analysis of the problems and opportunities related to flood control, navigation, and ecosystem sustainability for the lower Red River, Old River, Mississippi River, and Atchafalaya River Basins.

This study relates primarily to the Mississippi River and Tributaries Project and, as such, would be funded under that project. It is discussed in this report because it would link closely with the Mississippi River Hydrodynamic Study (via the modeling to be developed) and because several proposed LCA features would either impact the operation of the ORCS and/or effect changes to the Atchafalaya Basin, the Mississippi River, and the coastal zone. As such, any potential LCA alternatives would have to assess the potential impacts to the existing river systems.

The primary objectives of the study are to:

1. Determine whether improvements are necessary to sustain the MR&T project's ability to pass project flow, maintain an efficient and safe navigation system, and maintain channel and bank stability.
2. Investigate the degradation of the Atchafalaya Basin and its ecosystem and develop solutions to stabilize and restore the system.
3. Investigate the sediment distribution needs and capabilities of the ORCS and determine the optimum distribution that is required to ensure adequate flood control, safe navigation, and ecosystem sustainability.

The secondary objectives of the study are to:

1. Investigate means to improve water quality and circulation in degraded areas of the Atchafalaya Basin that are not covered by the Water Management Units.
2. Investigate the ability of the system to transport sediment and freshwater to the Louisiana coastal area for delta building and marsh restoration purposes.
3. Investigate the potential of the system to further contribute to coastal ecosystem restoration.

This large-scale study would examine modifications to the ORCS operation to alter water circulation in the Atchafalaya Basin back swamps and associated lakes and bayous. Altering water circulation may achieve greater transport of sediment to coastal wetlands and reduced nutrient delivery to the Gulf of Mexico. Other potential benefits include enhanced water quality and aquatic ecosystem health in the upper Atchafalaya Basin Floodway. Adjustments to the operation of the ORCS may include daily and seasonal deviations from the 70/30-flow distribution while maintaining the flow distribution on an annual basis. Channel modifications within the upper basin would also be examined.

Increased sediment availability to coastal wetlands may act synergistically with other efforts to maximize the beneficial influence of these vital river resources through other elements of the near term LCA Plan. This includes the enhancement of Atchafalaya River/GIWW freshwater inflows into the central and eastern Terrebonne Basin, the operation of the Houma Navigation Canal Lock, and other water control features within the proposed Morganza to the Gulf Hurricane Protection Project for restoration purposes. The Atchafalaya River Diversion Study is expected to begin in FY04 and end in FY07.

2.8.4.3 Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study

The purpose of this study is to further develop a comprehensive management plan to restore the Chenier Plain's large-scale system hydrology and maximize the influence of the available sediment and fresh water. More efficient management of the existing limited water and sediment resources would stabilize and restore the wetlands of the region.

This study area is comprised of the Louisiana Chenier Plain, which extends from the western bank of Freshwater Bayou westward to the Louisiana-Texas border in Sabine Lake, and from the marsh areas just north of the Gulf Intracoastal Waterway (GIWW) south to the Gulf of Mexico in Vermilion, Cameron, and Calcasieu parishes. Although this system is linked to the Mississippi River Delta, the processes which governed its creation and subsequent degradation are different from those that affect the Deltaic Plain. The Chenier Plain wetland ecosystem developed primarily as a result of the interplay of three coastal plain rivers (Sabine, Calcasieu, and Mermentau Rivers), the intermittent mudstream from the Mississippi River outlets, and the Gulf of Mexico. During periods of active delta building in the western Mississippi Deltaic Plain, gulf currents transport fine-grained sediment west in a mudstream towards the Chenier Plain and form expansive mudflats. As Mississippi River Delta building switched to the east, this influence is removed and gulf processes rework the mudflats into beach ridges (cheniers). Subsequent westward shifts of the Mississippi River strand these cheniers inland, giving the Chenier Plain its defining characteristic.

Public works projects and other man-made and natural factors have altered the hydrology of the Louisiana Chenier Plain. In some areas, the estuarine character has been completely lost. In others, enhanced marine and tidal influences to sensitive areas have contributed to marsh degradation. Previous study efforts have indicated the technology currently applied to address the problems of the Louisiana Chenier Plain may be ineffective and insufficient to restore this region's landscape. A greater understanding of the availability of freshwater and sediment is necessary to plan appropriate ecosystem actions in the area.

Building on existing and ongoing modeling efforts, this study would help facilitate the development of a comprehensive restoration plan for the Chenier Plain ecosystem. Potential features to be analyzed may also include modification of existing authorized navigation and flood control projects, dedicated or beneficial use of dredged material, shoreline protection, modifications of land-use practices, and restoration of tidal influence to appropriate areas. The study is scheduled to begin in FY04 and conclude in FY07 at an estimated cost of $12 million.

2.8.4.4 Mississippi River Delta Management Study

The purpose of this study is to identify and evaluate features that would greatly increase the deposition of Mississippi River sediment in shallow coastal areas and restore deltaic growth in the Mississippi River Delta Plain. The study area is the Mississippi River Delta below Pointe a la Hache.

Every year, the Mississippi River transports millions of cubic yards of sediment to the delta at the mouth of the river. The District dredges approximately 31 mcy (2.4 million cubic meters) of sediment (sand) in the lower Mississippi. The river also transports a suspended sediment load (mostly silts) to the mouth of about 70 mcy (5.4 million cubic meters). Most of this material, as well as some of the sand load, is transported to deep waters of the Gulf of Mexico. However, little of this material is captured by the surrounding wetlands around the Mississippi River Delta. In addition, excess nutrients are diverted offshore instead of filtering through wetlands for assimilation, which leads to the annual development of a significant hypoxic zone in the northern Gulf of Mexico. The lack of sediment and nutrient input into the surrounding marshes has reduced regional soil building rates to a point where they are insufficient to offset effects of relative sea level change (RSLC), and massive land loss has resulted.

The District completed a Mississippi River Delta Reconnaissance Study in 1990 that indicated significant potential land building could be achieved by implementing diversion and channel projects, but environmental and economic analyses were insufficient to fully evaluate the NER/NED benefits and impacts. Recent investigations with a small-scale physical model have also indicated qualitatively that river diversions as well as alternative arrangements of navigation channels may contribute significantly to the restoration program. Environmental benefits would potentially include increased land building and maintenance and reduced hypoxia in the gulf.

This study would analyze two types of projects—large diversions (greater than 50,000 cfs [1,400 cms]) from the Mississippi River and alternative navigation channel alignments. The large- scale river diversions could potentially maximize the river’s sediment and freshwater resources available for ecosystem maintenance. Diversion sites, capacities, and outfall management measures would also be assessed to help optimize diversion plans. Such massive diversions, however, may cause adverse impacts to the existing navigation channel; so alternative scenarios must be investigated to accommodate navigation needs. Alternate navigation scenarios include new channels to the east or west of the current river while providing navigation either in the new channel or by maintaining the existing navigation channel as a slack-water channel by the construction and operation of a lock system. In addition, the study would evaluate potential impacts of natural and man-made factors on the environment and economy. The study will run from FY06 through FY10 at an estimated cost of $15,350,000.

2.8.4.5 Mississippi River Hydrodynamic Study

Development of a Mississippi River Hydrodynamic Study, which would represent the existing Mississippi and Atchafalaya river systems below ORCS is necessary to properly assess the operation and parameters of the MR& river system with respect to water and sediment transport, flood control and navigation. The proposed study area encompasses the Mississippi and Atchafalaya Rivers from the ORCS to the Gulf of Mexico.

Although significant data has been collected on the amount of sediment, nutrients, and freshwater available in the river system, this information has not been assembled in a comprehensive modeling/study effort that would allow reliable estimates of the quantities of the total resources (water and sediment) that can be allocated for restoration purposes without compromising the river's existing navigation and flood control functions.

This study effort would include data collection, data synthesis, extension of existing modeling, and possibly new models. The comprehensive study would assist in determining the need, location, size, and seasonal variations for planned diversions and future restoration projects. Once a comprehensive model has been developed, calibrated, and verified for existing conditions, it would then be used to simulate a new base condition for the coastal area, one that represents/simulates the collective impacts of the near-term features and any other existing or planned projects that affect the river systems. As the average flow in the Mississippi/ Atchafalaya system is about 640,000 cfs (18,000 cms), the relatively small diversions in the near-term plan are unlikely to have a significant cumulative impact to the river system, but would become the base condition as these projects are implemented. The base condition model would then be used to evaluate the impacts of potential large-scale restoration features on the river system. In addition, the model would be used to evaluate adaptive management and potential adjustments to restoration features. This study is scheduled to begin in FY04 and end in FY07 at an estimated cost of $10,250,000.

2.8.4.6 Third Delta Study

The purpose of the Third Delta Study is to examine large-scale alternatives for the restoration of the lower areas of Terrebonne, Lafourche, and Jefferson parishes in the region of the Barataria-Terrebonne National Estuary. As proposed by Gagliano and van Beek (1999), this restoration concept involves constructing a conveyance channel parallel to Bayou Lafourche that would carry Mississippi River water and sediment to the western Barataria and eastern Terrebonne Basins in order to create two new deltas in this estuarine complex.

The Barataria-Terrebonne estuarine complex is bounded by the Mississippi and Atchafalaya Rivers. Bayou Lafourche separates this complex into two basins, Barataria Basin to the east, and Terrebonne Basin to the west. Bayou Lafourche was the main route of the Mississippi River until about 800 to 1,000 years ago. When the river changed course, Bayou Lafourche and the Lafourche delta gradually entered the final degradation phase of deltas. As such, flow from the Mississippi River down Bayou Lafourche gradually decreased until, by the mid-1800s, the bayou was a minor distributary. Prior to 1904, Bayou Lafourche maintained a hydrologic connection to the Mississippi River. Flows down the bayou were relatively small except during large floods on the Mississippi River, but helped to maintain some areas of the estuary. When the bayou was closed off from the Mississippi River in 1904 to provide flood protection along the bayou, water quality and quantity in the bayou decreased and no longer helped sustain the estuary. In the 1950s a pumping station was constructed at Donaldsonville, to divert up to 340 cfs (10 cms) from the Mississippi River into Bayou Lafourche to help improve water quality and provide water supply along the bayou (although channel conditions limited diversions to about 200 cfs [6 cms]). Conditions in the estuary, however, continued to deteriorate.

Today this area experiences the greatest rates of land loss along the entire Louisiana coast due to the numerous factors associated with coastal loss, including the disconnection of the estuarine system from the Mississippi River, the natural subsidence of the marsh, sea level change, oil & gas exploration, channelization, salinity intrusion, etc. This endangered ecosystem serves as valuable habitat for numerous species of birds, finfish, shellfish, reptiles, amphibians, and mammals that spend all or part of their life cycle in the Barataria-Terrebonne estuary, including several species that are categorized as either threatened or endangered. The vast acreage of marsh that is being eroded also serves to protect critical oil and gas infrastructure as well as the Louisiana Highway 1 corridor connecting Port Fourchon and Grand Isle to the rest of the state and Nation.

Restoration of the lower areas of Barataria-Terrebonne, and especially the eastern Terrebonne marshes on the western side of Bayou Lafourche, has been confounded by the long distances sediment must travel from the Mississippi River. The Third Delta concept proposed by Gagliano and van Beek (1999) involves creating a new delta between the Atchafalaya River and Mississippi River Birdfoot Deltas. The proposed two new deltas would be formed by sediment carried through a constructed conveyance channel. To reduce channel construction cost and increase availability of sediment in the created delta, a pilot channel would be constructed, and natural riverine processes would erode the conveyance channel to its final design width and discharge. The conveyance channel, as proposed, would follow the eastern slope of the natural Bayou Lafourche levee system, and split into two channels near Raceland. The eastern channel would terminate in Little Lake in Barataria Basin, and the western channel would cross Bayou Lafourche and carry sediment to Terrebonne Basin, ending near the Pointe au Chein Wildlife Management Area, north of Lake Felicity and Lake Raccourci (**figure 2-19**).

The State of Louisiana has conducted initial engineering studies of the Third Delta concept and concluded that the concept as proposed by Gagliano and van Beek (1999) could be engineeringly feasible, although serious concerns remain regarding the time scale and spatial extent of land building, the destruction of valuable swamps and marshes within the path of the conveyance channel, and the drastic alterations of the estuarine character of the receiving areas. In developing the feasibility study, the LCA Program would proceed with three additional phases: identifying alternatives to the proposed concept that would attain project goals, analyzing the significant environmental and economic effects of each alternative, and determining the economic feasibility of implementing the best project alternative. Potential alternatives include alternate diversion routes, the use of dedicated dredging, pipeline conveyance of sediment from the Mississippi River, and diverting water from the Atchafalaya River into Terrebonne Basin. As this study progresses, assessment tools developed under the Mississippi River Hydrodynamic Study, previously discussed, would be used to evaluate the water and sediment transport capabilities of the alternative plans evaluated. Restoration of the Western Barataria-Eastern Terrebonne estuarine complex is challenging because of its remote location relative to the Mississippi and Atchafalaya Rivers. Yet, successfully restoring this region is crucial to the long-term sustainability not only of the coastal wetlands, but also to the sustainability of one of the world's most productive fisheries, and to protection of communities and infrastructure that is vital not only to the State of Louisiana, but also the Nation.

The study is currently underway through efforts funded by the State of Louisiana and would conclude in FY10, at an estimated cost of $15,290,000.

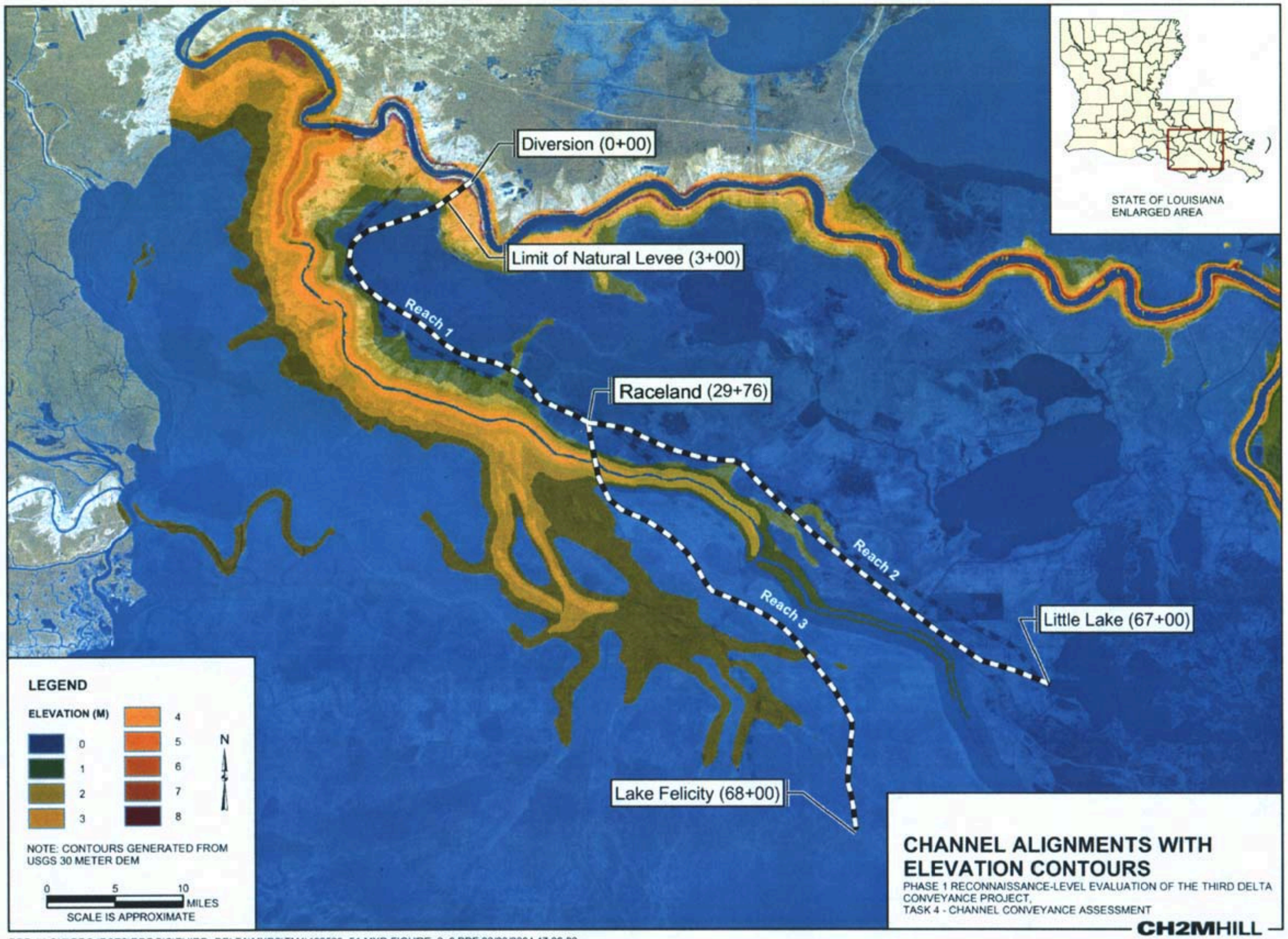


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Figure 2-19. Location of proposed conveyance channel for the Third Delta Study (LDNR, 2004).

2.8.5 Science and Technology (S&T) Program

Section 3.1 PLANNING CONSTRAINTS detailed the key scientific uncertainties and engineering technology challenges in LCA implementation. Appendix A SCIENCE AND TECHNOLOGY PROGRAM details the proposed plan and program to resolve these challenges and facilitate effective implementation. It is proposed that a 10-year Science and Technology S&T (S&T) Program be funded as an authorized item subject to construction cost share percentages (65 percent Federal and 35 percent non-Federal would be applied for construction features and the S&T Program) at a total amount not to exceed $100 million. A major component of the S&T Program would be programmatic authorization for demonstration projects.

The LCA S&T Program would provide a strategy, organizational structure, and process to facilitate integration of science and technology into the decision-making processes of the Program Management and the Program Execution Teams. Implementation of this S&T Program would ensure that the best available science and technology are available for use in the planning, design, construction, and operation of LCA Plan features, as well as other coastal restoration projects and programs, such as CWPPRA. There are five primary elements in the S&T Program (outlined in the S&T Plan) and each element has a different emphasis and requirement. These include: (1) S&T Information Needs, (2) Data Acquisition and Monitoring, (3) Data and Information Management, (4) Modeling and AEAM, and (5) Research. Determining S&T needs requires a continuous process in place that solicits such needs from Program Managers, the PET, and scientists. Data Acquisition and Monitoring require standard operating procedures and rigorous adherence to those standards. Data and Information Management requires standards and procedures to assure data can be shared or compiled from a variety of sources. Modeling and AEAM requires broad interactions among scientists, Program Management, and the PET. Research requires clear hypothesis testing and a substantial degree of scientific independence but close coordination with the PET. A systematic process would be established to provide minimum standards for data quality and data management for information received and used by LCA.

The LCA S&T Program would perform the following:

- Work with LCA Program Management and the LCA PET to review and assess goals, objectives, and key documents of the LCA Program, Identify S&T needs to assist the LCA Plan in meeting those goals and objectives;
- Establish and maintain independent science and technology advisory and review boards;
- Manage and coordinate science projects for (1) data acquisition and monitoring, (2) data management, (3) modeling, and (4) research to meet identified scientific needs of the LCA Plan;
- Coordinate with other research efforts, such as CREST program; the Louisiana Governor's Applied Coastal Research and Development Program, and other state and Federal R&D entities;

- Incorporate lessons learned and experiences (pros and cons) of other large-scale ecosystem restoration science and engineering programs such as the Everglades, Chesapeake Bay, and Calfed;
- Conduct scientific evaluations, assessments and peer reviews to assure that the science implemented, conducted or produced by the S&T Program meets an acceptable standard of quality, credibility, and integrity;
- Establish performance measures for restoration projects and monitor and evaluate the performance of program elements;
- Improve scientific understanding of coastal restoration issues within the context of AEAM, infuse this improved information into planned or future restoration planning, projects and processes conducted by the PET;
- Prepare scientific documents including a periodic Science and Technology Report and conduct technical workshops and conferences; and
- Provide reports on science projects to support the Government Performance and Results Act (GPRA).

Monies allocated for the S&T Program would be used to:

- Establish and staff the S&T Office;
- Develop, implement and maintain a comprehensive data management structure and process;
- Establish, in concert with the CRMS, key monitoring stations to collect critical baseline data for planned projects and long-term monitoring of ecosystem status and trends;
- Identify key S&T uncertainties and focus efforts (e.g. monitoring and assessment, demonstration projects, research) to resolve them; and
- Develop analytical tools (i.e., hydrodynamic, ecological, and socioeconomic models) to help the Program Execution Team more effectively predict potential feature outcomes

Data collection and monitoring and assessment efforts to fully support the implementation of the LCA Plan and the S&T Program would require extensive collaboration between and funding support from Federal and state agencies, NGOs, and universities. Further details regarding the S&T Program can be found in appendix A: SCIENCE AND TECHNOLOGY PROGRAM.

2.8.6 Programmatic Authorization for Demonstration Projects

The purpose of LCA S&T Program demonstration projects is to resolve critical areas of scientific, technical, or engineering uncertainty while providing meaningful restoration benefits whenever possible. After design, construction, monitoring, and assessment of individual demonstration projects, the LCA Program would leverage the lessons learned to improve the planning, design, and implementation of other Louisiana coastal zone restoration projects.

There are numerous types of uncertainties to be addressed to support and improve LCA restoration efforts. Each uncertainty requires a different resolution strategy, based on the effects of the uncertainty on the program, degree of uncertainty, cost of addressing the uncertainty, and importance of reducing the uncertainty. Different strategies for resolving uncertainties may include, focused research projects, focused monitoring of existing projects or natural conditions, or demonstration projects.

Uncertainties may be related to basic understanding of the data availability, science, modeling, and other analytical tools, socio-economic impacts, implementation, technical methodology, resource constraints, cost, or effectiveness of restoration features. Uncertainties may also be related to development and refinement of forecasting tools. An uncertainty is considered critical if its resolution is vital to advancing the planning and implementation of the LCA Plan in the near-term. A role of the S&T Program is to identify and prioritize critical areas of uncertainty, to formulate the most appropriate means of resolving uncertainties, to ensure focused data collection aimed at resolving these areas of uncertainty, and to make recommendations to LCA Program Management regarding program and project refinements in light of the reduced uncertainty.

Critical areas of uncertainty identified by the PET, academics, or agency personnel would be proposed to the S&T Office Director. Proposed areas of uncertainty should be identified in relation to anticipated program activities. However, the S&T Office would not be constrained to targeting only these needs, and would be open to facilitating the pursuit of new technology, experimentation, and innovative ideas when suitable for the advancement of the LCA Program.

Areas of uncertainty would be prioritized based on the relative importance of resolution of the uncertainty to advancing the LCA Program. The S&T Office Director would be responsible for determining the significance of the uncertainties relative to the advancement of the LCA Program in coordination with Program Management and the PET.

Demonstration projects represent one of several strategies that the S&T Office would employ to reduce uncertainties. Demonstration projects may be necessary to address uncertainties not yet known and discovered in the course of individual project implementation or during the course of studies of large-scale and long-term restoration concepts. The Program Manager would review and approve requests from the S&T Director to prepare decision documents of potential demonstration projects. In addition to standard decision document information, the demonstration project decision documents would clearly identify major scientific or technological uncertainties to be resolved and a monitoring and assessment plan to ensure that the demonstration project would provide results that contribute to overall LCA Program effectiveness. Once the completed decision document is approved by the Secretary of the Army, construction could begin.

It is proposed that demonstration projects developed by the S&T Program be funded as a construction item at an amount not to exceed $100 million over 10 years, including a maximum cost of $25 million per project. The PDT developed five initial candidate demonstration projects, but these may be modified or replaced by demonstration projects of higher priority as determined by the S&T Director. In order to support continued development of the LCA Plan through AEAM, it is possible that additional and/or different demonstration projects would be needed.

The S&T Office would be responsible for defining and developing all demonstration projects to answer key ecological or technological uncertainties. A short description of some potential demonstration projects is provided below. The potential projects illustrate the general scope and purpose of the demonstration project's concept, but are not intended to represent the only demonstration projects that would be developed once the S&T Office is established.

2.8.6.1 Demo 1 – Marsh restoration and/or creation using non-native sediment

Uncertainty Addressed: This demonstration project would address the uncertainty involved in selecting sources of material for marsh creation, restoration of maritime forests, and restoration of cheniers. There is uncertainty regarding the efficacy of using saline mineral soils to support these habitats. Uncertainties regarding the time required for soil to leach out salts and increase organic matter content in order to make the soils suitable for the establishment of freshwater and terrestrial vegetation would need to be resolved prior to using this technique on a large scale. Other uncertainties include the cost of restoring cheniers and the potential benefits, such as habitat functionality.

Background: Coastal cheniers are critical habitats for many wildlife populations, especially migratory birds; however, these habitats are disappearing rapidly and are designated as critically imperiled by the Louisiana Natural Heritage Program. These chenier habitats provide upland habitat in very close proximity to marshes, which is instrumental in creating diverse upland/wetland assemblages. In addition to providing critical habitat, natural ridges, such as cheniers and natural distributary ridges, provide additional levels of flood protection. In spite of these potential benefits, coastal restoration programs in Louisiana have relatively little experience with chenier restoration.

Because marsh creation and chenier and maritime forest restoration are hampered by the availability of sediment that contains soil characteristics similar to the native soils (most available sediment is located in salt water offshore), it is important to determine the best methods of amending dredged sediment to create soils capable of sustaining this specialized habitat.

Description: This demonstration project could be located in the southwestern Barataria Basin, just north of Port Fourchon, in the "Chenier Unit" of the partially completed Barataria Basin Marsh Creation Study although the specific location of the project would not be selected until careful examination by the S&T Office in consultation with the Program Execution Team. This demonstration project would use different methods of soil modification and planting regimes to determine the quickest and most cost-effective, reliable means of attaining viable soils. A wide variety of variables selected by the S&T Office would be monitored to determine plant productivity, landform stability, and to evaluate impacts related to the acquisition of borrow material and its effect on the local ecosystem.

Anticipated Outputs: This demonstration project would provide insight into appropriate sources of available substrates, cost effective transport mechanisms, and time requirements for vegetation establishment on coastal cheniers. Documentation of impacts related to the acquisition of borrow materials and its effect on the affected area ecosystems would also be provided. This would enable more effective restoration of these habitat types in other areas of the coast.

2.8.6.2 Demo 2 – Marsh restoration using long-distance conveyance of sediment

Uncertainty Addressed: This demonstration project would address the uncertainty involved in marsh restoration through long distance conveyance of sediment via pipeline. Two major components of the demo will be examined: 1) most cost-effective mechanisms for long distance transport, and 2) most effective disposal of transported material to enhance land bridge and marsh construction. Concerns about the cost effectiveness of using conventional dredging techniques to transport large quantities of sediment long distances from sediment sources must be addressed. Conventional dredging equipment typically requires large pipelines for transport of sediment. However, there are uncertainties about how the material can be effectively transported efficiently over long distances and distributed. Variability in the sections of the restored marsh would facilitate monitoring to determine optimal final grade vs. design grade, dewatering periods, and potential water quality effects of transported materials. Tests may also be conducted to assess a two-tiered approach whereby large pipeline systems are used to convey high volumes of material but smaller dredges could be used to then disperse the material into final locations. Different mechanisms to distribute transported sediment within the marsh environment to minimize marsh damage and establish appropriate elevations for sustainable land bridge formation and marsh development would also be examined.

Background: Although modeling results indicate that very large diversions (e.g., 100,000 cfs [2,800 cms]) would build tremendous amounts of land; these results also indicate that such diversions would greatly alter the receiving basin's ecosystem. Furthermore, certain areas of the coastal zone that have experienced the greatest land loss may ultimately prove to be too far removed from the Mississippi or Atchafalaya Rivers for diversions to be a viable restoration technique. Long-distance sediment delivery via pipeline for marsh restoration is a promising alternative to very large diversions.

Dredged sediment is currently used for marsh creation; however, the scale is relatively small and the marsh creation sites are relatively close to the source of the material. Marsh nourishment is the concept of applying sediment to degrading marsh surfaces either by flowing low sediment concentration slurries over the surface or by direct spray disposal. These techniques have been shown to be effective on very small scales, but application to large areas is unproven and presents several challenges. These challenges include the logistics of moving material over and onto existing deteriorating marsh while minimizing damage, the need and methods to ensure vegetation colonization, and the cost-effectiveness of this restoration technique. Because marsh creation and nourishment have been shown to be successful on small, localized scales, the application of this technique on a larger scale makes it an excellent candidate for a demonstration project.

Description: This demonstration project would be located in the vicinity of a degrading land bridge. The specific location would be identified after the S&T Office is established. Techniques to be demonstrated may include spray disposal of dredged sediment to create marsh platforms in open water areas and application of thin sediment slurries over existing degrading marsh. Sources of material may be from offshore areas or from routine navigation channel maintenance dredging.

Anticipated Outputs: Results from this demonstration project would be used to determine the viability of transporting sediment slurries over long distances via pipeline for marsh restoration. Determination of cost-effectiveness would relate to the future use of these techniques. This project is further justified as a demonstration project because results can inform the appropriate design and cost estimates when these techniques are included as alternatives in large feasibility studies. Lessons learned from this demo project would be applicable to other dredging activities throughout the nation. Additionally, lessons learned from this demonstration project could be applied to improve the performance of beneficial use programs associated with the LCA Study and other efforts throughout the nation.

2.8.6.3 Demo 3 – Canal restoration using different methods

Uncertainty Addressed: This demonstration project would address uncertainties involved in restoration of canals. Canals, cut throughout the coastal marshes to support navigation, and oil and gas exploration needs, have resulted in fragmentation and accelerated erosion of many of the marshes. Considerable uncertainty exists and continues to be debated regarding the most effective approach to restoring existing canals. There are also uncertainties regarding the viability of restoration efforts and the timing of restoration.

Background: Many scientific papers suggest that these canals are one of the primary contributors to the land loss problem in coastal Louisiana. In addition to the direct removal of wetlands caused by their construction including dredged material banks, these canals have caused secondary indirect impacts by altering the natural hydrology of marshes and by accelerating erosion rates along the canal banks. The dredged material banks associated with these canals prevent the introduction of sediment and nutrients and cause artificially prolonged flooding. These effects combine to eliminate soil-building processes necessary to counteract subsidence. Additionally, canals provide avenues for higher salinity water to move into previously freshwater marshes, which ultimately leads to land loss. This demonstration project would address the many uncertainties related to canal restoration. The optimum method for closing these canals remains uncertain, but the intended outcome is known. In order to be sustainable, the linkage between wetlands and new sediment and nutrient sources must be reestablished. Thus, it must be demonstrated that the action taken is capable of attaining the desired ecological response by minimizing further erosion along the canal banks and by reestablishing historic hydrologic conditions.

Description: This demonstration project would be constructed in locations in both Barataria and Terrebonne basins, as these areas have some of the highest concentrations of canals. Different approaches to restoration should be examined and monitored including: 1) backfill with small hydraulic or mechanical dredge; 2) placing gaps in the excavated material disposal banks to restore natural hydrology; and 3) constructing plugs at canal entrances as stand alone features to reduce erosion within the canal. If backfill is used, impacts related to the acquisition of borrow material and its effect on the local ecosystem must also be addressed. The S&T Program may recommend additional restoration approaches to carry out this demonstration project or recommend further demonstration projects that build on or expand upon this demonstration project.

Anticipated Outputs: This demonstration project has implications for restoration throughout the entire coast of Louisiana. Once the most beneficial techniques have been identified and costs have been determined, these actions could be implemented as part of the restoration strategies for every subprovince. Any procedures for successful restoration of unused canals resulting from this demonstration project may be shared with regulatory agencies and departments for future permit actions.

2.8.6.4 Demo 4 – Shoreline erosion prevention using different methods

Uncertainty Addressed: This demonstration project would address uncertainties involved in restoration of eroding shorelines throughout the coastal area. Erosion along open bays and channels has lead to wetland losses across the coast. Different approaches to impede future erosion would be examined and monitored for long-term effectiveness, sustainability, and costs. Project monitoring would include comparative evaluations of settlement occurring within the various erosion protection/foreshore protection features.

Description: This demonstration project would be implemented through construction and monitoring of a variety of erosion protection/foreshore protection features in a variety of foundation conditions. This demonstration project would be constructed along several different reaches of shoreline subject to different wave energy regimes.

Anticipated Outputs: Results from this demonstration project would be used to determine the most efficient means of erosion protection/foreshore protection for different foundation conditions and wave energies. The findings from this demonstration project would be applicable to restoration efforts associated with shoreline erosion control. Once the most beneficial techniques have been identified and costs have been determined, these actions could be implemented as part of restoration strategies for the coastal areas

2.8.6.5 Demo 5 – Barrier island restoration using offshore and riverine sources of sediment

Uncertainty Addressed: This demonstration project would address uncertainties involved in restoration of barrier islands with offshore or riverine sources of sand. Focused research and restoration projects already completed in the LCA have contributed to an understanding about the most effective and sustainable island geometry design. However, several issues remain regarding the potential sources of the large quantities of sediment that would be required to re-establish or restore coastal barrier islands. Two sand sources already identified are Ship Shoal and the Lower Mississippi River. Uncertainties related to Ship Shoal are the quantity of available material and the cost-effectiveness of transporting this source relative to other sources. The sources of sands must be quantified and different transport mechanisms tested to determine a cost-effective approach to establishment. Demonstration project test sections would also vary in the types of sediment (percentage of sand/silt/clay) used for barrier islands and back barrier marsh creation. Monitoring would focus on vegetation growth and island stability.

Background: Barrier islands are critical land features in the Louisiana coastal area acting as the first line of defense from daily wave energies in the Gulf of Mexico and from less frequent hurricanes. The islands have been proved to reduce wave height and energy resulting in storm surge protection for coastal communities, but more importantly, the barrier islands provide protection from everyday wave activity; thereby promoting an environment that is conducive to marsh formation and sustainability. The islands also provide critical habitat to numerous species of wildlife, including specialized habitat required for rookeries of endangered brown pelicans. As barrier islands disappear, so do the invaluable services they provide.

Sediment resources located in the open Gulf of Mexico in shallow water are potentially major sources of high quality sand for barrier island restoration. Dredge equipment used for barrier island restoration is available primarily during the winter months. However, open gulf conditions in the winter months limit the ability of typical dredge operations in shallow conditions.

Costs and logistics of dredge operations on a busy commercial channel (the Mississippi) and the feasibility of pumping sediment long distances through a pipeline are difficult to estimate reliably. Other issues are associated with obtaining sediment, such as from Mississippi River point bars, including the renewability of the resource and the effects of removal from the point bars on river currents and navigation. This issue would be answered in part through the demonstration project directed at investigating the pipeline delivery of sediment. This demonstration project would more closely investigate methods associated with barrier island configuration, sediment placement, and habitat configurations (e.g. percent dune to marsh).

Description: This demonstration project would be constructed along sections of the Terrebonne and Barataria barrier islands.

Cost-effective techniques that would be feasible in difficult weather conditions need to be developed to capture and transport sediment from offshore sand bodies to a barrier island restoration site.

Construction of a sediment trap, potentially in the vicinity of the Head of Passes, may also be considered. This would potentially provide a renewable source of large-grained sediment, which could then be dredged and pumped through a pipeline delivery system to restoration sites. Initial construction of the sediment trap would also provide significant volumes of sand that could be used for restoration purposes. Second, sediment from point bars in the Mississippi River may be mined and pumped through a pipeline for delivery to restoration sites.

Anticipated Outputs: The expected output is to determine a viable source of large quantities of material and based on its source and composition the best method of use. Once uncertainties are resolved, these potential borrow sources would be incorporated more fully into future designs of restoration projects in both the Barataria and Terrebonne barrier shorelines.

2.8.7 Programmatic Authorization for the Beneficial Use of Dredged Material

The District has the largest annual channel O&M program in the USACE, with an annual average of 70 mcy (54 million cubic meters) of material dredged. Currently, approximately 14.5 mcy (11.1 million cubic meters) of this material is used beneficially in the surrounding environment with funding from either the O&M program itself or the Continuing Authorities Program (CAP) defined by the WRDA 1992 Section 204 for beneficial use of dredged material. Within the O&M program, beneficial use may be funded if the cost increment increase for the beneficial use transport and disposal is a minimal percentage increase above the O&M Base Plan for standard transport and disposal. The CAP Section 204 provides another funding source to "carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in conjunction with dredging for construction, operation, or maintenance by the Secretary [of the Army] of an authorized navigation project." Section 204 projects are completed in conjunction with existing O&M contracts and pay for the incremental cost above the Base Plan for the beneficial use alternative. The Base Plan is defined as "Disposal of dredged material … in the least costly manner consistent with sound engineering practice and meeting all Federal environmental requirements." Combined, the existing O&M program and the CAP Section 204 (with $15 million in annual funding spread throughout USACE) do not provide the resources for the District to take full advantage of the available sediment resources.

The LCA Plan would be enhanced by programmatic authorization for beneficial use of dredged material. This program would allow the District to take greater advantage of existing sediment resources made available by maintenance activities to achieve restoration objectives. Annualized, there is reasonable potential to use an additional 30 mcy (23 million cubic meters) of material beneficially if funding were made available. (A portion of the average annual material total of 70 mcy (54 million cubic meters) is not available for beneficial use because it is resuspended material from upstream maintenance; if taken out of the system upstream, it is not available for downstream beneficial use.) Other limitations within particular areas include threatened and endangered species operating restrictions; cultural resource site operating restrictions; and unfavorable maritime working conditions. The following list is a small subset of the many areas with significant opportunity for additional beneficial use of material in coastal Louisiana:

- The MRGO, LA, project;
- The bay reach of the Barataria Bay Waterway, LA project;
- The MR&T project, Head of Passes and Southwest Pass;
- The Atchafalaya River and Bayous Chene, Boeuf, and Black, LA, project;
- The inland reach of the Calcasieu River and Pass, LA, project; and
- The Houma Navigation Canal.

The LCA Plan recommends $100 million in programmatic authority to allow for the extra cost needed for beneficial use of dredged material. Funds from the Beneficial Use of Dredge Material Program would be used for restoration activities that are above and beyond what would otherwise be funded by the USACE O&M program. Approximately 15 percent would be used for feasibility studies, and the remaining $85 million would be used for placement of dredged material within the acquired disposal sites. Previous Section 204 projects have demonstrated an incremental cost of $1.00 per CY for placement. Additionally, these projects have demonstrated approximately 0.00025 acres per CY (0.0001 ha per CY) created. Based on the requested funds and a ten-year period of implementation, it is expected that the LCA beneficial use of dredged material could attain approximately 21,000 acres (8,500 acres) of newly created wetlands. This beneficial use program represents a vital opportunity to contribute to the attainment of the LCA objectives. Programmatic authority would allow for the application of funds appropriated for LCA for beneficial use of dredged material under guidelines established by the Secretary of the Army, which may be similar to the current guidelines specified for the Section 204 Continuing Authorities Program. Approval of individual beneficial use projects may be delegated by the Secretary of the Army and managed by Division based on the appropriated annual funds. Implementation would proceed with a more detailed analysis of the potential beneficial use disposal sites. Additional funds should not exceed $100 million over the initial 10 years of the LCA program and would greatly contribute to achieving restoration objectives by utilizing existing sediment resources from coastal zone navigation channels.

2.8.8 Programmatic Authorization for Investigations of Modifications of Existing Structures

Coastal Louisiana is a dynamic environment that requires continual adaptation of restoration plans. With this recognition, opportunities for modifying or rehabilitating existing structures and/or their operation management plans to contribute to the LCA ecosystem restoration objectives may be required in the future. Examples of existing structures include: Davis Pond, Bonnet Carré Spillway, MRGO, Bayou Sorrel Lock, and Leland Bowman Lock. Each of these structures may be modified to influence flow, stage, and/or water quality.

Initiation of investigations of modifications of existing structures requires advanced budgeting. Standard budget sequencing may limit responsiveness to recommendations made within the LCA Plan. As a result, the LCA Plan seeks programmatic authorities to initiate investigations of modifications of existing structures utilizing funds within the LCA appropriations, not to exceed $10 million.

2.8.9 Cost Estimates for Components of the LCA Plan

Estimated costs for each of component of the LCA Plan are shown in **table 2-30**. Cost estimates are based on June 2004 price levels.

The fully funded cost estimate of the five near-term critical restoration features are as follows:

- MRGO Environmental Restoration Features $121,736,000
- Small Diversion at Hope Canal $ 80,281,000
- Barataria Basin Barrier Shoreline Restoration $275,471,000
- Small Bayou Lafourche Reintroduction $167,582,000
- Medium Diversion with Dedicated Dredging at Myrtle Grove $340,311,000

The fully funded cost estimate for the LCA Plan is $2,323,653,000.

Table 2-30. LCA Plan Component Cost Estimates (June 2004 Price Levels)

Item		Cost ($)
MRGO environmental restoration features		$ 80,000,000
Small diversion at Hope Canal		$ 10,645,000
Barataria Basin Barrier shoreline restoration		$ 181,000,000
Small Bayou Lafourche reintroduction		$ 75,280,000
Medium diversion with dedicated dredging at Myrtle Grove		$ 142,920,000
	SUBTOTAL	$ 489,845,000
LERRD		$ 178,619,000
First Cost	SUBTOTAL	$ 668,464,000
Feasibility-Level Decision Documents		$ 54,673,000
Preconstruction, Engineering, and Design (PED)		$ 36,252,000
Engineering and Design (E&D)		$ 29,018,000
Supervision and Administration (S&A)		$ 68,973,000
Project Monitoring		$ 6,685,000
Conditionally Authorized Cost	SUBTOTAL	**$ 864,065,000**
Science & Technology Program Cost (10 year Program)		**$ 100,000,000**
Demonstration Program Cost (10 year Program)*		**$ 100,000,000**
Beneficial Use of Dredged Material Program*		**$ 100,000,000**
Investigations of Modifications of Existing Structures		**$ 10,000,000**
Total Authorized LCA Plan Cost		**$ 1,174,065,000**
Multi-purpose operation of Houma Navigation Canal (HNC) Lock #		$ -
Terrebonne Basin Barrier shoreline restoration		$ 84,850,000
Maintain Land Bridge between Caillou Lake and Gulf of Mexico		$ 41,000,000
Small diversion at Convent / Blind River.		$ 28,564,000
Increase Amite River Diversion Canal influence by gapping banks		$ 2,855,000
Medium diversion at White's Ditch		$ 35,200,000
Stabilize Gulf shoreline at Point Au Fer Island		$ 32,000,000
Convey Atchafalaya River Water to Northern Terrebonne marshes		$ 132,200,000
Modification of Caernarvon diversion		$ 1,800,000
Modification of Davis Pond diversion		$ 1,800,000
	SUBTOTAL	$ 360,269,000
LERRD		$ 208,100,000
First Cost	SUBTOTAL	$ 568,369,000
Feasibility Level Decision Documents		$ 47,529,000
Preconstruction, Engineering, and Design (PED)		$ 36,027,000
Engineering & Design (E&D)		$ 45,635,000
Supervision & Administration (S&A)		$ 58,673,000
Project Monitoring		$ 5,683,000
Approved Projects Requiring Future Congressional Authorization for Construction		**$ 761,916,000**
Mississippi River Hydrodynamic Study		$ 10,250,000
Mississippi River Delta Management Study		$ 15,350,000
Third Delta Study		$ 15,290,000
Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study		$ 12,000,000
Acadiana Bays Estuarine Restoration Feasibility Study		$ 7,110,000
Upper Atchafalaya Basin Study^		$ -
Large-scale and Long Term Studies Cost	SUBTOTAL	**$ 60,000,000**
Total LCA Restoration Plan Cost		**$ 1,995,981,000**

*Program total costs include any estimated Real Estate costs for these activities
Feature of the Mississippi River and Tributaries, Morganza Louisiana to the Gulf of Mexico Hurricane Protection project
^ Study to be funded under the Mississippi River and Tributaries authority

2.10 PLAN MANAGEMENT

The purpose of the LCA Management Plan (Management Plan) is to maximize attainment of the planning objectives for restoration of Louisiana's coastal wetlands. This management plan and structure describe how various entities would be integrated into the planning and decision-making process during the LCA Plan implementation. This proposed management structure would also facilitate communication and coordination between the Federal and state agencies in the implementation of broader coastal restoration efforts and programs.

This section of the report describes the working relationships between the various entities and their respective roles and responsibilities to facilitate efficient management of coastal restoration activities. Due to the significance and magnitude of wetlands losses and the far-reaching national extent of the problems generated by coastal Louisiana land losses over the next 50 years, a Washington-level Task Force is needed to fully address the issues.

For each of the groups involved in the implementation of the LCA Program (**figure 2-20**), the purpose, structure, and roles and responsibilities are described. The groups include: Headquarters, a Program Management Team, a Program Execution Team, a proposed Task Force, the Assistant Secretary, a Regional Working Group, and a S&T Office. **Figure 2-20** depicts their overall relationship and the interaction that would be needed to achieve coastal restoration and consistency.

Management of the LCA restoration efforts would also include a decision support system that relies on clearly defined procedures to assess uncertainties and develop alternatives for the decision making process. The decision support system would be developed with and implemented by the program teams, and outputs from the system would be reported to the Program Management Team, who would be responsible for program-level decisions. The decision support system would be developed to explicitly identify constraints and tradeoffs among new projects, existing and backlogged projects and other planning and regulatory decisions made that affect the implementation and effectiveness of restoration efforts. Program planning efforts would support informed decision making in recognition of the interdependencies among actions and the tradeoffs in outcomes affecting the recreational and commercial uses of the working coast.

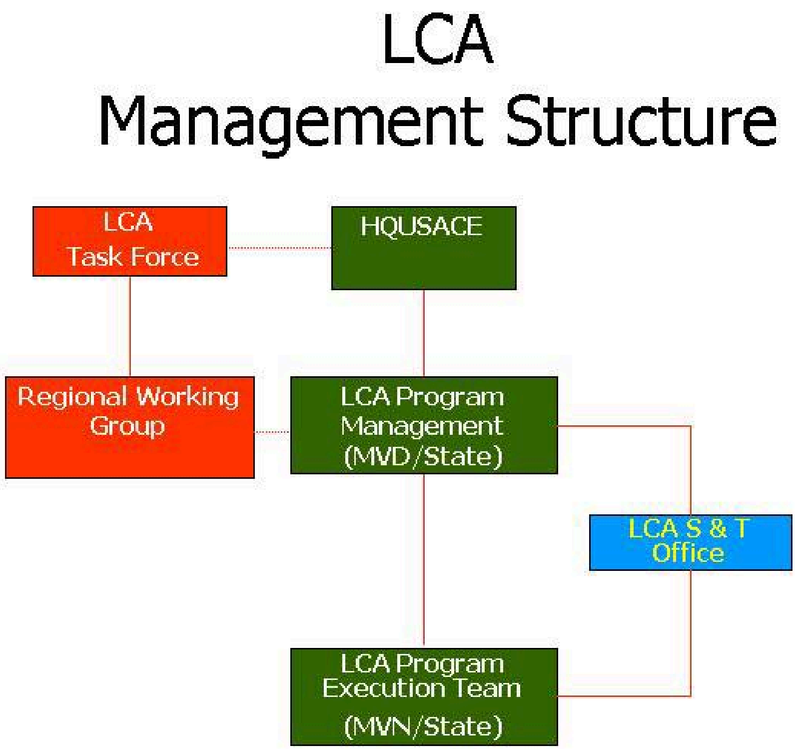

Figure 2-20. Coastal Restoration Management Structure.

2.11 ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (AEAM)

As detailed in section 2.2 EXISTING AND FUTURE WITHOUT-PROJECT CONDITIONS, large coastal ecosystems like the Louisiana coastal area are dynamic systems that integrate terrestrial and marine processes nested in scale from global to local influences against a backdrop of historical conditions. The scientific and technological uncertainties outlined in section 3.1 PLANNING CONSTRAINTS, as well as watershed influences that affect delivery of water, sediment, and nutrients, and uncertainty in the timing and magnitude of infrequent, but high-energy events such as floods and storms, storms make response prediction within these large ecosystems inherently difficult. Integration of an AEAM system within the LCA Program would facilitate management of this complex system to best meet the planning objectives.

AEAM prescribes a management process wherein future actions can be changed as the efficacy of past actions on the ecosystem is determined through monitoring and other means to improve knowledge about the response of the system (Holling and Gunderson 2002). The AEAM approach recognizes that uncertainty is unavoidable in managing large-scale ecological systems. If properly planned and maintained, the feedback element can be used to sequentially improve management actions so that future system conditions become more consistent with program goals and objectives than past actions. AEAM allows development of an iterative and flexible approach to management and decision-making.

All organizations within the LCA Management Structure have a role in implementing AEAM. The LCA S&T Office would make AEAM recommendations to the Program Management Team and the PET based on assessment of monitoring data and the development of new tools or technologies. Specifically, the Program Manager is responsible for the overall program and issuing programmatic guidance to make necessary adjustments to better meet program objectives. The PET would implement changes directed by the programmatic guidance. **Figure 2-21** depicts this iterative process and the roles of the different groups.

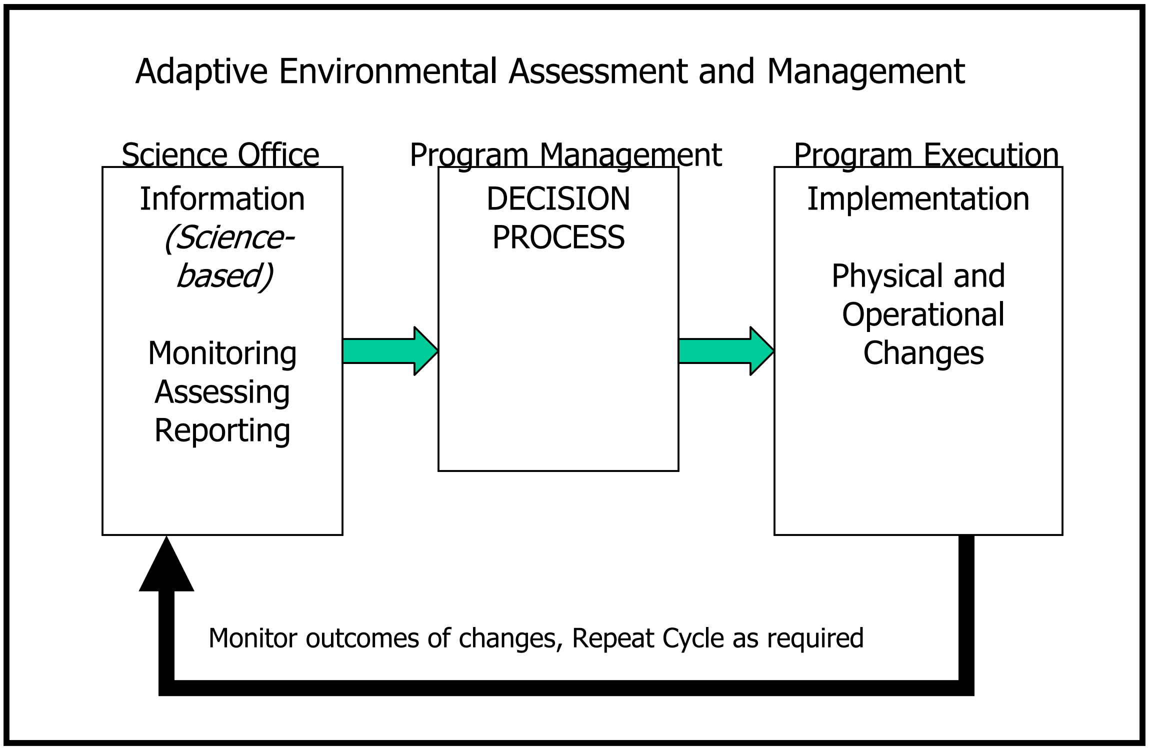

Figure 2-21. Adaptive Environmental Assessment and Management.

It is important to note that the scope of decisions presented in the "decision process" in **figure 2-21** would differ in scale. One way of expressing this is to distinguish between strategic decisions and tactical decisions. Strategic decisions comprise the decisions about the nature and timing of large projects and major policies related to the overall programmatic effort. Tactical decisions comprise those decisions about implementation and operation that are necessary for the projects and policies to succeed. The AEAM framework applies to both strategic and tactical decisions about coastal restoration. The key attribute of the decision process under AEAM is well-defined and effective communication. The AEAM within the LCA Program management would build upon lessons learned over the past several years in CWPPRA, along with CWPPRA-initiated tool development, such as the Coast-wide Reference Monitoring System (Steyer et al. 2003).

The structures and general process outlined in the LCA S&T Program provide the basic elements of an AEAM program. To make the AEAM effort most effective, it would be important to view the restoration effort as a learning process, with adaptation as required. Timely and effective communication of information to all participants would be instrumental in effectively implementing the AEAM process and to further attain program objectives. Examples of communication tools are project-specific assessment reports (report cards), annual programmatic AEAM report, and science symposia convened on an annual or biennial basis. Appendix A SCIENCE AND TECHNOLOGY PROGRAM expands on this general discussion of AEAM.

2.12 COMPARISON OF RESTORATION OPPORTUNITES

2.12.1 No Action Alternative ─ Future Without-Project

The No Action Alternative or future without-project assumes no further ecosystem restoration actions beyond the presently planned/approved construction or maintenance actions in the study area, including those contained in the CWPPRA, and other flood control, navigation, and restoration programs described in Section 1.7 "Opportunities" of this DPEIS and Section 1 "Introduction" of the Main Report.

Without action, marine influences and other natural and human factors, such as subsidence, sea level change, navigation channels, and oil and gas canals would result in continued coastal habitat loss in both the Deltaic and Chenier Plains. Land building would continue in the Deltaic Plain at the two active deltas, as well as in areas influenced by CWPPRA projects and the Davis Pond and Caernarvon Freshwater Diversion Projects. Coastal habitats in these areas of land creation would primarily be freshwater marsh, a result of the riverine influence that formed them. Other areas in the Deltaic and Chenier Plains would experience significant land loss. Louisiana coastal wetlands have been subjected to high rates of relative sea level change (rise) for centuries at least due to high subsidence rates associated with the compaction and dewatering of deltaic sediments. Some Louisiana marshes have adjusted to these high rates, and still survive in areas where measured rates from tide gauges are over 1 cm per year, and others are experiencing stress which may in part be driven by the relative sea level change. In Louisiana it is well documented that high water events associated with frontal passages and tropical storms and hurricanes deliver most of the sediment that is currently deposited in coastal marshes (Reed, 1989; Cahoon et al., 1995). These factors undoubtedly contribute to sustainability of existing Louisiana marshes and it is not known how marshes will accommodate future increases in relative sea level. Quantification of future land loss is described in section 1.5.2.6, PROJECTED 2000-2050 LAND CHANGE SUMMARY.

The preliminary modeling output predicted habitat changes in acres resulting from future without-project conditions. These changes were due to land lost or gained and habitat change due to future conversion between habitat types. Overall there would be a net loss of 13 percent of today's wetland acres. In **table 2-31**, the percent acreage of each habitat type for existing (Year 0) and future without-project (No Action at Year 50) conditions is displayed. In addition, for each subprovince, graphs depict the change in habitat acreage and vegetative productivity index for Year 0, 10, 20, 30, 40, and 50, assuming there is no additional action (**figures 2-21** to **2-24**).

These figures illustrate that decreases in plant productivity across the entire coast are a function of land loss and mirror the continued trend of coastal land loss throughout the study area (see appendix C for more information on plant productivity modeling and calculations).

Table 2-31. Percent Habitat Composition.
With the Future Without-Project Conditions (No Action Alternative) At Year 0 and Year 50 By Subprovince.

Percent Composition							
	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Saline Marsh	Swamp	Water	Upland[1]
Subprovince 1							
No Action Year 0	2.0	4.4	5.0	3.1	9.7	61.8	14.0
No Action Year 50	5.7	2.7	3.9	1.5	9.0	63.2	14.0
Percent Change	185.0	-38.6	-22.0	-51.6	-7.2	2.3	0.0
Subprovince 2							
No Action Year 0	10.1	4.8	3.6	6.6	16.4	40.4	18.1
No Action Year 50	14.2	2.9	0.0	0.0	15.9	48.9	18.1
Percent Change	40.6	-39.6	-100.0	-100.0	-3.0	21.0	0.0
Subprovince 3							
No Action Year 0	12.6	7.1	7.4	4.2	14.3	44.4	10.0
No Action Year 50	1.2	22.8	1.5	0.2	12.4	51.9	10.0
Percent Change	-90.5	221.1	-79.7	-95.2	-13.3	16.9	0.0
Subprovince 4							
No Action Year 0	25.4	20.8	10.1	2.2	0.3	29.8	11.5
No Action Year 50	22.9	17.4	14.8	0.0	0.2	33.2	11.5
Percent Change	-9.8	-16.3	46.5	-100.0	-33.3	11.4	0.0

[1]Approximate percent composition is provided for upland habitat but uplands were not assessed in the coastal land loss modeling effort, as described in appendix B.
Note: The "Percent Change" represents the change for each specific habitat class in each subprovince from Year 0 to Year 50 with No Action. Future without-project conditions were generated from the ecological modeling efforts described in appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING.

Subprovince 1

Over 5 percent of the total emergent wetland acres are predicted to be lost by 2050. Land acreage would continue to decrease through year 2050, while plant productivity**,** which is based on a percent of maximum productivity as influenced by changes in salinity and inundation, would initially increase through year 10, and then decrease slightly through year 2050 (**figure 2-22**). The majority of the direct wetland loss is expected to be caused by shoreline erosion in the brackish and saline Biloxi Marshes. Cypress swamp could be lost to the west of Lake Maurepas.

Fresh marsh is expected to nearly triple in acreage, especially in the upper Breton Sound marshes where influence of the Caernarvon Diversion would be felt. The predicted approximately 40 percent loss in intermediate marsh is mainly because it is expected to convert to fresh marsh in the Caernarvon influence area. Much of the predicted loss of 20 percent of the existing brackish marsh would be due to conversion to intermediate marsh. By 2050, fresh marsh and swamp/wetland forest are predicted to make up 65 % of the wetlands, and saline marsh only 7 percent.

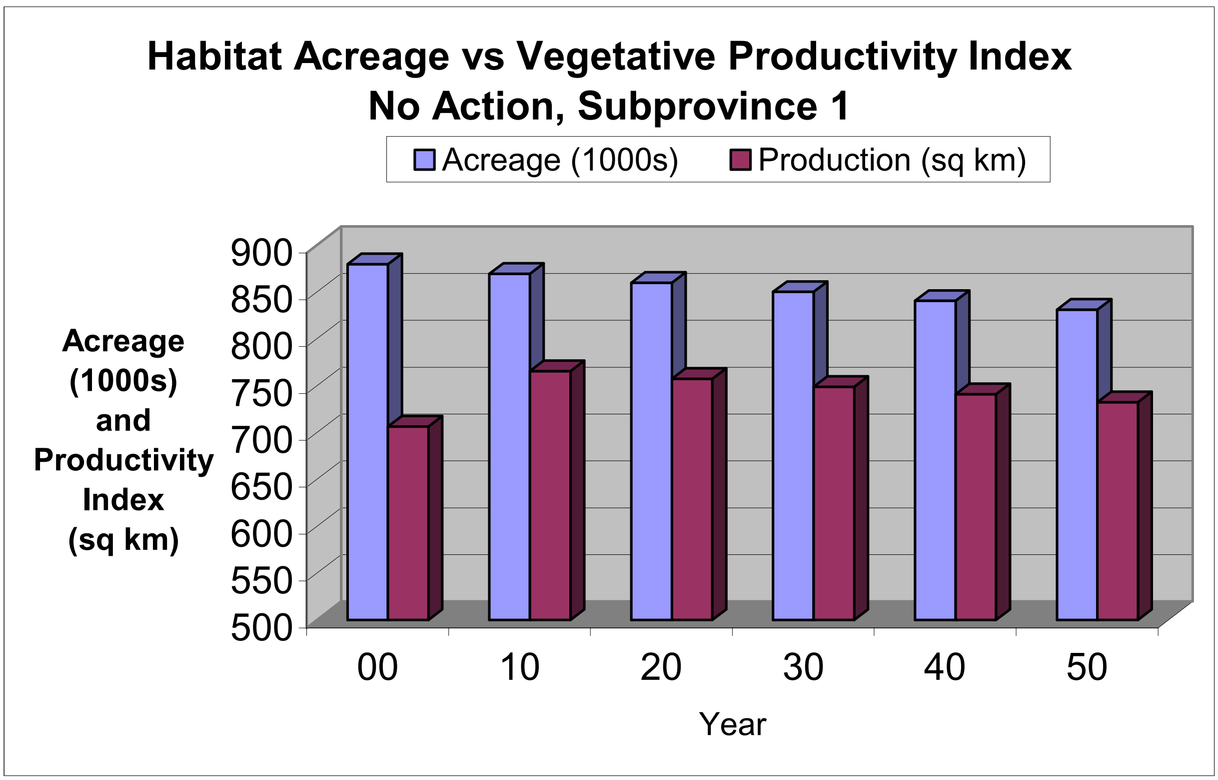

Figure 2-22. Habitat Acreage and Vegetative Productivity Index for Subprovince 1 Under Future Without-Project Conditions.

Subprovince 2

Approximately 22 percent of the existing emergent wetlands are predicted to be lost by 2050. Land acreage would continue to decrease through year 2050, while plant productivity, which is based on a percent of maximum productivity as influenced by changes in salinity and inundation, would initially increase through year 10, and then decrease through year 2050 (**figure 2-23**). The majority of the wetland loss is expected to occur in the lower portions of the subprovince, as existing brackish and saline marshes convert to open water. Losses are also predicted in the upper area in cypress swamp.

Anticipated inputs from the Davis Pond Diversion are predicted to greatly expand the area of fresh marsh by causing the conversion of existing brackish and intermediate marshes to fresh marsh. The total loss of saline marshes is predicted to be mainly due to conversion to open water. However, some saline marsh is expected to convert to intermediate and brackish marsh. By 2050, over 90 percent of the subprovince is anticipated to be fresh marsh and swamp/wetland forest with the remaining 9 percent either intermediate or brackish marsh.

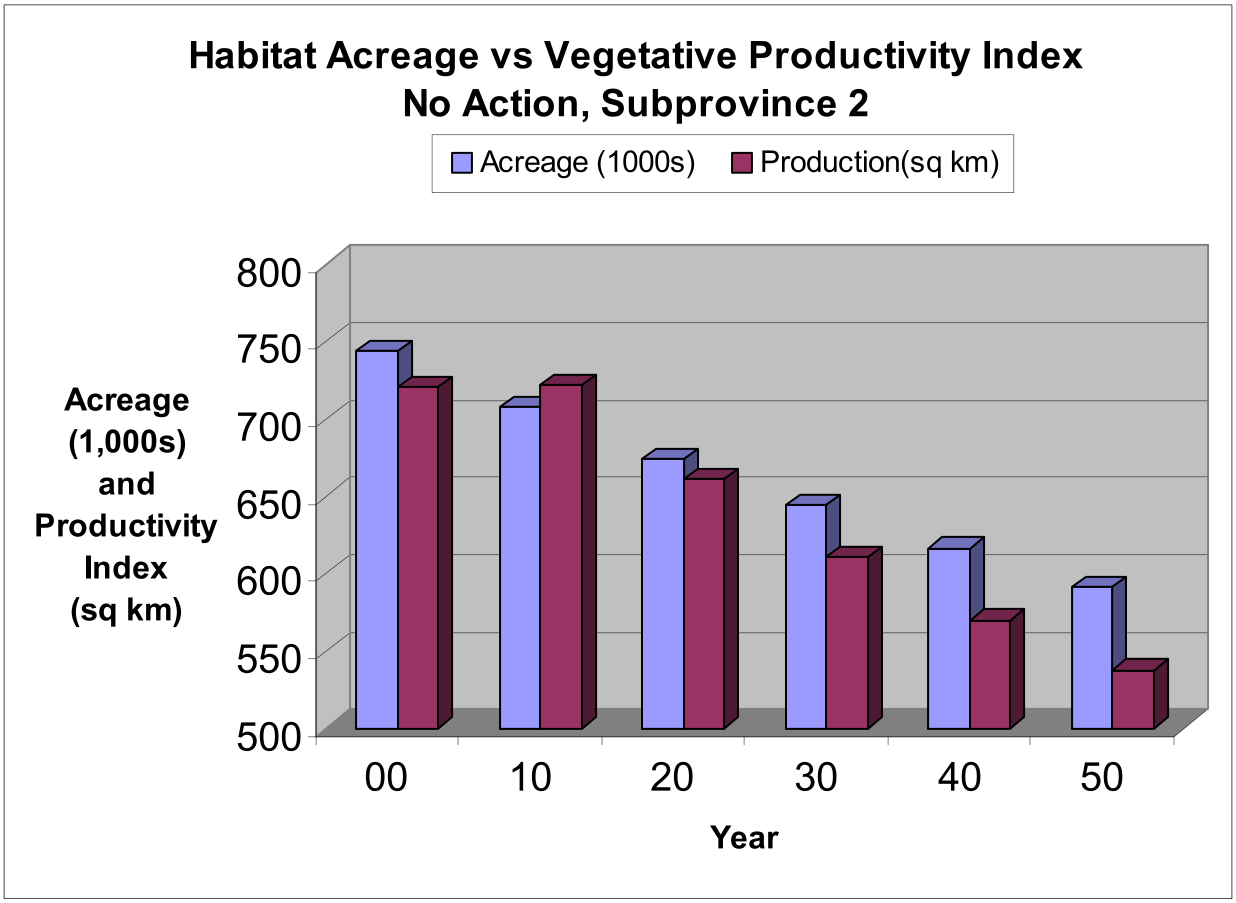

Figure 2- 23. Habitat Acreage and Vegetative Productivity Index for Subprovince 2 Under Future Without-Project Conditions.

Subprovince 3

Approximately 16 percent of the existing emergent wetlands are predicted to be lost by 2050. Land acreage and plant productivity, which is based on a percent of maximum productivity as influenced by changes in salinity and inundation, would continue to decrease through year 2050 (**figure 2-24**). The majority of the loss would occur in the eastern portion of the subprovince with loss increasing from north to south. Additional loss is also predicted north of the GIWW. Whereas land gain is anticipated in the two deltas in Atchafalaya Bay.

Approximately 13 percent of the swamps are predicted to be lost, mainly due to elevated water levels in the Verret Basin. A large increase (220 percent) in intermediate marsh is predicted by the model. This increase is probably due to threshold constraints of the model and the necessity of averaging salinities from western Terrebonne with Atchafalaya Bay. Most of the predicted decrease in fresh marsh is due to conversion to intermediate marsh. The 80 percent decrease in brackish marsh is expected to be caused by conversion to other marsh types and loss to open water. Most of the predicted 95 percent loss of salt marsh would occur as it becomes open water. By 2050, almost 60 percent of the emergent wetlands are predicted to be intermediate marsh, and 33 percent will be swamp and wetland forest.

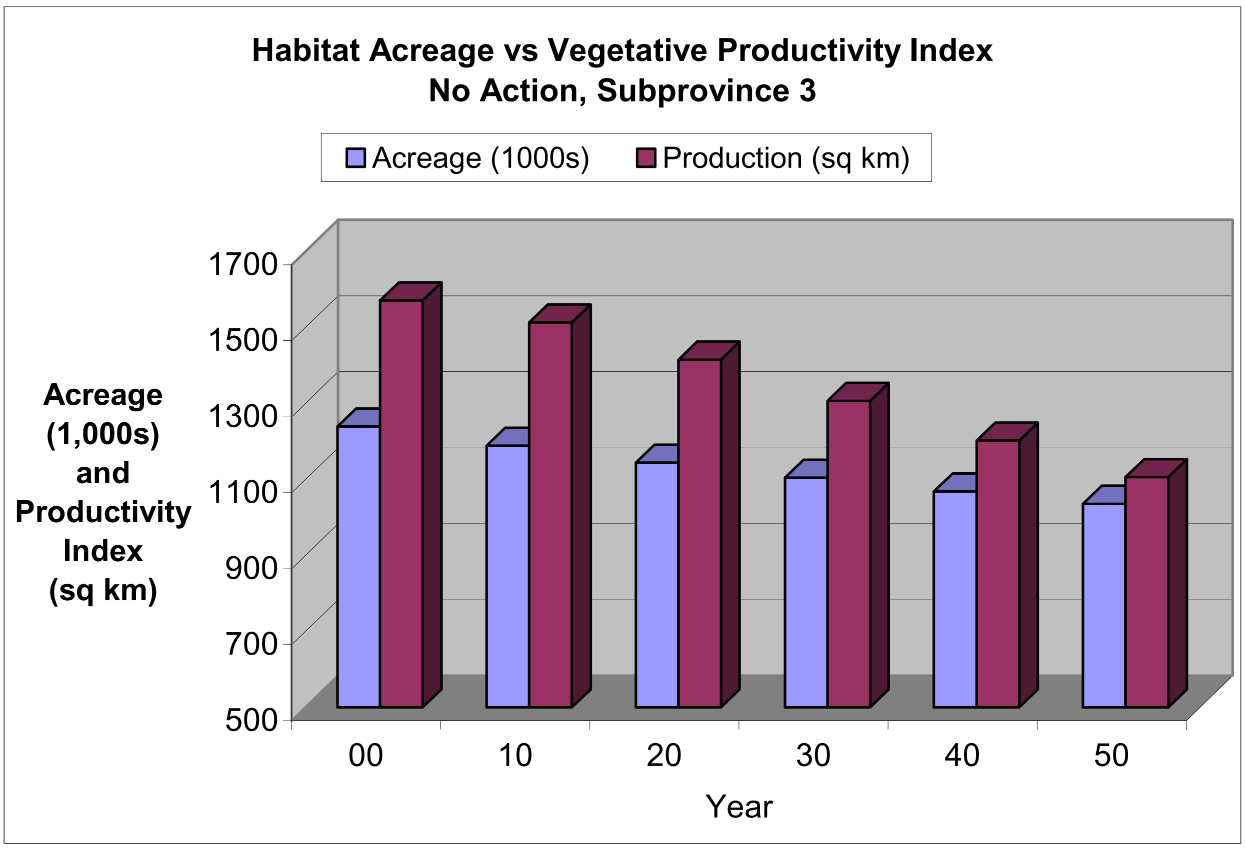

Figure 2- 24. Habitat Acreage and Vegetative Productivity Index for Subprovince 3 Under Future Without-Project Conditions.

Subprovince 4

Approximately 6 percent of the existing emergent wetlands are predicted to be lost by 2050. Land acreage would continue to decrease through year 2050. While a slight increase in vegetation productivity of 3% would occur in the first ten years, a slight declining trend is predicted to follow resulting in a net decrease of 2.4% by year 2050 (**figure 2-25**). Much of the loss is anticipated to occur south of Highway 82 and in the Big Burn area.

Brackish marsh is predicted to expand by almost 150 percent of the current acreage. This increase will be almost entirely because increasing salinity causes conversion of fresh and intermediate marshes to brackish marsh. By 2050, 41 percent of the wetlands will be fresh marsh, 32 percent intermediate marsh and 27 percent brackish marsh.

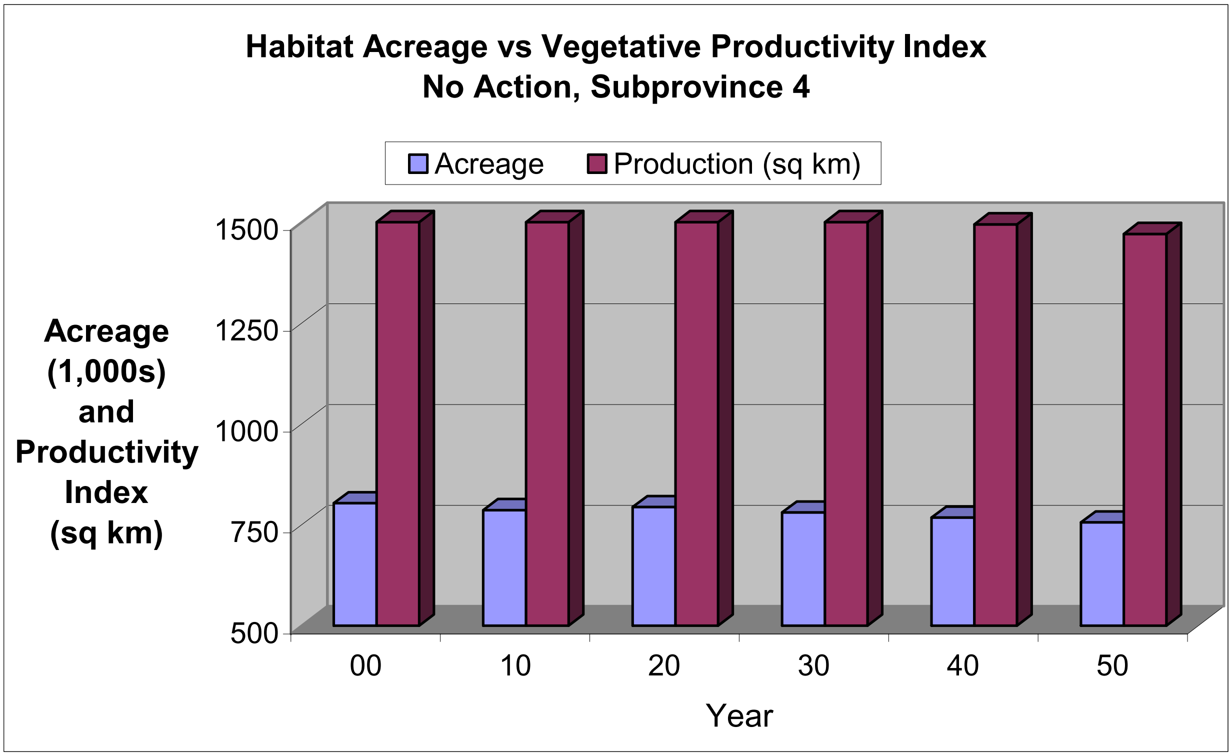

Figure 2-25. Habitat Acreage and Vegetative Productivity Index for Subprovince 4 Under Future Without-Project Conditions.

Table 2-32 is a comparison of the potential impacts of each restoration feature to significant resources.

TABLE 2-32
Comparison of Restoration Opportunities to No Action Among Significant Resources

Significant Resource	No Action	Alternative Plan B (deltaic processes)	Alternative Plan D (geomorphic structure)	TSP
Soils	Continued coastal land loss with predicted 328,000 acres lost over next 50 years; organic soils will not be able to maintain their elevation.	River diversions would build and/or nourish land; dedicated dredging would build new land; hydrologic restoration improves conditions for plant growth resulting in reduction of soil erosion.	Marsh creation would build new land; hydrologic restoration improves conditions for plant growth resulting in reduction of soil erosion.	Impacts would be combination of both ALT B and ALT D.
Offshore Sand Resources	Natural processes continue to build offshore sand deposits; continued multiple uses of offshore sands and sand bodies.	ALT B does not present any likely restoration opportunities for use of offshore sand resources.	Almost all of ALT D restoration features could potentially impact offshore sand resources; there would be short-term minor to long-term significant adverse impacts due to removal of over 61 million cy of sands required for restoration purposes.	Impacts similar to ALT D.
Salinity Regimes	Preliminary modeling shows freshening in influence areas of existing diversions (Subprovince 1&2). However, some increased salinity intrusion into some interior portions of all subprovinces due to human-induced and natural coastal land loss.	Long-term minor direct to long-term minor-to-moderate indirect impacts associated with slight freshening from diversions in localized areas of subprovince 1, 2 and 3; otherwise, salinity regimes would be similar to the future without conditions.	Impacts would be similar to ALT B but to a much lesser degree.	Impacts would be a combination of ALT B and ALT D.
Barrier Systems	Continued natural and human-induced land-loss processes at rates similar to present.	No direct or indirect impacts to barrier systems.	Long-term significant positive impacts of restoring over 32 miles of barrier systems; short-term minor adverse impacts due to construction of restoration features.	Impacts would be a synergistic combination of ALT B and ALT D.
Barrier Reefs	Natural and human-induced processes continue form/erode barrier reefs.	No restoration features for barrier reefs.	No restoration features for barrier reefs.	No restoration features for barrier reefs.
Coastal Vegetation	Long-term significant coast wide net decrease due to continued coastal land losses.	Long-term significant net decrease of all coastal wetland vegetation habitat types, but with a minor reduction in the rate of loss, particularly with small increase in productivity of fresh and intermediate marsh and swamp/wetland forest; brackish and saline marsh and barrier shoreline vegetation would remain similar to the future without conditions.	Long-term significant net decrease of all coastal wetland vegetative habitat types (depending upon the locations of beneficial use), but with a minor reduction in the rate of loss, particularly with brackish, saline and barrier shoreline vegetation.	Impacts would be somewhat greater than the combination of both ALT B and ALT D. Long-term significant net decrease of all coastal wetland vegetation habitat types would occur, but with a small reduction in the rate of loss, and small increases in productivity in all habitat types.
Wildlife	Continued decline in most coastal Louisiana wildlife species.	Most coastal Louisiana wildlife species would benefit.	Most coastal Louisiana wildlife species would benefit.	Impacts would be a combination of ALT B and ALT D.

TABLE 2-32
Comparison of Restoration Opportunities to No Action Among Significant Resources

Significant Resource	No Action	Alternative Plan B (deltaic processes)	Alternative Plan D (geomorphic structure)	TSP
Plankton	Increased potential for algal blooms due to increases in nutrients.	In the Delta Plain, freshwater diversions result in species switching from saltwater-dominant to freshwater dominant.	Restoration of geomorphic structure only would result in negligible impacts.	Impacts similar to ALT B.
Benthic	Increases in benthic species and community diversity.	In the Delta Plain, freshwater diversions result in species switching from saltwater-dominant to freshwater dominant; creation of significant acres of new habitat with greater heterogeneity and interspersion.	Unavoidable direct loss of benthos due to construction activities; however, creation of significant acres of new habitat with greater heterogeneity and interspersion.	Impacts would be a combination of both ALT B and ALT D.
Marine Fisheries	Would have a net loss in fisheries population size and diversity.	Long-term benefits may overcome adverse impacts of increased freshwater input.	Some adverse impacts, with long-term benefits.	Marine fisheries would benefit from this plan
Estuarine-Dependent Fisheries	Would have a net loss in fisheries population size and diversity.	Estuarine-dependent fisheries would benefit due to preservation of habitat.	Estuarine-dependent fisheries would benefit due to preservation of habitat.	Estuarine-dependent fisheries would benefit due to preservation of habitat.
Freshwater Fisheries	Would have a net loss in fisheries population size and diversity.	This plan would benefit freshwater fisheries.	Minimal, if any adverse impacts; some long-term benefits of marsh creation.	Combination of ALT B and ALT D.
Essential Fish Habitat	Continued loss and degradation of EFH.	This plan would preserve some highly productive categories of EFH expected to be lost with no action	This plan would preserve some highly productive categories of EFH expected to be lost with no action in isolated areas of the Louisiana coastal area. This preservation is not expected to be sustainable.	Of the near term plans, this plan best preserves some highly productive categories of EFH expected to be lost with no action.
Threatened & Endangered Species	Continued population decline and loss of critical habitat principally for the piping plover and sea turtles.	Would generally increase and enhance all coastal wetland habitats.	Would increase and enhance piping plover critical habitat (barrier islands) and would generally enhance all habitats.	Would increase and enhance piping plover critical habitat (barrier islands) and would generally enhance all habitats.
Hydrology Flow Patterns	Flow rates would continue to increase.	Increase freshwater flow to the wetlands, Subprovinces 1-3, decrease Mississippi River flow. Effects on water levels not known.	Reduce Gulf flow and alter flow patterns.	Increase freshwater flow to the wetlands, Subprovinces 1-3, decrease Mississippi River flow. Effects on water levels not known. Reduce Gulf flow and alter flow patterns.
Sediment	Sediment supply does not offset land loss.	Increased sediment deposition in wetlands, Mississippi River, existing channels and canals, and estuarine areas, Subprovinces 1-3. Changed deposition patterns in all Subprovinces.	Decreased sediment output in wetlands and estuarine areas Subprovinces 1-3. Changed depocenter patterns in all Subprovinces.	Decreased sediment output in wetlands and estuarine areas all subprovinces. Changed depocenter patterns in Subprovinces 1-3, Increased sediment deposition in wetlands, Mississippi River, existing channels and canals, and estuarine areas Subprovinces 1-3.

TABLE 2-32
Comparison of Restoration Opportunities to No Action Among Significant Resources

Significant Resource	No Action	Alternative Plan B (deltaic processes)	Alternative Plan D (geomorphic structure)	TSP
Water Use & Supply	Some coastal areas, saltwater intrusion events continue & increase in frequency and magnitude. Result is reduced surface supplies & increased reliance on ground water, which is limited in many coastal areas.	All LCA Study components would generally increase freshwater availability in the receiving areas of the subprovinces and decrease freshwater availability in the Mississippi River.	Negligible effects on water use and supply (freshwater availability).	All LCA Study components would generally increase freshwater availability in the receiving areas of the Subprovinces and decrease freshwater availability in the Mississippi River.
Groundwater	Continued withdrawals.	Unlikely impacts on groundwater.	Unlikely impacts on groundwater.	Unlikely impacts on groundwater.
Water Quality	Continued institutional recognition to restore and protect waterbodies, especially with respect to point sources. Nonpoint sources still unregulated and increasing potential for accidental discharges due to exposed infrastructure because of coastal land loss.	Long-term minor-to-moderate positive/adverse effects (depending upon perceptions of water uses) of introducing river water from diversions into receiving basins; similar to what occurred naturally prior to construction of levees. Sediments introduced into the receiving basins from diversions or from direct placement (dredge material disposal) would add some constituents, but would likely not have unacceptable, adverse impacts.	Sediments introduced into the receiving basins from diversions or from direct placement (dredge material disposal) would add some constituents, but would likely not have unacceptable, adverse impacts.	Impacts of the TSP would be a synergistic positive result over and above the additive combination impacts and benefits of ALT B and ALT D.
Historic & Cultural Resources	Potential loss of resources due to natural and human causes.	Requires project specific cultural resources investigation	Requires project specific cultural resources investigation	Requires project specific cultural resources investigation
Recreation	Potential loss of recreational resource base due to coastal land loss.	ALT B would support and sustain a greater number of freshwater-based recreational opportunities, provide for a more stable freshwater-based recreation economy, and possibly increase the Louisiana recreation industry compared to the future without-project conditions.	ALT D would support and sustain a greater number of saltwater-based recreational opportunities, provide for a more stable saltwater-based recreation economy, and possibly increase the Louisiana recreation industry compared to the future without-project conditions.	Impacts similar to ALT B and ALT D in that the TSP includes restoration features common to both of these restoration opportunities.
Aesthetic	Continued human population growth and development and other human activities have the potential to destroy, enhance, or preserve visual resources.	Impacts of maintaining visually appealing resources systems would further support tourism as one travels Louisiana's Scenic byways and remote areas of visual interest.	Impacts similar to ALT B.	Impacts would be a combination of ALT B and ALT D.

TABLE 2-32
Comparison of Restoration Opportunities to No Action Among Significant Resources

Significant Resource	No Action	Alternative Plan B (deltaic processes)	Alternative Plan D (geomorphic structure)	TSP
Air Quality	Continued decline in air quality as human population growth and development increases and despite legislative attempts to address problems.	Some abatement of air quality since restoration would result in reduction of the rate of loss of vegetated habitats and small increase in productivity of fresh and intermediate marsh and swamp/wetland forest thereby positively impacting air quality via absorption of carbon dioxide and other air pollutants. Short-term minor adverse impacts due to construction activities.	Generally same as ALT B except fewer restoration features would result in less long-term abatement and less short-term negative construction impacts.	Impacts would be similar to ALT B and ALT D since the TSP includes restoration features from both plans.
Noise	Continued noise pollution as human population growth & development, industry, and other human activities continue to increase	Noise typically associated with actual construction activities. All legal requirements for noise abatement would be followed. No significant cumulative impacts anticipated.	Similar, but less than ALT B, since ALT D has fewer restoration features.	Impacts would be a combination of ALT B and ALT D.
HTRW	Continued growth of human population, development, industry, and other activities would further increase HTRW areas of concern within the Louisiana coastal area.	An HTRW Phase I ISA would be performed on a project-by-project basis. Any HTRW identified will be avoided or removed prior to initiation of construction activities.	An HTRW Phase I ISA would be performed on a project-by-project basis. Any HTRW identified will be avoided or removed prior to initiation of construction activities.	An HTRW Phase I ISA would be performed on a project-by-project basis. Any HTRW identified will be avoided or removed prior to initiation of construction activities.
Gulf Hypoxia	Continued nutrient loading into Gulf of Mexico; possible upstream abatement.	Small reduction in nutrient loading from Mississippi River to Gulf of Mexico.	No effect.	Small reduction in nutrient loading from Mississippi River to Gulf of Mexico.
Population	Due to coastal erosion population would shift further inland and to urban and suburban areas.	Population shift would be slower. With implementation subsistence fishermen would potentially relocate to follow fishery species that are affected by the change in salinity levels.	Impacts would be similar to ALT B, but less due to fewer restoration features. There would be no relocation of subsistence fishermen.	Impacts would be similar to ALT B and ALT D.
Infrastructure	Infrastructure nearest to the coast would be exposed to more frequent erosion and damage. Infrastructure would have to be relocated, replaced, and repaired.	ALT B would reduce some erosion and damage.	Similar to ALT B, but less due to fewer restoration features.	Impacts would be similar to ALT B and ALT D.
Socio-Economic and Human Resources	Some industrial employers, petroleum, and seafood would be threatened by coastal land loss and storms, thus causing a loss of associated employment and income. Population would shift further inland and to urban and suburban areas.	ALT B would reduce coastal erosion and protect these assets. Loss of jobs and income due to coastal erosion and storms would be reduced.	Impacts would be similar to ALT B, but less due to fewer restoration features.	Impacts would be similar to ALT B and ALT D.

TABLE 2-32
Comparison of Restoration Opportunities to No Action Among Significant Resources

Significant Resource	No Action	Alternative Plan B (deltaic processes)	Alternative Plan D (geomorphic structure)	TSP
Commercial Fisheries	The fishing industry and its supporting business and activities would experience a decline.	Overall with ALT B the industry would be more stable. ALT B could cause a shift from some saltwater species to brackish species. The diversions could increase costs to get to marine waters, though sustainability of the resource is enhanced. The diversion could have a positive impact on the crawfish industry.	ALT D would not impact the industry as much as ALT B.	Impacts would be similar to ALT B and ALT D.
Oyster Leases	Gradual loss of production from leases. Increased production in bands of intermediate distance from freshwater introduction.	SP1-2 reduced production from leases; SP3 slight impacts both negative and positive; no oyster leases in SP4	SP1-3 minimal localized impacts in construction areas; no oyster leases in SP4.	Impacts similar to ALT B and ALT D.
Oil, Gas & Minerals	Increased damages to refineries, wells, and other oil and gas producing facilities and equipment. Some relocations would occur due to erosion.	ALT B would reduce damages and provide protection to these assets.	Similar to ALT B, but would provide some increased protection to the LOOP facility due to restoration of the Caminada-Moreau Headland.	Impacts similar to ALT B and ALT D.
Navigation	Probable damages to and relocation of port facilities, inland waterways, and traffic.	Possible negative impacts due to increased O&M dredging requirements. Could have positive impacts for GIWW traffic.	Possible negative impacts for O&M funding competing with beneficial use funds. Possible significant negative impacts depending on MRGO restoration measures selected.	Similar impacts to both RO1 and RO2.
Flood Control	Continuing erosion of the coast would cause increased flood damages due to storm surge. Some people would choose to relocate.	ALT B would reduce flood damages and prevent some relocations.	Impacts would be similar to ALT B, but less due to fewer restoration features.	Impacts similar to ALT B and ALT D.
Pipelines	Increased damages to pipelines and related equipment. Some relocations would occur due to erosion. Potential for environmental damage and disruptions in our energy supply.	ALT B would increase protection of these assets and decrease damages.	Impacts would be similar to ALT B. Barrier islands and shoreline protection can be expected to increase protection for pipelines.	Impacts similar to ALT B and ALT D.
Hurricane Protection Levees	Continuing erosion of the coast would cause increased flood damages to levees due to storm surge and increased maintenance.	ALT B would reduce some of the damage and increased maintenance to levees. Short-term minor impacts to some levees due to construction activities.	ALT D would have minimal impact on the levee system; some storm surge reduction.	Impacts similar to ALT B and ALT D.
Agriculture	Continuing erosion of the coast would cause increased agricultural flood damages due to storm surge and increased salinity levels.	ALT B would benefit agriculture by limiting saltwater intrusion and would prevent the loss of some agricultural land. Some minor loss of land due to the footprint of construction activities.	ALT D would prevent some of the damage to agricultural lands.	Impacts similar to ALT B and ALT D.

TABLE 2-32
Comparison of Restoration Opportunities to No Action Among Significant Resources

Significant Resource	No Action	Alternative Plan B (deltaic processes)	Alternative Plan D (geomorphic structure)	TSP
Forestry	Continued coastal land loss reduces forestry opportunities.	A net decrease in forestry resources although the rate of loss compared to future without-project would be reduced and small increase in productivity of swamp and wetland forest habitat. Project-induced increases in swamp and wetland forests habitat would provide some opportunities for forestry activities.	No impacts on forestry resources by ALT D.	Impacts similar to ALT B and ALT D.
Water Resources	Increased levels of salinity in some of the coastal areas. Potentially businesses could relocate, adversely impacting jobs, income, population, and employment.	ALT B would reduce salinity levels.	ALT D would have negligible effects. Possibly some decrease in salinity in the MRGO area.	Impacts similar to ALT B and ALT D.

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CHAPTER 3 AFFECTED ENVIRONMENT

This chapter first describes the coastal system processes that have shaped the Louisiana coastal ecosystem then presents the historic and existing conditions for significant natural environment and human environment resources. Significant resources presented include: soils; offshore sand resources; salinity regimes; barrier systems — barrier shorelines, headlands, and islands; barrier reef resources; coastal vegetation resources; wildlife resources — birds, mammals, amphibians, and reptiles; plankton resources; benthic resources; fisheries resources; essential fish habitat; threatened and endangered species; hydrology; water quality resources; historic and cultural resources; recreation resources; aesthetic resources; air quality; noise; hazardous, toxic, and radioactive waste (HTRW); and socioeconomic and human resources (population; infrastructure; employment and income; commercial fisheries; oyster leases; oil, gas, and minerals; pipelines; navigation; flood control; hurricane protection levees; agriculture; forestry; and water supply). Information regarding gulf hypoxia is also presented.

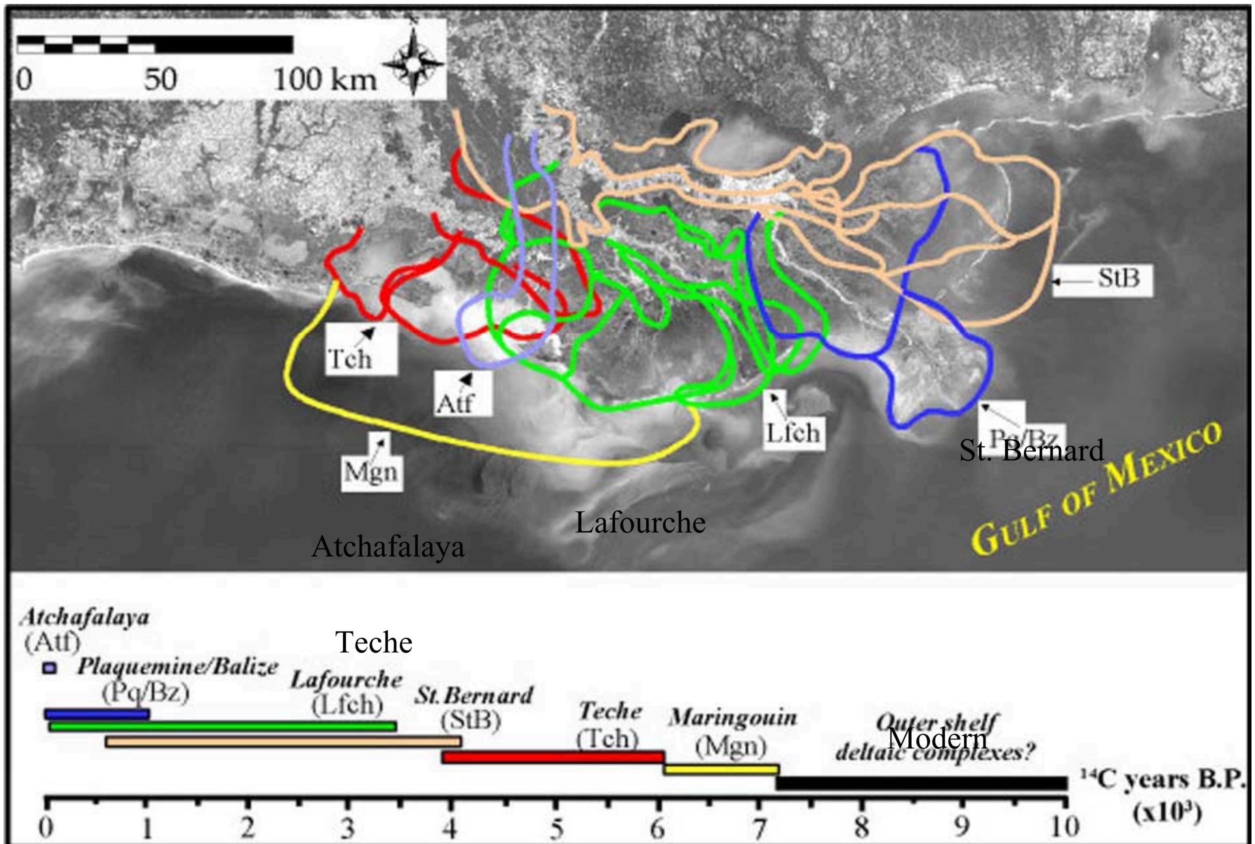
3.1 COASTAL SYSTEM PROCESSES

3.1.1 The Deltaic Cycle

Important contributions to the understanding of the geologic history of the lower Mississippi alluvial valley and the Louisiana coastal plain have been made by Fisk (1944, 1952, 1955), Fisk and McFarlan (1955), McFarlan (1961), Kolb and van Lopik (1966), and Frazier (1967). More recent work by Smith et al. (1986), Boyd and Penland (1988), and Coleman (1988) focuses in detail on the historical development of the Deltaic Plain.

The geologic development of coastal Louisiana is closely related to shifting Mississippi River courses. The Mississippi River has changed its course several times during the last 7,000 years, leading to the development of the Mississippi River Deltaic and Chenier Plains. The Deltaic Plain is composed of six major delta complexes: two prograding and four degrading (see **figure 3-1**). Within a delta complex there may be several major distributaries contributing to the development of individual delta lobes. Frazier (1967) was able to subdivide the Mississippi's delta complexes into 16 separate delta lobes.

In contrast to the Deltaic Plain, the Chenier Plain formed to the west, away from active deltaic growth. When the Mississippi River was in a more westward position, fine silts and clays were transported by westward flowing nearshore currents and deposited as mudflats along the existing shoreline. When Mississippi River deposition ceased or declined, as the river shifted eastward, these mudflats were reworked by marine processes, concentrating the coarser grained sediments and shell material into shore-parallel ridges called "cheniers." Introduction of new sediments by the next westward shift of the Mississippi River resulted in isolation of these ridges by accretion of mudflats gulfward of the ridges. Numerous cycles of deposition and erosion are responsible for creating the alternating ridges separated by marshlands characteristic of the Chenier Plain.



By at least 10,000 years B.P. deltaic sequences were being constructed on the upper shelf during times of relative sea-level stability in the overall rising sea level (Boyd et al. 1989). Following sea-level highstand at approximately 4,000 years B.P., deltaic progradation switched to the east, migrating through distributary switching processes to the west and eventually to the modern Birdfoot Delta (Balize depocenter). Net result of the migrating depocenters is a vertically stacked and offset sedimentary package of primarily deltaic deposits that have created the extensive fluvial networks and wetlands of southern Louisiana. Following abandonment of individual delta lobes the deltaic depocenters became submerged and reworked by marine processes. The depocenters then formed transgressive coastlines, barrier island systems, and ultimately submerged sand shoals on the continental shelf.

Figure 3-1. The Mississippi River Deltaic Plain with locations of major delta complexes. The Atchafalaya and Modern Delta complexes are active and the Teche, Lafourche, and St. Bernard complexes are inactive (*modified from Frazier 1967*)**.**

Recognition that the Deltaic and Chenier Plains are formed by an orderly progression of events related to shifting Mississippi River courses led to the identification and characterization of the deltaic cycle. The delta cycle is a dynamic and episodic process alternating between periods of seaward progradation of deltas (regressive deposition) and the subsequent landward retreat of deltaic headlands as deltas are abandoned, reworked, and submerged by marine waters (transgressive deposition). **Figure 3-2** illustrates the stages in the development of a major delta lobe through its regressive and transgressive phases, from stream capture to submarine shoals (Roberts 1997). Key components of each phase are discussed in the following sections.

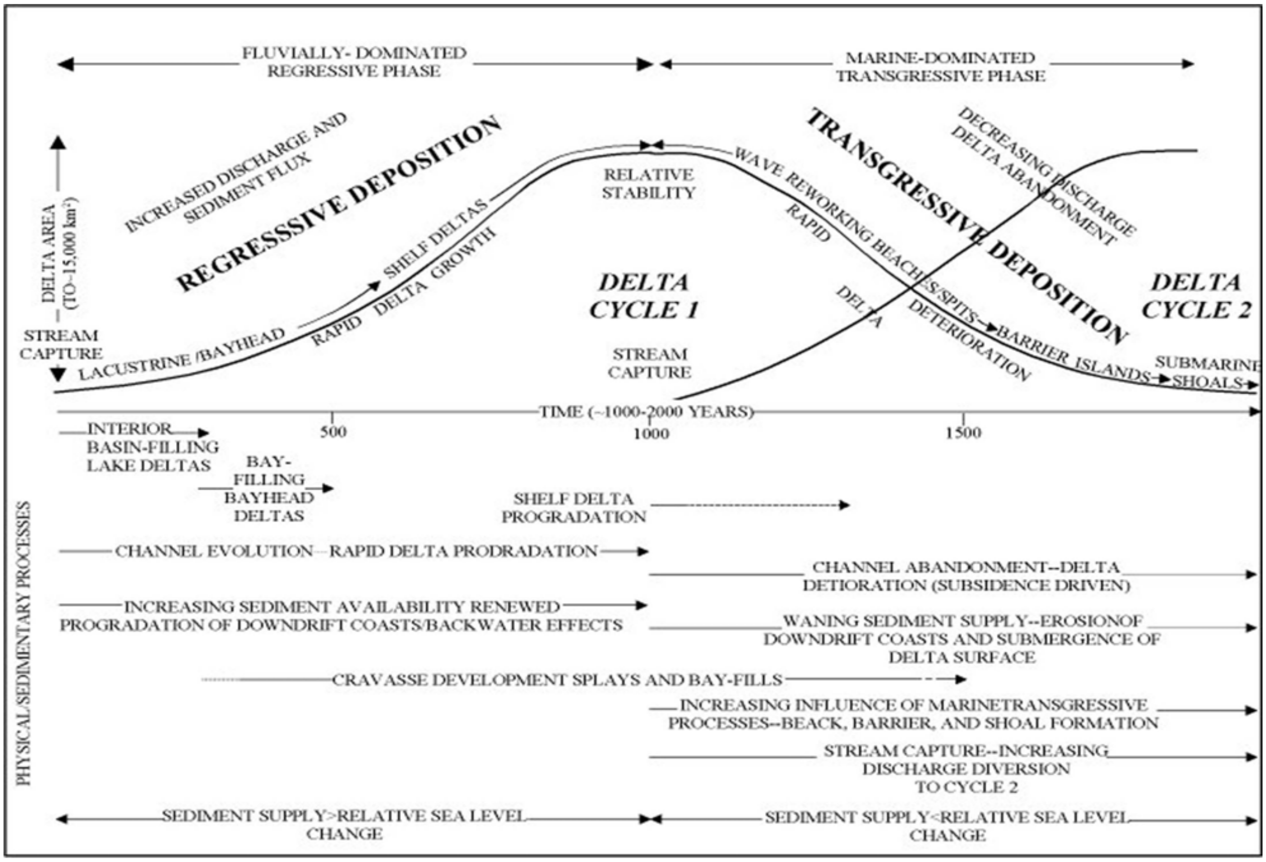


Figure 3-2. Graph of the delta cycle showing the growth and decay of individual delta lobes through processes of fluvial switching and relative sea level change *(from Roberts 1997).*

3.1.1.1 Delta Advancement

The fluvial dominated regressive phase of the deltaic cycle begins with the progressive capture of the primary flow and sediment source by a geologically younger or more efficient channel (**figure 3-2**). This stream capture initiates the filling of inland lakes. Interior lakes fill rapidly with lacustrine, lacustrine delta, and swamp deposits. Fluvial processes dominate this phase with little or no marine influence. Flow into the Atchafalaya River and subsequent Atchafalaya Basin filling is an example of this phase. As the interior basin fills, more fluvial sediments are delivered to the coast by distributaries, resulting in bayhead delta development. Shallow bays are filled with fine sand, silts, and clays resulting in the formation of laterally extensive subaerial delta lobes. The thickness of bayhead deltas is largely dependent on accommodation space (the area available to receive sediments).

The Wax Lake and Atchafalaya Deltas are examples of bayhead deltas. Atchafalaya River sediments reaching the coast are also being carried westward and are deposited as progradation mudflats along the eastern Chenier Plain, thus representing a new episode of the Chenier Plain development process (Huh et al. 1991). As bayhead deltas prograde seaward, shelf stage delta development begins.

3.1.1.2 Delta Abandonment

As the receiving basin fills, there is a reduction in stream gradient and a loss of hydraulic efficiency, which ultimately leads to a new stream capture upriver. The abandoned delta shifts from the fluvial-dominated, progradation phase to the marine-dominated, transgressive phase of the deltaic cycle. During this phase, sediment deposition is reduced or eliminated, and compaction and reworking of the delta lobe lead to land loss and marine transgression (see **figure 3-3**).

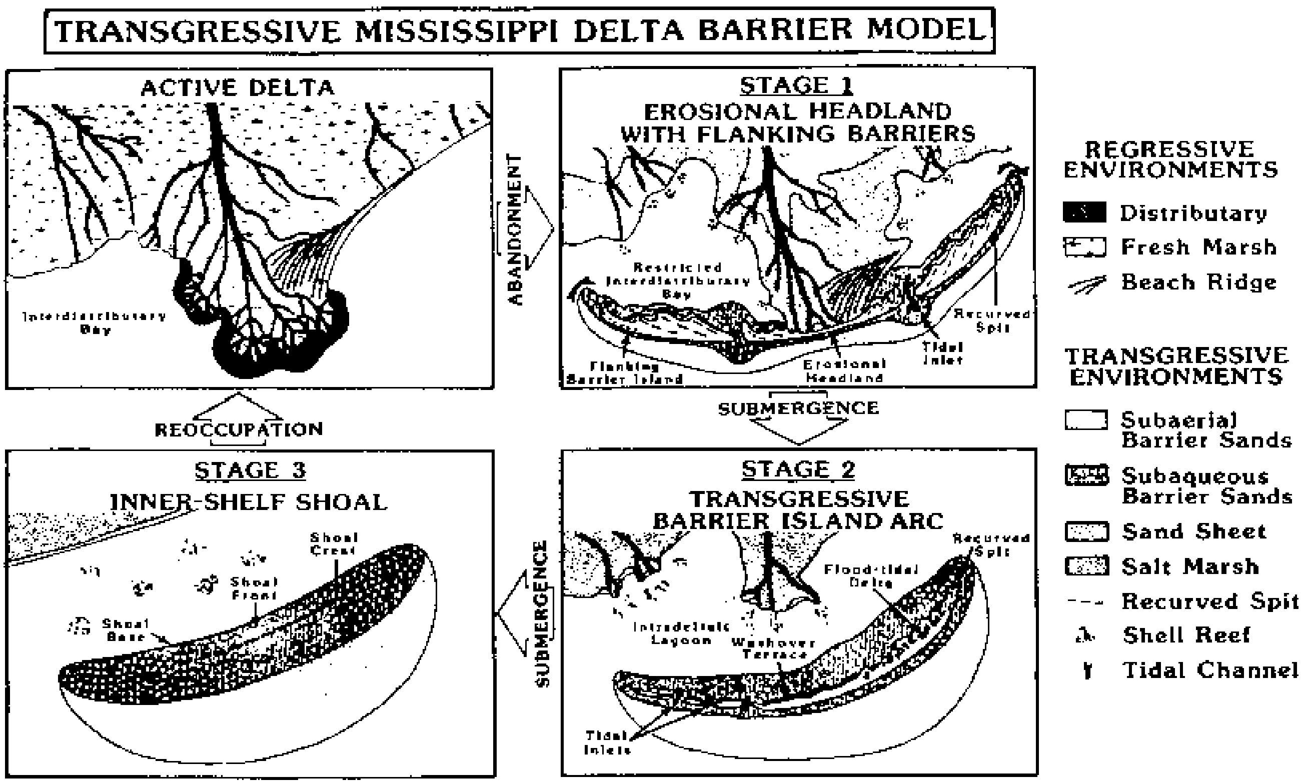


Figure 3-3. Three-stage geomorphic model summarizing the genesis and evolution of transgressive depositional systems in the Mississippi River Deltaic Plain. It begins with stage 1, erosional headland with flanking barriers *(from Penland and Boyd 1981; Penland et al. 1988).*

3.1.2 Deltaic Geomorphology

3.1.2.1 Delta Switching

Delta switching is responsible for constructing the Louisiana coastal plain over the last 7,000 years. The "delta cycle" is controlled by this switching and is characterized by a fluvially-dominated, regressive phase and a marine-dominated, transgressive phase. Many variables act to determine the phase of the "delta cycle" active at any one location. Time, sediment supply, accommodation space, relative sea level change, and rate of discharge are some of the variables responsible for development of the Deltaic and Chenier Plains of coastal Louisiana.

Throughout most of the last 7,000 years the "delta cycle" has created more land by building deltas (regressive phase) than was destroyed by relative sea level change and erosional processes (transgressive phase). Since the early 1900s humans have had a major influence on many of the key elements controlling the delta cycle. The Old River Control Structure has eliminated the delta switching process by maintaining the river in its current position. Flood protection levees built in the early 1900s contain the flow of the river eliminating overbank flooding and the nutrients and sediment that accompany these floods. Also, the sediment load of the Mississippi River has declined by approximately 50 percent between the 1930 to 1952 period and the 1963 to 1982 period (Kesel 1988). This decline has been attributed to bank stabilization by revetments, dams constructed on the Missouri River and other large tributaries, and other erosion control measures. This reduction in sediment load means that even if the delta switching process were restored, delta development would likely be less robust when compared to former deltas.

As the natural delta-building process was restrained, relative sea level rise and erosion (transgressive processes) began to dominate the coastal landscape. Within this environment of diminished delta building, man began a period of extensive development in the coastal zone beginning in the 1950s. Man-made alterations to the natural landscape such as dredging of navigation and access canals, construction of roads and levees within the wetlands, and drainage projects altered the natural hydrology compounding the negative effects of relative sea level change and erosion. Land loss rates exceeding 40 mi^2/yr were documented for the period from 1958 to 1974 and elevated rates of loss continue today.

Coastal Louisiana is characterized by depositional environments and shoreline configurations representing various phases of the delta cycle. Presently, most of the Louisiana coastal zone is in the marine-dominated, transgressive phase of the delta cycle. Only the Modern and Atchafalaya Deltas are in the fluvially-dominated, regressive phase. However, both of these deltas are limited in their development by human influences. The Atchafalaya River flow is limited to 30 percent of the Mississippi River flow, retarding growth of the Atchafalaya and Wax Lake Deltas. Much of the deposition at the mouth of the Modern Mississippi River Delta has been forced into deep water by confining its flow. Shelf edge deltas build less subaerial land mass and contribute less sediment to the nearshore littoral system for nourishing downdrift wetlands than inner shelf deltas.

In the past, areas of the coast experiencing transgression and erosion were ultimately renourished with sediments and nutrients by the next episode of delta switching and progradation. The land loss resulting from erosion and relative sea level change served as a receiving area for these new delta lobes. Without the delta switching process, natural introduction of significant volumes of sediment and nutrients to degraded coastal areas is difficult. Controlling the natural delta-building processes has extended the marine-dominated, transgressive phase longer than would be expected for large areas of the coast. Without significant introduction of sediment and nutrients, those declining delta lobes within the coast will continue to deteriorate at a rapid rate.

3.1.2.2 Biologic Diversity and Delta Switching

The deltaic cycle of growth, abandonment, and degradation is paralleled by the cycle of biological diversity and productivity (**figure 3-4**). However, this second cycle peaks slightly after the geologic cycle. The biological diversity and productivity of the Mississippi Deltaic Plain is linked to the extensive diversity of coastal habitats in this geographically distinct central Gulf coast region. The biological productivity cycle is at its highest during the early degradation phase of the geologic cycle. In this phase, the marshes are fragmented by channels, ponds, lakes, and bays and thus, have an increasing amount of “edge” (land-water interface). Net primary plant productivity and fishery productivity are the highest in this phase. The inshore shrimp harvest is especially correlated to the edge in a delta (Turner 1979).

In addition, estuaries in general and coastal wetlands in particular, tend to produce an excess of organic material, some of which is exported seaward where it represents a major energetic pathway and supports coastal fisheries (Day et al. 1989). This is known as the “outwelling” hypothesis (Odum 1980).

As the delta degradation phase continues, biological diversity and productivity also eventually declines (**figure 3-4**). Generally, there is no longer the natural interplay of the various stages of the delta cycle across coastal Louisiana to offset delta degradation or losses in one area with delta progradation or increase in other areas. Consequently, both land-building and biological diversity and productivity continue to peak and decline.

From an ecosystem restoration perspective, a "return" to an earlier part of the delta phase would initially have an associated reduction in biological productivity and habitat diversity for that basin. Hence, restoration of coastal Louisiana requires consideration of the trade-offs between the land building via the river versus the potential impacts to biological productivity and habitat diversity. From a coast wide perspective, the Louisiana coastal area is a dynamic system, and while one area may be land building with resultant reduction in biological productivity and habitat diversity, there remain many other areas that will continue to suffer land loss and associated increases in biological diversity and productivity. Hence, coast wide, there would continue to be a dynamic interplay of the many different habitats that characterize the Louisiana coastal area with different ranges of biological diversity and productivity, which would be similar to what has been experienced over the past.

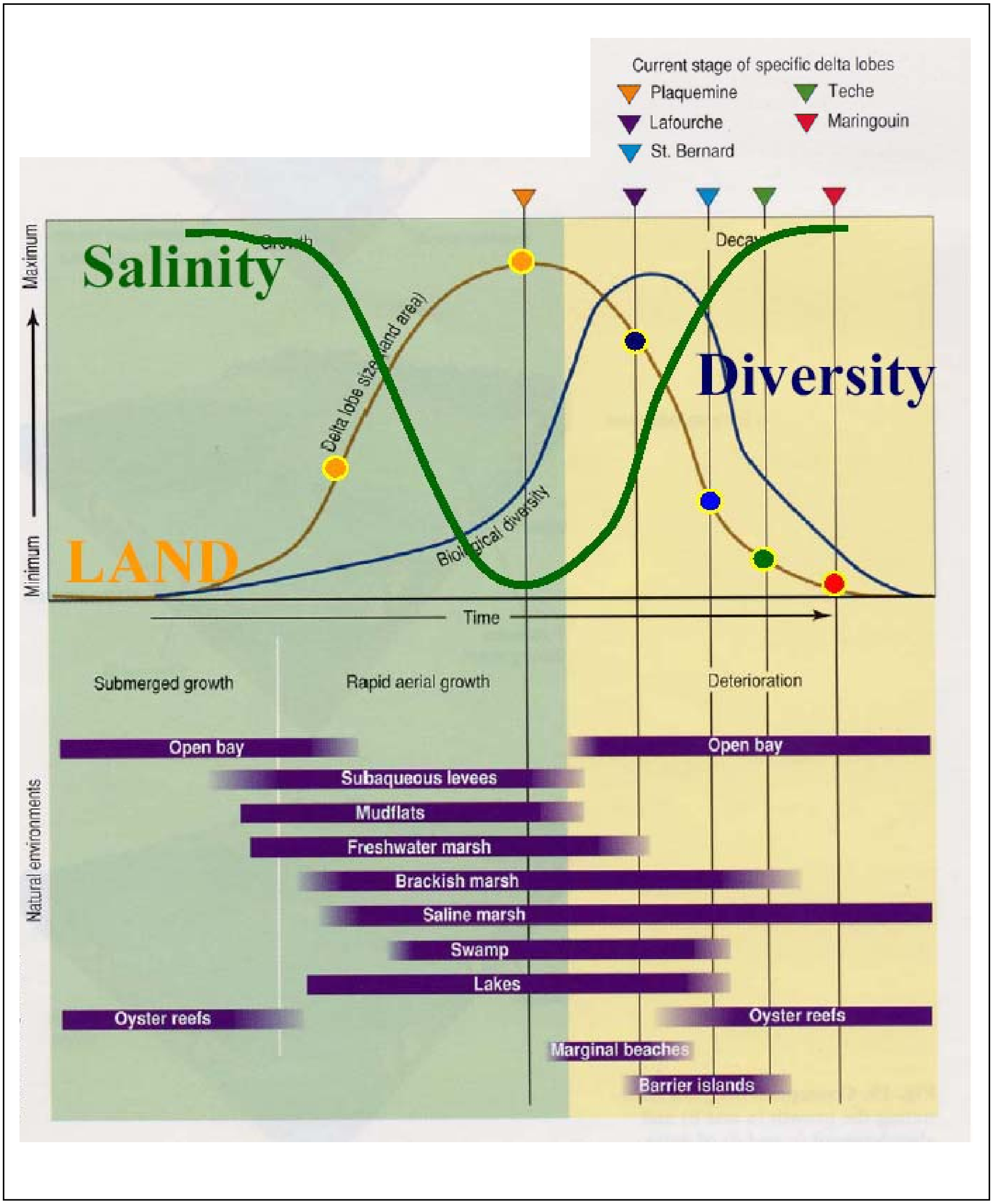


Figure 3-4. Graphical depiction of the growth and degradation of a delta lobe *(adapted from Gagliano and van Beek 1975; and Neill and Deegan 1986).*

3.1.2.3 Relative Sea Level Change

The entire Louisiana coastal zone is experiencing relative sea level rise (RSLR). RSLR is defined here as the net effect of numerous processes that result in the downward displacement of the land surface relative to sea level. RSLR is controlled by several major factors that include eustatic sea level, geosynclinal downwarping, compaction of Holocene deposits, and faulting (currently estimated to be between 0.6 and 1.3 m^3/yr). Recent studies have shown that subsurface fluid withdrawal may be a contributor to RSLR, but the magnitude of its contribution is not well understood (Morton et al. 2002).

Eustatic sea level refers to the global fluctuations in sea level primarily due to changes in the volume of major ice caps and glaciers, and expansion or contraction of seawater in response to temperature changes. Past studies based on worldwide tide gauges estimate the rate of eustatic sea level rise at 0.12 m^3/yr (0.04 inch/yr) (Gornitz et al. 1982). More recent studies have predicted an increase in this rate to 0.34 m^3/yr (0.13 inch/yr) for the next 100 years due to global warming (USEPA 1995).

Downwarping (regional subsidence of the earth's crust) of the Gulf Coast Geosyncline accounts for a small percentage of the observed RSLR in coastal Louisiana. For millions of years, fine sediments have been deposited along the continental margin, downwarping the basement and creating a gradually subsiding trough. The downwarping continues as new sediments are added to the basin. Kolb and van Lopik (1958) estimate the rate of downwarping at 0.02 m^3/yr (0.008 inch/yr) over the last 60 million years, with the greatest downwarping occurring during periods of maximum deposition.

Compaction of Holocene deposits is considered the primary contributor to RSLR in the coastal plain. The three major components of Holocene sediment compaction include 1) primary consolidation, 2) secondary compression, and 3) oxidation of organic matter (Terzaghi 1943; Roberts 1985). Primary consolidation occurs as the volume of the soil mass is reduced due to dewatering under a sustained load. Secondary compression results from a decrease in soil volume due to rearrangement of the internal soil structure. Oxidation of organic matter through chemical reactions reduces the soil volume.

Compaction of Holocene sediments varies widely throughout the coastal zone and is closely linked to the thickness and age of deposits. Fine-grained deposits with high water contents characterize the coastal zone. The thicker the deposits, the more interstitial water is available for removal, which leads to high rates of RSLR as they compact. Older deposits have already undergone most of the primary consolidation and secondary compression and therefore exhibit lower RSLR rates than recently deposited sediments. The age, thickness, and to some extent the type of deposits, are responsible for the variability in RSLR rates across the coast.

Movement on the downthrown side of deep-seated fault blocks is a well-documented process in coastal Louisiana. However, the effects on the shallow subsurface and surface are poorly understood. A recent investigation by Gagliano et al. (2003) identified likely areas of fault-induced subsidence, but the magnitude and spatial extent of their impact are still being determined. Morton et al. (2002) proposed that extraction of oil and gas from deep reservoirs in south Louisiana may result in accelerated rates of RSLR at the surface. A minor amount of movement along fault planes can have major impacts on wetlands where accretion barely exceeds RSLR.

An important man-made contributor to RSLR is drainage of wetlands for agriculture, flood protection, and development. Forced drainage results in lowering the water table, resulting in accelerated compaction and oxidation of organic material. RSLR of up to several feet has been documented in developed areas of Jefferson and Orleans Parishes, and large areas of coastal land loss are found associated with failed land reclamation projects.

Marsh accretion plays a critical role in the existence of marsh habitat by maintaining elevation within a given tidal range. Accretion takes place through a combination of mineral sediment and organic matter accumulation (Hatton et al. 1983). Marsh surfaces must vertically accrete to keep pace with the rate of RSLR or they will be submerged. Hydrologic modifications resulting from the construction of levees, navigation channels, and access canals have reduced the amount of mineral sediments available to the marshes. In general, marsh accretion rates vary from approximately 0.5 m^3/yr (0.2 inch/yr) to 1.3 m^3/yr (0.5 inch/yr), depending on proximity to the source of sediment. In many locations the accretion rate is not great enough to equal or exceed the RSLR rate.

3.2 SOILS

3.2.1 Historic and Existing Conditions

This resource is institutionally significant because of: the CEQ memorandum of August 11, 1980, entitiled "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act (NEPA);" Executive Order 11990 - Protection of Wetlands; and the Agriculture and Food Act of 1981 (Public Law 97-98) containing the Farmland Protection Policy Act (PL 97-98; 7 U.S.C. 4201 *et seq*.).

Coastal land loss is directly and inextricably linked to the five factors of soil formation. There are six general soil groups in the Louisiana coastal zone. These groups align with physiographic sub-regions identified in Agricultural Handbook 296. The following subsections present a description of the soil formation factors that are key elements for restoration efforts.

3.2.1.1 Factors of Soil Formation

Soil is a natural, three-dimensional body that forms on the earth's surface. The five main factors that influence the process of soil formation include: climate; formation of the soil material from the parent material; the physical and chemical composition of the original parent material; the kinds of plants and other organisms living in and on the soil; the relief of the land and its effect on runoff and erosion; and the length of time the soil has to form. The effect of any one factor can differ from place to place, but the interaction of all the factors determines the kind of soil that forms. Interaction of the factors results in differences among the soils and has an effect on the type of properties expressed in soils at any given site.

Parent Material: The soils in the Louisiana coastal zone formed in either alluvial sediments or loess, and many have accumulations of organic material in the upper part. Some soils are organic throughout, and some, nearest to the coast, formed in marine sediments. The alluvium is from distributary streams of former deltas of the Mississippi River (Saucier 1974).

Bordering the stream channels are low ridges called natural levees. These levees are highest next to the channels and slope gradually into backswamps further from the channels. The levees are shaped by waters that overspread the stream banks. When the water slows, it drops sand, then silt, and finally, clay particles. Thus, the soils on the highest parts of natural levees generally formed in loamier parent materials. These soils are generally lighter in color, more permeable, and better drained than the soils on the lower part of the natural levees and in the backswamps. The soils on the lower part of the natural levees and in the backswamps beyond the natural levees generally formed in more clayey parent materials that were deposited by slowly moving water or stagnant backwater.

Organic material accumulates in areas that are continuously saturated or flooded. Water prevents the complete oxidation and decomposition of the plant residue. Water, vegetation, and time, coupled with a change in sea level and land subsidence, created conditions where thick layers of organic material accumulated in the marshes. Historically, the buildup of organic material kept pace with land subsidence and sea level change during the advancement phase of the delta cycle.

Climate: The Louisiana coastal zone has a humid subtropical climate characteristic of areas near the Gulf of Mexico. The warm, moist climate promotes rapid soil formation by determining water availability for weathering minerals, transporting the materials released, and through its influence on temperature that determines the rate of chemical weathering in the soil.

Plants and Other Organisms: This factor includes plants, bacteria, fungi, and animals. The native plants, and their associated complex communities of bacteria and fungi, generally have a major influence on soil formation. Additionally, human activities, such as cultivating crops, channel construction, burning, draining, diking, flooding, paving, and land smoothing, affect the soil. Some soils in the coastal zone have been changed drastically through artificial drainage that de-watered and made firm the formerly semi-fluid clay layers in those soils.

Relief**:** Relief and the landscape position have influenced the formation of the different soils. Relief and other physiographic features mainly influence soil formation processes by affecting internal soil drainage, runoff, erosion and deposition, salinity levels, and exposure to the sun and wind. In the coastal zone, sediment historically accumulated at a much faster rate than erosion removed sediments. This accumulation of sediment throughout the active Deltaic Plain occurred at a faster rate than many of the processes of soil formation. This is evident in the distinct stratification in lower horizons of some soils. Levee construction and other water-control measures may have reversed this trend for some soils. Soil slope and rate of runoff on the alluvial soils are low enough that erosion is not a major problem. However, the slope and rate of runoff on the terrace uplands are high enough to be an erosion hazard.

Differences in the content of organic matter in the soils are related to the length of time the soils remain saturated, and consequently, to relief. The content of organic matter generally increases as the length of time the soil remains saturated increases, and at some point, a layer of partially decomposed organic matter begins to accumulate on the surface. Soils on higher positions of the landscape have better surface runoff, internal drainage, and aeration. This allows more rapid and complete oxidation of organic matter to take place. The soils on lower positions of the landscape receive runoff from those on higher positions; thus, the soils on lower positions remain saturated nearer to the surface for longer periods. In many areas, suitable outlets do not exist for the water to readily leave these areas.

The overall surface elevation in the coastal zone relative to sea level is slowly changing because the soils are on a low-lying, slowly subsiding landmass. In addition, post-depositional sediment compaction can result in some subsidence, and local deposition of sediment can contribute to similar, but more localized changes.

Time: In general, the soils of the coastal zone formed in various kinds of parent material, ranging in age from the most recent deposits along distributary channels and in swamps and marshes to the late Pleistocene sediments that form the core of the terrace uplands.

3.2.1.2 Soil Formation

Processes that result in development of soil structure have occurred in most of the mineral soils. Plant roots and other organisms contribute to the rearrangement of soil material into secondary aggregates. The decomposition products of organic residue and the secretions of organisms serve as cementing agents that help stabilize structural aggregates. Alternate wetting and drying, as well as shrinking and swelling, contribute to the development of structural aggregates and are particularly effective in soils that have appreciable amounts of clay. Consequently, soil structure is typically most pronounced in the surface horizon, which contains the most organic matter, and in clayey horizons that alternately undergo wetting and drying.

3.3 OFFSHORE SAND RESOURCES

Potential sand resources suitable for coastal restoration purposes include the major offshore sand shoals, near-shore sand bodies, and sand rich shoreline depositional areas such as distributary mouth-bar deposits, tidal inlets, and tidal deltas. Of these, the offshore sand shoals and the larger nearshore sand bodies represent potential sources for the millions of tons of sand sediment that would be necessary for coast wide restoration. These offshore sand resources are especially essential for the restoration of the barrier shorelines, headlands, and islands. Louisiana's four major sand shoals are described in the following subsections, followed by a description of the nine near-shore sand bodies located off the Barataria barrier shoreline.

3.3.1 Historic and Existing Conditions

3.3.1.1 Trinity Shoal, Outer Shoal, St. Bernard Shoals, and Ship Shoal

Penland et al. (1986), Williams et al. (1989), Suter et al. (1991), Kulp et al. (2002), and Williams et al. (2002) describe Louisiana's major sand shoals that contain large volumes of high sand content sediment suitable for coastal restoration. These shoals, the reworked remnants of former deltaic lobes, include: Trinity Shoal, Outer Shoal, St. Bernard Shoals, and Ship Shoal (see **figure 3-5**).

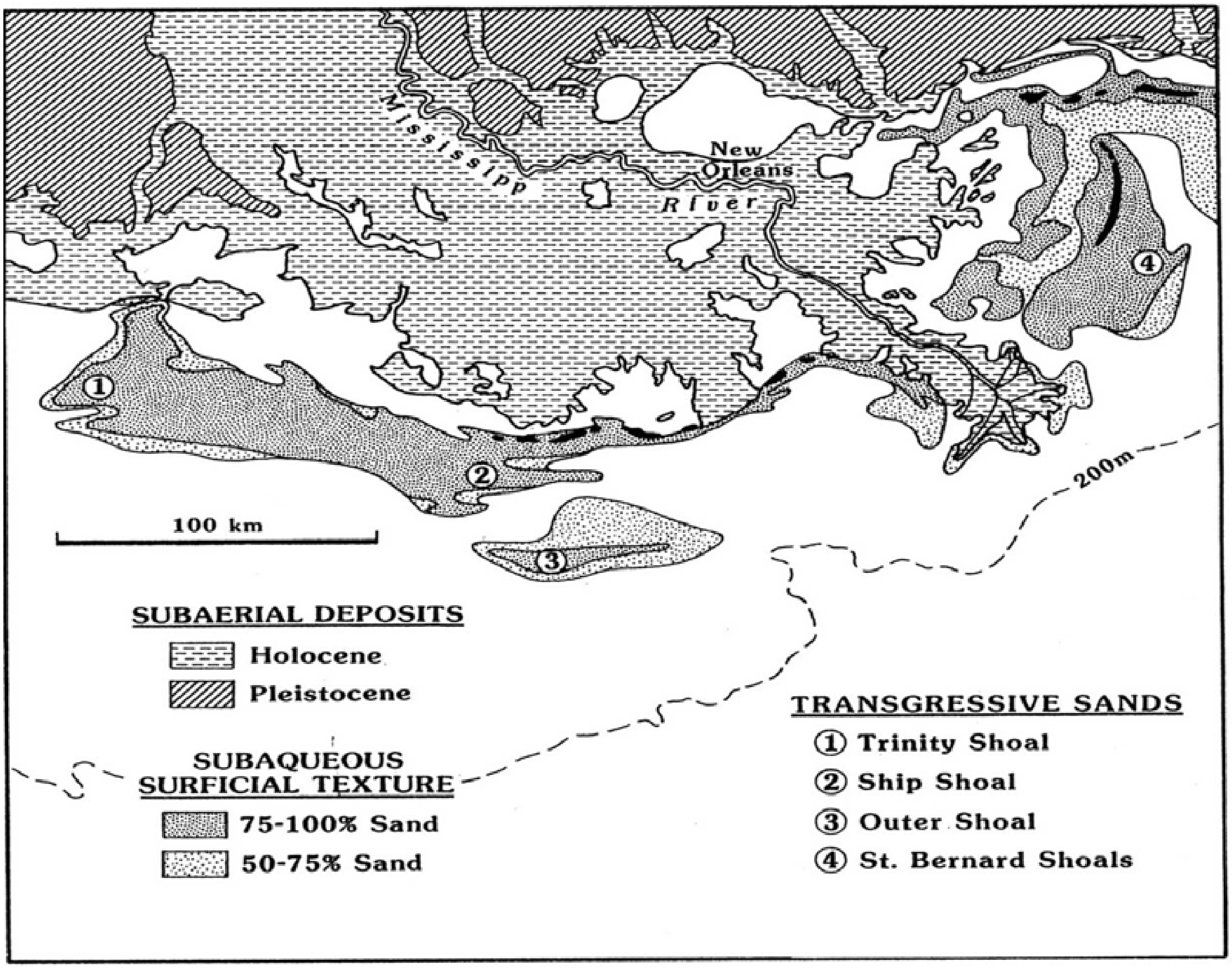


Figure 3-5. Louisiana offshore sand sources: Trinity Shoal, Ship Shoal, Outer Shoal, and St. Bernard Shoals *(from Penland et al. 1986).*

Trinity Shoal is a large, isolated shoal located on the western Louisiana shelf offshore of Marsh Island and Cheniere Au Tigre. This shoal, approximately 18 miles (29 km) long and 3 to 6 miles (4.83 km) wide, is covered by approximately 23 to 32 ft (7 to 10 meters (m)) of water and has 6 to 12 ft (1.8 to 3.6 m) of relief relative to the surrounding seafloor.

Outer Shoal is approximately 21.75 miles (35 km) long, 3.11 to 6.21 miles (5 to 10 km) wide, and lies approximately 15.53 miles (25 km) seaward of Ship Shoal on a platform lying between the –18 to –20 m (–19.6 to –21.8 m) isobaths (an imaginary line or one drawn on a map connecting all points of equal depth below the surface of a body of water).

The St. Bernard Shoals, a set of smaller 3 to 4 mile (4.8 to 6.4 km) wide shoals within a larger inner shelf sand body, are located approximately 20 miles (32.2 km) offshore of the Chandeleur barrier islands.

Ship Shoal, the largest submerged shoal off Louisiana, is a Holocene sand body located on the south-central Louisiana inner shelf about 9.32 miles (15 km) seaward of the Isles Dernieres. Ship Shoal is approximately 31.07 miles (50 km) long and 3.11 to 7.46 miles (5 to 12 km) wide, with relief of up to 11.81 ft (3.6 m). It lies in a water depth of 19.69 to 29.53 ft (6 to 9 meters) and is composed primarily of well-sorted quartz sand, a benthic substrate not commonly found on the Louisiana inner shelf (Stone 2000). The geologic framework and character of Ship Shoal and the surrounding area has been described from the results of several studies that involved the collection of seismic reflection and vibracore data. Penland et al. (1986) and Cuomo (1984) provide relatively comprehensive descriptions of Ship Shoal area geology and the in situ sand resource.

Resource estimates for the volumes of sand comprising the Ship Shoal structure are 1.2 billion cubic meters (m^3) (15.6 billion cy) ranging from very fine to medium sand, 112 million m^3 (151 million cy) in the shoal crest, 430 million m^3 (580 million cy) in the shoal front, and 640 million m^3 (864 million cy) within the shoal base. An additional 123 million m^3 (166 million cy) of sand is estimated to be contained as distributary channel fill deposits under the shoal (Penland et al. 1986).

3.3.1.2 Offshore Meteorology and Physical Oceanography

The Louisiana inner shelf is an example of a low-energy environment where significant hydrodynamic activity is generated almost exclusively by local storms, including both tropical (summer) and extratropical (winter) storms. The degree to which Ship Shoal mitigates the wave climate along the Isles Dernieres and the central Louisiana coast has been studied in recent years by researchers from LSU through a cost-sharing arrangement between LSU and the U.S. Minerals Management Service. These efforts have provided baseline information relative to wind and wave conditions, as well as bottom currents in and around the Ship Shoal area.

3.3.1.2.1 *Meteorology of Ship Shoal Area*

Stone (2000) recently completed a three-year field study of the Ship Shoal area that involved the deployment of bottom-mounted instrumentation to collect data relative to bottom currents and sediment transport. However, a primary focus of the work was to investigate the influence of meteorological conditions and, in particular, high-energy wind events (storms) on inner shelf processes in Louisiana. Wind records indicate that, annually, average wind speed in coastal Louisiana is approximately three meters/second (m/s) (9.8 ft/s) from the southeast. Hourly wind data during the deployment period were obtained from the National Oceanographic and Atmospheric Administration (NOAA) station located on Grand Isle, Louisiana at $29^{o}27'$ N, $89^{o}96'$ W (Station GDIL1). These measurements were supplemented by daily national weather maps obtained from the National Weather Service, which were inspected visually to verify the occurrence of cold front passages.

Wind speed during the deployment averaged 4.8 m/s (15.7 ft/s) and had a mean direction toward the southwest (228^{o}). Hourly wind speed and direction for the deployment period are shown in **figures 3-6** and **3-7,** which clearly demonstrate the increases in wind speed characteristic of extratropical storms, as well as the clockwise rotation of wind direction during their passage.

Spectral analysis of the wind speed over the 61-day deployment period shows a statistically significant peak in energy at a frequency of roughly every five days, or approximately the same as that of extratropical storm passages (**figure 3-8**). This suggests that extratropical storms were responsible for most of the variability in wind speed during this time, a result consistent with other published research for the northern Gulf of Mexico.

Nine storms occurred during the 61-day deployment, a frequency of one every 6.8 days. Mean wind speed and direction were 8.1 m/s (26.5 ft/s) and 174^{o}during storms and 3.8 m/s (12.4 ft/s) and 293^{o} during fair weather. On the whole, storms during the period were characterized by strong winds blowing toward the south, while the mean wind direction during fair weather was westerly.

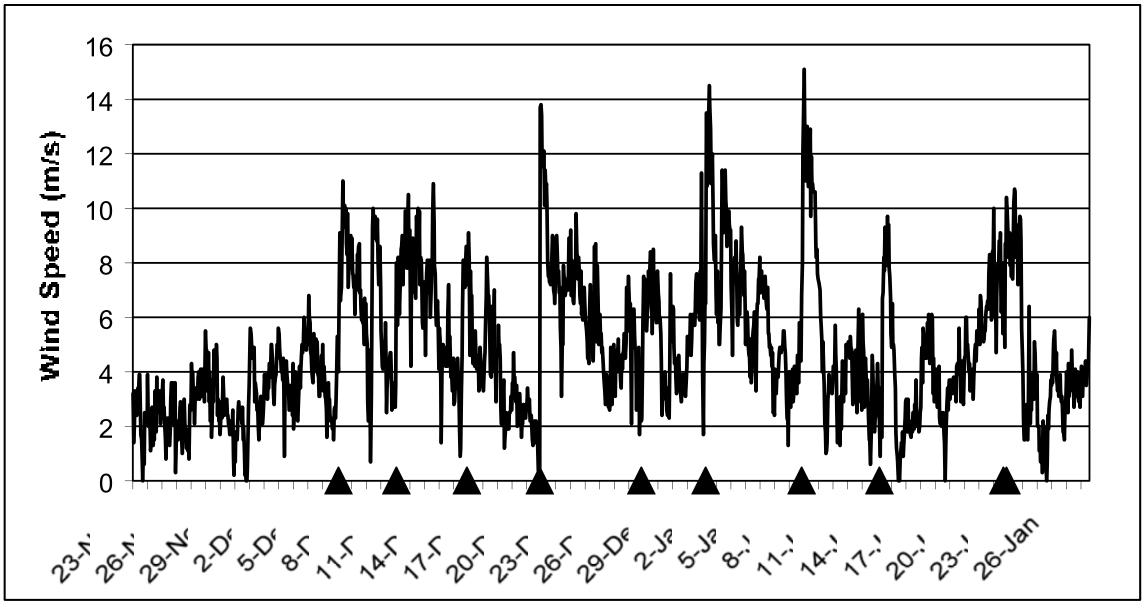


Figure 3-6. Wind speed during the instrumentation deployment period for the Stone (2000) study. Black arrows indicate the time of the cold front passages associated with extratropical storms.

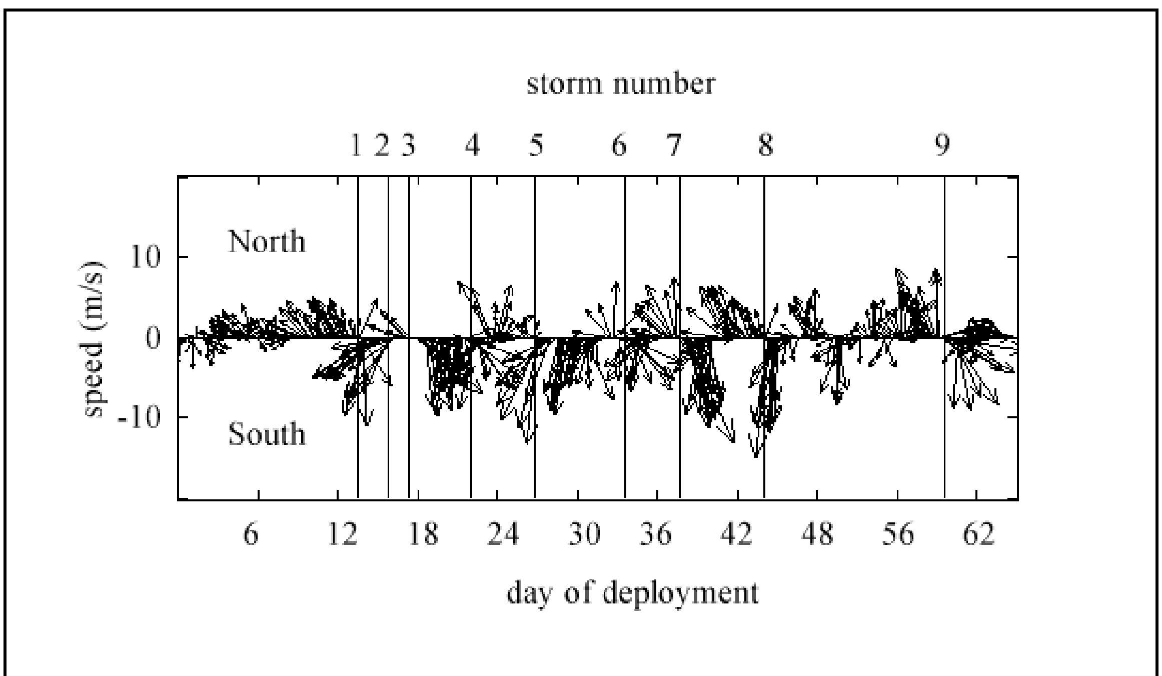


Figure 3-7. Feather plot of hourly wind vectors during the instrumentation deployment period for the Stone (2000) study.

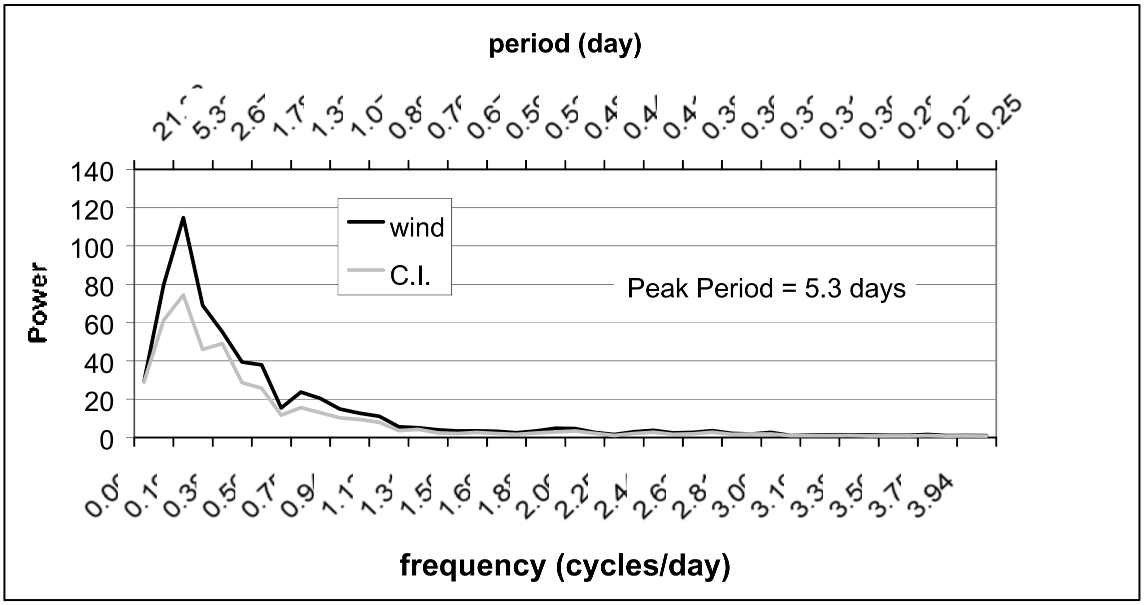


Figure 3-8. Power spectrum of wind speed during the instrumentation deployment period for the Stone (2000) study. C.I. represents the 90 percent confidence interval.

3.3.1.2.2 *Physical Oceanography of the Ship Shoal Area*

The recently completed three-year field study of wave climate, wave-current interactions, bottom boundary layer dynamics, and sediment transport in the Ship Shoal area, landward to the inner shelf adjacent to the Isles Dernieres conducted by Stone (2000) gives the most complete picture of the wave and current climate in the Ship Shoal area to date. The study was a follow-up effort to a numerical modeling effort completed in October 1996 (Stone and Xu 1996). **Figure 3-9** shows the location of the field effort and the location of bottom-mounted instrumentation.

The project involved: (1) directional wave spectra measured simultaneously at two geographical locations to check the numerically modeled results obtained from the wave modeling effort; (2) direct field measurements of temporally- and spatially-varying directional wave spectra at two proposed locations conducted under different wave conditions (storms, fair weather, etc.) to facilitate numerical model output checking and to develop a quantitative wave climate for the study area; and (3) direct field measurements of bottom boundary layer hydrodynamic processes and suspended sediment transport. The data analysis indicates that massive and rapid sediment movement occurs on Ship Shoal during storm events. This sediment movement is important in understanding the dynamics of the shelf/shoal complex.

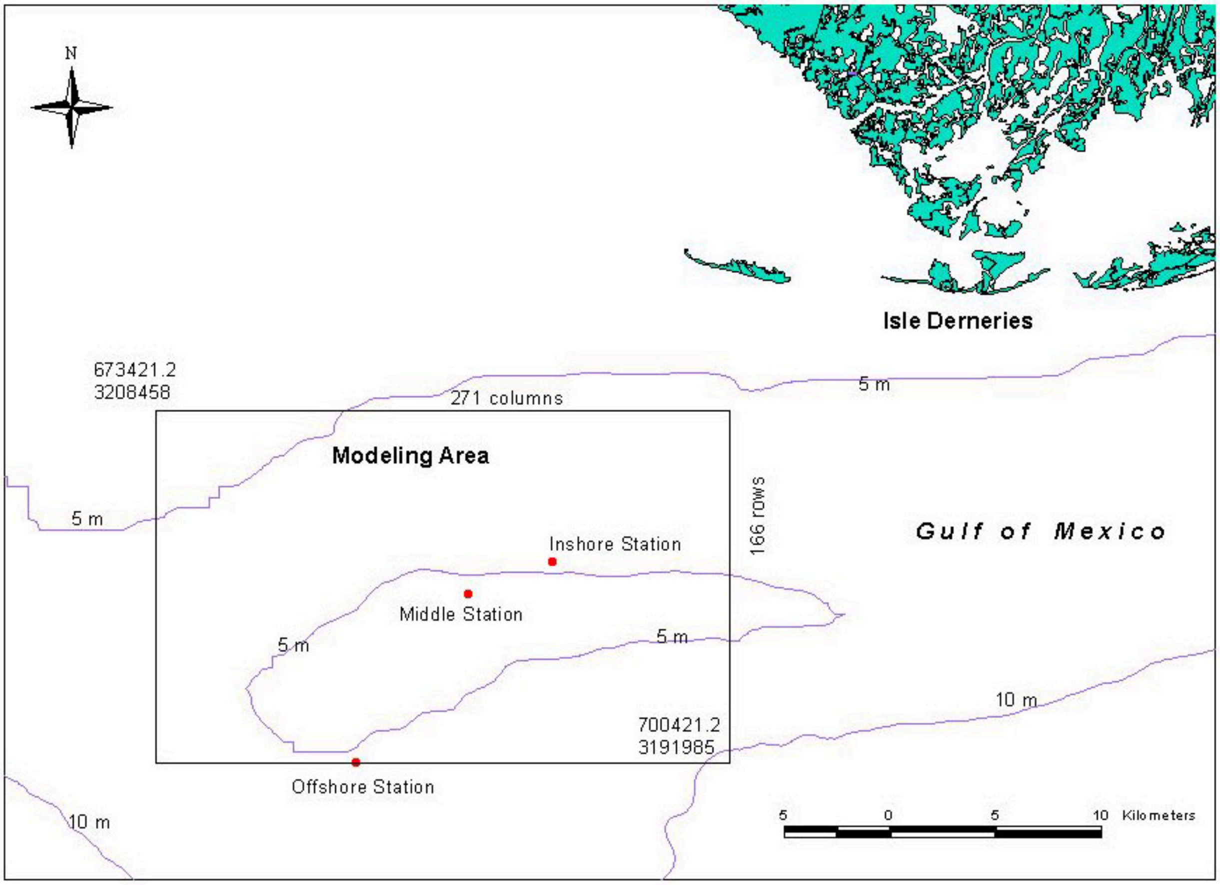


Figure 3-9. Location of the Stone (2000) field effort and bottom-mounted instrumentation. Site 1 = Offshore Station, Site 2 = Inshore Station. An additional site (Middle Station) was established for the 2000 deployment.

3.3.1.2.3 *Wave Climate*

The wave climate in and around the Ship Shoal area can be characterized using both hindcast and measured data. **Table 3-1** shows the location of hindcast and actual data stations. In a 20-year (1956–1975) hindcast Wave Information Study (WIS) conducted by the USACE (Hubertz and Brooks 1989), statistics from the hindcast stations adjacent to the study area indicated an annual-mean significant wave height of 1.0 ± 0.2 m (3.28 ± 0.6 ft) and mean peak period of 4.5–6.0 seconds. The maximum hindcast wave heights at the same stations exceeded 5 m (16.4 ft), and the wave peak period associated with the largest wave exceeded 11 seconds. The monthly mean significant wave heights in winter months (December - March) were 0.2–0.6 m (0.6–1.9 ft) higher than that of the rest of the year. The data also show that the predominant wave directions were from the southeastern quadrant.

Despite the dominant low wave energy environment in the study area, tropical storms and hurricanes influence sea state significantly. The 20-year hindcast of hurricane waves shows that the significant wave height for a 50-year return period is greater than 15 m (49.2 ft). The 5-year return period significant wave height is approximately 6–7 m (19.6–22.9 ft).

Table 3-1. Sources of wave climate data.

Sources	Lat. (N)	Long. (W)	Water Depth (m)
WIS 19	28.5^o	91.0^o	33
WIS 20	28.5^o	90.5^o	38
WIS 21	28.5^o	90.0^o	91
NDBC 42017	27.5^o	90.5^o	407
LATEX 16	28.9^o	90.5^o	21

3.3.1.2.4 *Bottom Currents at Ship Shoal*

Table 3-2 presents an overall summary of hydrodynamic parameters for the entire deployment for the Stone (2000) study. The data indicate that Ship Shoal has an important effect on regional hydrodynamics; an influence that is presumably also significant on any inner shelf that includes submerged sand bodies or other prominent bathymetric features. Furthermore, this has important implications for bottom boundary layer dynamics and sediment transport on the south-central Louisiana inner shelf. In particular, storm events resulted in significant increases in wave height and current velocities, supporting prior observations that the area is a storm-dominated one. Significant wave height during the observed storm events was several times the mean fair weather value and was clearly higher at Site 1 (offshore) than at Site 2 (nearshore), supporting the conclusion that Ship Shoal is responsible for measurable wave energy attenuation. Dramatic increases in both mean and wave-driven flow tended to accompany storms (**figures 3-10** and **3-11**). F**igure 3-12** illustrates the observed current speed relative to direction at Site 1.

Table 3-2. Summary of hydrodynamic parameters recorded by the systems throughout the deployment for the Stone (2000) study.

Location		***Site 1 (Offshore)***		***Site 2 (Nearshore)***
System	***Statistic***	***1A (ADV)***	***1B (WADMAS)***	***2A (ADV)***
Total Depth (m)	Mean	8.8	9.0	7.3
	Minimum	8.2	8.4	6.7
	Maximum	9.2	9.5	7.8
Hs (m)	Mean	n/a	0.61	0.45
	Minimum	n/a	0.07	0.10
	Maximum	n/a	2.80	1.53
Tp (s)	Mean	n/a	5.3	5.0
	Minimum	n/a	3.6	3.6
	Maximum	n/a	9.1	9.1
Orbital Velocity (cm/s)	Mean	11.7	10.6	9.9
	Minimum	2.6	0.8	0.0
	Maximum	35.9	53.1	36.5
Current Speed (cm/s) (~0.3m above bed)	Mean	5.8	4.6	6.3
	Minimum	0.1	0.1	0.0
	Maximum	44.8	34.2	47.6
Current Speed (cm/s) (~1m above bed)	Mean	12.4	8.0	13.9
	Minimum	0.1	0.1	0.0
	Maximum	72.4	53.2	62.3
Current Direction	Mean	245	240	292

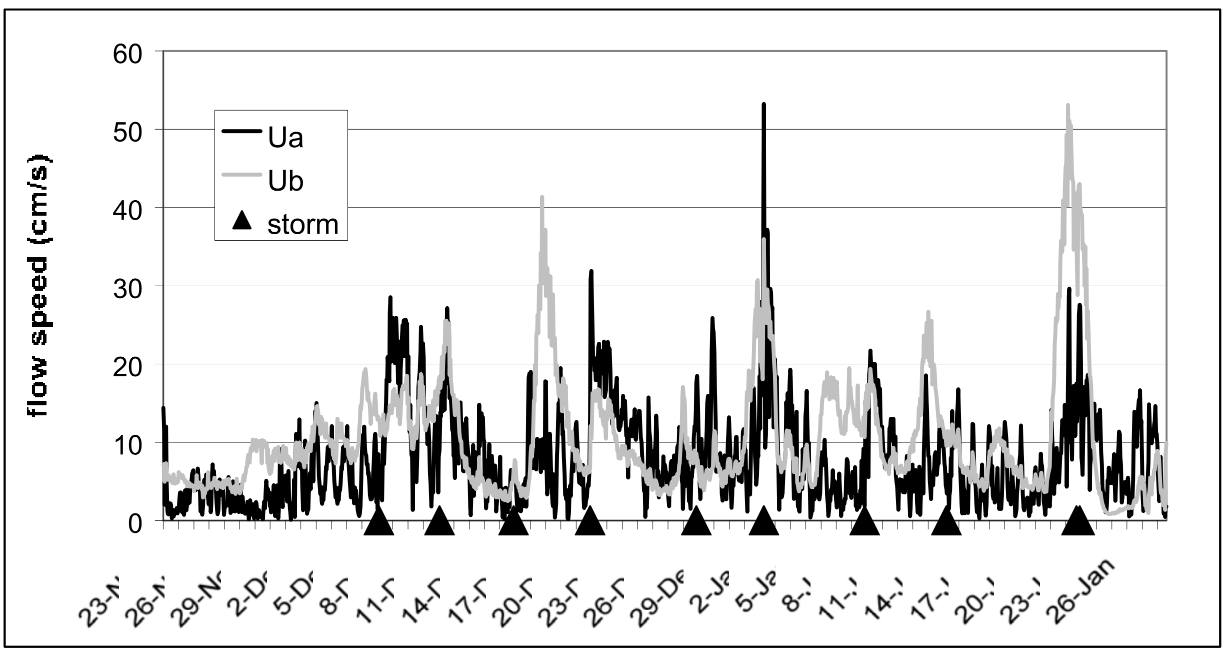


Figure 3-10. Flow speed of mean (Ua) and orbital (Ub) currents at Site 1 (Stone and Xu 1996).

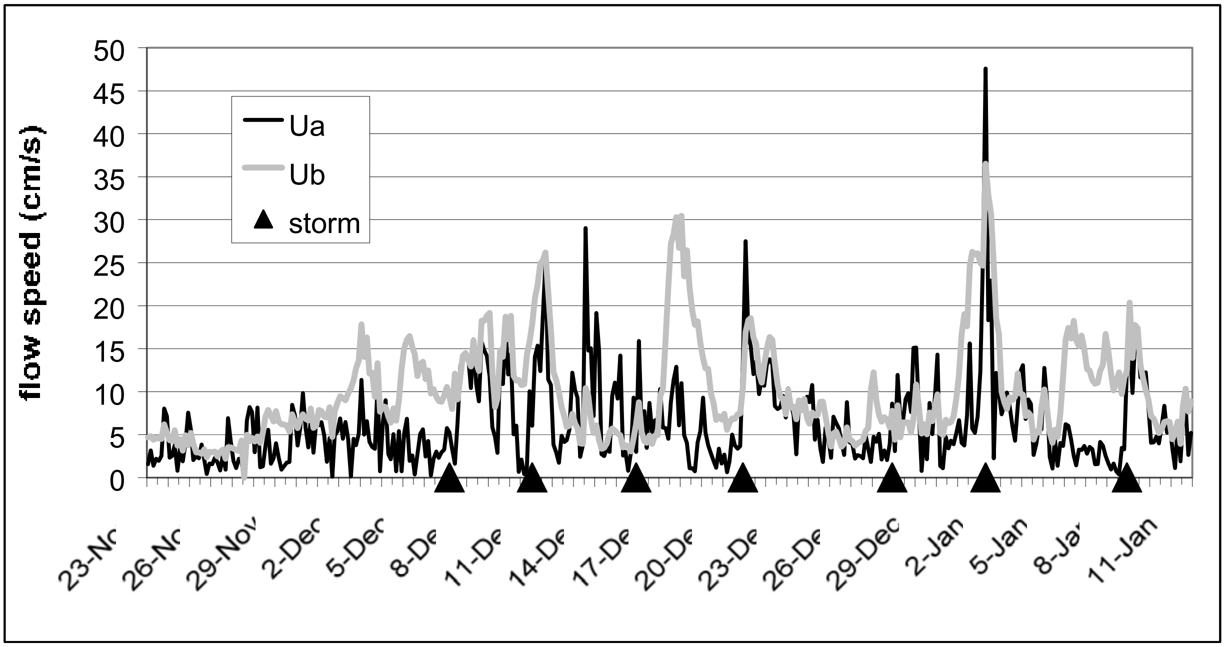


Figure 3-11. Flow speed of mean (Ua) and orbital (Ub) currents at Site 2 (Stone 2000).

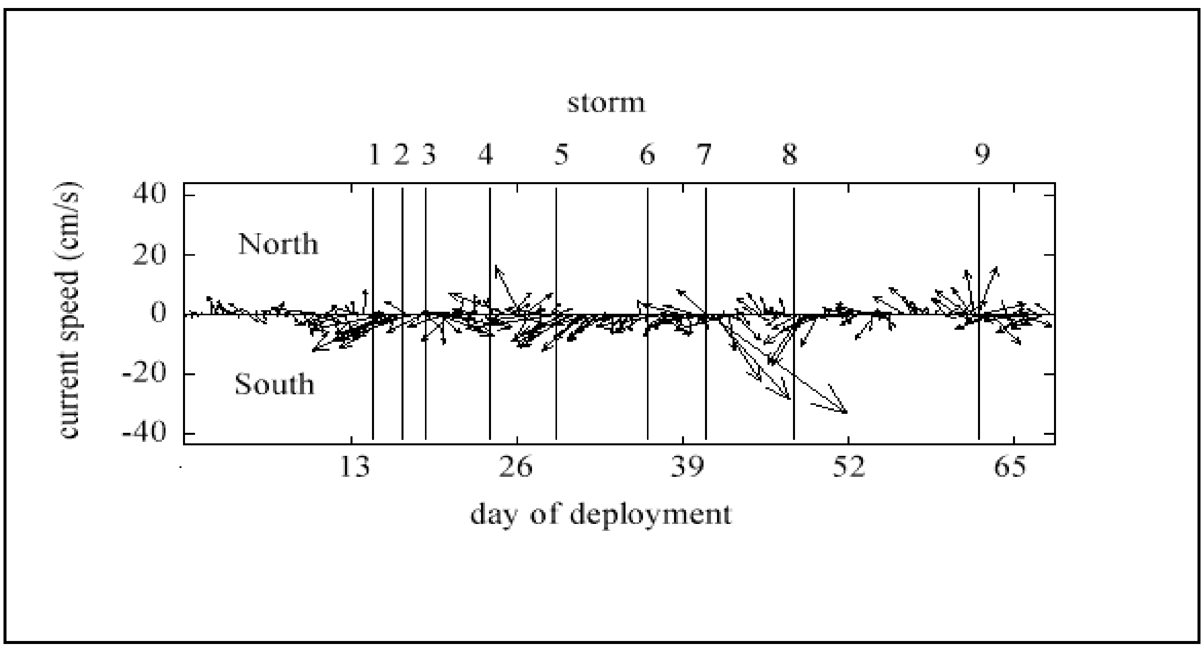


Figure 3-12. Vector plot of mean current direction at Site 1 during the deployment (Stone 2000).

3.3.1.2.5 *Bottom Boundary Layer Parameters*

Stone (2000) observed episodic increases in current and wave-current shear velocity associated with storm activity (**figures 3-13** and **3-14**). Shear velocity was particularly high during the period of strong wave-orbital flow for three of the observed storm events, when mean flows were particularly strong.

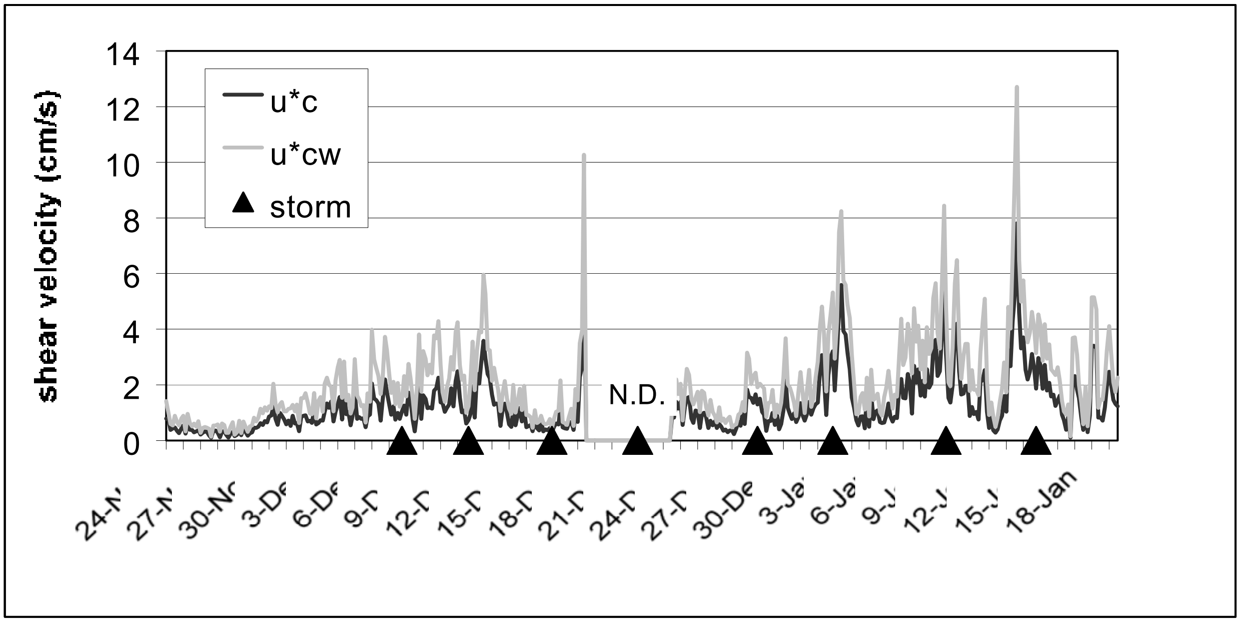


Figure 3-13. Current and combined wave-current shear velocity as measured at Site 1 (Stone 2000).

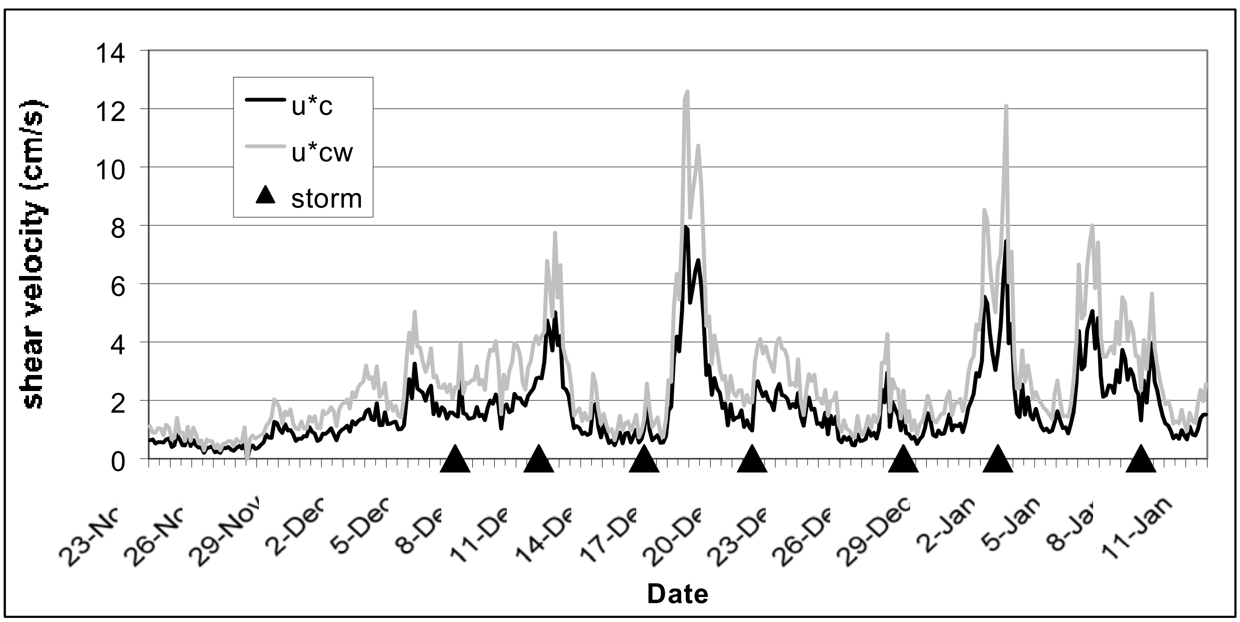


Figure 3-14. Current and combined wave-current shear velocity as measured at Site 2 (Stone 2000).

3.3.1.2.6 *Sediment Transport at Ship Shoal*

Four high sediment transport events were noted during the Stone (2000) study, and were generally associated with storms. Sediment transport direction varied considerably between storms as well as during individual storms. Two of the most significant storms were characterized by opposing trends in sediment transport direction – while onshore and eastward (i.e., NE) transport dominated during one of the storms, offshore and westward (i.e., SW) transport dominated during another storm event. Within these storms, transport direction fluctuated by 180^o on a very short time scale (i.e., several times per storm). This may have been related to diurnal fluctuations resulting from either tidal or inertial current flow, or to other variations in relative wave and current energy and direction.

3.3.1.2.7 *Summary of the Physical Oceanographic Regime of Ship Shoal*

Based on the data collected and analyzed by Stone and Xu (1996), a picture of the physical oceanographic regime within the Ship Shoal area emerges:

1. Hydrodynamic, bottom boundary layer, and sedimentary variability on the Louisiana inner shelf during the winter is episodic, and is largely the result of recurring extratropical storm passages.

2. Considerable variability between storms, as well as during storms themselves, is reflected in hydrodynamic, bottom boundary layer, and sedimentary parameters. Some indices are several orders of magnitude greater during strong storms than during fair weather, while in the case of weak storms, the same parameters may actually be weaker.

3. Despite this considerable variability, storms are generally characterized by increases in wave height, near-bed orbital and mean current speed, shear velocity, suspended sediment concentration, and sediment transport. Decreases in wave period and apparent bottom roughness are also apparent.

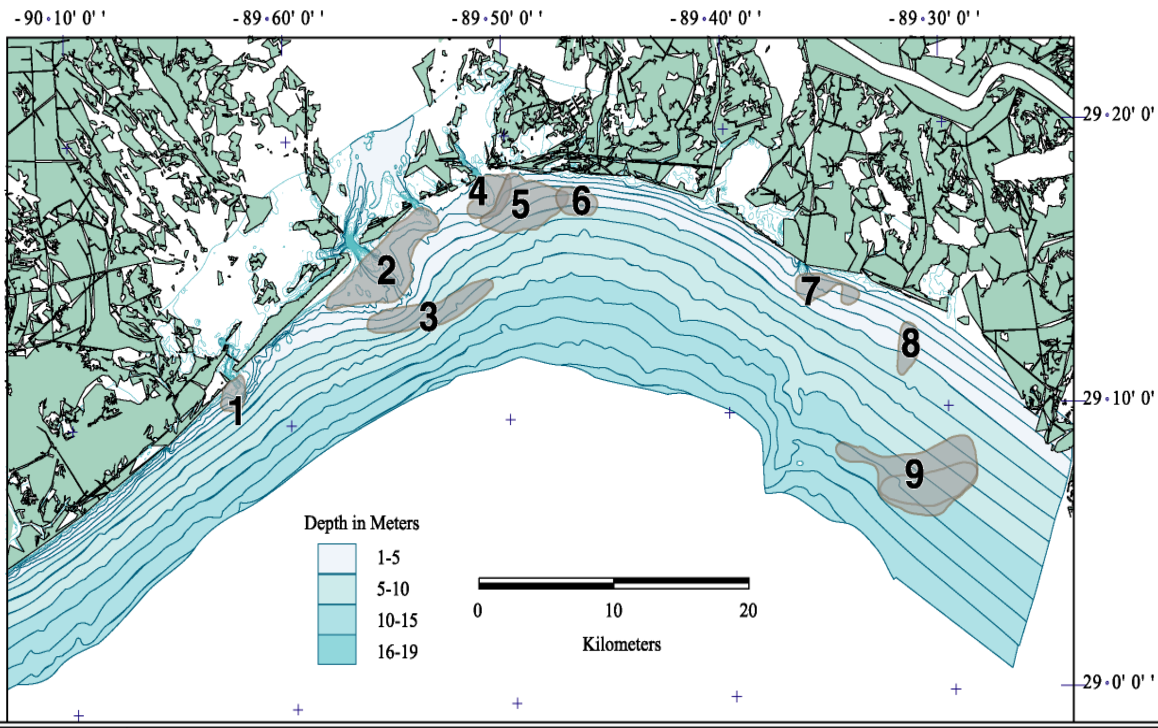
4. Sediment transport during the winter is dominated by the strongest storms, when net sediment flux tends to be seaward.

5. Differences between the seaward and landward flanks of Ship Shoal are apparent. Waves tend to be higher and longer in period on the seaward side, while mean currents are generally higher landward, where they are directed onshore, in comparison with the seaward currents that predominate at the offshore site. It is apparent, therefore, that Ship Shoal exerts a significant influence on regional hydrodynamics, reducing wave energy and modulating current velocity.

6. The long-term evolution of Ship Shoal appears to be the result of a balance between fair weather influences, which cause erosion, and winter storm influences, which cause accretion. Superficially, this closely follows the commonly held notions of nearshore storm/fair weather sediment transport on barred, but direct parallels are avoided for the moment since the details of process and response require further investigation.

3.3.1.3 Barataria Nearshore Sand Resources

Kulp and Penland (2001), Kindinger et al. (2001), and Kulp and Penland (2002) investigated several sand resource sites located adjacent to the Barataria Basin barrier shoreline for use in its potential restoration during the ongoing Barataria Basin Barrier Shoreline Restoration feasibility study (see **figure 3-15**). Seismic and sonar interpretations verified geologic samples (vibracores and borings) that there are nine nearshore sand body areas that meet or exceed the minimum criteria for potential mining sites (**figure 3-15**). The nine sand bodies potentially contain between 396 and 532 million cy and can be characterized into three surfical and six buried sites. However, while these nine potential sand sources consist primarily of fine sand, a full 90 percent of the sand body areas would need almost 570 million cy of overburden removed if the entire resource is mined. Kindinger et al. (2001) recommend using the sand for barrier island shore face restoration and the overburden to build back-barrier platforms for marsh restoration.



Target Site	Surface Area (Mi.^{2})	Depth to Target (ft below MSL)	Thickness of Overburden (ft)	Est. Target Thickness (ft)	Percent Sand %	Grain size range (phi)	Est. Vol. Sand (low) (yd^3)	Est. Vol. Sand (high) (yd^3)
1. Caminada	1.24	5-10	0	4	60-80	2.5-4.7	3,060,924	4,081,233
2. Barataria (inshore)	8.80	5-10	0	4-9	60-85	2.5-4.7	35,436,544	50,201,771
3. Barataria (offshore)	4.96	25-40	10-15	7-9	60-80	2.5-5.5	24,563,918	32,751,891
4. Quatre Bayou (shallow)	2.45	10	0	5-10	60-80	2.5-4.7	11,406,726	15,208,968
5. Quatre Bayou (deep)	5.32	22-45	7-15	5-22	70-100	2-5.5	53,832,158	76,903,083
6. Quatre Bayou (D2)	1.70	45-47	30-40	7+	50-80	3-5	7,372,288	9,829,717
7. Empire	2.10	17-25	3-10	3-6	60-80	2-3.5	5,854,464	7,805,952
8. Scoffield	1.50	30	9	6+	80-90	2.5-5.5	7,434,240	8,363,520
9. Sandy Point	11.60	40-48	8-13	20-30	60-80	2.5-5.5	179,660,800	239,547,733

Figure 3-15. Barataria nearshore sand resources *(from Kindinger et al. 2001).*

3.3.1.4 Sand Suitability

To determine the suitability of a specific sand source for beach nourishment, the mean grain size of the source material should be close to or slightly larger than that occurring at the in situ or target beach. The term "beach quality" sand commonly infers a significant or a high degree of similarity between the sediment textural parameters of the sand source (shoal or deposit) and the sand target (coastal beach). However, estimates of beach quality are often considered by assessing an "overfill factor." James (1975) examined criteria that would indicate the probable behavior of borrow material on a natural beach. The overfill factor concept and determination methodology were developed to describe a measure of the amount of source material that would need to be placed on a target beach to compensate for the losses that occur from natural winnowing processes along the shoreface. The overfill factor, $R_{A,}$ represents the number of m^3 of material required to create one m^3 of in situ beach when the beach is in a condition compatible with the native material. Overfill factors are expressed as a ratio of a unit volume of natural, or in situ beach, to a volume of source material required; the factor is commonly listed as the unit of fill volume required. McBride et al. (1989) used James' overfill factor formula to calculate an overfill factor for the Isles Dernieres shoreline using sand from Ship Shoal. The calculated overfill factor is determined to be 1:1.03, or 1.03. Based on that overfill factor, Ship Shoal sand constitutes an excellent source of sand for Isles Dernieres beach nourishment projects. These calculations would be needed for determining suitability of other shoals and sand bodies.

3.4 SALINITY REGIMES

3.4.1 Historic and Existing Conditions

Salinity measurement has traditionally been an important parameter for estuarine hydrology and habitat potential. Orlando et al. (1993) describe the importance of understanding salinity:

- Salinity is a direct measure of the relative influence of the sea and the freshwater sources in an estuary.
- Salinity is an excellent hydrographic tracer, indicating the movement and exchange of water masses.
- Salinity, as a hydrodynamic variable, dominates the density structure of an estuary and therefore exerts important controls on currents and turbulence.
- Salinity is an essential element in determining estuarine habitat. It directly affects distribution, abundance, and composition of biological resources.
- Salinity is easily measured using various techniques and historical information available.

Salinity is the predominant factor responsible for change of fresh, intermediate, brackish and saline habitats. For example, Flynn et al. (1995) indicate that extreme salinities may lead to conversion of fresh and intermediate marshes to open water.

Perret et al. (1971) provide one of earliest comprehensive descriptions of salinity regimes across coastal Louisiana (see **figure 3-16**). They present the 10, 15, and 20 percent isohaline (salinity) lines for the Louisiana coast for the period of April 1968 through March 1969.

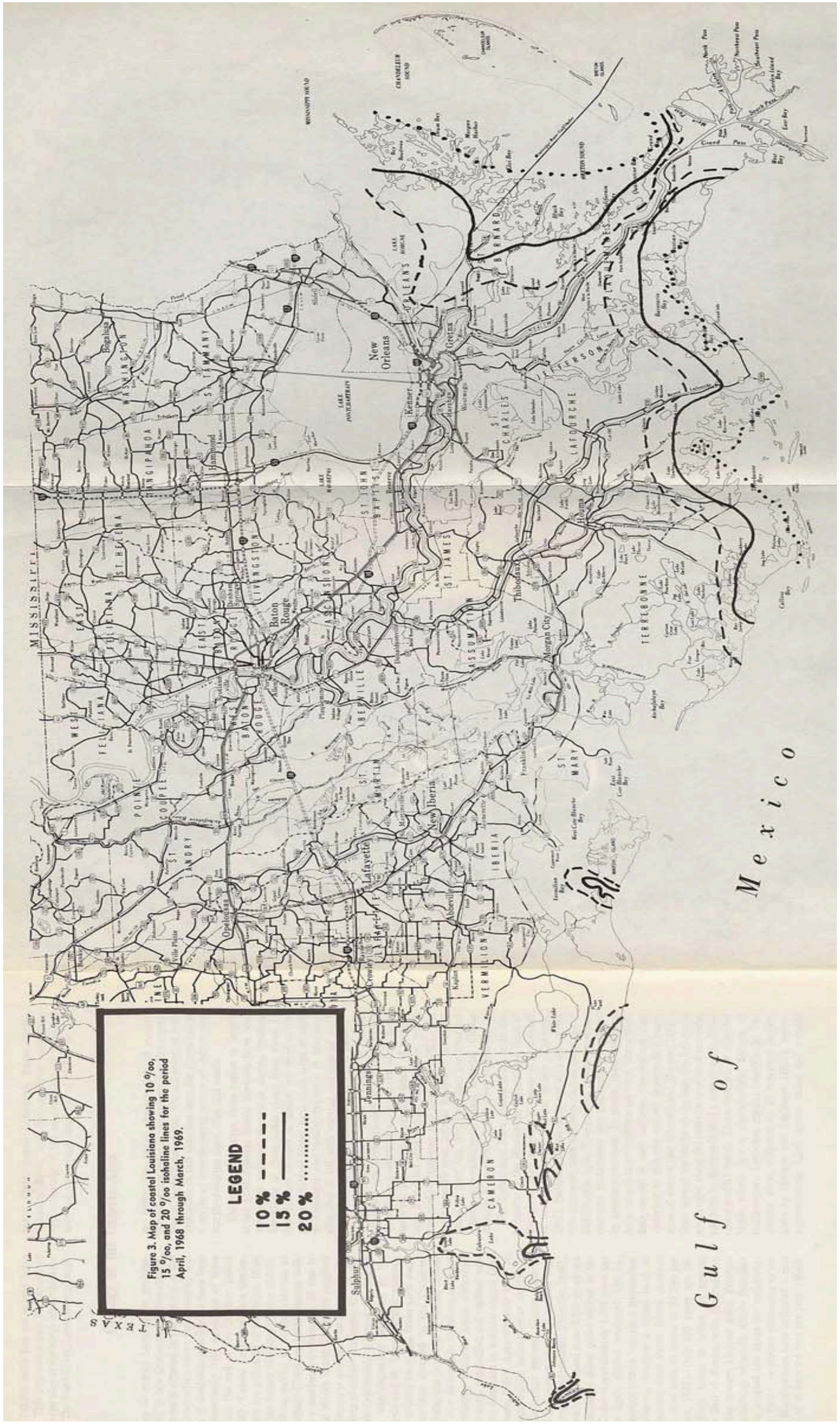


Figure 3-16. Map displaying 10, 15, and 20 percent isohaline lines from 1968-1969 coastal Louisiana (*from Perret et al. 1971*).

3.4.1.1 Coastal Louisiana Estuarine Salinity Patterns – Existing Conditions

As part of NOAA's National Estuarine Inventory, Orlando et al. (1993) provided a comprehensive synthesis of salinity information for 26 principal gulf estuaries. Those sections of Orlando et al. (1993) pertaining to Louisiana's coastal basins are incorporated by reference. Orlando et al. (1993) indicate that besides being a critical factor that determines habitat, salinity provides a direct measure of estuarine transport behavior. An estuary's ability to retain, flush, and mix pollutants is determined by the same processes affecting how freshwater inputs combine with seawater, which is directly measured by salinity. Orlando et al. (1993) utilized a time series of records of freshwater inflow and salinity, in conjunction with available background information on tides, wind, and other factors to quantify salinity variability. Representative three-month seasonal averaging periods were used to reflect the normal range of high- and low-salinity regimes under typical and present-day hydrologic conditions.

According to Orlando et al. (1993), the salinity patterns throughout the major basins of coastal Louisiana may be influenced by the following forcing mechanisms: freshwater inflow, tides, wind, and coastal shelf processes. Coastal Louisiana estuaries' seasonal freshwater discharge source and timing of delivery vary between estuaries as well as within estuaries. Generally, the high-inflow/low-salinity periods are typically from late winter to late spring. The low-inflow/high-salinity periods are typically from late spring to late fall. With the exception of the Atchafalaya estuary, most of Louisiana's estuarine systems are shallow, wind-driven systems with small tidal action that prevents salinity stratification. In the Atchafalaya, prevailing seasonal winds and entrainment of diluted gulf waters are secondary modifiers of the salinity structure in this basin.

Figures 3-17 through **3-20** display modeling results for salinity patterns under the base conditions (and Future Without-Project conditions, see section 4.3, SALINITY REGIMES) for each subprovince. Models are based on simplifying assumptions, subject to uncertainty and error, and are only approximations of real conditions. The models used in this study have not been fully validated and their results should be considered within that context. Appendix C, HYDRODYNAMIC AND ECOLOGICAL MODELING of the Main Report provides a more detailed presentation of the numerical model results of salinity distributions. These models are static images (snapshots) of typical salinity distributions.

The base, or existing conditions, mean salinity distributions for Subprovince 1 are displayed in **figure 3-17**. The hydrologic model assumed that Caernarvon freshwater diversion structure would be running all year at 235 cfs. The freshest mean salinities, 0 to 2 parts per thousand (ppt), would be found in the interior-most portions of the subprovince in the vicinity of Lake Maurepas (boxes IA and IB) and in the general vicinity south of the Mississippi River Gulf Outlet (MRGO) and Caernarvon (boxes VA and VB). Lake Pontchartrain would grade from 2-4 ppt in the western portions to 4-6 ppt in the eastern portions of the lake. The southern portions of the Lake Borgne area (box IIIA) would have a mean salinity range of 6–8 ppt with the northern portions of the lake ranging from 8–10 ppt (box IIIB). The eastern portion of the Mississippi River Delta (box VE) would have a mean salinity range of 2–4 ppt. The remainder of the subprovince, Chandeleur Sound and Breton Sound (boxes IV, VC, and VD), would have the greatest mean salinity ranges of greater than 10 ppt.

The base, or existing conditions, mean salinity distributions for Subprovince 2 are displayed in **figure 3-18**. The hydrologic model assumed that the Davis Pond Diversion would be running all year at 5,000 cfs. At the present time, such an operational scheme is not authorized. The interiormost portions of the subprovince (boxes 1A, 1B, 2A, 2B, 3A, and 3B) would have the freshest mean salinity range of 0–2 ppt. The region east of the Barataria Bay Waterway, extending from Myrtle Grove south to the western portion of the Mississippi River Delta (box 4B), would have a mean salinity range of 4–6 ppt. The Caminada Bay and headland area (box 4A) would have the highest mean salinity range of greater than 10 ppt.

The base, or existing conditions, mean salinity distributions for Subprovince 3 are displayed in **figure 3-19**. The freshest portions of the subprovince would be the interior portions of Terrebonne Parish (box I) with a mean salinity range of 0-2 ppt. The areas adjacent to the Atchafalaya River, Wax Lake Delta, and regions surrounding East and West Cote Blanche Bays would have a mean salinity range of 2-4 ppt (boxes IV, VIII, and IX). The area extending from Caillou Lake in the east to Point au Fer in the west (box V) and the area surrounding Vermilion Bay (box VII) would have a mean salinity distribution of 4-6 ppt. The interior portion of Terrebonne Bay (box II) would have a mean salinity distribution of 6-8 ppt. The area from Terrebonne Bay in the east to Caillou Bay in the west (boxes III and VI) would have the highest mean salinity range of greater than 10 ppt.

The base, or existing conditions, mean salinity distributions for Subprovince 4 are displayed in **figure 3-20**. The interior regions of the subprovince, extending from Freshwater Bayou in the eastern portion of the subprovince, north of Louisiana State Highway 82, and west of Grand Lake (boxes 2C1, 2C2, 2A1, 2B1, 2B2, 2A2, 2A4, 2A3, and 3E5) and the isolated areas west of Calcasieu Lake (boxes 3E6, 301, 306, and 3C2) would have the lowest mean salinity range from 0-2 ppt. The area south of White Lake (boxes 1C2 and 1B2), east of Calcasieu Lake (box 3E4), bordering the Sabine River (boxes 3B1, 3B2, 3B3, and 3B4) and bordering the western gulf shoreline (box 3A2) would have a mean salinity range of 4-6 ppt. The areas bordering the gulf shoreline from Freshwater Bayou, west to Lower Mud Lake (boxes 1B3, 1B1, and 1A1), and the area west of Calcasieu Lake (boxes 3C1, 3C4, and 3C5) would have a mean salinity range of 6-8 ppt. The area at the mouth of the Sabine River (box 3A1) and west of Calcasieu Lake (boxes 3D2 and 3D3) would have a mean salinity range of 8-10 ppt. The Calcasieu Lake and immediate surrounding area (boxes 3E1, 3E2, 3E4, and 3D4) would have the greatest mean salinity range of greater than 10 ppt.

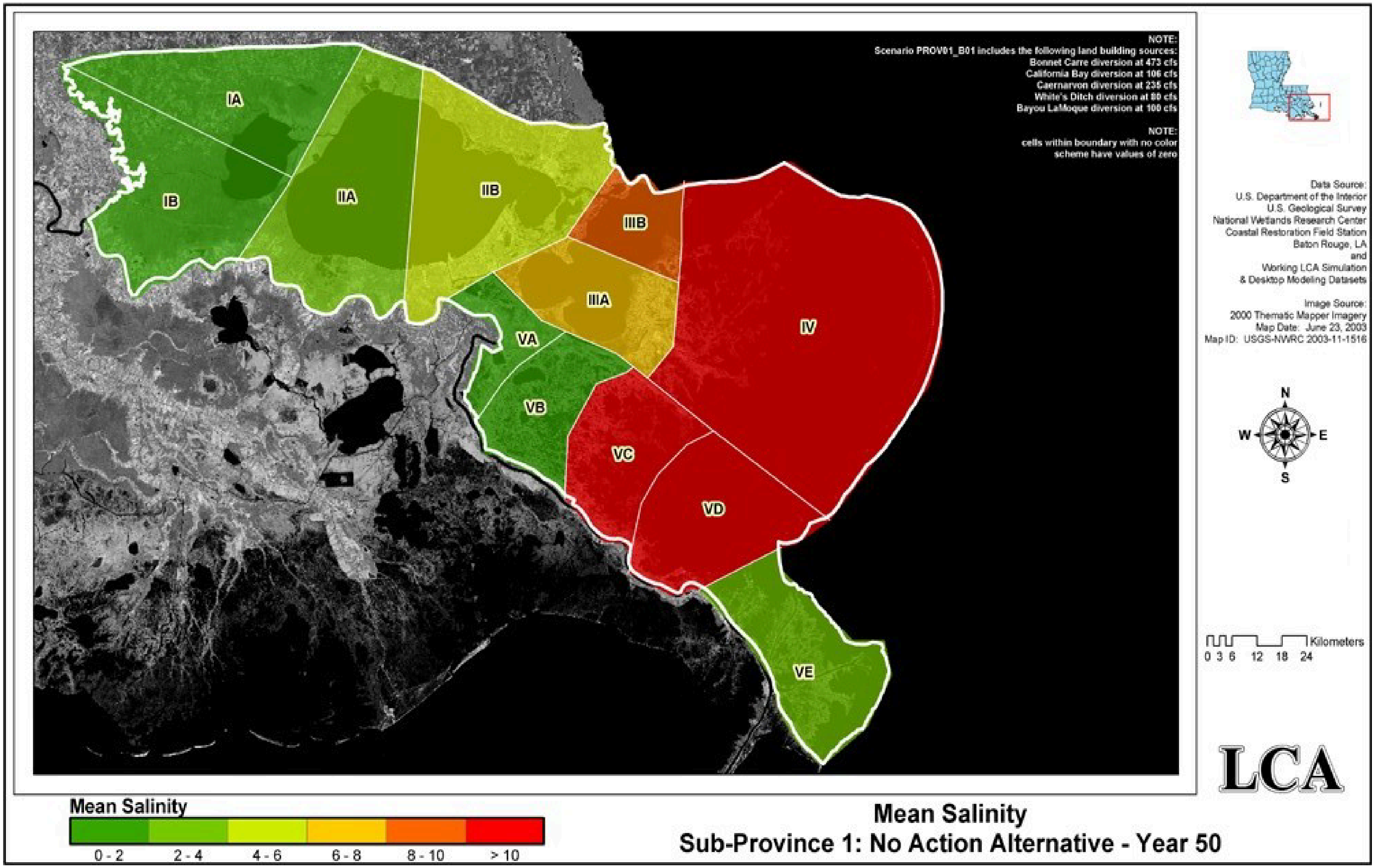


Figure 3-17. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 1.

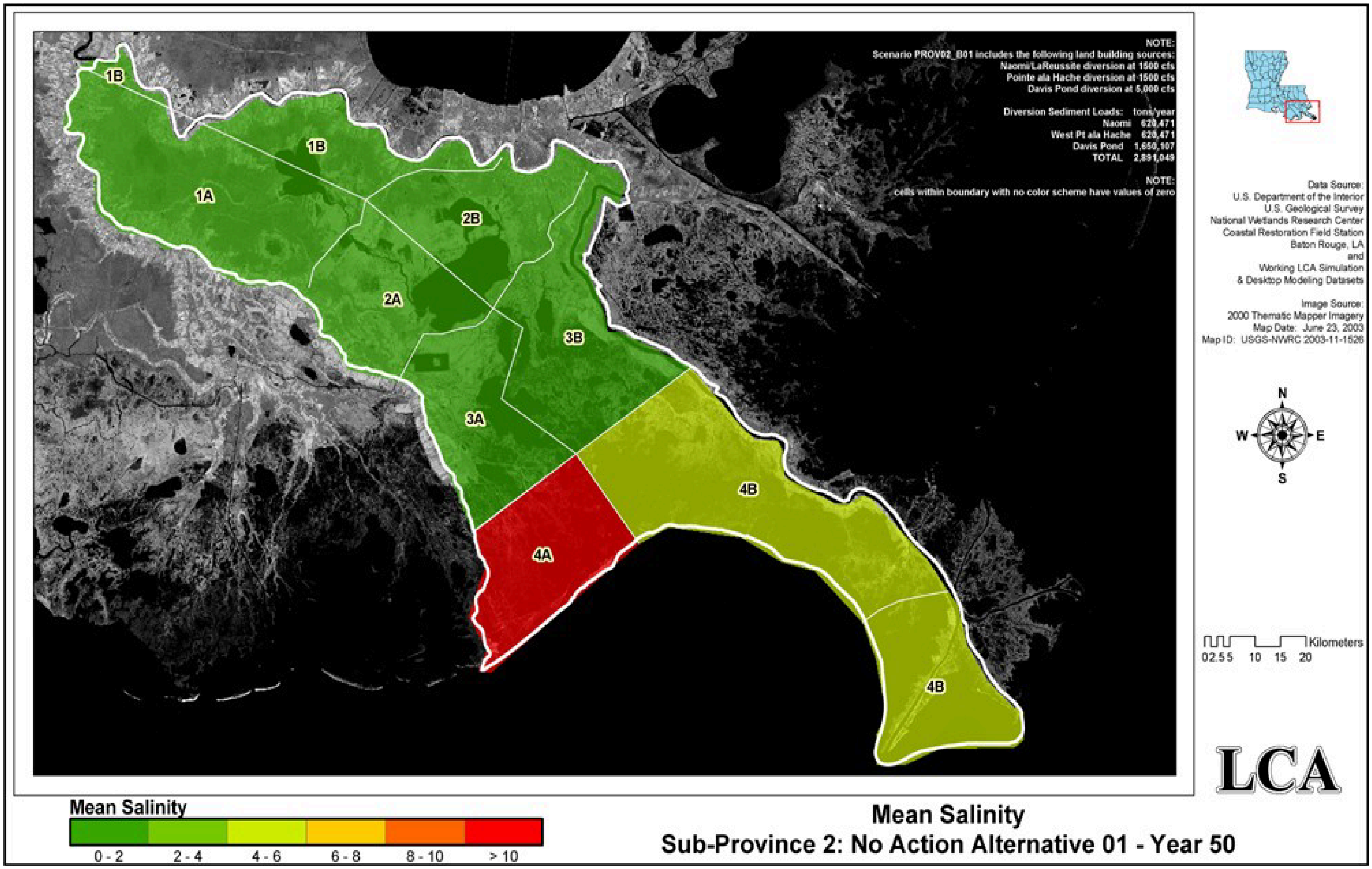


Figure 3-18. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 2.

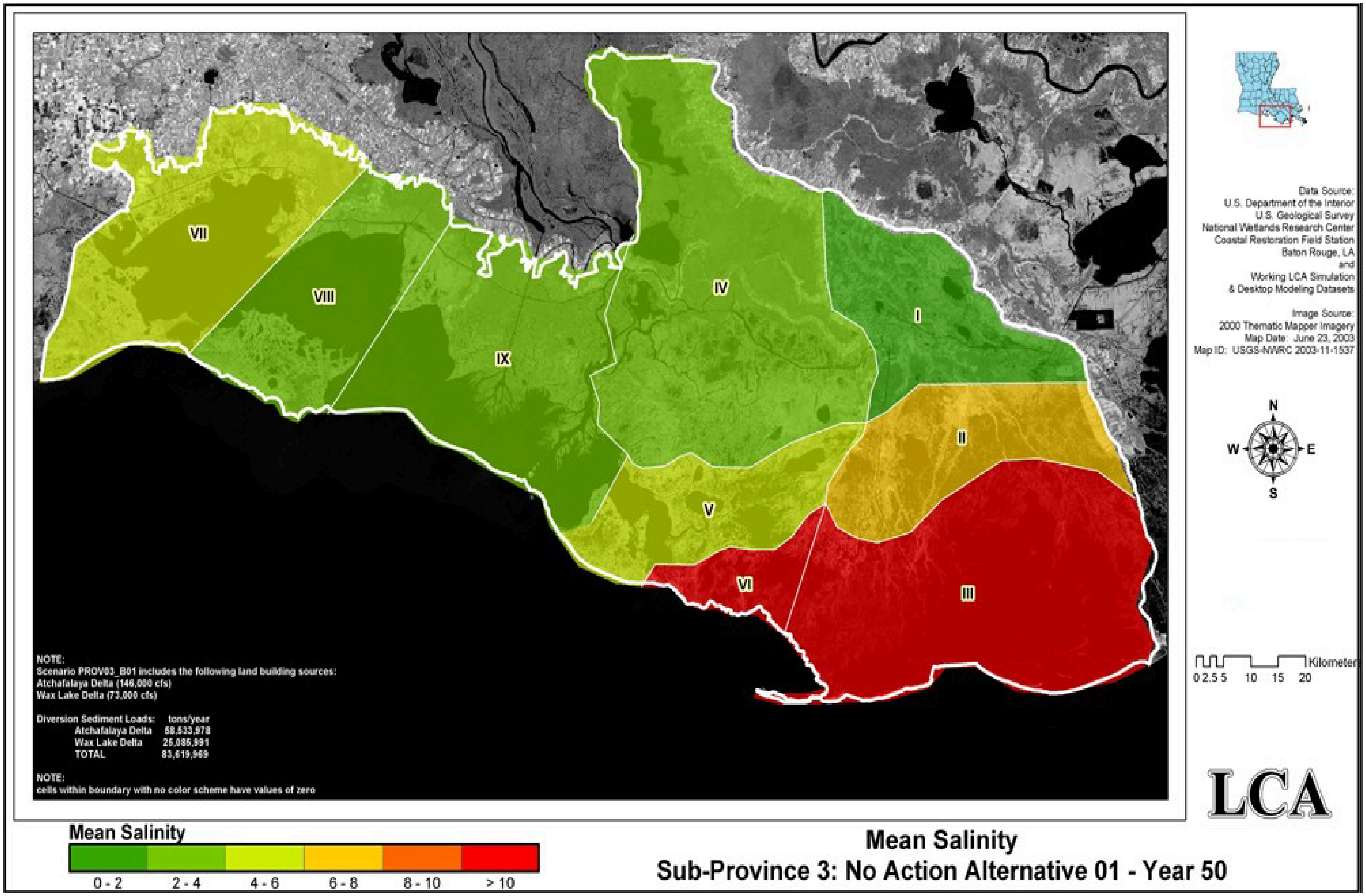


Figure 3-19. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 3.

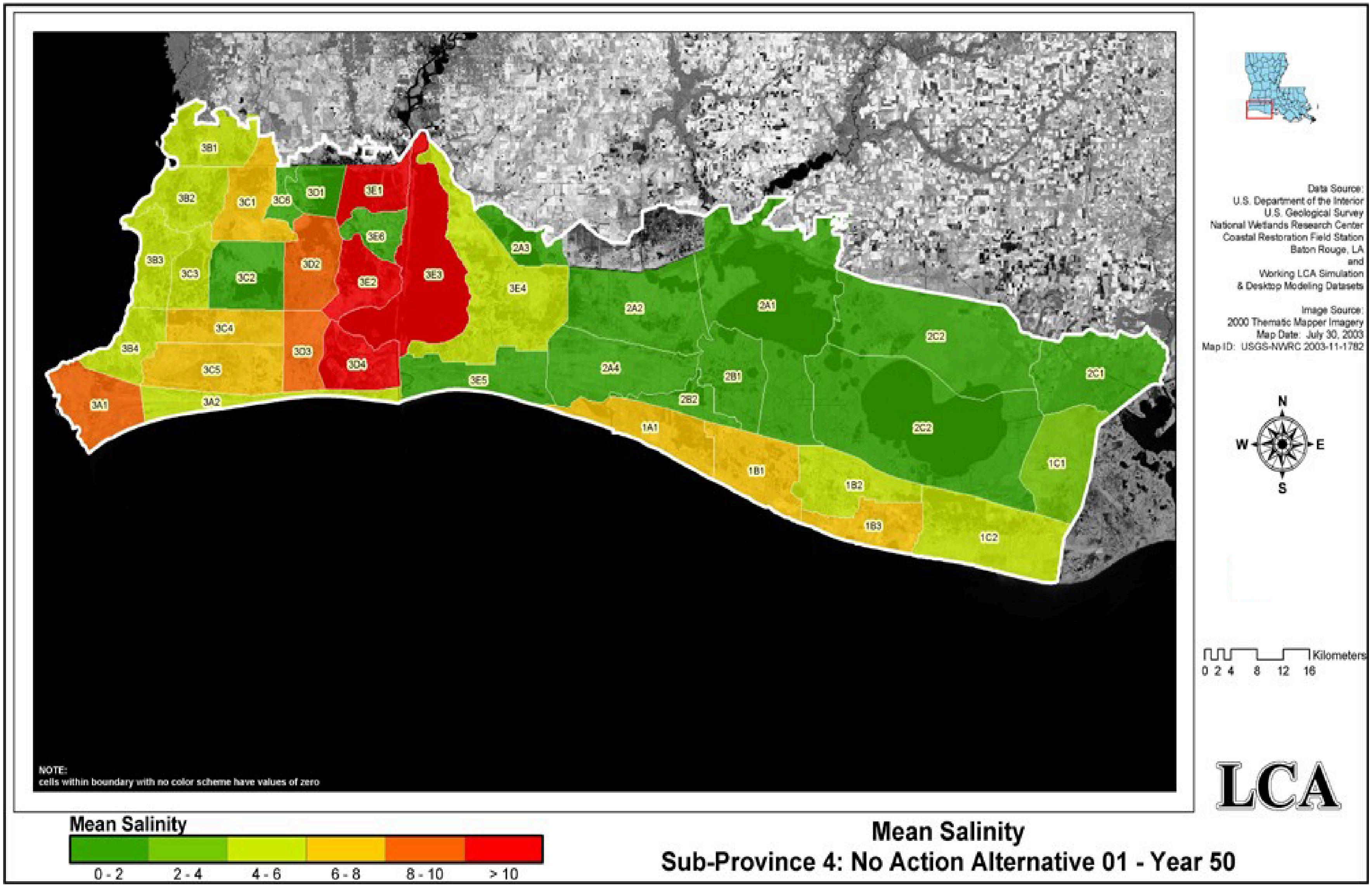


Figure 3-20. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 4.

3.5 BARRIER SYSTEMS: BARRIER SHORELINES, HEADLANDS AND ISLANDS

3.5.1 Importance of Louisiana's Barrier Systems

A more detailed description of barrier system resources is provided in appendix D LOUISIANA GULF SHORELINE RESTORATION REPORT of the Main Report. These resources are institutionally recognized by the Coastal Barrier Resources Act of 1990 (16 U.S.C. §§3501-3510). Section 3501 of the act describes the Congressional statement of findings that:

- Coastal barriers provide habitats for migratory birds, wildlife, finfish, shellfish and other aquatic organisms;
- Coastal barriers contain resources of extraordinary scientific, recreational, natural, historic, and ecologic importance;
- Coastal barriers serve as natural storm protective buffers and are generally unsuitable for development because they are vulnerable to hurricane and other storm damage and because natural shoreline recession and the movement of unstable sediments undermine human structures;
- Certain actions and programs of the Federal Government have subsidized and permitted human development on coastal barriers and the result has been the loss of barrier resources, threats to human life, health, and property, and the expenditure of millions of tax dollars each year; and
- A program of coordinated Federal, state, and local governments is critical to the more appropriate use and conservation of coastal barriers.

Barrier systems provide protection of the wetlands, bays, and estuaries behind the islands. Barrier systems help reduce wave energy at the margins of coastal wetlands, thereby limiting mechanical erosion; additionally, they limit storm surge heights and retard saltwater intrusion (Williams et al. 1992). Barrier islands and shorelines mark a transition between land and sea. They are not only geologic entities, but also biological entities whereby the biological vigor reflects physical diversity (Britton and Morton 1989). On May 3, 2001, the USFWS designated critical habitat for wintering populations of the endangered piping plover, which includes most of the Louisiana barrier islands. Appendix D LOUISIANA GULF SHORELINE RESTORATION TEAM REPORT of the Main Report presents a more detailed discussion of this resource.

Louisiana's barrier systems contain about 300 miles (483 km) of shoreline that stretch from the Chandeleur Islands southeast of the Pearl River and the Louisiana/Mississippi border west to Sabine Pass on the Texas/Louisiana border. The barrier system helps protect the area behind the coastline that is affected by coastal processes in the Gulf of Mexico, such as waves, salinity, water levels, and storms.

Louisiana's barrier systems are the first line of defense against the storms and hurricanes that impact coastal Louisiana; they dampen the impacts of waves and surges before they move landward toward more fragile inland estuarine and wetland areas. They also protect the inshore oil and gas extraction infrastructure that is not built to withstand the gulf waves.

Louisiana's barrier systems regulate the exchange of higher salinity gulf waters with the lower salinity waters of the interior coastal areas. This is seen in the estuarine gradient of progressively fresher vegetation zones as one travels inland from the saline marshes near the gulf, landward to less saline brackish marshes, intermediate marshes, freshwater marshes, and swamps (see also section 3.7, COASTAL VEGETATION RESOURCES).

The diversity and abundance of natural resources in Louisiana's barrier systems plays a major role in making this unique area "A Working Coast." This "working coast" is also a rich fishery, recreational or "sportsman's paradise", and coastal and offshore petroleum production area. In addition to providing critical habitat for threatened and endangered species, such as the piping plover, brown pelican, and sea turtles, Louisiana's barrier systems protect what many consider to be critically imperiled human habitat (see appendix D LOUISIANA GULF SHORELINE RESTORATION TEAM REPORT of the Main Report).

Louisiana's barrier systems are experiencing some of the highest land loss rates in the Nation, due to both natural and man-made factors. The following sections describe the historic and predicted land loss of this area.

3.5.2 Historic and Existing Conditions

Deltaic Plain Barrier Systems

Louisiana's barrier systems are located principally in the Deltaic Plain region and include the Chandeleur, Plaquemines, Bayou Lafourche, and Isles Dernieres barrier systems. More detailed descriptions of Louisiana's barrier islands, especially land loss comparisons over the past 100 years, is provided in Williams et al. (1992), "Atlas of Shoreline Changes in Louisiana from 1853 to 1989." A series of reports prepared by the Louisiana Geological Survey entitled "The Coastal Sand Dunes of Louisiana: An Inventory" provides the most comprehensive description of Louisiana's vanishing barrier islands. This series of publications includes: the Isles Dernieres (Ritchie et al. 1989), the Plaquemines Shoreline (Ritchie et al. 1990), the Chandeleur Islands (Ritchie et al. 1992), and the Bayou Lafourche Barrier Shoreline (Ritchie et al. 1995).

Chandeleur Barrier System: At over 46.60 miles (75 km) long, the Chandeleur barrier system is the oldest transgressive barrier island arc on the Deltaic Plain. These islands enclose Breton Sound and Chandeleur Sound in St. Bernard and Plaquemines Parishes. The Chandeleur Islands are part of the Breton National Wildlife Refuge (NWR), a large portion of which is a designated wilderness area. The Chandeleur Barrier System include the following islands: Chandeleur, New Harbor Islands, North Islands, Freemason Islands, Curlew, Errol, Grand Goosier, and Breton Islands.

Plaquemines Barrier System: This 24.85 to 31.07 miles (40 to 50 km) long barrier system forms the seaward geologic framework for the eastern Barataria Basin and lies about 31.07 miles (50 km) northwest of the active Mississippi River Delta. Historic Fort Livingston is situated upon West Grand Terre, the largest island in this system. The Plaquemines barrier system consists of remnant barrier spits and islands defined either by a tidal pass, or the entrance to a bayou. These islands include: Cheniere Ronquille, Bay La Mer Gulf Shore, Bay Joe Wise Gulf Shore, Shell Island, Pelican Island, and Dry Cypress Bayou Gulf Area.

Bayou Lafourche Barrier System: The Bayou Lafourche barrier system stretches over 37.28 miles (60 km) from Barataria Pass near Grand Isle to Cat Island Pass. This barrier system forms the seaward geologic framework of western Barataria Basin and the eastern Terrebonne Basin. This barrier system consists of the only commercially developed barrier island in Louisiana, Grand Isle. The 12.43-mile (20 km) Caminada-Moreau headland, with some of the highest rates of shoreline loss in coastal Louisiana, is the landfall site of many oil and gas pipelines, including the Louisiana Offshore Oil Port (LOOP) facilities. The westernmost islands in this barrier system include Timbalier Island and East Timbalier Island. These islands have experienced more lateral morphological change than any others in Louisiana (Williams et al. 1992).

Isles Dernieres Barrier System: At over 16.84 miles (30 km) long, the Isles Dernieres barrier system forms the seaward geologic framework for the western Terrebonne Basin. In 1853, this barrier system was a continuous shoreline system, except for Wine Island (Williams et al. 1992). Today, this barrier system consists of five main islands: Wine Island, East Island, Trinity Island, Whiskey Island, and Raccoon Island.

Chenier Plain Barrier Shoreline

The Chenier Plain of southwestern Louisiana, with elevations of approximately 6 to 20 ft (2 to 6 m), extends from Sabine Pass, Texas to Southwest Point, Louisiana. A chenier plain consists of multiple shore-parallel, sand-rich ridges that are perched on and physically separated from one another by relatively finer-grained, clay-rich sediments. Oak trees (“cheniers” in French) grew on these ridges and gave the region its name. The Chenier Plain evolved during the Holocene as a sequence of progradational mudflats that were intermittently reworked into sandy or shelly ridges to form the modern physiography. Numerous cycles of deposition and erosion created alternating ridges separated by marshlands. These processes concentrated the coarse-grained sediments and formed shore-parallel ridges called “cheniers” (Gould and McFarlan 1959; Byrne et al. 1959). Introduction of new sediment by westward shifts of the Mississippi River Delta resulted in the isolation of these ridges by accretion of new material on the existing shoreline (**figure 3-21**). Thus, repeated seaward growth and retreat along the Chenier Plain is a consequence of deltaic deposition farther east as well as the periodic cessation of sediment supply to the Chenier Plain as deltaic depocenters were abandoned. Currently, the Atchafalaya River is supplying the Chenier Plain with fine sediments by westward-directed longshore transport of fine-grained material.

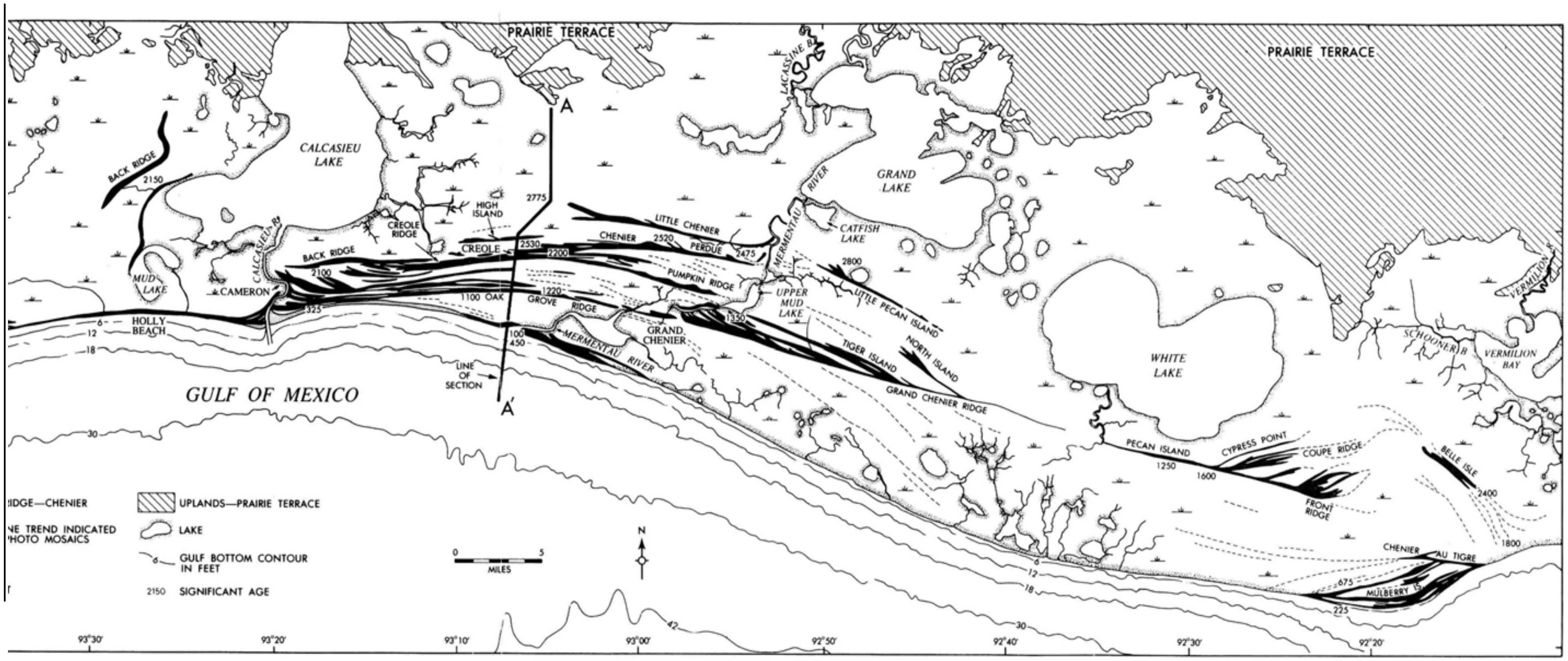


Figure 3-21. Regional geomorphologic framework of the southwestern Louisiana Chenier Plain. Note the shore-parallel distribution of sandy ridges separated by ridge-elongate mud flats and marshlands. Ages on ridges indicate their radiometrically-determined times of formation (by Gould and McFarlan 1959)

3.5.3 Barrier Island Erosion

The high rates of coastal erosion and wetland loss in Louisiana have been recognized and documented since the 1950s (Morgan and Larimore 1957; Gagliano and van Beek 1970; Adams et al. 1978; Gosselink et al. 1979; Wicker 1980; Walker et al. 1987; Britsch and Kemp 1990; Dunbar et al. 1990; Penland et al. 1990; Williams et al. 1990; Williams et al. 1992). Williams et al. (1992) wrote in the " Louisiana Barrier Island Erosion Study":

The physical processes that cause barrier island erosion and wetlands loss are complex, varied, and poorly understood. There is much debate in technical and academic communities about which of the many contributing processes, both natural and human-induced, are the most significant. There is further controversy over some of the proposed measures to alleviate coastal land loss.

Dingler and Reiss (1990) recognized the importance of cold-front driven storm erosion and overwash in the central part of the Isles Dernieres. More recently, Morton (2002) describes that about once every seven to ten days from November to April, winter storms related to the passage of a cold front occur throughout the Louisiana coastal region. These winter storms act like pumps that cause rapid changes in water levels and associated wave erosion. Preceding passage of a cold front, low barometric pressure generates strong onshore winds that set water up along the coast, flooding open ocean and mainland beaches and exposing the shores to strong wave attack. As the front passes the coast, strong winds are directed offshore driving water onto the back barrier flats and away from the ocean beaches. The frequent oscillation in water levels and waves erodes both sides of barrier islands as well as mainland and bay shores. Such Gulf Coast winter storms cause much less land loss or property damage than do hurricanes, so they are not ranked or given names like severe northeasters of the Atlantic coast.

Our knowledge of barrier system restoration has since increased over the ensuing years, particularly with the several barrier island restoration projects constructed under the CWPPRA program. However, the knowledge of ecosystem and coast wide-level restoration is still in its formative stage, thereby requiring an adaptive management approach for restoration and site-specific evaluation.

Over the last century, the rate of erosion along Louisiana's gulf shoreline has progressively increased, threatening the health of coastal Louisiana. Using historical maps and aerial photography, the patterns and rates of shoreline change are mapped. **Figure 3-22** displays the long-term shoreline change history of the Louisiana gulf shoreline from the 1880s to 2002 (from Connor et al. 2004). **Figure 3-23** displays the short-term shoreline change history of the Louisiana gulf shoreline from the 1880s to 2002 (from Beall et al. 2004).

Figure 3-22. Long-term shoreline change history of Louisiana gulf shoreline from 1880s to 2002 *(from Connor et al. 2004).*

Figure 3-23. Short-term shoreline change history of Louisiana gulf shoreline from 1880s to 2002 *(from Beall et al. 2004).*

The gulf shoreline is divided into 31 reaches based on the geomorphology, change trends, existence of man-made structures, and/or a combination of these factors. Reaches 1-10 make up the Chenier Plain; reaches 11-31 make up the Deltaic Plain gulf shoreline.

The average rate of long-term (greater than 100 years) shoreline change is –19.9 ft/yr (6.1 m/yr). The average short-term (less than 30 years) rate of shoreline change is 30.9 ft/yr (9.4 m/yr). The highest rates of erosion are often found in the erosional shadows of hard coastal structures, such as navigation jetties, seawalls, and breakwaters. Beach nourishment, dune construction, and backbarrier marsh creation are the only project types that built new land and reversed gulf shoreline erosion.

3.6 BARRIER REEF RESOURCES

A massive complex of intertidal oyster reefs once spanned the interface between the Gulf of Mexico and the bays and wetlands of the Atchafalaya and Teche/Vermilion Basins (see **figure 3-24**). This reef complex is about 44 miles (70.8 km) long and can be separated into 3 reef zones. The first is the Point Au Fer reef that is about 27 miles (43.5 km) long, which forms the lower boundary of Atchafalaya Bay and separates the bay from the gulf. The second zone is a smaller reef field that developed on the submerged natural levees of Bayou Sale, which extends from Point Chevreuil on the mainland southwesterly towards Shell Keys at the gulf for a distance of 18 miles (28.9 km). Only the lower portion of this discontinuous reef field contributes to the barrier complex; the upper portion forms the boundary between Atchafalaya Bay and East Cote Blanche Bay. The third zone lies adjacent to and gulfward of Marsh Island and is a continuous reef field for a distance of about 15 miles (24.1 km). This extensive assemblage of reefs is recognized as a unique ecological feature of the Louisiana coast (Burk and Associates, Inc. 1976) and a natural barrier to coastal erosion (Morgan and Morgan 1983). It is a significant resource considering its value to protecting existing wetlands and to enhancing the formation of new wetlands in the Atchafalaya Delta.

3.6.1 Historic and Existing Conditions

This massive barrier reef complex likely flourished until the late 1800s when the Atchafalaya River discharge altered the salinity conditions making the area unfavorable for oysters. Today, the Atchafalaya–Vermilion estuary is the freshest estuary along the northern Gulf of Mexico (Orlando et al. 1993). By the early 1900s commercial oyster production had greatly declined on the reefs east of Marsh Island. It was then that the State of Louisiana began leasing the Point Au Fer and Point Chevreuil reefs for shell mining. This leasing and mining continued through much of the 20th century, resulting in the removal of most of the barrier reef between Point Au Fer Island and Marsh Island. Presently, shell mining (or shell dredging) no longer occurs in coastal Louisiana.

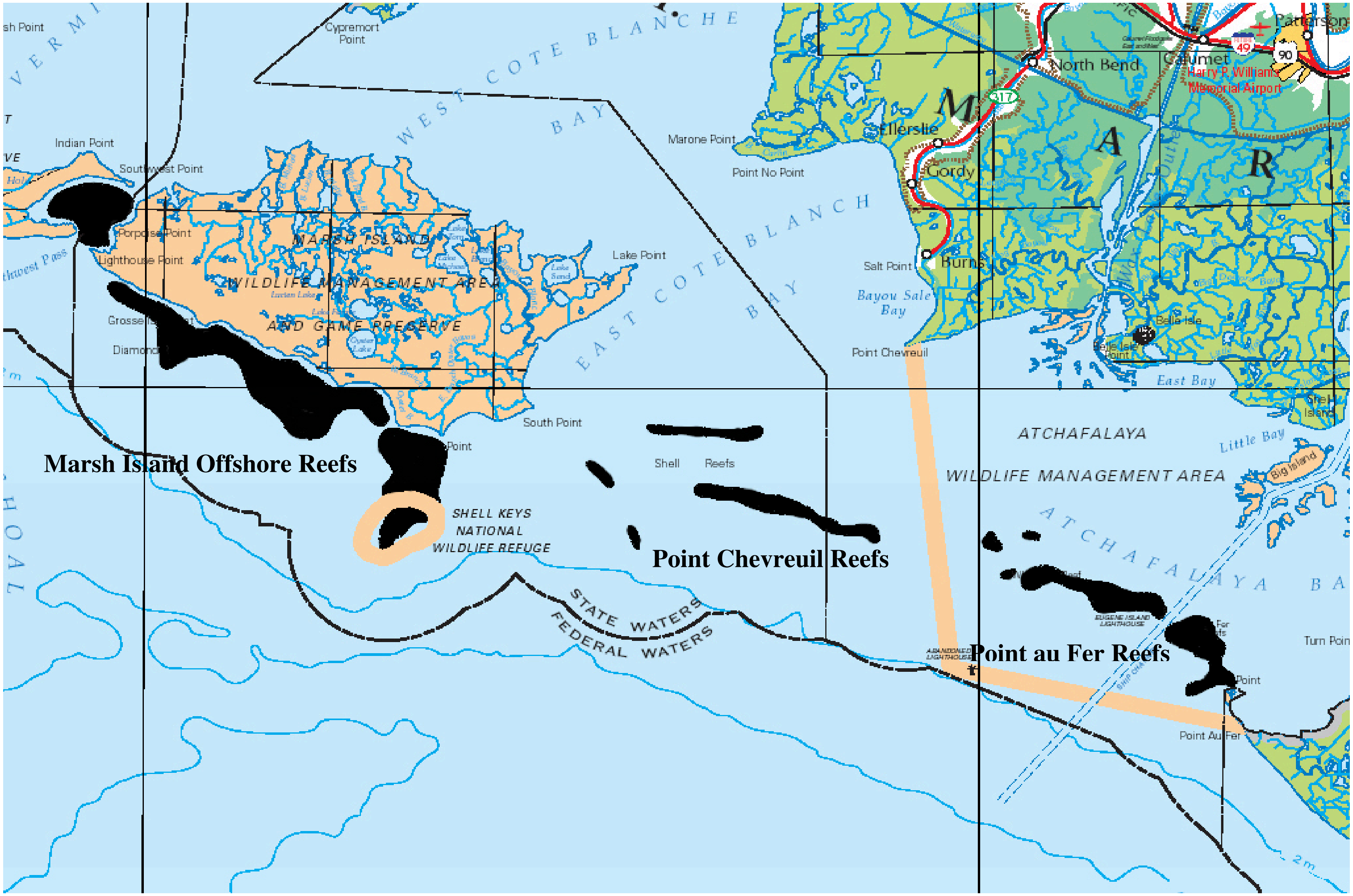


Figure 3-24. Louisiana barrier reefs (filled in black).

Point Au Fer Reef: Only remnants of this barrier reef complex remain and it is partially encompassed by the Atchafalaya Delta Wildlife Management Area (WMA), which is administered by the Louisiana Department of Wildlife and Fisheries (LDWF). The water bottoms of the reef area, along with those of Atchafalaya Bay and the bays in the Teche/Vermilion Basin, have been designated as seed oyster grounds by LDWF. Only the waters close to Marsh Island experience salinity regimes necessary for oyster production. These salinity regimes occur during periods of drought and/or low Atchafalaya River discharge. The remaining areas are usually too fresh to produce harvestable oysters.

Point Chevreuil Reef: Like the Point Au Fer reef, most of the reefs have been mined. Several years ago shell was added to Rabbit Island, a once prominent emergent shell island in this reef field located near Point Chevreuil. It is one of the few remaining remnant reefs that are popular recreational saltwater fishing areas. Again, like the Point Au Fer reef complex, only the areas close to Marsh Island experience salinity regimes necessary for oyster production.

Marsh Island Offshore Reefs: These reefs have largely survived the shell mining decades and are still commercially productive. This reef complex is located far enough from the Atchafalaya River that it is not affected by the freshening that occurs in the easterly portions of the barrier reef complex. The Marsh Island reef complex effectively reduces offshore wave energies to protect the Marsh Island shoreline. Marsh Island is a WMA administered by LDWF.

Shell Keys National Wildlife Refuge: Shell Keys, located at the southeastern boundary of the barrier reef complex and about three miles (4.8 km) south of Marsh Island, is a NWR. Wave action and water circulation patterns maintain the narrow keys by winnowing shell fragments from nearby oyster reefs. The 5 to 7-acre (2.0 to 2.8 ha) Shell Keys NWR was established in 1907. By executive order, the refuge was "... reserved and set apart...as a reserve and breeding ground for native birds." The refuge is located in Iberia Parish, Louisiana, in the offshore waters to the west of the Atchafalaya River Delta, and south of Marsh Island WMA. The refuge is composed of a few small shell spits or islands that are continually being built up and then eroded and moved by storm events. The area has large concentrations of shorebirds and colonial sea birds. The refuge is a bird sanctuary and is closed to all public use.

3.7 COASTAL VEGETATION RESOURCES

3.7.1 Historic Conditions

The inherent oscillating nature of the formation processes drove domination of coastal ecosystems back and forth between riverine and marine influence. Over time, a variety of distinct combinations of environmental conditions that regulate vegetative succession waxed and waned across the coast. As a result, the history of Louisiana coastal vegetative communities is one of continuous development and adaptation, change or loss throughout the coastal formation period. These circumstances provided the ingredients necessary for the development of an ecosystem with an abundant and highly diverse vegetative tableau overlaying the coastal landscape.

Louisiana's coastal wetlands comprise a variety of environments formed by spatially and temporally varying conditions that continually influence and change the vegetative landscape. The environmental factors and their innumerable combinations that regulate the occurrence and distribution of plant species and associations include, but are not limited to, soil and water salinity, soil type, elevation, hydrology and flooding regime, tidal influence, and climate. Competition, especially from invasive species, herbivory pressure, and man-made disturbance, such as burning or hydrologic modification, are other forces that can impact vegetative species.

Each plant species adapts to a definite range of environmental conditions, and those species that are adapted to similar conditions form communities or associations that are best able to grow and successfully compete for a particular site. Wherever the prevailing environmental conditions are similar, analogous communities with comparable species composition and dominance tend to occur. When environmental conditions change, succession can occur where plant species or whole communities are replaced by others more suited to the new conditions (O'Neil 1949; Chabreck 1972a).

In habitats with restricted variation in conditions, such as those with extreme salinity, species diversity is reduced. Since the source of salinity in coastal Louisiana is the Gulf of Mexico, salinity levels exist along a gradient, which declines as the saltwater moves inland. A zonation of plant species that differ in salinity tolerance exists along that gradient, with the species diversity of those zones increasing from salt to fresh environments (see **table 3-3**).

Table 3-3
Salinity ranges for the four coastal wetland types.

Wetland Type	Range (ppt)	Mean (ppt)	Typical Range (ppt)
Fresh	0.1 – 6.7	<3.0	0 – 3
Intermediate	0.4 – 9.9	3.3	2 – 5
Brackish	0.4 – 28.1	8.0	4 – 15
Saline	0.6 – 51.9	16.0	12+

(Source: Chabreck 1972; Louisiana Coastal Wetlands Conservation and Restoration Task Force; and the Wetlands Conservation and Restoration Authority 1998)

Louisiana's coastal vegetative landscape is characterized by a diversity of plant communities that have been previously classified and mapped according to major association or type (Penfound and Hathaway 1938; O'Neil 1949; Chabreck et al. 1968; Chabreck 1970, 1972b; Cowardin et al. 1979; Chabreck and Linscombe 1978, 1988; Visser et al. 1998, 1999, 2000; and Chabreck et al. 2001).

The combination of salinity, elevation, and organic substrate gradients contributes to distinct zonation in Louisiana's coastal wetland communities. The dominant zonation, with increasing distance from the coast, is salt, brackish, intermediate, and freshwater organic marshes, and swamp and bottomland hardwood communities, which have been well described by Penfound and Hathaway (1938), Chabreck (1970, 1972b); Visser et al. (1998, 1999, 2000); and Visser and Sasser (1998).

The types and productivity of vegetative communities are greatly influenced by the same factors responsible for coastal land loss. Furthermore, the persistence of a vegetative community is dependent upon its ability to adapt to changing conditions. The loss of wetlands has and continues to impact all vegetative community types from the barrier islands, headlands, and salt marshes at the coastal shore to the interior fresh marshes, swamps and bottomland forests.

There is difficulty in assessing trends in vegetative community changes coast wide because of high variability within the coastal landscape. Successional changes have been bi-directional, illustrating that there is no single factor that can explain trends at a coast wide scale. In many areas, transitions in habitat types toward more salt tolerant communities have been recorded over the past 50 years (O'Neil 1949; Chabreck et al. 1968; Chabreck and Linscombe 1978 and 1988; and Linscombe et al. 1997a and 1997b). In others, fresh marsh vegetation types did not show a predicted change to more salt-tolerant communities, but did reflect significant changes in species dominance (Visser et al. 1999).

Sequential mapping of habitats based on coast wide surveys of vegetative communities has been described by O'Neil (1949), Chabreck et al. (1968), Chabreck and Linscombe (1978 and 1988), and Linscombe et al. (1997a and 1997b). Differences in mapping areas and survey approaches between each mapping period make direct acreage comparison of habitat types between maps inappropriate (G. Linscombe, LDWF, 2002 – personal communication). The variability of the coastal vegetation community habitat over time is illustrated on **figures 3-25** and **3-26**.

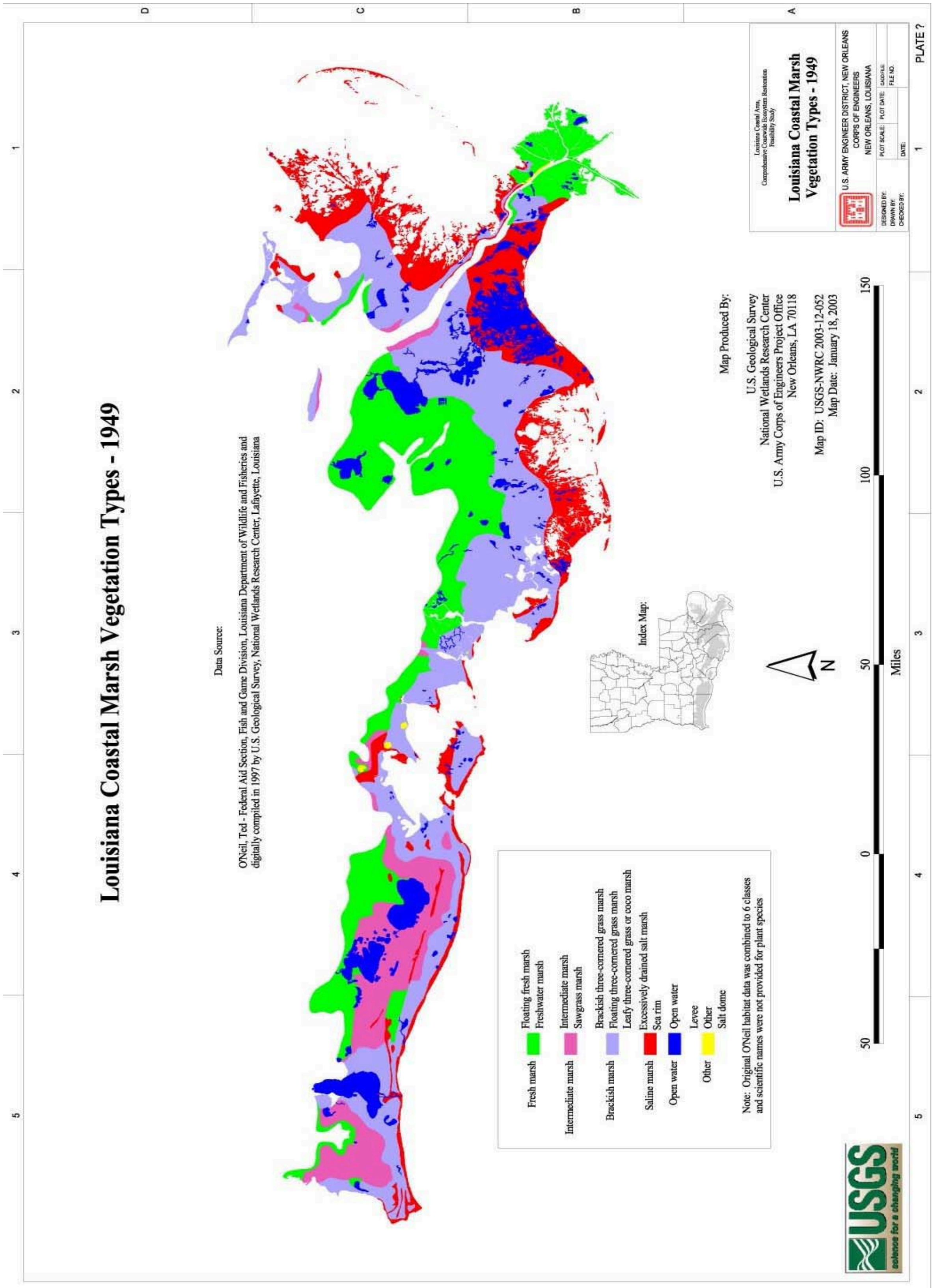


Figure 3-25. Louisiana Coastal Marsh Vegetation in 1949.

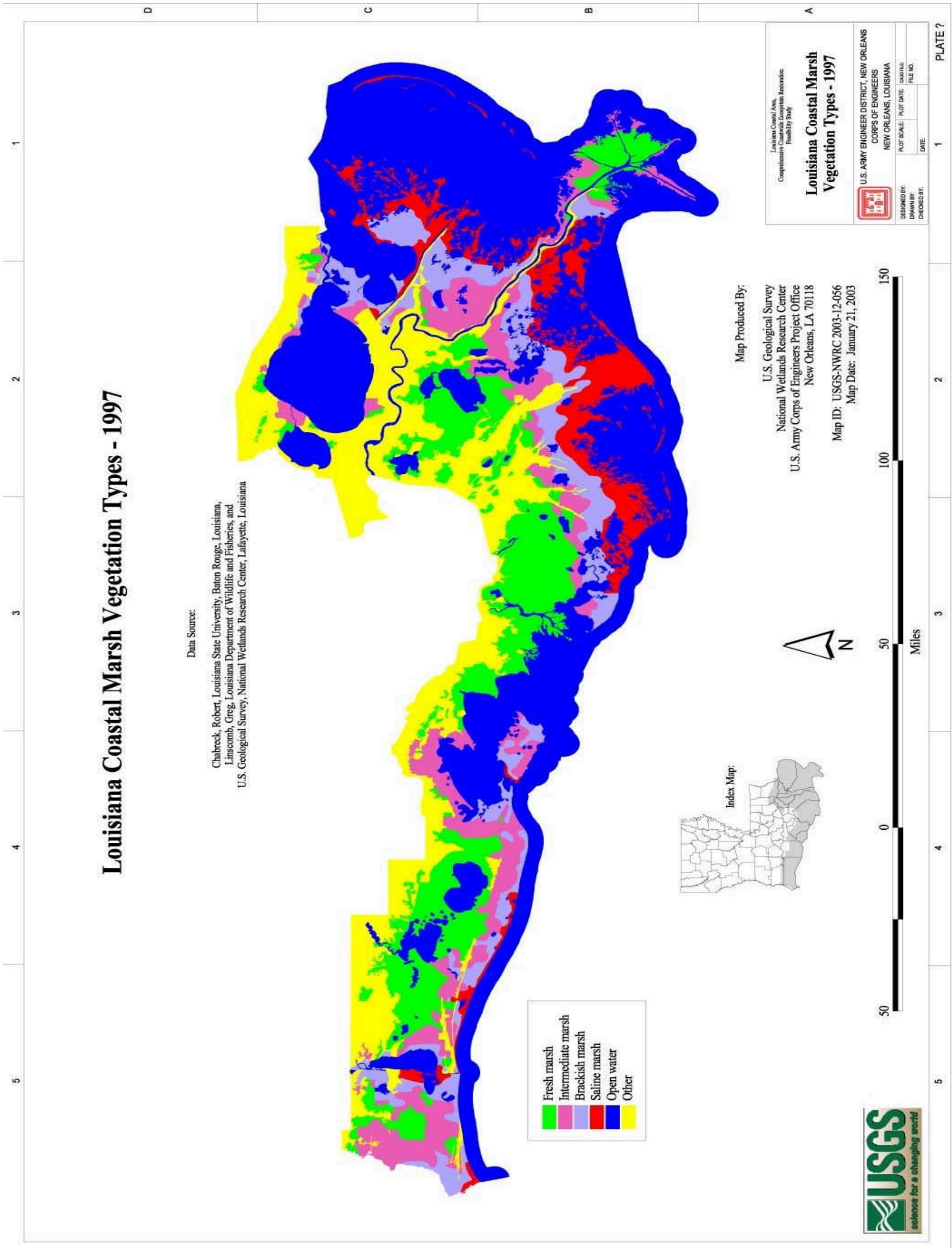


Figure 3-26. Louisiana Coastal Marsh Vegetation in 1997.

3.7.1.1 Major Mechanisms of Vegetative Change

Just as varying combinations of predominant environmental conditions influenced the distribution and successional patterns of vegetation communities during Louisiana's coastal formation, alteration of those conditions brought about by modern landscape changes, land loss, and other events affects the continued existence of wetland vegetation. It is important to understand the major mechanisms of how vegetation is impacted in the course of landscape alteration and by land loss and other factors to develop effective and efficient means to protect and rehabilitate Louisiana's coastal wetlands. Moreover, while many coastal wetland plant species are resilient to single stressor events, there is a growing body of evidence that suggests the combined effects of multiple stressors occurring simultaneously are the most detrimental to plant communities (Webb and Mendelssohn 1996; Baldwin and Mendelssohn 1998; DeLaune et al. 1987). If change is too rapid or at a magnitude beyond the tolerance limits of plant species to allow succession, conversion to open water can occur. The major mechanisms of vegetative change include the following:

- Accretion and Submergence: The vertical accumulation of wetland soils is achieved by accretion of mineral sediment inputs and/or organic accumulation resulting from above- and below-ground plant productivity (DeLaune et al. 1983a; DeLaune et al. 1990a). The survival and productivity of marshes is reliant on these soil-building processes to offset submergence, which results from subsidence and soil oxidation-decomposition losses, and to maintain the marsh surface elevation with respect to sea level change (DeLaune et al. 1978; DeLaune et al. 1979; DeLaune et al. 1990b).
- Flooding: Wetland plants employ different physical and/or metabolic mechanisms that enable them to tolerate and grow in flooded soils. However, in almost all cases plants are dependent on the maintenance of soil surface elevation to sustain the flooding regime to which they are adapted. Increases in flooding, depth, and duration, and salinity levels stress plants by altering metabolic function, and negatively impacting productivity, survival, and regeneration.
- Salinity: Wetland plant species have evolved different levels of tolerance to salinity and respond to salinity with different mechanisms. Numerous studies have demonstrated that elevated salinity can negatively affect all wetland species and can contribute to large-scale vegetation dieback (Chabreck and Linscombe 1982; McKee and Mendelssohn 1989).

3.7.1.2 Factors Driving Changes in Vegetative Resources

Levee System: Since the 18th century, levee construction has interrupted overbank flows and halted the large-scale dissemination of sediment to wetlands. Many of the interior marshes coast wide no longer receive sufficient sediment and associated nutrient input to support vigorous plant productivity and vertical accretion (DeLaune et al. 1990c). This modern environment of sediment deprivation now exists while compaction and subsidence of the coastal area continues as part of the natural degradation of abandoned delta lobes. Descending marsh surface elevation and the resulting increase of flooding, erosion, and saltwater intrusion drove habitat shifts toward more salt tolerant plant communities or conversion to open water that continues today.

Channelization: Construction of canals for oil and gas production and deep navigation channels has affected wetland vegetation by changing the marsh hydrology, interrupting sheet flow, inhibiting drainage, altering sediment movement patterns, causing impoundment and flooding, and facilitating saltwater intrusion and increased tidal exchange.

Drainage for Development and Agricultural Use: Sizable tracts of fresh wetland vegetative communities were also converted for development or agronomic use early in the last century. Wetland soils are not suitable for typical long-term cropping or pasture improvement without establishing significant hydrologic control, so many large expanses of marshes converted for development or agricultural use were leveed and managed with pump-drainage systems (USDA 1977; Okey 1918a; Okey 1918b).

Other Hydrologic Alteration: Installation of other infrastructure, such as municipal drainage systems and road and railroad embankments, has also been associated with wetland deterioration and loss due to accelerated drainage, interruption of natural drainage and impoundment, and physical removal for borrow material.

Fire: Marsh burns, either conducted for management or occurring as a natural phenomenon, have also affected species distribution and successional patterns of plant communities.

Herbivory: Muskrat, nutria, and sometimes geese have been the reported culprits of damage across the coastal area due to “eat-outs,” where all marsh vegetation in an area, including the root system, is consumed (O’Neal 1949; T. Vincent, Audubon Refuge 1995 – personal communication; Linscombe and Kinler 1997).

Invasive Species: The aggressive spread of invasive species decreases stands of native plants in many areas, thus rapidly altering ecosystem function. Different ecosystem types vary in the species that pose problems and the degree to which they are currently impacted or threatened by invasive species (USGS 2000). Disturbed ecosystems are more vulnerable to invasive species than stable ecosystems. Invasive plant species often increase and spread rapidly because the new habitat into which they are introduced is often free of insects and diseases that are natural controls in their native habitats. Invasive species frequently out-compete native plants and alter ecosystem function. Ecosystems vary in their vulnerability to invasion (USGS 2000). In coastal Louisiana water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera philoxeroides*), and hydrilla (*Hydrilla verticillata*) are well-known invasive plants. More recently, common salvinia (*Salvinia minima*), giant salvinia (*Salvinia molesta*), and variable-leaf milfoil (*Myriophyllum heterophyllum*) also have become invasive, displacing native aquatic species and degrading water quality and habitat quality.

Invasive aquatic species frequently change local ecology and hinder the growth and reproduction of native aquatic plants (Chabreck 1972a). In many cases invasive plant species interfere with drainage and flood control and impede navigation and recreational activities (Westbrooks 1998). For example, due to the physical and ecological problems created by water hyacinth, anglers, boaters, SCUBA divers and swimmers are just a few of the groups that are adversely impacted. Water hyacinth degrades water quality, which reduces fishing opportunities. When water hyacinth takes over a waterway, it physically limits the use of that waterway and makes conditions very difficult for boaters and swimmers. Also, when mats of water hyacinth are formed, underwater visibility and biodiversity are reduced, and SCUBA divers are unable to enjoy various underwater features.

Chinese tallowtree (*Triadica sebifera*, formerly *Sapium sebiferum*) and sea-side cedar (*Tamarix gallica*), because of their tolerance to flooding and salt stress, rapidly colonize higher disturbed open ground and interrupt the natural succession of native prairie, scrub-shrub, and woody species. Escaped populations of Chinese tallowtree have established extensive, self-replacing monocultures that have radically altered ecosystems (USGS 2000). Barrow et al. (2000) illustrates how the invasive Chinese tallowtree, in crowding out native species, provides less food for migrating birds.

Cogongrass (*Imperata cylindrica*) is a fast-growing perennial grass that is infesting gulf coast wetlands, savannas, and forests. Considered one of the top-ten worst weeds in the world, cogongrass invades dry to moist natural areas and forms dense colonies with extensive root/rhizome systems that displace native plant and animal species. Cogongrass has been recorded in parts of Louisiana (Center for Aquatic & Invasive Plants 2000), and recently has been found to be locally abundant in a few areas (J. Pitre, USDA NRCS, 2002 - personal communication).

Climate: Wetlands already weakened by extreme weather conditions may be more vulnerable to damage from subsequent events as plant communities become stressed beyond their ability to recover or shift toward communities with more tolerant species. Prolonged periods of drought can also impact coastal vegetation, such as the "brown marsh" phenomenon in 2000 where damage or dieback was reported in areas of unprecedented size in the Terrebonne and Barataria saline marshes.

3.7.2 Existing Conditions

Chabreck et al. (1968), Chabreck (1970, 1972), Chabreck and Linscombe (1978, 1988), and Chabreck et al. (2001) subdivided and mapped Louisiana coastal wetlands into four zones on the basis of Penfound and Hathaway’s (1938) descriptions of the major vegetation types within salinity zones. This classification of marsh vegetation is widely recognized and often used in broadly describing coastal wetlands. The four vegetation types are fresh, intermediate, brackish, and saline, and occur in zones that generally parallel the coast (**figure 3-27**).

Coast wide, the range of salinity within each of these vegetation zones can vary drastically; however, as shown in the Coast 2050 report, the ranges of salinity that occur most frequently are typically much more narrow (**table 3-3).**

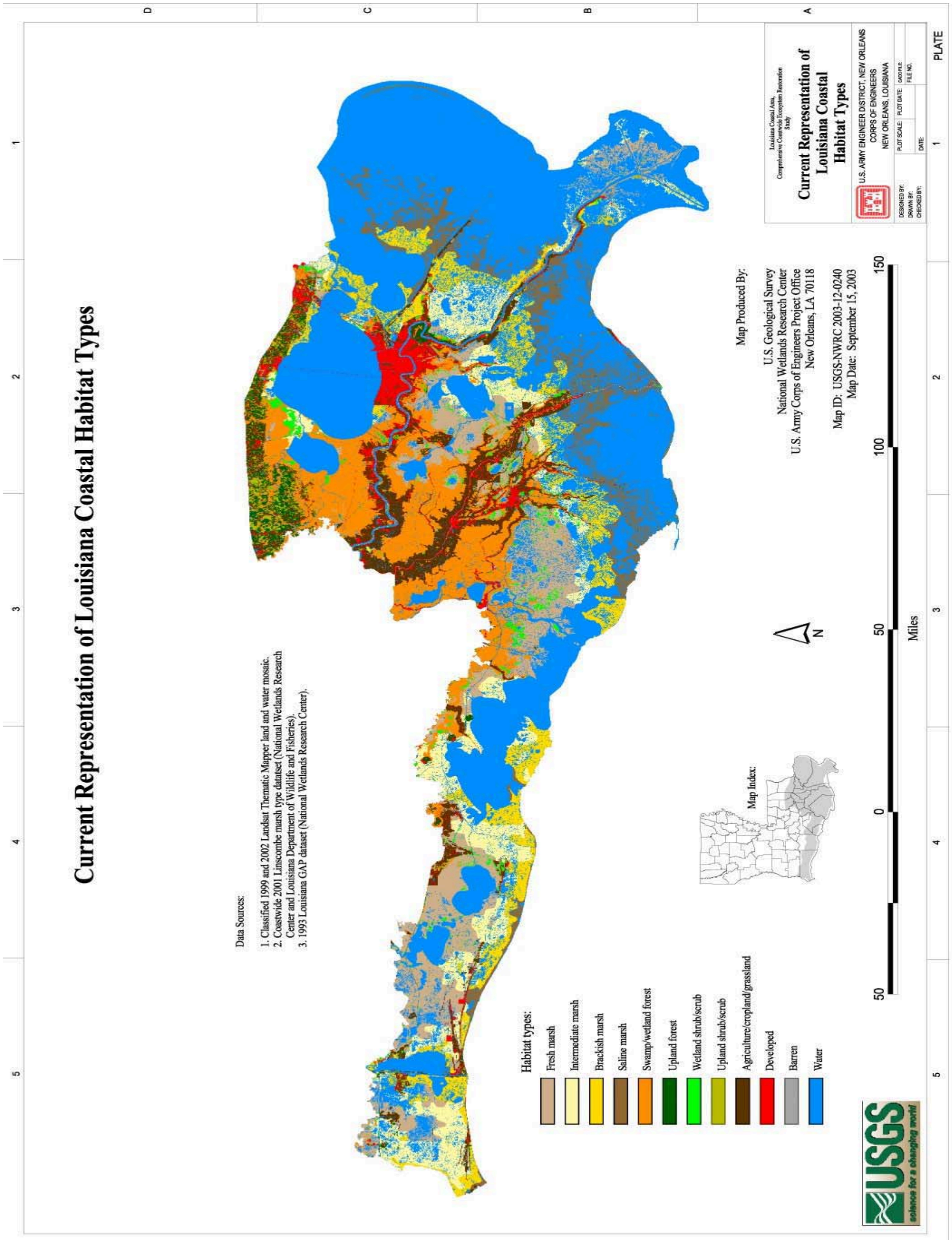


Figure 3-27. Louisiana Coastal Area Vegetative and Other Habitat Types.

In a coast wide survey, Chabreck (1972) recorded a total of 118 species of vascular plants in all marsh types. The species found in the greatest amount overall was marshhay cordgrass (*Spartina patens*), making up about one-fourth of the vegetation in the coastal marshes. Within the broad groupings of major vegetative habitat types found coast wide, such as described above, additional subdivisions of vegetative communities or associations exist (O'Neil 1949). Penfound and Hathaway (1938) acknowledged that there are many associations within which are several "specialized" subgroups that have developed in correlation with specific local differences in environmental factors. It is likely, because of the number and variation of environmental factors that exist and the potential combinations thereof, that division and subdivision of vegetative communities based on characteristic differences could continue until almost every community could be partitioned based on a unique attribute. For practical reasons, this level of division is not warranted, but to protect the diversity in Louisiana, conservation efforts must take this phenomenon into account (Smith 1988).

Using recent GIS analysis and classification by USGS NWRC for LCA Study planning, the desktop model output of one square kilometer resolution provides a current summary of the acreages of fresh, intermediate, brackish, and saline marsh types, and swamp/wetland forest based on a subdivision of the Louisiana coastal zone by subprovince (**table 3-4**).

Table 3-4
Wetland Habitat Acreage by Subprovince in Louisiana Coastal Zone
(from Desktop Model Analysis)

Habitat Classes (Acres)	Sub Province 1	Sub Province 2	Sub Province 3	Sub Province 4	Total LCA Area
Fresh Marsh	71,279	180,876	341,733	346,923	940,811
Intermediate Marsh	160,752	85,267	193,569	284,702	724,290
Brackish Marsh	180,441	65,337	201,216	137,529	584,523
Saline Marsh	113,149	117,809	113,513	30,307	374,778
Swamp/Wetland Forest	353,904	294,397	388,811	3,674	1,040,786
Total*	879,525	743,687	1,238,841	803,135	3,665,188

NOTE: Wetland Shrub/Scrub acreage has been distributed among the broader habitat classes used by the desktop model.
* All acreage figures provided for all habitat types exclude habitat that occurs within fastlands because they are hydrologically disconnected from areas that would be affected by LCA Plan restoration actions and are not included in the areas analyzed by the LCA Study desktop model.

The model aggregated the acreage of many distinct vegetative communities according to local environmental conditions (salinity and water levels) into the larger wetland habitat classifications of Fresh Marsh, Intermediate Marsh, Brackish Marsh, Saline Marsh, Swamp/Wetland Forest, and Upland and other non-wetland classes (see appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING). For instance, wetland scrub/shrub habitat was distributed according to the appropriate broader habitat classification within which it occurred, and barrier island communities were aggregated into saline habitat, as delineated in Linscombe's 2001 dataset (see Data Source list in **figure 3-27**). Although important, unique vegetative communities such as Coastal Dune Grasslands or Mangrove Thicket on barrier islands were not specifically distinguished or delineated by the model. Also, the model did include Upland habitat acreage that was not located within fastlands; however, the model assumed no change in Upland acreage over the 50-year period of analysis.

The primary focus of Chabreck's (1972) and Chabreck and Linscombe's (1978, 1988, 2001) classification is the vegetative species of the natural marshes and interior water bodies of the coastal area. However, it is important to recognize that within those broadly delineated zones of marsh habitat types, other wetland areas with distinctive surface features and vegetative communities occur in association with the marshes. The following are descriptions of other major habitat types that comprise and illustrate the diversity of the LCA Study area:

- <u>Swamp and Wetland Forests</u>: Of the approximately 1,031,868 acres of swamp/wetland forests in the LCA Study area (Barras 2002, unpublished), the three major communities are swamp forest, bottomland forest, and wet pine flatwood forest. Cypress and cypress-tupelo swamps with fairly open canopies sometimes support fresh marsh and scrub/shrub species as groundcover, and very often the water surface in cypress-tupelo swamps is covered by floating vegetation. Extensive coastal swamps are found in the Pontchartrain, Barataria, Terrebonne, and Atchafalaya basins where they generally occupy the area between fresh marshes and developed areas of higher elevation. Healthy cypress swamps occur only in freshwater areas experiencing minimal daily tidal action and where the salinity range does not normally exceed two ppt. Both the bottomland hardwood forests and wet pine flatwoods occur only in fresh areas. Bottomland hardwood forests exist primarily in broad floodplains and distributary ridges of the Atchafalaya River and on the distributary ridges of the Mississippi River. Wet pine flatwoods within the LCA Study area are generally found on poorly drained flats and depressional areas in the "Florida Parishes" (Smith 1986). Wet pine flatwoods also contain a very diverse herbaceous community that can include many state rare species and, within in the LCA Study Area, may include the endangered species Louisiana quillwort (*Isoetes louisianensis*).
- <u>Scrub/Shrub</u>: There are approximately 121,314 acres of wetland scrub/shrub habitat, and 84,725 acres of upland scrub/shrub habitat in the LCA Study Area (Barras 2002, unpublished). Scrub/shrub habitat is found along bayou ridges and on dredged material embankments, and is typically bordered by marsh at lower elevations and by cypress-tupelo swamp or bottomland hardwoods (in fresh areas) or developed areas at higher elevations. Scrub/shrub communities are found associated with all four marsh types, from salt marsh to fresh marsh.
- <u>Upland Forests</u>: There are approximately 172,025 acres of upland forests in the LCA Study area (Barras 2002, unpublished). Three major communities of upland forest in the

area include chenier/maritime forest, mixed hardwood forest, and mixed pine-hardwood forest (Craig et al. 1987).

- Cropland/grassland: There are approximately 481,824 acres of cropland/grassland in the LCA Study area (Barras 2002, unpublished). Predominant crops include sugarcane (*Saccharum* sp.) (about 440,000 acres), rice (*Oryza* sp.) (about 306,000 acres) soybeans (*Glycine* sp.) (about 72,000 acres), and hay/grass (about 58,000 acres) (LSU Agricultural Center / Louisiana Cooperative Extension Service 2001).
- Urban areas: There are approximately 262,536 acres of urban area in the LCA Study area (Barras 2002, unpublished), including fringing suburbs, built-up areas of metropolitan communities, man-made structures, and associated disturbances that may or may not include vegetation.
- Barren: There are approximately 1,350 acres of barren area in the LCA Study area (Barras 2002, unpublished). Barren areas consist primarily of exposed, unvegetated (less than 25 percent vegetation) areas that are inundated annually and typically associated with rivers, streams, lakes, ponds, and impoundments. Barren areas occur within upland and wetland zones.
- Water: There are approximately 4,491,105 acres of water in the LCA Study area (Barras 2002, unpublished), including the Gulf of Mexico, coastal bays and lakes, lagoons, ponds, impoundments, canals, rivers, and streams. Excluding the Gulf of Mexico, coastal bays and large lakes, such as Lake Pontchartrain, there are approximately 984,366 acres of water.

3.7.2.1 Chenier and Deltaic Plains

Louisiana's coastal zone can be divided into two areas based on geologic origin: the Chenier and Deltaic Plains. Although these are two very large areas and both contain the habitat types described above, some differences in wetland vegetative communities can be found between the plains. Visser et al. (1998) conducted quantitative analyses of vegetation data collected by Chabreck and Linscombe in 1997 to determine naturally occurring vegetation associations in the Louisiana coastal zone marshes. The Visser et al. (1998) vegetative type analysis used species dominance and species association as the primary criteria to classify marsh areas, rather than species composition, which was used to delineate the four habitat types described by Chabreck (1972). Of the 12 vegetation associations occurring within four salinity regimes that Visser et al. identify, 11 are found in the Deltaic Plain, but only six are found in the Chenier Plain. While the Deltaic Plain hosts more types of associations, especially in the fresh and intermediate regimes, species richness is somewhat higher in the fresher regimes in the Chenier Plain associations. Also, in the association types that are found to occur both in the Chenier and Deltaic Plains, the dominant species are the same in both regions, but the overall species composition is notably different.

3.7.2.2 Rare, Unique, and Imperiled Vegetative Communities

Further subdivision of each subprovince by hydrologic basin provides a focus on the unique vegetative communities associated with distinctive local environmental factors (Louisiana Natural Heritage Program (LNHP) 2002) (see **figure 3-28).**

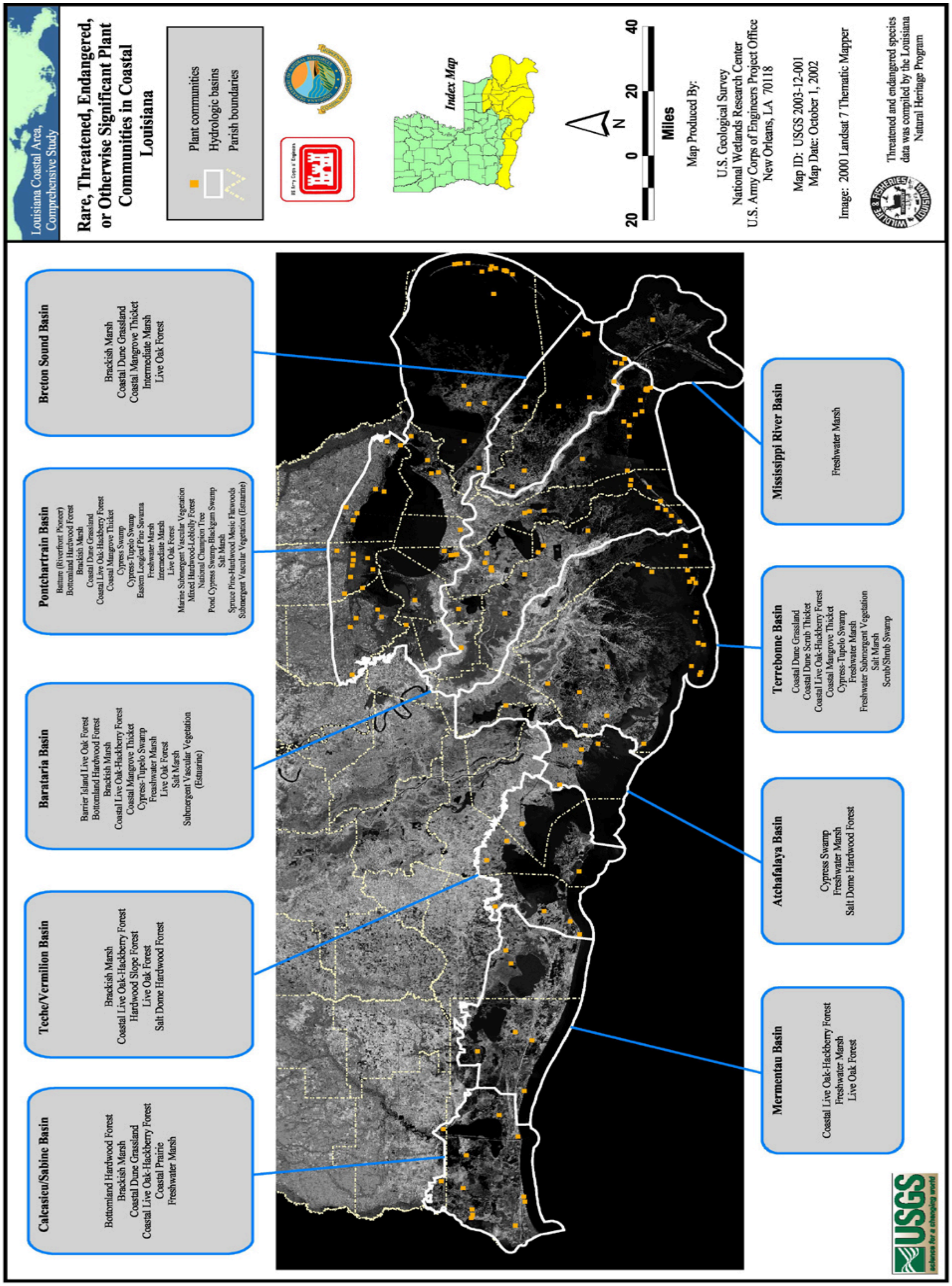


Figure 3-28. Rare, threatened, endangered, or otherwise important plant communities in coastal Louisiana *(from LNHP).*

Some examples of the unique communities include floating marshes, barrier island and coastal dune communities, and maritime forests (Craig et al. 1987; Sasser 1994). The LNHP classification system (Craig et al. 1987) provides descriptions of coastal Louisiana's natural plant communities, their dynamics, locales, and a community status ranking. Each identified community is assigned a ranking according to its relative occurrence and/or level of security or endangerment within the state. Many unique communities in coastal Louisiana are listed by the LNHP as imperiled or critically imperiled because of their rarity or vulnerability to extirpation (local extinction). The following are LNHP descriptions of communities occurring in the Louisiana coastal area that have been designated as imperiled or critically imperiled. The wide range of these communities provides an illustration of the extent of the recognized threat to Louisiana's rich habitat diversity.

The following unique communities, nestled within the broader vegetative habitats, are important in that they contribute to the extensive diversity of the coastal ecosystem, are the basis for its productivity, and are essential to the stability of the bionetwork. Overall, plant communities provide protection against substrate erosion and contribute food and physical structure for cover, nesting, and nursery habitat for wildlife and fisheries. Continued degradation and loss of existing wetland areas, in concert with truncation of replenishing processes, will accelerate decline in the interdependent processes of plant production and vertical maintenance necessary for a stable ecosystem.

- <u>Marine Submergent Vascular Vegetation Communities</u>: Also known as seagrass beds, occur in shallow, relatively clear offshore marine systems with unconsolidated substrate. The primary community species listed are turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), sea grass (*Halophila engelmanii*), shoal grass (*Halodule wrightii*), and widgeon grass (*Ruppia maritima*).
- <u>Estuarine Submergent Vascular Vegetation Communities</u>: Composed primarily of water celery (*Vallisneria americana*), widgeon grass, southern naiad (*Najas guadalupensis*), and horned pondweed (*Zannichellia palustris*). These brackish communities grow in sand/mud bottom substrates in shallow, protected waters with low turbidity. Activities that cause long-term increase in turbidity in the waters surrounding the beds are a serious threat to their viability. This community is ranked as imperiled.
- <u>Coastal Mangrove Thicket</u>: Dominated by black mangrove (*Avicennia germinans*), this estuarine community has several important ecological functions - he extensive root systems stabilize shorelines and reduce erosion, provide cover and food, improve surrounding water quality by filtering nutrients and suspended sediments, and provide nesting areas for colonial water birds.
- <u>Coastal Dune Grassland</u>: Also known as maritime grasslands, occurs on beach dunes, relatively elevated backshore areas above intertidal beaches on barrier islands, and mainland shores. The frequent flooding, erosion, and shifting dune substrate constantly influence the dynamic community composition. Marshhay cordgrass is usually the dominant species, but saltgrass (*Distichlis* sp.), seashore paspalum (*Paspalum vaginatum*), beach panicgrass (*Panicum amarum*), seacoast bluestem (*Schizachyrium maritimum*), and broomsedges (*Andropogon* sp.) are common associates.

- Coastal Dune Shrub Thicket: Occur on stabilized sand dunes and beach ridges on barrier islands and mainland coast. It is of very limited extent in Louisiana due to relatively poorly developed coastal dunes. This community normally appears as a relatively dense stand of shrubs that usually include wax myrtle (*Myrica cerifera*), yaupon (*Ilex vomitoria*), marsh elder (*Iva frutescens*),eastern baccharis (*Baccharis halimifolia*), and occasionally acacia (*Acacia smallii*) and toothache tree (*Zanthoxyllum clava-herculis*).
- Barrier Island Live Oak Forest: In 1999, the LNHP designated a separate community classification, barrier island live oak forest, to describe the single known extant live oak (*Quercus virginiana*) community on Grand Isle, a Louisiana barrier island.
- Vegetated Pioneer Emerging Delta: These communities are dynamic, forming primarily within the actively building delta region at the mouth of the Atchafalaya River. Zonation of species occurs on the newly accreted land. This very diverse community is successional in nature, changes rapidly with time, and is restricted to one region of Louisiana.
- Coastal Prairie: The coastal prairie was once very extensive in southwestern Louisiana, but today, of the approximately 2.5 million original acres, less than 100 acres remain and are relegated to small remnant parcels. The coastal prairie is extremely diverse and dominated by grasses, sedges, rushes, and a wide variety of forbs. Fire is a major contributor to the maintenance of the prairie, and its suppression allows certain woody species to invade.
- Live Oak Forest: Occurs principally in southeastern Louisiana on natural levees, ridges, or frontlands, and on islands within marshes and swamps in the coastal zone. Live oak dominates the stand, but water oak (*Quercus nigra*), American elm (*Ulmus americana*), sugarberry (*Celtis laevigata*), red maple (*Acer rubrum*), and green ash (*Fraxinus pennsylvanica*) are usually prominent community members. There are only a small number of populations known to exist and they are vulnerable to extirpation (local extinction).
- Salt Dome Hardwood Forest: This community is a variable mixed forest that occurs on the elevated salt domes near the coast. The natural community includes live oak, various elms (*Ulmus* sp.), and other species not typical of hardwood slope forests above the coastal zone.
- Coastal Live Oak-Hackberry Forest: Also known as chenier maritime forest, this is a natural community that formed on abandoned beach ridges primarily in southwest Louisiana, although abandoned beach ridges and stream levees in the southeast are also locally known as cheniers. Live oak and hackberry (also referred to as sugarberry) are the dominant canopy species, and other common species are red maple, sweet gum (*Liquidambar styraciflua*), water oak, green ash, and American elm. These species populate ridges composed primarily of reworked sand and shell that are normally four to five feet (1.2 to 1.5 m) above sea level. Cheniers serve as natural hydrologic buffers, providing some protection for the interior marshes against saltwater intrusion.
- Live Oak-Pine-Magnolia Forest: Also known as maritime mesophytic forest, this vegetation type principally occurs in sandy soil within two miles (3.2 km) of Lake Pontchartrain where the Pleistocene prairie terrace meets the lake. This community

exhibits site-to-site variation in species composition, and may experience exposure to salt spray and saltwater inundation associated with storm events.

- Fresh Marsh: Although the fresh marshes, as previously described, compose a large amount of the entire coastal marsh acreage, the LNHP ranks this community as imperiled because it has undergone the largest reduction in acreage of any of the marsh types over the past 20 years due to saltwater intrusion. In general, this community occurs on substrates with the highest organic matter content of any marsh type, making it more vulnerable to loss through erosion and subsidence.
- Floating Fresh Marsh: Also known as flotant marsh, it is included within the LNHP's overall fresh marsh classification and therefore is not described or ranked separately as a distinct community subclass. Nevertheless, it is discussed separately in this writing for two reasons. First, in North America the largest areas of floating marsh appear to be in the freshwater marshes of the Louisiana Deltaic Plain (Mitsch and Gosselink 1993). Second, in the last decade work by Sasser (1994) and Visser et al. (1999) brought to light that the extensive maidencane (*Panicum hemitomon*)-dominated, thick mat flotant described by O'Neil in 1949 has been drastically reduced.

3.8 WILDLIFE RESOURCES: BIRDS, MAMMALS, AMPHIBIANS, AND REPTILES

3.8.1 Historic and Existing Conditions

This resource is institutionally significant because of the Fish and Wildlife Conservation Act of 1980, the Fish and Wildlife Coordination Act of 1958, as amended, the Migratory Bird Conservation Act, the Migratory Bird Treaty Act, the Endangered Species Act of 1973 (ESA), and Executive Order 13186 Migratory Bird Habitat Protection. Wildlife resources are technically significant because they are a critical element of the various coastal habitats, they are an indicator of the health of various coastal habitats, and many wildlife species are important commercial resources. Wildlife resources are publicly significant because of the high priority that the public places on their esthetic, recreational, and commercial value.

The biodiversity characterizing coastal Louisiana is nationally significant. Coastal Louisiana contains an estimated 40 percent of the vegetated estuarine wetlands in the contiguous United States. Louisiana's coastal wetlands provide important habitats for various life cycle phases for over 50 rare, threatened, or endangered species including: piping plover (*Charadrius melodus*), bald eagle (*Haliaeetus leucocephalus*), brown pelican (*Pelicanus occidentalis*), Kemp's Ridley sea turtle (*Lepidochelys kempii*), loggerhead sea turtle (*Caretta caretta*), diamondbacked terrapin (*Malaclemys terrapin*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), and Louisiana black bear (*Ursus americanus luteolus*). In the Barataria-Terrebonne estuary alone, one of the most degraded but most productive and diverse estuary complexes of coastal Louisiana, it is estimated that 353 species of birds are known to occur, of which 185 species are annual returning migrants. In total, approximately 735 species of birds, finfish, shellfish, reptiles, amphibians, and mammals spend all or part of their life cycle in the estuary (http://www.btnep.org).

The wetlands and associated habitats of coastal Louisiana are of national importance and provide essential habitat to diverse and abundant wildlife resources, including a wide range of resident and migratory birds as well as critical habitat for the wintering populations of the piping plover. Coastal Louisiana has the Nation's largest concentrations of colonial nesting wading birds and seabirds. One hundred ninety-seven colonies of wading birds and seabirds (representing 215,249 pairs of nesting birds), were observed in coastal Louisiana during a 2001 survey (Michot et al. 2003). Louisiana coastal marshes provide habitat to 14 species of ducks and geese (those species for which data is available), including approximately 50 percent of the wintering duck population of the Mississippi Flyway (Michot 1996).

Coastal Louisiana's marshes, swamps, and associated habitats support millions of neotropical and other migratory avian species such as rails, gallinules, shorebirds, wading birds, and numerous songbirds. The rigors of long distance flight require most migratory birds to rest and refuel several times before they reach their final destination. Louisiana coastal wetlands provide migratory birds essential stopover habitat on their annual migration route. During the spring, many of these birds are on their way to nesting areas further north. Migration in the fall is important since it provides resting and refueling habitat prior to crossing the Gulf of Mexico. These advantages certainly enhance survival of individual migrating birds, increases in population size, and in time, survival potential for the species as a whole.

Reincke et al. (1989) describe the importance of the Mississippi alluvial valley for migrating and wintering waterfowl. Continuing losses of wintering habitat (Tiner 1984; Forsythe 1985) and a better appreciation of the interdependence of waterfowl requirements throughout the annual cycle (Anderson and Batt 1983) have led to a more balanced concern for the conservation of breeding, migration, and wintering habitats. The North American Waterfowl Management Plan (NAWMP) (Canadian Wildlife Service [CWS] and USFWS 1986), a multi-nation agreement for the management of waterfowl, proposes to restore prairie nesting areas and protect migration and wintering habitat for waterfowl and other migratory bird populations in the lower Mississippi River and Gulf Coast regions, among others. The NAWMP identifies coastal Louisiana as part of one of the most important regions in North America for the maintenance of continental waterfowl populations.

Coastal Louisiana has been a leading fur-producing area in North America. Common furbearers include nutria (*Myocastor coypus*), mink (*Mustela vison*), muskrat (*Ondatra zibethica*), raccoon (*Procyon lotor*), and river otter (*Lutra canadensis*). The coastal marshes and swamps also support game mammals such as white-tailed deer (*Odocoileus virginianus*) and swamp rabbit (*Sylvilagus aquaticus*) and smaller mammals such as bats, mice, and squirrels. Louisiana marshes provide abundant habitat for many reptiles, most notably the American alligator (*Alligator mississippiensis*). Coastal Louisiana supports approximately 1.5 million alligators, for which sport and commercial hunting is strictly regulated. The swamps and fresh/intermediate marshes support many amphibians, especially various frog species.

The following information is taken from the Coast 2050 report and appendices B – F (specifically, tables 1-4), which provide the most recent information about wildlife functions, status, trends, and projections for the entire LCA Study area. A general discussion is presented for those instances where species or species groups have been decreasing or increasing in abundance over the last 10 to 20 years.

3.8.1.1 Subprovince 1 – Pontchartrain Basin, Breton Basin, and Eastern Mississippi River Delta

Wintering waterfowl use is high in parts of the upper subprovince, including the La Branche area, Bayou Sauvage, and Delta National Wildlife Refuges (NWR); Pass a Loutre Wildlife Management Area (WMA); and the Chandeleur Islands. Dabbling duck and diving duck numbers are increasing in the vicinity of freshwater diversions, such as in the Caernarvon area. However, numbers have somewhat declined where the MRGO has had a negative influence. Wading bird colonies are present in suitable habitat throughout the area and have been steady or increasing in those areas. The outer saline marshes and the Chandeleur Islands contain several seabird colonies that have been decreasing as those marshes continue to decline.

Game mammals and furbearers are generally associated with forested wetlands. The wetlands of this subprovince were an important area for the production of furbearers. In recent history, fur production has been on a downward trend. This decline is largely attributed to saltwater intrusion and a corresponding reduction in carrying capacity for fur animals such as the muskrat and nutria (Kerlin 1979).

American alligator abundance has been increasing in the upper portions of the subprovince and decreasing in the lower portions, but overall has declined as fresh marsh converted to intermediate and brackish marsh. According to Dundee and Rossman (1989), several amphibians and reptiles occupy a wide variety of habitats throughout the subprovince.

3.8.1.2 Subprovince 2 – Barataria Basin and Western Mississippi River Delta

Over the past 10 to 20 years, duck numbers have declined in the brackish and saline marshes and increased in the vicinity of freshwater diversions. The decline is a result of marsh loss and a conversion to saltier marsh types as marine forces increasingly penetrate into the interior marshes of this basin. The abundance of seabirds, wading birds, shorebirds, and other birds using marsh and open water habitats is declining in areas of high land loss. There are nearly 100 waterbird nesting colonies known within the area in every habitat type from cypress swamp to barrier islands. Brown pelican and bald eagle abundance is increasing, primarily as a result of improved nesting success in other parts of the coast.

Furbearer, alligator, and game mammal populations have decreased in areas of land loss, mainly the lower basin. Populations appear steady in the rest of the subprovince.

3.8.1.3 Subprovince 3 – Terrebonne, Atchafalaya, and Teche/Vermilion Basins

The bald eagle has increased in numbers over the past 10 to 20 years as a result of increased nesting in and around this subprovince. Over the last 10 to 20 years, dabbling ducks, wading birds, shorebirds, seabirds, furbearers, and alligators have experienced decreasing populations in eastern Terrebonne Basin as a result of marsh loss and a conversion to saltier marsh types. Across this subprovince, the greatest loss of coastal wetlands has occurred in the fresh and intermediate marshes of the Terrebonne Basin. Terrebonne Basin fresh and intermediate marshes and swamp represent a major fall staging and wintering area for migratory waterfowl.

With steady growth of emergent wetlands occurring since 1973, the Atchafalaya Basin has experienced an increase in wildlife usage and provides excellent habitat for most wildlife species/species groups. Atchafalaya Delta WMA provides some of the highest quality habitat for wintering waterfowl in coastal Louisiana. Beneficial use of dredged material has created nesting habitat in the Atchafalaya Delta WMA that has become important for nesting colonial seabirds in Louisiana (Carloss 1997 and Leberg et al. 1995). Wading bird nesting colonies exist on both the Wax Lake Delta and the Main Delta. Neotropical migrants use forested areas extensively during migration. There are numerous waterbird nesting colonies within the subprovince, the most significant on Raccoon Island.

Consistent with the stable wetland conditions and freshening across the Teche/Vermilion Basin, the trend for most wildlife species/species groups has been one of stable or, in some cases, increasing populations.

3.8.1.4 Subprovince 4 – Calcasieu-Sabine and Mermentau Basins

The most recent trend toward marsh stability and the diversity of marshes in the area have led many species to exhibit increasing or stable population trends over the past 10 to 20 years. Increasing populations of the American alligator have been associated with fresh and intermediate marshes, while several groups of birds, such as waterfowl, have also been increasing in population. Stable populations of furbearers, seabirds, coots, rails, and game mammals also exist in this subprovince. This subprovince generally provides high quality habitat for waterbirds and wading birds. Several amphibians and reptiles are common to the Mermentau and Calcasieu/Sabine Basins and occupy a variety of habitats.

3.8.2 Invasive Mammalian Species

The following information is taken from LDWF et al. (2003). The two mammals identified as invasive species in Louisiana are the nutria and feral hogs (*Sus scrofa*).

Nutria are large, rodent-like, herbivorous, aquatic mammals with large orange incisor teeth. They were introduced to Louisiana from Argentina between 1900 and 1940 for fur farming. However, when some fur farms failed, the nutria were released into the wild, and it was thought they would act as a biocontrol for invasive water hyacinth (LeBlanc 1994).

Nutria are prolific breeders and they exacerbate coastal wetland loss by digging into soft wetland soils and eating the roots of marsh vegetation. As the vegetation dies, the soft soils become open water; these holes in the marsh are called “eat-outs” (USGS 2000). Historically, fur demand meant that hunters and trappers kept populations somewhat in check. After the price of nutria pelts plummeted in 1989, however, nutria populations began to grow unbounded (USGS 2000).

The Coastwide Nutria Control Program, approved under CWPPRA in 2002, is designed to remove approximately 400,000 nutria annually through an incentive payment program designed to encourage nutria harvesting. Thus far, the program has collected 308,160 nutria tails from 342 participants. The preliminary results indicate that the 2002-2003 harvest overlaps with nutria damage (vegetative eat outs) from 2002.

Feral hogs are actually a combination of purebred wild boars, purebred domestic livestock, and hybrids of those two species (Aguirre and Poss 1999). Besides competing with deer, bears, rabbits, and other native species for habitat and food resources, feral hogs can pose a serious risk to Louisiana residents. In their quest for food, feral hogs damage hurricane protection levees with their snouts and hooves (Jensen 2001). Weakening hurricane protection levees is a very serious problem in Louisiana; without levees, low-lying areas are more prone to floods from storm surges caused by heavy winds, such as in a hurricane.

3.9 PLANKTON RESOURCES

3.9.1 Historic Conditions

Plankton communities serve an important role in the coastal waters of Louisiana. The plankton are composed of three groups, the bacterioplankton, phytoplankton, and zooplankton (Knox 2001). The phytoplankton are the primary producers of the water column, and form the base of the estuarine food web. The zooplankton provide the trophic link between the phytoplankton and the intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fish species (Day et al. 1989). Microzooplankton appear to be important consumers of bacterioplankton, which are typically enumerated primarily by culture and microscopic techniques. Culture techniques are selective and invariably underestimate bacterial densities (Day et al. 1989).

"The Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana," prepared by the Louisiana Wildlife and Fisheries Commission in 1971, provides a summary of plankton across the coastal estuaries of Louisiana in the late 1960s (Perret et al. 1971).

The dominant member of the zooplankton community throughout that study was the copepod *Acartia tonsa*. The greatest concentrations of zooplankton were encountered in Breton Sound. The lowest concentrations were encountered in Chandeleur Sound and Lake Borgne east of the Mississippi River, Lakes Barre and Raccourci, and Terrebonne and Timbalier Bays. Species diversity was greatest in the Breton Sound and Mississippi River, East Bay, Garden Island Bay, and West Bay areas. Historically, salinity appears to be the chief controlling factor in the number of species present, while temperature, competition, and predation control the number of individuals present. In addition, the abundance of certain zooplankton may be indicative of good fishing areas.

3.9.2 Existing Conditions

3.9.2.1 Phytoplankton

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

In recent years, blooms of blue-green algae have been observed in several coastal lakes in Louisiana. Large-scale blooms occurred in Lake Pontchartrain in 1993 and 1997, with smaller blooms observed in other years. The 1997 bloom occurred after a month-long opening of the Bonnet Carre Spillway, which introduced up to 240,000 cfs of Mississippi River water into Lake Pontchartrain. Blooms in the lake are not unusual in July or August, when light winds allow for low turbidity. This in turn allows for light penetration into the water column, and in combination with high nutrient concentrations and high temperatures, conditions are optimal for phytoplankton growth. Lake Pontchartrain, Lac Des Allemands, and various other coastal lakes that receive runoff high in nutrients experience algal blooms under such conditions. Runoff from fertilized areas, including lawns, golf courses, agricultural fields, and both treated and untreated sewerage provide nutrients that cause such lakes to be eutrophic. Such water bodies tend to be high in primary productivity, which fuels the estuarine food web. Abundant growth of green algae can be observed in healthy water bodies. Phytoplankton production is the major source of autochthonous organic matter (produced within the system) in most estuarine systems (Day et al. 1989). However, too much productivity can be detrimental to a lake's ecology when blooms, particularly blooms of blue-green algae, occur.

Lane et al. (1999) studied water quality impacts of the Caernarvon Freshwater Diversion Project, which diverted approximately 740 to 7,500 cfs of water from the Mississippi River into the Breton Sound, depending on the month of the year. The authors concluded that "there was no significant impact of the diversion at all of the water quality monitoring stations for $NO_2 + NO_3$." Specifically, they stated that rapid reduction of $NO_2 + NO_3$ seemed to occur, indicating that "the Breton Sound wetlands and shallow waters were acting as a strong sink for $NO_2 + NO_3$." The study also concluded that the total nitrogen and total phosphorus levels did not have a significant impact due to the diversion.

In south central Louisiana, Rabalais et al. (1995) found that the sediment record (from the Barataria and Terrebonne salt marshes) indicates that the wetlands adjacent to the estuarine system incompletely buffer the effects of increased nutrient loading on water quality and that the ability of the wetlands to absorb additional amounts of nutrients is much less than 100 percent.

Phytoplankton in more saline environments can cause a different kind of bloom; *Karenia breve* (formerly known as *Gymnodinium breve*), for example, is a dinoflagellate that has been associated with red tides. Red tides are so named because the prolific growth stains the water red. Toxins associated with red tides are capable of killing fish and shellfish. Red tide populations well below the fish kill level pose a serious problem for public health through shellfish contamination. Bivalve shellfish, especially oysters, clams, and coquinas, can accumulate so many toxins that they become toxic to humans. Public health concerns also emerge from studies that show that the presence of airborne toxins have an impact on the human respiratory system (Mote Marine Lab website: http://www.marinelab.sarasota.fl.us/~mhenry/WREDTIDE.phtml). Freshwater diversion has been utilized in some instances to attempt to reduce the spread of red tides into coastal waters.

3.9.2.2 Zooplankton

Zooplankton are faunal components of the plankton, including small crustaceans such as copepods, ostracods, euphausiids, and amphipods; the jellyfishes and siphonophores; worms, mollusks such as pteropods and heteropods; and the egg and larval stages of the majority of benthic and nektonic animals (Rounsefell 1975). Zooplankton are weakly swimming animals comprised of two broad categories: holoplankton, which are planktonic species as adults, and meroplankton, which are organisms that occur in the plankton during early life stages before becoming benthic or nektonic (most common are immature forms of benthic invertebrates). Zooplankton serve as food for a variety of estuarine consumers, but also are important for their role in nutrient cycling.

Although there are no clear general patterns of zooplankton abundance in estuaries, some regional seasonal patterns have been described (Day et al. 1989). The zooplankton of many estuarine water bodies are dominated by copepods of the genus *Acartia.* Cyclopoid copepods and cladocerans are often abundant in low salinity waters of Louisiana (Hawes and Perry 1978). Zoeae (a larval stage in some crustaceans) can make up a large component of the meroplankton. Zooplankton in Louisiana waters are in some cases dominated by zoeae of the mud crab *Rithropanopeus harrisii*.

While some zooplankton are euryhaline, others have distinct salinity preferences. Therefore, introduction of river water into estuarine systems can have dramatic short-term impacts on plankton populations in adjacent coastal waters (Hawes and Perry 1978).

3.10 BENTHIC RESOURCES

3.10.1 Historic and Existing Conditions

The bottom estuarine substrate (benthic zone), regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is commonly called a "benthic effect" (Day et al. 1989). Within a salt marsh, less than 10 percent of the above-ground primary production of the salt marsh is grazed by aerial consumers. Most plant biomass dies and decays and its energy is processed through the detrital pathway. The major consumer groups of the benthic habitat include: bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink 1993).

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

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

3.10.2 Outer Continental Shelf Benthic Resources

3.10.2.1 <u>Benthic Environment of the Ship Shoal Area</u>

As described in section 3.3 OFFSHORE SAND RESOURCES, offshore sand shoals and the larger nearshore sand bodies represent potential sources for the millions of tons of sand sediment that would be necessary for coast wide restoration. With its extensive oil and gas activities, the benthic resources on Ship Shoal have been extensively studied. The following is a summary of the benthic resources on Ship Shoal provided by the MMS.

Ship Shoal is a Holocene sand body located on the south-central Louisiana inner shelf 15 kilometers seaward of the Isles Dernieres. It is approximately 50 km (31 miles) long and 12km (7 miles) wide. It lies in a water depth of six to nine meters and is composed primarily of well-sorted quartz sand, a benthic substrate not commonly found on the Louisiana inner shelf (Stone 2000).

The benthic communities are threatened by two natural environmental perturbations that occur on the Louisiana continental shelf (LCS), anoxic to hypoxic bottom conditions and tropical cyclones. The change from anoxic to hypoxic conditions occurs annually with inconsistent intensities and ranges (Rabalais et al. 1993). On average, one tropical cyclone visits the LCS once every four years, which can vary in intensity (Stone 2000). It can take anywhere from one to two years for the benthic communities to recover from either of these events (Baker et al. 1981).

In a Southwest Research study conducted by Baker et al. in 1981, samples from the LCS, including Ship Shoal, were studied to determine the ecological effects of petroleum production platforms in the central Gulf of Mexico. The sampling stations for Ship Shoal were located roughly 27km (17 miles) from the shore, in approximately six meters of water. Results from this study indicated that the benthic communities of the Ship Shoal varied from that found throughout the LCS.

The taxonomic composition of meiofauna on Ship Shoal varied significantly from the meiofauna found in the LCS. Foraminefera, which were found to be high in both species richness and diversity in benthic communities on the LCS, only comprised 0.2 percent of all meiofauna found on Ship Shoal (**table 3-5**). Only *Bolvina lowmani*, one of the four dominant species of foraminefera located on the LCS, was found in significant abundance on Ship Shoal. Conversely, the distribution of taxa Nematoda, which were not found high in species richness on the LCS, comprised 97.7 percent of the total meiofauna, and included predominantly Cyantholaimidae, Theristus, Sabatieria, Linhomoe, Choniolaimade and Chromadoriade (Baker et al. 1981). The high taxonomic composition of Nematoda on Ship Shoal can most likely be attributed to the high sand content of the shoal and is an indication that sand on Ship Shoal is non-polluted (Baker et al. 1981).

Macroinfauna Polychaeta was found in similar taxonomic composition on both Ship Shoal and the LCS. Polychaeta consisted of 62.6 percent of the total macroinfauna on Ship Shoal and 69.0 percent on the entire LCS (Baker et al. 1981). The density and diversity of taxa Polychaeta on the LCS were found to be higher than those seen on Ship Shoal, except in areas where the sediment composition was similar to that of Ship Shoal (sand). Polychaetes are known to favor a less sandy substrate, explaining the low values of diversity and density of Polychaeta on ship Shoal.

Table 3-5. Percent taxonomic composition of meiofauna, macroinfauna and macroepifauna for the Baker et al. (1981) study.

Category and Taxa	Ship Shoal (%)	Louisiana Continental Shelf (%)
Meiofauna		
Formineferia	0.2	55.3
Nematoda	97.0	34.7
Macroinfauna		
Polychaeta	62.6	69.0
Macroepifauna		
Osteichytes	69.3	32.8
Decapoda	30.7	25.7

Results from the Southwest Research Institute study indicated that the prevailing macroepifauna and demersal fish on Ship Shoal are located in the taxa Osteichytes (69.3 percent) and Decapoda (30.7 percent) (**table 3-5**). Taxa Decapoda, although similar in taxonomic composition to that found on the LCS, was lower in diversity on Ship Shoal. The taxa Osteichytes was found to be particularly higher in taxonomic composition (69.3 percent) of the total macroepifauna, but lower in diversity when compared to the entire LCS. Shallower water depths such as those found on Ship Shoal were correlated to a larger abundance of taxa Osteichytes and would explain the increased taxonomic composition (Baker et al. 1981). The biomass of demersal fish on Ship Shoal was found to be much higher than those of the LCS on average. The biomass on Ship Shoal was recorded at 68.7 kg/hr (151.8 pounds/hr) in comparison to an average of 19.6 kg/hour (43.3 pounds/hr) throughout the LCS (Baker et al. 1981). These results suggest that Ship Shoal is an extremely productive ground for demersal fish in the context of the LCS.

The diversity, taxonomic composition, and presence of opportunistic species indicate that the fauna residing on Ship Shoal and the LCS are stressed. This slightly depressed state may remain constant because of the periodic perturbations and recovery time needed by benthic communities. Even though the benthic communities of the LCS are stressed they still resemble the assemblages of similar environments. Results from the Southwest Research Study found that the benthic assemblages on the LCS and Ship Shoal were similar to those found offshore of Texas and the eastern United States despite their depressed state (Baker et al. 1981; Vittor 1987).

3.11 FISHERIES RESOURCES

3.11.1 General

This resource is institutionally significant because of the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act), the Fish and Wildlife Coordination Act of 1958, as amended, and the Endangered Species Act of 1973 (ESA). Fisheries resources are technically significant because they are a critical element of many valuable freshwater and marine habitats, they are an indicator of the health of various freshwater and marine habitats, and many fish species are important commercial resources. Fisheries resources are publicly significant because of the high priority that the public places on their esthetic, recreational, and commercial value.

Louisiana’s vast and biologically diverse coastal area serves as an important gulf coast estuarine system, which functions as a nursery, feeding, spawning, and growout area for many aquatic organisms. Louisiana ports produce a catch comparable to that of the entire Atlantic seaboard, and more than triple that of the remaining gulf states (NMFS 2001). Four Louisiana ports have ranked among the top 10 in value of commercial fisheries landings throughout the U.S. since 1981 (NMFS 2003a). Louisiana’s commercial landings have been over one billion lbs/yr for over 20 years, with a value exceeding $400 million in 2000. White shrimp (*Litopenaeus setiferus)*, brown shrimp (*Farfantepenaeus aztecus*), and gulf menhaden (*Brevoortia patronus*) account for the majority of commercial harvest by value (personal communication from NMFS Statistics and Economics Division).

The term fish, as used in this document, includes a variety of finfish and shellfish. There are several ways to profile this diverse collection of organisms. For the purpose of this DPEIS, the general salinity preference of an organism for the freshwater, estuarine, or marine environment is used.

Freshwater species inhabit lakes, rivers, and backwaters where salinities remain low. Lagoons, bayous, and ponds throughout Louisiana provide excellent freshwater habitat for species such as largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis* spp.), various other sunfish species, and catfish (*Ictalurus* sp.).

The majority of the LCA Study area is considered estuarine habitat; therefore, estuarine aquatic organisms are a significant resource within the project area. Estuarine fishery species may be resident (species residing in the estuary throughout their life cycle), such as killifishes (*Cyprinodontidae*), or transient (species that use estuaries during their life cycle), such as gulf menhaden, blue crab (*Callinectes sapidus*), and shrimp.

Marine species are found in offshore waters throughout the gulf coast and generally do not depend on coastal estuaries to complete any part of their life cycle. These species are in some ways dependant on the health and productivity of coastal estuaries, in that their prey often are made up of estuarine dependant species. In addition, some marine species frequently inhabit the lower reaches of estuaries, where productivity is high.

The American oyster (*Crassostrea virginica*) is indigenous to coastal Louisiana, and provides a rich ecological and commercial resource. This organism is unique in that it does not migrate like other estuarine species. Salinity plays a key role in oyster sustainability. Typically, they proliferate in salinities ranging from 5 to 15 parts per thousand. Fresher waters fail to support biological function, and more saline waters promote disease and predation.

3.11.2 Historic and Existing Conditions

Louisiana commercial landings have increased significantly since the early 1900s and recreational harvests have been relatively stable for the past 10 years. Coastal habitats that support Louisiana fisheries have been impacted over the last 50 years by subsidence, sea level change, channelization of bayous, dredging of canals, and intensive management of marshes for wildlife and waterfowl. **Table 3-6** provides a 10-year average value for the most economically important species in Louisiana, and their value relative to the Gulf of Mexico and United States landings.

Table 3-6
The Top Four Valued Fisheries in Louisiana for the 10-year Period 1992-2001

Fishery	10-year Average Dollars	% of Gulf Value	% of U.S. Value
Shrimp	163,261,317	35%	29%
Menhaden	56,125,930	85%	54%
Blue Crab	27,365,792	70%	20%
Oyster	24,857,736	58%	26%

Personal communication from the National Marine Fisheries Fisheries Statistics and Economics Division, Silverspring, MD

Even though extensive areas of marsh have been lost in coastal Louisiana, commercial harvest and recreational catches of most species have not diminished (NMFS Statistics and Economics Division – personal communication). It is important to note that recreational catch and commercial landings are fishery dependent data. The increase in Louisiana landings may reflect the expansion of the commercial fishing industry, the growing efficiency in harvest technologies, and the growing demand for seafood over the past century. One hypothesis to explain continued high fisheries production is that as marshes have deteriorated, tremendous amounts of organic detritus have been released into the estuarine system, consequently driving high levels of primary productivity. High primary productivity increases the resources available for secondary productivity. Additionally, an increase in marsh to water interface (i.e., marsh edge), and the formation of shallow, protected lagoons and ponds, has resulted in prime areas for growth and development of estuarine species (Browder et al. 1985; Browder et al. 1989; Minello and Rozas 2002). At the same time, saltwater intrusion into previously low-salinity areas has increased the amount of estuarine area available to estuarine and marine fishery species (Chesney et al. 2000; Zimmerman et al. 2000). However, this intrusion can exacerbate marsh loss in those areas (Chabreck and Linscombe 1982; McKee and Mendelssohn 1989).

Production of oysters in Louisiana has been relatively stable for the last 50 years, with harvest from public beds replacing the decreasing harvest from private leases. The Louisiana oyster industry has been experiencing many stressors over the past several decades that threaten the long-term sustainability of both the industry and the resource. Increasing coastal land loss is reducing the amount of marsh that provides shelter to reefs, and saltwater intrusion is exacerbating disease and predation. In addition, the industry is faced with changing environmental conditions, fluctuating market demands, public perception issues, and increased competition.

Current and future fishery population trends are described in the Coast 2050 report (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998), and were used to evaluate existing trends and future projections over the LCA Study area. The Coast 2050 report projects fishery population to the year 2050 based on land loss predictions. The selected species represent a group of species similar in habitat requirements, seasonal occurrence in the estuary, salinity preference, and spawning or migratory season. **Figure 3-29** represents a summary of the Coast 2050 report on fisheries population trends and projections for estuarine species.

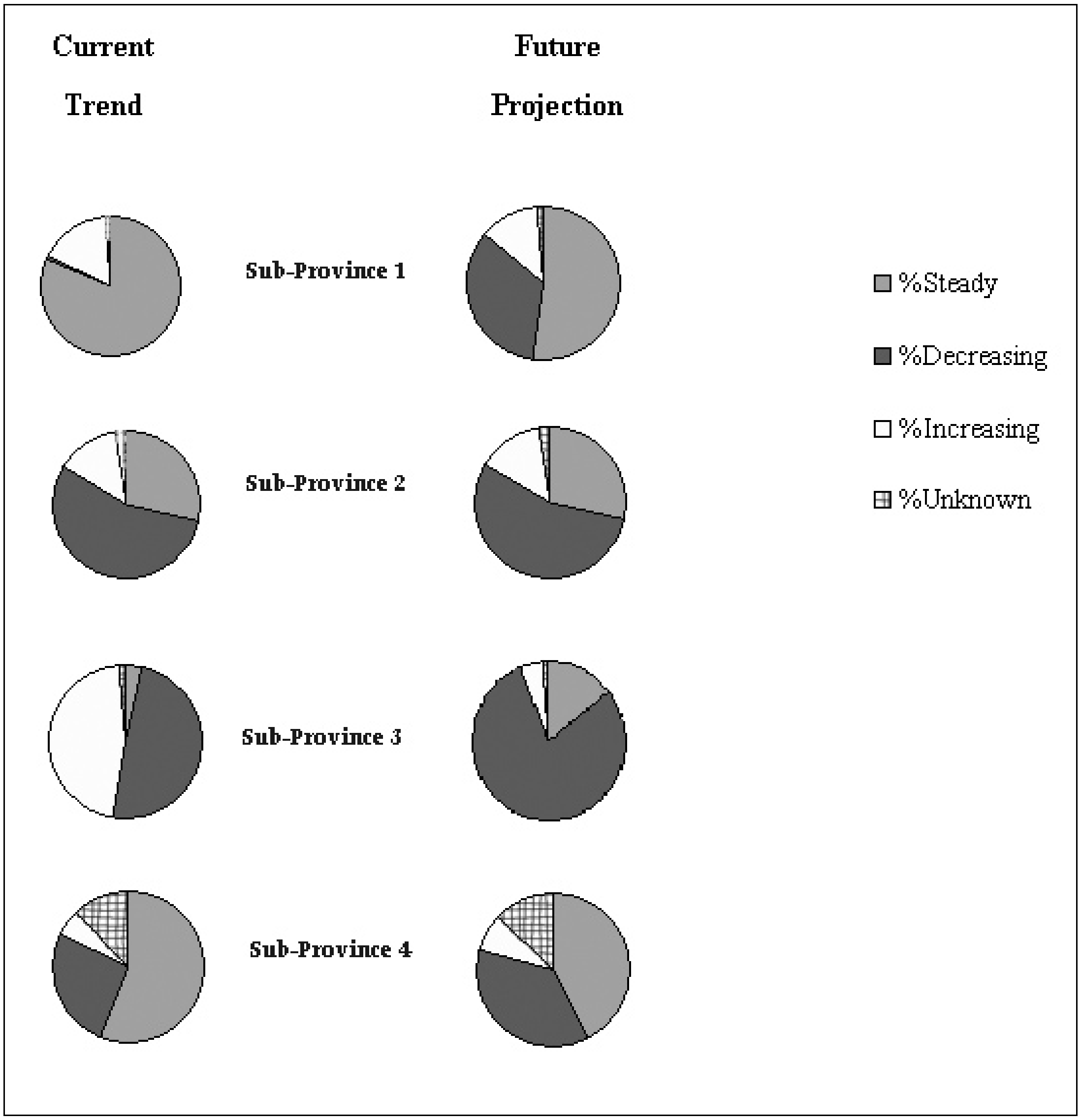


Figure 3-29. Estuarine Fisheries Population Trends and Projections by Subprovince. (*Data from: Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998)*

3.12 ESSENTIAL FISH HABITAT

This resource has statutory significance because of the Magnuson-Stevens Act (P.L. 104-297), which intended to promote the protection, conservation, and enhancement of Essential Fish Habitat (EFH). The EFH designation is an important component of building and maintaining sustainable marine fisheries through habitat protection. The Magnuson-Stevens Act defines EFH for Federally managed fish species as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." A summary of EFH requirements for species managed by the Gulf of Mexico Fishery Management Council (GMFMC), and for which EFH has been designated in Louisiana, is in **table 3-7**.

Table 3-7
Summary of the Magnuson-Stevens Fishery Conservation and Management Act (P.L. 104-297) designation of Essential Fish Habitat for Coastal Louisiana*

Species	Life Stage	EFH
Brown shrimp *Farfantepenaeus aztecus*	eggs larvae postlarvae/ juvenile subadult adult	(Marine system) < 110 m, demersal (Marine system) < 110 m, planktonic (Estuarine system) marsh edge, submerged aquatic vegetation, tidal creeks, inner marsh (Estuarine system) mud bottoms, marsh edge (Marine system) < 110 m, silt sand, and muddy sand
White shrimp *Litopenaeus setiferus*	eggs larvae postlarvae/ juvenile, subadult adult	(Marine system) < 40 m, demersal (Marine system) < 40 m, planktonic (Estuarine system) marsh edge, submerged aquatic vegetation, marsh ponds, inner marsh, oyster reefs (Marine system) < 33 m, silt, soft mud
Red drum *Sciaenops ocellatus*	eggs, larvae postlarvae/ juvenile subadult adult	(Marine system) planktonic (Marine and Estuarine systems) submerged aquatic vegetation, estuarine mud bottoms, marsh/water interface (Estuarine system) mud bottoms, oyster reefs (Marine and Estuarine systems) Gulf of Mexico & estuarine mud bottoms, oyster reefs
Red snapper *Lutijanus campechanus*	larvae, postlarvae/juvenile adult	(Marine system) structure, sand/mud; 17-183 m (Marine system) reefs, rock outcrops, gravel; 7-146 m
Vermilion snapper *Rhomboplites aurorubens*	juvenile	(Marine system) reefs, hard bottom, 20-200 m
Spanish mackerel *Scomberomorus maculatus*	larvae juvenile adult	(Marine system) <50 m isobath (Marine and Estuarine system) offshore, beach, estuarine (Marine system) pelagic
Bluefish *Pomatomus saltatrix*	postlarvae/juvenile adult	(Marine and Estuarine systems) beaches, estuaries, and inlets (Marine and Estuarine systems) Gulf, estuaries, pelagic

*Detailed information on Federally managed fisheries and their EFH is provided in the 1998 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council (GMFMC).

Proposed activities are unlikely to impact EFH for red snapper and vermilion snapper. Therefore, there will be no further discussion of these species in relation to impacts on EFH. Primary categories of EFH that could be impacted as a result of restoration efforts in the LCA Study area include, but are not limited to, estuarine wetlands (e.g., marsh edge, inner marsh, marsh ponds, and tidal creeks); submerged aquatic vegetation; seagrasses; mud, sand, shell, and rock substrates (e.g., oyster reefs and barrier island flats); mangrove wetlands; and estuarine water column. Any activities that may adversely affect EFH should be avoided, minimized, or mitigated to conserve EFH.

Fish and most macro-crustaceans are highly mobile, and they rely on a variety of habitats for different functions (Miller and Dunn 1980). The characteristics of coastal Louisiana waters essential to fish are not static. There are a number of fish species that are Federally managed, with a variety of life stage requirements. The Magnuson-Stevens Act requires a conservative approach to designating EFH. For these reasons, EFH is not confined to isolated locations. All of the estuarine and marine portions of the LCA Study area are considered EFH and are an important consideration in the development of any restoration plan.

3.12.1 Historic and Existing Conditions

As conditions along Louisiana's coast have changed, effects to different categories of EFH have varied. For example, as the marsh has been lost, it has generally been replaced with other categories of EFH, such as submerged aquatic vegetation or mud bottoms. In contrast, in areas where active delta growth is occurring, the opposite may have happened (e.g., mud bottoms have been replaced with marsh). It is important to have a balance between different categories of EFH for the various life stages of Federally managed fishery species in the LCA Study area. The general trend in the recent past has been one of conversion of highly productive categories of EFH, such as inner marsh and marsh edge, to less productive estuarine water column; and mud, sand, or shell substrates. If this trend continues, it is likely to result in less complex, biologically diverse habitats and unsustainable fishery productivity.

All tidally influenced waters and substrates within the subprovinces, including the sub-tidal and tidal vegetation (seagrasses, algae, marshes, and mangroves) are designated as EFH. There are over 8 million acres (3.24 million ha) of marsh and water habitat, of which over 4.4 million acres (1.7 million ha) are surface water. Over half of the waters are between 0 and 1.8 m (0–5.9 ft) in depth (Perret et al. 1971). Sediments are mud, sand, and silt across the coast (Barrett et al. 1971). Submerged vegetation occurs along the coast, but no acreage figure is available, except for Lake Pontchartrain, where an estimated 20,000 acres (8,094 ha) exist (Gulf of Mexico Fishery Management Council 1998).

EFH alterations of particular concern are the marsh loss experienced along the Louisiana coast, as described in section 3.9 PLANKTON RESOURCES. Land/water interface has been shown to be more important to fishery production than total wetland acreage (Faller 1979; Gosselink 1984; Zimmerman et al. 1984).

3.13 THREATENED AND ENDANGERED SPECIES

Within the State of Louisiana there are 25 animal and 3 plant species (some with critical habitats) under the jurisdiction of the USFWS and/or NMFS (see **table 3-8**), which are presently classified as threatened or endangered (see **figure 3-30**). The USFWS and NMFS share jurisdictional responsibility for sea turtles and the gulf sturgeon. Of the animals and plants under USFWS and/or NMFS jurisdiction, only 16 animal and 1 plant species are within the study area. Those species outside of the study area will not be affected by the proposed restoration plans. For a complete description of those species, their critical habitat geographic designations, management objectives, and current recovery status, refer to the USFWS endangered species web site at http://endangered.fws.gov and the NMFS endangered species web site at http://www.nmfs.noaa.gov/prot_res/overview/es.html. In addition, the USFWS has published the "Report to Congress On The Recovery Program For Threatened And Endangered Species, 1996, Appendix" (USFWS 1996). This report assigns each species a Listing Status, Lead Region, Population Status, Recovery Plan, Plan Stage Recovery Achieved, and Recovery Priority (http://endangered.fws.gov/recovery/96apndx.pdf).

Informal coordination with the USFWS and NMFS was initiated to determine potential impacts of conceptual, programmatic restoration alternatives to threatened and endangered species and their critical habitats. Generally, formal coordination and preparation of any necessary documentation such as Biological Assessments, if necessary, would be initiated with either or both of these agencies on a specific project-by-project basis as required. Portions of this section concerning organisms under the jurisdiction of the USFWS was prepared with input from members of the USFWS, Lafayette Field Office, Endangered Species Section. Portions of this section concerning organisms under the jurisdiction of NMFS was prepared with input from members of the Endangered Species regional office in Florida.

3.13.1 Historic and Existing Conditions

From a programmatic standpoint, historic and existing conditions for threatened and endangered species relevant to the LCA Study area principally stem from the alteration, degradation, and loss of habitats; human disturbance and exploitation; and pollution. Louisiana's unabated coastal land loss continues to reduce available coastland resources. This creates increased competition among and between the various threatened and endangered species for scarce coastal resources. A more detailed description of the historic and existing conditions for those threatened and endangered species that may be found in the study area is provided in appendix B1 PROGRAMMATIC BIOLOGICAL ASSESSMENT.

Table 3-8
Threatened and Endangered Species in Louisiana.
(E=Endangered; T= Threatened; C=Candidate)
(Species in bold are those found within the study area)

Species Under Jurisdiction of the USFWS
Status Common Name *Scientific Name*

Mammals
E[1] -- Florida Panther (*Felis concolor coryl*)
E[1] -- Red wolf (*Canis rufus*)
E -- West Indian manatee (*Trichechus manatus*)
T -- Louisiana black bear (*Ursus americanus luteolus*)

Birds
E[2] -- Bachmans's warbler (*Vermivora bachmanii*)
E -- Brown pelican (*Pelecanus occidentalis*)
E[1] -- Eskimo curlew (*Numenius borealis*)
E[1] -- Ivory-billed woodpecker (*Campephilus principalis*)
E -- Least tern; interior population (*Sterna antillarum*)
E -- Red-cockaded woodpecker (*Picoides borealis*)
T -- Bald eagle (*Haliaeetus leucocephalus*)
T -- Piping plover (*Charadrius melodus*)

Reptiles
E -- Hawksbill sea turtle (*Eretomchelys imbricata*)
E -- Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempii*)
E -- Leatherback sea turtle (*Dermochelys coriacea*)
T(S/A)[3] --American alligator (*Alligator mississippiensis*)
T -- Gopher tortoise (*Gopherus polyphemus*)
T -- Green sea turtle (*Chelonia mydas*)
T -- Loggerhead sea turtle (*Caretta caretta*)
T -- Ringed sawback turtle (*Graptemys oculifera*)
C -- Snake, Louisiana pine (*Pituophis ruthveni*)

Fish
E -- Pallid sturgeon (*Scaphirhynchus albus*)
T -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)

Invertebrates
E – Mussel, Fat pocketbook (*Potamilus capax*)
E -- Pink pearlymussel Mucket (*Lampsilis abrupta*)
T -- Inflated (Alabama) heelsplitter (*Potamilus inflatus*)
T -- Louisiana pearlshell (*Margaritifera hembeli*)

Plants
E -- American chaffseed (*Schwalbea americana)*
E -- Louisiana quillwort (*Isoetes louisianensis*)
T -- Earth fruit (*Geocarpon minimum*)

Species Under Jurisdiction of NMFS
Status Common Name *Scientific Name*

Marine Mammals
E -- Sperm whale (*Physeter macrocephalus*)
E -- Sei whale (*Balaenoptera borealis*)
E -- Humpback whale (*Megaptera novaeangliae*)
E -- Finback whale (*Balaenoptera physalus*)
E -- Blue Whale (*Balaenoptera musculus*)

Sea Turtles[4]
E -- Hawksbill sea turtle (*Eretomchelys imbricata*)
E -- Kemp's (Atlantic) ridley sea turtle *Lepidochelys kempii*)
E -- Leatherback sea turtle (*Dermochelys coriacea*)
T -- Green sea turtle (*Chelonia mydas*)
T -- Loggerhead Sea Turtle (*Caretta caretta*)

Fish
T -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)

Candidate Species[5]
Dusky shark (*Carcharhinus obscurus*)
Sand tiger shark (*Odontaspis taurus*)
Night shark (*Carcharinus signatus*)
Speckled hind (*Epinephelus drummondhayi*)
Saltmarsh topminnow (*Fundulus jenkensi*)
Jewfish (*Epinephelus itajara*)
Warsaw grouper (*Epinephelus striatus*)

E[1] The Florida panther, red wolf, Eskimo curlew, and ivory-billed woodpecker are presumed to be extinct in the state.
E[2] There has been no confirmed Bachman's warbler U.S. nesting ground sighting since the mid-1960s, however, several sightings of the species have occurred on wintering grounds during the last decade. This species may be extirpated in Louisiana.
T(S/A)[3] For law enforcement purposes, the alligator in Louisiana is classified as "Threatened due to Similarity of Appearance." They are biologically neither endangered nor threatened. Regulated harvest is permitted under state law.
[4] The USFWS and NOAA share jurisdictional responsibility for sea turtles and the gulf sturgeon.
[5] Candidate species are not protected under the ESA, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

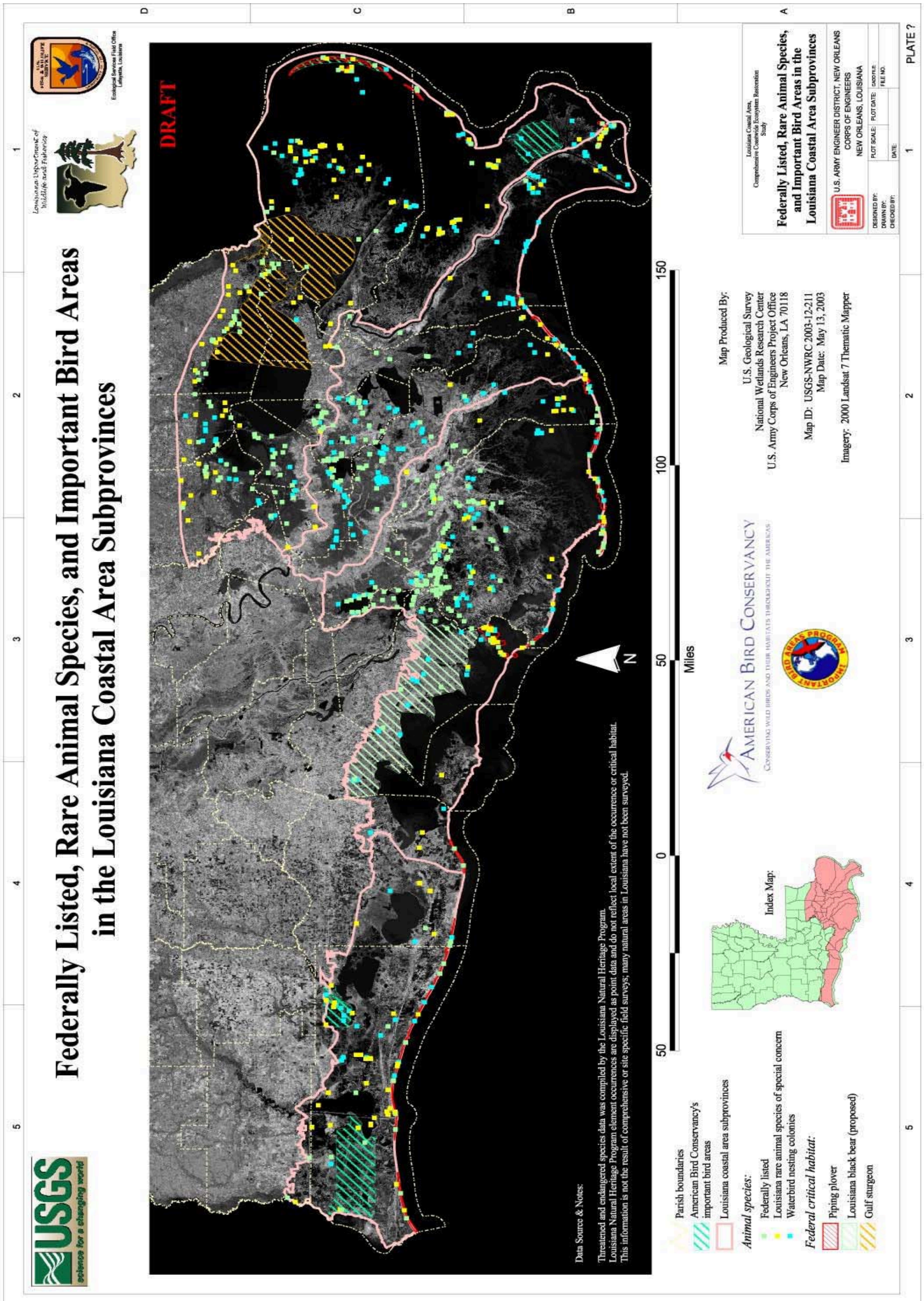


Figure 3-30. Federally listed rare animal species and important bird areas in the subprovinces *(from LNHP).*

3.14 HYDROLOGY

3.14.1 Flow and Water Levels

3.14.1.1 Historic and Existing Conditions

The hydrology of today's Mississippi River alluvial flood plain evolved from the formation of the different deltas and has been altered by human activity. In the shallow water deltas, such as the Teche, Lafourche, and St. Bernard, there was one main channel and numerous distributaries. As the delta evolved, the banks of the channels built up, rainfall runoff and overflow moved away from the channel and crevasses formed in the banks.

Beginning with human development in the 1700s and until present day, the Mississippi River was leveed and water levels in the river rose as a result. As documented earlier, during this time, numerous crevasses occurred along the Mississippi River and formed channel networks away from the main channel, thus flooding adjacent land and bringing in sediment. The flood control improvements along the Mississippi and Atchafalaya Rivers eliminated crevasses and other natural overflow. Today, flow exits the main channel through controlled structures such as the Bonnet Carre Spillway, Caernarvon, Whites Ditch Siphon, Bohemia Spillway, and Bayou Lamoque, which subsequently convey water into Subprovince 1; Davis Pond, the Naomi Siphon, and West Pointe a La Hache Siphon into Subprovince 2; and Old River Control Complex and Morganza Floodway into Subprovince 3.

In the lower portion of the river, near Head of Passes, crevasses in the channel banks formed subdeltas such as the one at West Bay. Channels within the subdelta conveyed water and sediment, thereby forming new land in the receiving area. Channels lengthened and energy slopes flattened, thus reducing sediment delivery. When slopes approached the slope of the Mississippi River, sediment delivery could no longer keep up with subsidence. That is likely the reason that the subdeltas today still convey a measurable portion of Mississippi River flow, yet land loss is occurring. The deep water delta distributary channels, Southwest Pass, South Pass, and Pass a Loutre convey about 65 percent of the river flow, with Grand Pass, Baptiste Collette, and Cubits Gap conveying the rest.

The flood control works have lowered peak flood stages along the Mississippi River in the New Orleans area and south. The operation of the dams along the Mississippi River and its tributaries has increased low flow volumes. Currently, the minimum annual flow in the Mississippi River is higher than it was in the 1930s.

Subprovince 1 - Mississippi River, Lake Pontchartrain, and Breton Basins

In Subprovince 1, the main basins are the eastern portion of the lower Mississippi River Delta, Lake Pontchartrain, and Breton Basins. Lake Pontchartrain, Lake Maurepas, and Lake Borgne are the major lakes in the subprovince. Rivers that drain into the lakes, in order of magnitude of average annual flow, are the Pearl, Amite, Tangipahoa, Tickfaw, and Tchefuncte. Predominant land use varies from agriculture and forestry to petroleum and fisheries. Runoff, in general, has increased over time due to urbanization. The Ross Barnett Reservoir on the Pearl River, completed in 1962, influences flow rates in the Pearl River, generally lowering peak stages and extending the duration of the runoff event. The operation of the Bonnet Carre Spillway can greatly increase the flow into Lake Pontchartrain.

Numerous navigation channels, drainage canals, and access canals, ranging in size from the Mississippi River deep draft channel to the MRGO to an oil well access canal, have altered the hydrology of the basins within the subprovince. These channels can confine freshwater flow, cross natural drainage boundaries, or convey gulf waters inland. The erosion of channel banks, due to waves generated from vessel traffic, can also change flow patterns.

Subprovince 2 – Mississippi River and Barataria Basin

In Subprovince 2, the main basins are the western portion of the lower Mississippi River and Barataria. Major water bodies are Barataria Bay, Lake Salvador, Lake Cataouatche, and Lac Des Allemands. The predominant land use is agricultural along ridges. Wetlands make up the majority of the subprovince. The Naomi and West Pointe a la Hache Siphons convey water from the Mississippi River into the subprovince. Flow from the Lower Atchafalaya River is also conveyed into Subprovince 2 via the GIWW. Historically, until completion of the closure at Donaldsonville in 1904, Bayou Lafourche was a source of freshwater supply to the rural population, the sugar cane industry, and the mills along the bayou. In 1955, a pumping station was placed in operation to provide a source of freshwater supply.

Drainage canals, roads, access canals, and navigation channels, including the GIWW and the Barataria Bay Waterway, have altered the hydrology of the subprovince. Channels and roads cross natural drainage boundaries, thus restricting or redirecting water movement. Channels can also convey gulf waters inland.

Subprovince 3 – Teche/Vermilion, Atchafalaya, and Terrebonne Basins

The Atchafalaya Basin Floodway System hydrologically divides Subprovince 3 and is also the major source of freshwater. The main basins to the east of the Atchafalaya are Lake Verret and Terrebonne. To the west, the main basins are the Teche and Vermilion Rivers. Major water bodies in the subprovince are Lake Verret, Lake Palourde, Terrebonne Bay, Timbalier Bay, and Four League Bay to the east; and Lake Fausse Pointe, Lake Dauterive, Vermilion Bay, and East and West Cote Blanche Bays to the west. Atchafalaya Bay is at the southern end of the Atchafalaya Basin Floodway. Channels that drain into the Terrebonne Basin include Bayou Boeuf and Bayou Black. The Bayou Black ridge restricts the flow of water along the northern boundary of the Terrebonne Basin. Channels that drain into the bays west of the Atchafalaya include the Vermilion River, Charenton Drainage Canal, and Bayou Teche. Land use is predominantly agricultural along the ridges.

The Atchafalaya Basin Floodway; GIWW; Atchafalaya River; Bayous Chene, Boeuf, and Black Navigation Channel; Houma Navigation Canal; and Houma area levees and pump systems, drainage canals, and access canals have altered the hydrology of the subprovince. Historically, annual flow volumes have increased into the Atchafalaya; however, flow increased from less than 10 percent of the combined Mississippi and Red River flow in the 1850s to 30 percent today. Within the last 30+ years, the GIWW has been discharging increasing amounts of Atchafalaya freshwater and sediments to the coastal area throughout Subprovince 3, mainly during the annual spring flood. The Houma Navigation Canal conveys almost two thirds of the Atchafalaya water in the GIWW (the GIWW channel through the Houma area restricts the movement of water farther east). Backwater effects can slow drainage through the Bayou Black ridge, thus affecting the duration of high water levels in the Lake Verret area.

Subprovince 4 – Calcasieu/Sabine and Mermentau Basins

The main basins of Subprovince 4 are the Sabine, Calcasieu, and Mermentau. Major water bodies are Calcasieu Lake, Sabine Lake, White Lake, and Grand Lake. The largest rivers that drain into the coastal area are Sabine, Calcasieu, and Mermentau. Land use is wildlife refuges and agricultural along the high ground.

Drainage canals, control structures, navigation channels (such as the Calcasieu and Sabine-Neches Ship Channels and the GIWW), and access canals have altered the hydrology of the subprovince. Water movement is in the east-west direction, as well as to the south. Water levels, or flow patterns, are controlled by structures such as the Schooner Bayou Control Structure and the Leland Bowman Lock. Refuge areas have been developed in the subprovince with individual water management areas.

3.14.2 Sediment

3.14.2.1 Historic and Existing Conditions

The major sources of sediment to the entire LCA Study area are the Mississippi and Atchafalaya Rivers. The Engineer Research and Development Center (ERDC) and Richard Kesel of LSU conducted two definitive studies of the suspended sediment regime and bed material gradation of the Mississippi River Basin in the early 1980s (Keown et al. 1981; Kesel 1988). These reports identify several cultural impacts over the past two centuries that have shaped the present character of the Mississippi main-stem suspended sediment regime in coastal Louisiana. In the late 1800s to early 1900s, land use in the Mississippi River Basin changed from primarily forest and grassland to agricultural activities. The Old River Control Complex, completed in 1963, regulates the flow between the Mississippi and Atchafalaya Rivers. Dams and other sediment retention structures were constructed on the Mississippi River system between 1953 and 1967 and on the Arkansas River system between 1963 and 1970. Construction of channel improvement features began in the 1800s. Kesel (1988) also attributed the New Madrid Earthquake of 1811-12 with altering the suspended sediment regime in the early 1800s.

For the Mississippi River in Louisiana, average suspended sediment loads decreased 25 percent between the late 1800s and 1950, and 40 to 60 percent since 1950, for a total of 79 percent from 1851 to present (Keown et al. 1981; Kesel 1988). The percentage of suspended sand load has also decreased by 45 percent since the late 1800s (Kesel 1988).

In the subprovinces, sediment enters the areas with freshwater inputs and with gulf waters. For existing conditions, the Atchafalaya River, Wax Lake Outlet, and Lower Atchafalaya River have average suspended sediment concentrations and grain sizes similar to the Mississippi River. The other rivers and channels in the subprovinces such as Calcasieu River and Mermentau River have concentrations significantly lower than the Mississippi River and grain sizes considerably finer.

Sediment deposition occurs in most channels within coastal Louisiana and in some estuary areas such as Vermilion Bay and Lake Verret. Navigation channels experience significant shoaling, and dredging is performed. In the Mississippi River navigation channel, over the past 20 years, an average of 15 to 20 million cy (11.4 to 15.2 million m^3) of material is annually dredged from the Head of Passes and Southwest Pass areas. Approximately 30 percent of the material dredged is used beneficially. The material removed by cutterhead dredges is used beneficially. In Southwest Pass, dangerous turns, coupled with deep draft traffic, make it unsafe to use the current cutterhead dredge fleet; therefore, hopperhead dredges are used instead. Under the present authority, the material from the hopperhead dredges cannot be used beneficially in a cost effective manner.

3.14.3 Water Use and Supply

3.14.3.1 <u>Historic and Existing Conditions</u>

Fresh ground and surface water is abundant in southern Louisiana. Prior to the 1900s, water used for most purposes was from surface sources. Many households collected rainwater for domestic uses and farmers generally relied on rainfall and irrigation ditches to provide water to their crops. During the late 1800s, water wells began to come into common usage and quickly proliferated in areas where fresh groundwater was available. The use of groundwater allowed farmers to plant crops in areas where sources of fresh surface water were unreliable or unavailable. In coastal areas of southeastern Louisiana, groundwater supplies are generally limited and surface water is primarily used. Large amounts of fresh groundwater are generally available and groundwater is used for most purposes.

During 2000, about 3,000 million gallons per day (Mgal/d) (11,370 million liters per day[Ml/d]) of freshwater were withdrawn for various uses in the LCA Study area. Of this water, about 97 percent was from surface sources and about 3 percent was from groundwater sources. Most of this use was in southeastern Louisiana in parishes that border or straddle the Mississippi River.

The Mississippi River and some of its distributaries were the largest sources of surface water, contributing 96 percent (2,800 Mgal/d [10,612 Ml/d]) of the total surface withdrawals. Other major sources included Bayou Lafourche (52 Mgal/d [197 Ml/d), the GIWW (10 Mgal/d [37.9 Ml/d]), Mermentau River (10 Mgal/d [37.9 Ml/d]), and Bayou Lacassine (7 Mgal/d [26.5 Ml/d]). Surface water was used for various purposes, including industry (1,340 Mgal/d), power generation (1,240 Mgal/d [4,699 Ml/d]), public supplies (310 Mgal/d [1,174 Ml/d]), and agriculture (47 Mgal/d [178 Ml/d]). Withdrawals for power generation and industry were primarily from the Mississippi River and used for once-through cooling and much of the water was returned to the source. Industrial withdrawals were primarily for petroleum refining and chemical manufacturing. In southwestern Louisiana, large amounts of fresh groundwater are available, and groundwater is used for most purposes.

3.14.4 Groundwater

3.14.4.1 Historic and Existing Conditions

Southern Louisiana generally has very abundant fresh groundwater supplies. However, aquifers along the coast typically contain saltwater that extends inland as a wedge along the base of the aquifer. Coastward, the saltwater wedge typically thickens and the overlying freshwater thins until the entire thickness of the aquifer contains saltwater. Salty groundwater is often defined as water containing a chloride concentration greater than 250 mg/L or a dissolved solids concentration greater than 1,000 mg/L. Saltwater can move into freshwater parts of the aquifer by lowering freshwater levels through pumping. Such movement of saltwater or the saltwater wedge is known as saltwater encroachment. Saltwater can move laterally or vertically in an aquifer. The USGS, in cooperation with the Louisiana Department of Transportation and Development, maintains a loose network of wells designed to monitor saltwater encroachment in coastal aquifers.

The water table is at or near the surface throughout most of the coastal zone. The silt- and sand-rich depositional environments such as point bar, intradelta, natural levee, beach, and near shore gulf are generally connected hydraulically to the adjacent water body (i.e., river, lake, distributary channel) and the elevation of the water table in these deposits reflects the level/stage of the adjacent water body. This is especially true in deposits adjacent to the Mississippi and Atchafalaya Rivers. Any potential connectivity should be investigated to determine its influence on uplift pressures, design of dewatering systems, and groundwater migration.

Three major aquifer systems are present in the coastal areas of Louisiana: the Southern Hills, Chicot, and New Orleans aquifer systems. In southeastern Louisiana, along the northern extent of Subprovince 1 and the Pontchartrain Basin, the Southern Hills aquifer system extends southward from southwestern Mississippi into southeastern Louisiana and contains freshwater as far south as the Baton Rouge fault. The Baton Rouge fault, which extends approximately from Baton Rouge eastward across the northern part of Lake Pontchartrain, is generally considered the southern limit of the Southern Hills aquifer system because most of the 30 aquifers that comprise the Southern Hills aquifer system contain saltwater south of the fault. The Southern Hills aquifer system is the principal source of freshwater in southeastern Louisiana north of the Baton Rouge fault and is used for most purposes. The base of freshwater in the Southern Hills aquifer system in the LCA Study area is about 3,000 ft (914.4 m) below sea level.

South of the Southern Hills aquifer system and the Baton Rouge fault, the New Orleans aquifer system consists of four aquifers that supply fresh groundwater to the southern parts of the Pontchartrain Basin in Subprovince 1, and the northern parts of the Barataria Basin in Subprovince 2. The aquifers that comprise the New Orleans aquifer system contain saltwater in many areas and only limited groundwater supplies are available in most areas. Because of this, surface water generally is used for public supplies and other major uses in the Barataria and southern Pontchartrain Basins. However, limited amounts of groundwater from the New Orleans aquifer system are withdrawn for public supply, industry, power generation, and other uses. The base of freshwater in the New Orleans aquifer system averages about 500 ft (152.4 m) below sea level in the LCA Study area.

The Chicot aquifer system is present throughout southwestern Louisiana and is the principal source of water to the Teche/Vermilion Basin in Subprovince 3, and the Calcasieu/Sabine and Mermentau Basins in Subprovince 4. Prior to development of the Chicot aquifer system, which began in the late 1800s, groundwater flow in the system was from north to south and water discharged upwards into springs in coastal areas from Calcasieu Parish to St. Mary Parish. By the late 1940s, pumping from the system had lowered water levels and altered flow gradients, and the springs disappeared. Flow in the system beneath coastal areas is now northward towards pumping centers in the central parts of southwestern Louisiana.

Groundwater from the Chicot aquifer system is used for all purposes, though most of the water pumped from the aquifer system within the LCA Study area is used for rice irrigation, public supplies, and industrial purposes. The Chicot aquifer system is completely salty in most of western Cameron Parish, southern St. Mary Parish, and the southern edges of Cameron and Vermilion Parishes. Saltwater extends inland as a wedge along the base of the Chicot aquifer system and present at some depth in the aquifer system throughout Subprovinces 3 and 4. The base of freshwater in the Chicot aquifer system within the LCA Study area averages about 500 ft (152.4 m) below sea level.

About 77 Mgal/d (291.8 Ml/d) of groundwater were withdrawn in the LCA Study area in 2000. Most of the withdrawals were withdrawn from the Southern Hills and Chicot aquifer systems near the northern edge of the study area. About 21 Mgal/d were withdrawn from the Southern Hills aquifer system in the study area and primarily used for public supplies. The same amount was withdrawn from the Chicot aquifer system, but was primarily used for rice irrigation and crawfish farming. About 28 Mgal/d (106 Ml/d) were withdrawn from the New Orleans aquifer system and was primarily used for shipbuilding, sugar refining, and chemical manufacturing. About 16 Mgal/d were withdrawn from the Mississippi River alluvial aquifer in the study area and was also used for chemical manufacturing and sugar refining.

No major sources of fresh groundwater are available in the Breton Sound and Mississippi River Delta Basins of Subprovince 2 or the Atchafalaya and Terrebonne Basins of Subprovince 3. Fresh groundwater is also not available in the eastern Pontchartrain Basin or all but the extreme northern part of the Barataria Basin. Parishes in these basins, including Assumption, Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, and Terrebonne, where little or no fresh groundwater is present, use large amounts of surface water for public supply and other uses.

3.15 WATER QUALITY RESOURCES

3.15.1 Historic and Existing Conditions

Historic and current water quality issues for rivers and streams in coastal Louisiana include the transport of nutrients, pesticides, synthetic organic compounds, trace elements, suspended sediment, and bacteria. The database for the Mississippi River at St. Francisville and the Atchafalaya River at Melville is extensive, with comprehensive water quality datasets beginning in the mid-1970s. Historically, sites have been operated in cooperation with the USACE and the Louisiana Department of Transportation and Development. These two sites are currently sampled as part of the USGS National Stream Quality Accounting Network (NASQAN). The database for the Mississippi River is extensive enough that several general conclusions can be made concerning its suitability for coastal restoration efforts:

1. Trace elements, including heavy metals, are generally not considered a water quality issue in the Mississippi River.
2. Nitrate concentrations average around 1.4–1.6 mg/L in the lower Mississippi River. This is the result of natural and human inputs, particularly agricultural fertilizers in the mid-continent. Nitrate at these concentrations can cause excessive algal growth and eutrophication in coastal water bodies and contribute to the hypoxia problem in the Gulf of Mexico.
3. Fecal coliform bacteria in the lower Mississippi River have declined dramatically with more effective sewage treatment at Baton Rouge and New Orleans since the mid- to late-1980s.
4. The primary pesticides detected in the Mississippi River are the herbicides atrazine, metolachlor, and acetochlor.
5. Per LDEQ's database[1], organic compounds are typically not detected in the Mississippi River.
6. For conventional parameters in LDEQ's database[1], there is essentially no difference in water quality spatially along the length of the Mississippi River between Pointe a la Hache and the Louisiana State line.

[1]LDEQ performs collection and analysis for 29 conventional parameters and fecal coliform through the Surface Water Monitoring Program with a priority pollutant scan quarterly at the Mississippi River sites.

The most common individual designated uses in the coastal plain of Louisiana include primary contact recreation, secondary contact recreation, fish and wildlife propagation, shellfish propagation, and drinking water supply. Primary contact recreation is defined by LDEQ as any recreational activity that involves or requires prolonged body contact with the water, such as swimming, water skiing, tubing, snorkeling, and skin-diving. Secondary contact recreation is defined as any recreational activity that may involve incidental or accidental body contact with the water and during which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, and recreational boating. Fish and wildlife propagation is defined as the use of water for preservation and reproduction of aquatic biota such as indigenous species of fish and invertebrates, as well as reptiles, amphibians, and other wildlife associated with the aquatic environment. This also includes the maintenance of water quality at a level that prevents contamination of aquatic biota consumed by humans. Shellfish propagation is the use of water to sufficiently maintain biological systems that support economically important species of oysters, clams, mussels, or other mollusks so that their productivity is preserved and the health of human consumers of these species is protected. See **table 3-9** for water quality issues throughout the LCA Study area.

Table 3-9
Water-quality issues, locations, and possible causes in the LCA Study Area

AREA	ISSUE	LOCATION	POSSIBLE CAUSES	COMMENTS
Subprovince 1	Pesticide pulse Nutrient pulse Eutrophication	Entire subprovince	Hydrologic modification of Miss. River Agriculture	Midcontinent pulses of pesticides (particularly atrazine) and fertilizers are a national concern. Levees throughout the Mississippi River system funnel these pulses to the Louisiana coastal area.
	Bacterial contamination	Entire subprovince	Inadequate waste treatment Unsewered camps	Fecal bacteria arise from both point and nonpoint sources, from humans and animals (mammals, birds).
	Potential sediment contamination in urban & industrial areas	Urban and industry centers: Bayou Bonfouca (known example that has been remediated)	Abandoned creosote plant Urbanization	Bed sediments from small tributaries and canals in this subprovince, especially the Lake Pontchartrain Basin, should be sampled before utilization.
Subprovince 2	Pesticide pulse Nutrient pulse Eutrophication	Entire subprovince	Hydrologic modification of Miss. River Agriculture	Midcontinent pulses of pesticides (particularly atrazine) and fertilizers are a National concern. Levees throughout the Mississippi River system funnel these pulses to the Louisiana coastal area.
	Bacterial contamination	Entire subprovince	Inadequate waste treatment Unsewered camps	Fecal bacteria arise from both point and nonpoint sources, both human and animal (mammals, birds).
	Potential sediment contamination in urban & industrial areas Trace elements	Harvey Canal Algiers Canal Bayou Lafourche	Light industry, boat repair, maintenance Urbanization	Trace elements and synthetic organic compounds. Use of canals for diversions or hydrologic restoration should take into consideration potential for resuspension of contaminants.
Subprovince 3	Pesticide pulse Nutrient pulse Eutrophication	Mostly Terrebonne; less severe westward	Hydrologic modification of Miss. River Agriculture	Midcontinent pulses of pesticides (particularly atrazine) and fertilizers are a National concern. Levees throughout the Mississippi River system funnel these pulses to the Louisiana coastal area.
	Bacterial contamination	Entire Subprovince; Terrebonne most severe	Inadequate waste treatment Unsewered camps	Fecal bacteria arise from both point and nonpoint sources, both human and animal (mammals, birds).
Subprovince 4	Potential sediment contamination in urban & industrial areas	Calcasieu	Petrochemical Agrichemical	Trace metals and synthetic organic compounds, particularly hexachlorobenzene, in the Calcasieu River just north of the LCA Study boundary.

Note: Gulf of Mexico waters off of all coastal parishes are under a fish consumption advisory due to mercury contamination.

The Louisiana Department of Health and Hospitals (LDHH) coordinates with LDEQ, the Louisiana Department of Wildlife and Fisheries, and the Louisiana Department of Agriculture and Forestry to issue water body advisories aimed at protecting the public's health. These include fish and shellfish consumption advisories and swimming advisories. Fish and shellfish consumption advisories employ a risk-based method to advise the public to limit or avoid the intake of certain species of fish and shellfish that have unsafe contaminant levels in their tissues. Swimming advisories may be issued for a water body due to fecal coliform or other types of contamination. The Gulf of Mexico waters off of all coastal parishes is under a fish consumption advisory related to mercury contamination (See section 4.14.2 for a brief discussion on methylmercury). This information comes from the latest publications on LDHH and LDEQ's websites in July 2004. Advisories for specific water bodies are discussed below in their respective subprovince.

The LCA project team has developed boundaries for the subprovinces of the coastal region. For this document, the applicable water quality subsegments from each basin as developed by LDEQ and presented in the "2002 Water Quality Management Plan, Water Quality Inventory, Section 305(b)" were identified that fall within each of the four subprovinces. The water quality data and references of each subsegment reviewed for this document follow the basin delineations. Below are the basins that fall within each subprovince.

Subprovince 1

- Portion of Lake Ponchartrain Basin (including Breton Sound)
- Eastern half of Mississippi River Delta Basin
- Western half of Mississippi River Delta Basin (spatially within Subprovince 2, but discussed under Subprovince 1)
- Lower portion of Pearl Basin

Subprovince 2

- Barataria Basin

Subprovince 3

- Terrebonne Basin (Coastal Area)
- Atchafalaya Basin (Coastal Area)
- Teche/Vermillion Basin (Coastal Area)

Subprovince 4

- Mermentau Basin (Coastal Area)
- Calcasieu Basin (Coastal Area)
- Sabine Basin (Coastal Area)

Subprovince 1 – Mississippi River, Lake Pontchartrain, and Breton Basins.

Of the 81 water body segments in the Pontchartrain Basin assessed in the LDEQ's "2002 Water Quality Management Plan, Water Quality Inventory, Section 305(b)" report (2002 305(b) report), 24 are fully supporting their designated uses. Forty-nine water body segments are partially supporting their designated uses, while eight are not supporting any of their designated uses. The major causes of impairment are fecal coliform, nutrients, dissolved oxygen (DO; refers to the amount of oxygen contained in water, which defines the living conditions for oxygen-requiring (aerobic) aquatic organisms), suspended solids, turbidity, oil and grease, and mercury. Suspected sources of impairment include on-site wastewater treatment systems, sanitary sewer overflows, municipal and industrial point sources, urban runoff, dairies, flow alterations, and land development.

Swimming advisories are in effect for the Lake Pontchartrain south shore, the Bogue Falaya River, Tangipahoa River, and Tchefuncte River. Those water bodies are under advisory due to bacteria counts that exceed the primary contact recreation water quality standard for swimming. A swimming advisory, due to organic chemical contamination (creosote), is in effect for Bayou Bonfouca.

Fish and shellfish consumption advisories, due to mercury contamination, are in effect for the Bogue Falaya River, Tchefuncte River Tangipahoa River, Bogue Chitto River, Pearl River, Bayou Liberty, Blind River, Amite River Drainage Basin, and Tickfaw River.

For the western and eastern portions of the Mississippi River Delta Basin, the 2002 305(b) report assessed that the Mississippi River from Monte Sano Bayou to Head of Passes was fully supporting the designated uses of secondary contact recreation and drinking water supply; however, this subsegment was assessed as not supporting primary contact recreation or fish and wildlife propagation. The suspected causes of impairment include nitrogen, phosphorus, and total fecal coliform from suspected sources of municipal point source discharges and upstream sources. The Mississippi River Basin Coastal Bays and gulf waters were assessed as not supporting fish and wildlife propagation due to mercury from atmospheric deposition. This subsegment was not assessed for the other designated uses due to insufficient data.

The 2002 Water Quality Inventory Section 305(b) Report assessed that the three water quality subsegment water bodies in the Pearl River Basin were fully supporting the designated uses of primary and secondary contact recreation, but not supporting fish and wildlife propagation. The suspected causes of impairment range from metals such as mercury, copper, and lead to pathogens and turbidity. The suspected sources of impairment include unknown sources, atmospheric deposition, and sand/gravel/rock mining or quarries.

Subprovince 2 – Barataria Basin

The water quality of the Barataria Basin is primarily adversely affected by periodic nutrient overloading (eutrophication) in selected parts of the upper- and mid-basin. Generally, there are no problems with trace metals in the basin, with the single documented exception of the Harvey Canal area. Fecal coliform concentrations can exceed designated uses, particularly after storms overwhelm local sewage treatment areas. Improper or untreated sewage from camps and boats is also a problem. The herbicide atrazine can consistently be detected throughout the Barataria Basin. Sources include both local use, particularly on sugarcane, and inputs from the mid-continent. Overall, the occurrence and amount of atrazine in the Barataria Basin does not appear to be a concern for human health.

Subprovince 3 - Teche/Vermilion, Atchafalaya, and Terrebonne Basins

According to the 2002 305(b) report, the Vermilion Bay was listed as fully supporting all of the designated uses, while the Vermilion-Teche River Basin Coastal Bays and gulf waters were assessed as fully supporting all designated uses except fish and wildlife propagation. The suspected source of impairment is mercury due to atmospheric deposition. The West Cote Blanche Bay and the East Cote Blanche Bay are both fully supporting the designated uses.

The 2002 305(b) report assessed the Lower Atchafalaya River as fully supporting its designated uses of primary contact recreation, secondary contact recreation, and fish and wildlife propagation. The report assessed the Atchafalaya Bay and Delta as not supporting its designated use of fish and wildlife propagation while it was not assessed for primary contact recreation, secondary contact recreation, or shellfish propagation. Mercury was the suspected cause of impairment in the Atchafalaya Bay and Delta. The Wax Lake Outlet, from U.S. Highway 90 to the Atchafalaya Bay, and the GIWW, from the Bayou Boeuf Lock to Bayou Sale, were not assessed for the 2002 305(b) report.

According to the 2002 305(b) report, the Terrebonne Basin Coastal Bays and gulf waters were listed as fully supporting all designated uses except fish and wildlife propagation. The suspected causes of impairment include phosphorus, nitrogen, and mercury. The suspected sources of impairment are upstream sources and atmospheric deposition. The Timbalier Bay is fully supporting all designated uses.

Subprovince 4 - Calcasieu/Sabine and Mermentau Basins

According to the 2002 305(b) report, the Calcasieu River Basin-Coastal Bays and gulf waters are fully supporting all designated uses except fish and wildlife propagation, due to mercury from atmospheric deposition. The 2002 305(b) report lists many of the coastal water body subsegments of the basin as not assessed. Caution is advised by LDHH on fish consumption from the Calcasieu Estuary due to low levels of chemical contamination including hexachlorobenzene, hexachloro-1-3-butadiene, and PCBs. Also, a fish and shellfish consumption advisory due to mercury contamination is in effect for the Calcasieu River Drainage Basin.

According to the 2002 305(b) report, the Sabine River Basin Coastal Bays and gulf waters are not supporting fish and wildlife propagation due to mercury from atmospheric deposition. There are approximately five other subsegments within the LCA near-term course of action project boundary that are not currently assessed.

The water quality in the coastal zone area of the Mermentau River Basin is primarily adversely affected by a small number of trace metals, agriculture runoff, and periodic eutrophication in selected parts of the upper coastal zone of the basin. The Mermentau River Basin Coastal Bays and gulf waters were assessed in the 2002 305(b) Report as not supporting fish and wildlife propagation. The suspected causes of impairment include carbofuran and mercury from atmospheric deposition, crop production, and unknown sources. Grand Lake and White Lake are not supporting fish and wildlife propagation due to turbidity, chlorides, ammonia nitrogen, sedimentation, and total suspended solids. Again, crop production is the suspected source of the impairment, as well as natural conditions.

3.16 HISTORIC AND CULTURAL RESOURCES

Coastal Louisiana contains numerous historic and prehistoric archeological sites as well as standing historic properties. These archaeological sites and historic properties span the human occupation sequence of the state and represent Louisiana's long cultural heritage. Over 3,000 archeological and historical sites have been recorded for the 20 parishes in the LCA Study area. In addition to these sites, more than 200 historic properties are listed on the National Register of Historic Places.

3.16.1 Historic and Existing Conditions

3.16.1.1 <u>Types of Cultural Resources</u>

Historic and prehistoric sites in the LCA Study area tend to be located along the natural levees of rivers and bayous that were used as transportation routes. The offshore borrow sites, such as Ship Shoal, also have the potential to contain historic shipwrecks.

The Mississippi River was the main means of transportation and its natural levees were the choice location for settlement. The surrounding coastal lakes and areas were gradually explored for natural resources and utilized as well. As the population along the Mississippi River increased, land along its natural levees became scarce. Settlers began to move further outward following waterways such as Bayou Lafourche, Bayou Teche, Bayou Terrebonne, the Vermilion River, and other bayous and rivers in the coastal area.

Prehistoric sites include hunting and food processing camps, hamlets, and village sites. Native Americans relied on hunting, fishing, and gathering of plants. Types of historic sites include domestic buildings, plantation sites, farmsteads, military sites, commercial sites, industrial sites, boat landings, and hunting and fishing camps along the coast. In addition to terrestrial historic sites, the project area has the potential to contain historic shipwrecks. Bayou Barataria, Bayou Lafourche, Bayou Teche, and the Atchafalaya, Vermilion and Calcasieu Rivers, as well as the other bayous in the study area, have been a major means of transportation in the Louisiana "bayou country" since prehistoric times. The smaller bayous that connect to Bayou Lafourche were also used by the local Native Americans as well as by trappers, hunters, and fishermen. Watercraft from all time periods could be present in the study area. Most of the vessels used historically in this area were vernacular watercrafts.

In the early 1900s, various subsistence activities that were initially developed prior to the 20th century became more commercial in nature. Moss, first gathered for the making of beds and as filler in the construction of houses, was commercially processed and sold to the upholstery business as stuffing for furniture and car seats. Following World War II, the moss industry declined as the result of the wide availability of foam rubber and the increased cost of gathering moss. The lumber industry that had flourished in the late 1800s continued to grow with the harvesting of cypress throughout south Louisiana. Lumber towns and sawmills dotted the landscape until most of the virgin cypress forests were cut and the lumber companies moved westward.

The trapping of animals in south Louisiana began with Native Americans and continued on into the 1900s. Otter, muskrat, and nutria were trapped in the marshes and provided furs for the garment industry all over the world. Hunting camps and processing stations were located throughout the marsh. The demand for furs has declined over the years. Nutria are trapped today for food and bounties, to keep the population from expanding and destroying the marsh, or from causing problems in municipal canals.

Seafood, one of the most important natural resources in south Louisiana, has continued to become more important to the economy of Louisiana. In the middle of the 19th century, methods of preservation (such as the drying of shrimp and canning of oysters) made it possible to export seafood. The introduction of the gasoline motor and refrigeration allowed fishermen greater access to markets in New Orleans and the larger towns inland from the coast. Seafood processing camps that had been established all over the coast in the 1800s, including Manila Village, Bayou St. Malo, and the Isle de Caminada, were abandoned after being hit by numerous tropical storms and hurricanes. In the 1900s, many of these fishermen established new settlement and seafood processing businesses along the major waterways leading away from the coast. Fishing remains a major economic activity in south Louisiana.

Rice and sugar remained major cash crops across the coastal parishes. By the eve of World War II, large sugar companies had developed after bad weather, plant diseases, and economic policies had almost destroyed sugar production in south Louisiana. Truck farming of vegetables and citrus to towns and cities provided fresh vegetables at local markets. Cameron and Vermilion Parishes are, today, the top two cattle producing parishes in Louisiana.
Other industries developed in south Louisiana in the 1900s that have shaped the economy of the state. The oil industry began in the early 1900s and continues to be a major industry. Large oil fields are located in the marshy areas of south Louisiana and offshore. Pockets of sulfur and salt are located across south Louisiana. The extraction of these natural resources became major industrial activities.

All of these economic activities have contributed to the constructed environment of south Louisiana. In addition to the residential homes, public buildings, and commercial buildings, these industries have contributed to the south Louisiana landscape and to the heritage of the area. Historic standing structures, archaeological sites, and landscape features associated with man's activities in the coastal area may be significant cultural resources. The Division of Archaeology maintains information on over 12,000 archaeological sites and thousands of historic standing structures.

3.16.1.2 Impacts Affecting Cultural Resources

The diverse resources available in coastal Louisiana have led to a diverse history and rich culture in the Louisiana coastal ecosystem. As a result, cultural resources are abundant in the area. Over the last 50 years, as land loss has progressed and saltwater intrusion has increased, many of these cultural resources have been put at risk or lost to erosion, inundation, and construction of navigation channels and canals.

Cultural resources in the LCA Study area are subject to a variety of natural and human impacts. Factors influencing archeological site preservation are presented in the following discussion. A thorough recognition of these factors is crucial in understanding archaeological site preservation. Many of the cultural resources located within the study area were reported as having been disturbed in the initial site forms on file with the Louisiana Division of Archaeology. Some of these sites were impacted by construction activities conducted prior to the implementation of regulations governing the treatment of cultural resources. Unfortunately, destruction of cultural resource sites from man-made actions continues in coastal Louisiana.

Factors that influence site preservation within the study area are essentially those that influence land loss and erosion in the coastal zone. Natural influences include subsidence, saltwater intrusion, and the frequency, magnitude, and duration of storms. Subsidence, compaction, and erosion accelerate the conversion of marsh to open water. Saltwater intrusion, coupled with subsidence, is resulting in the landward encroachment of the gulf. These processes are deleterious to archeological sites located in proximity to various lakes, bays, sounds, canals, and other water bodies.

Other factors influencing site preservation are related to the climate and topography of the area. The climate in this area is influenced by air masses, which result in severe storms during the summer months and sporadic, high energy disturbances during the winter months. The effects of severe wind and rain are enhanced by the low topography common throughout the area.

The actions of man are also major factors influencing site preservation in the area. Natural levees and their adjacent waterways represent important features to the region historically. Distributary channels formed important routes of transportation while the adjacent levees provided suitable landforms for settlements, fortifications, and access to the area's abundant natural resources. Prehistoric settlements focused on these high ridges and natural levees. The high ground was also preferred for historic settlements. Some of the first agricultural concessions in the area were granted along the Mississippi River and the major bayous of the study area. This focus on suitable dry land adjacent to navigable watercourses continues to the present and increased commercial/industrial developments influences site preservation.

The construction of various flood and water control structures is another factor that has influenced site preservation in the coastal zone. Levees have been constructed to prevent flooding and control the flow of water in some areas. These projects affect both sediment transport and deposition in the area. They have also been known to obliterate any evidence of, as well as destroy, cultural resources directly during construction. Excavation and maintenance dredging of canals for the extraction of mineral resources and for navigation has accelerated erosion and has dug into archeological sites. Many archaeological sites in the study area have subsided and were exposed during dredging activities for these canals. Other archeological sites were split by canals and subsequently eroded, resulting in the loss of cultural deposits. Another major source of destruction of archaeological sites is wakes from boats utilizing the waterways.

Since the passage of the National Historic Preservation Act of 1966, NEPA, and other National laws, Federal agencies are required to examine and avoid impacts to significant cultural resources. In cases where the site cannot be avoided, mitigation measures are developed either to retrieve significant data on the cultural resource or to compensate for the impact.

The land in the study area is eroding rapidly. The protection of these lands by some of the ongoing CWPPRA or other restoration projects, such as disposal of borrow material adjacent to archaeological sites, may actually protect these sites in the long-term by stopping or slowing land erosion. Depending on the restoration feature, the proposed actions could help to restore the surrounding wetlands, thus protecting the land and whatever sites that may be located in the area.

Past construction actions in the study area have had an adverse impact on significant cultural resources. These actions include:

- Dredging material from borrow areas, which impacts submerged cultural resources such as shipwrecks.
- The construction of plugs, shoreline protection devices, levees, etc. could all affect recorded and unrecorded cultural resources.
- Increased sediment flows have caused direct impacts on sites throughout the study area, while in some cases sediment flows have helped protect cultural sites by preventing further erosion.
- Depositing sediment on top of a known site has changed the environment in which a site has survived. This has, in some instances, caused adverse impacts.
- Dredging waterways has impacted prehistoric sites and historic shipwrecks in the study area.
- Construction of erosion control devices, such as weirs and dikes, and the building and removal of canal banks, have also adversely impacted prehistoric and historic sites in the study area.

3.16.1.3 Offshore Archaeological Resources

Archaeological resources are defined as any prehistoric or historic site, building, structure, object, or feature that is man-made or modified by human activity. The new MMS Archaeological Resource Regulation at 30 CFR 250.194(b) grants specific authority to the Regional Director to require archaeological resources surveys and reports. Surveys are required prior to any sea floor disturbing activities on leases within the archaeological high-probability areas (NTL 98-06).

3.16.1.3.1 *Historic*

With the exception of Ship Shoal Lighthouse, historic archaeological resources on the outer continental shelf (OCS) consist of shipwrecks. A 1977 MMS archaeological baseline study for the northern Gulf of Mexico indicated that 2 percent of the pre-20th century shipwrecks and 10 percent of all wrecks reported lost between 1500 and 1945 have known and/or verified locations (CEI 1977). An MMS-funded study by Texas A&M University (Garrison et al. 1989) updated the shipwreck database. Statistical analysis of over 4,000 potential shipwrecks in the northern Gulf indicated that many of the OCS shipwrecks occur in cluster patterns related mainly to natural geological navigation hazards, storms, and port entrances.

The management of potential historic shipwreck resources on the OCS has been accomplished through the establishment of a high-probability zone for the occurrence of historic shipwrecks. This high-probability zone consists of three subzones - (1) shoreline to 10 km from the shore; (2) 21 half-degree-square quadrates associated with cultural and geographic features including historic ports, barrier islands, and reefs; and (3) specific nine-lease-block high-probability search polygons associated with shipwrecks located outside of the two aforementioned zones. The Ship Shoal Area has one of the densest concentrations of shipwrecks in the Gulf of Mexico. The Texas A&M University study (Garrison et al. 1989) indicated there were 33 known wrecks (10 of which are historic), 13 unknown wrecks and two underwater bottom obstructions recorded within the Ship Shoal Area. The 33 known shipwrecks and their presumed Block locations are presented in **table 3-10.**

The Texas A&M study also examined variables affecting shipwreck site formation process and shipwreck preservation potential. Ship Shoal Block 88 falls within the MMS Central Planning Area (CPA). In general, the study concluded that there is a high degree of shipwreck preservation potential in the eastern portion of the CPA where there is a thick deposit of Holocene deltaic sediments. There is a lower potential for preservation in the central and western part of the CPA, where sedimentation rates are thinner and were slower to develop. Block 88 falls near the Middle of the CPA and, based on the Texas A&M study, the shipwreck preservation potential would be moderate to high. Ship Shoal Block 88 is located within one of the MMS high-probability search polygons and will require a 50-m (164 ft) marine remote-sensing instrument survey.

Table 3-10 Shipwrecks in the Ship Shoal Area
Source: MMS database.

Vessel Name	Lease Area	Lease Block
EMMA LOUIS	SS	0004
CHANCELLOR	SS	0006
TWIN BROTHER	SS	0013
MARJORIE	SS	0019
MARIAN S	SS	0023
G. MO. MARCONI	SS	0036
MISS LIBERTY	SS	0039
VALKYRE	SS	0045
MISS ELLEN	SS	0063
SEA DUKE	SS	0067
SHIP SHOAL	SS	0067
JO ANN	SS	0074
MINNIE	SS	0086
GOLDEN ISLE	SS	0090
BIG ELEVATOR	SS	0093
GULF OF MEXICO	SS	0093
BRETON ISLAND	SS	0093
SALLY GALE	SS	0093
HELEN BUCK	SS	0097
DAHLIA	SS	0099
CARDINAL ELEVATOR	SS	0107
ATLAS	SS	0109
BLUE WAVE	SS	0109
BRETON ISLAND	SS	0114
MISS MORGAN CITY	SS	0128
G.C.T. CO.16	SS	0159
JOSEPH H. DAVI	SS	0167
R W GALLAGHER	SS	0207
KERR MCGEE 11055	SS	0214
HEREDIA	SS	0216
ANDY MARTIN	SS	0221
LIL TEXAN	SS	0235
JEFF DAVIS	SS	0258

3.16.1.3.2 *Prehistoric Conditions of the Offshore Area*

The migration of early man into the Gulf of Mexico region is currently accepted to be around 12,000 years before the present (B.P.) (Aten 1983). Sea level curves developed for the northern Gulf of Mexico by Coastal Environments, Inc. (CEI 1982) indicate that sea level at 12,000 years B.P. would have been approximately 45 m (147.6 ft) below present sea level. Therefore, the prehistoric archaeological high-probability zone is a contiguous area between the Federal/state boundary and the 45-m (147.6 ft) bathymetric contour.

Based on their 1977 baseline study, CEI proposed that prehistoric sites analogous to the type of sites frequented by Paleo-Indians on land can be identified on the now-submerged continental shelf. Geomorphic features that have a high probability for associated prehistoric sites include barrier islands and back-barrier embayments, rivers channels and associated floodplains and terraces, and salt-dome features. Recent investigations in Louisiana and Florida indicate that mound building activities by prehistoric inhabitants may have occurred as early as 6,200 years B.P. (Hagg 1992; Russo 1992). Therefore, man-made features, such as mounds, may also exist in the shallow inundated portions of the OCS. Remote-sensing surveys performed by the oil and gas industry have been very successful in identifying these types of geographic features that have a high probability for associated prehistoric sites.

Regional geology studies for the Ship Shoal area by Fisk and McFarlan (1955) and Frazier (1974) indicate that this area is underlain by a portion of the abandoned and drowned Maringouin delta complex. This is a subdeltaic mass deposited from about 7,500 to 6,000 years B.P. by the Mississippi River when rising sea level followed the late Wisconsin glacial peak. Subsequently in this area, the Teche and LaFourche deltas, which were active from about 3,500 to 2,500 years B.P. and 1,000 to 300 years B.P., respectively (Kolb and van Lopik 1958), deposited a sequence of deltaic and marine sediments on the Maringouin subdelta. Typical deltaic sequences were deposited as sheets of sand at river mouth bars, with sand and coarser silt remaining nearshore and finer silt and clay were carried offshore by prevailing currents. As the Teche and LaFourche courses were abandoned by the Mississippi River, the massive deltaic sand bodies to the west-southwest were reworked by current action into an elongated shoal, Ship Shoal, which overlies the downwarped, subaerially weathered Prairie formation.

Floyd (1995) performed a geoarchaeological analysis of the Ship Shoal area, Block 72 and 87 geohazard survey. Block 87 borders on the western edge of Ship Shoal 88 and is germane to the prehistoric site potential of Block 88. Floyd (1995) states that this portion of the inner continental shelf was above sea level for thousands of years prior to conversion into a marine environment. He continues with an analysis of the subbottom profiles from Blocks 72 and 87, stating they were examined for relict landforms that may have supported prehistoric human groups prior to complete conversion of this region into an offshore environment (Floyd 1995). Regional geologic information indicates that the post-transgressive, Holocene Age deposits are approximately 110 feet (33.5 m) thick (Bernard 1970). The upper Holocene soil unit covers the Western Wall of the former Mississippi Canyon, which was entrenched during the low sea level cycle. Further, any archaeological sites associated with prehistoric human occupation of this Pleistocene Age river valley are buried beyond reasonable recovery depths (115 feet [35.1 m]). However, there may have been archaeological sites along the subaerial levees of the Holocene Age deltas (e.g., Teche and LaFourche deltas) that aggraded in this region over the past 6,000 years.

Ship Shoal Block 88 falls within the MMS prehistoric high-probability zone (e.g. 45-m [147.6 ft] bathymetric contour) and is subject to prehistoric archaeological clearance prior to any sea floor disturbance.

3.17 RECREATION RESOURCES

While individual significance or value of recreation may differ greatly, nationally it is very significant. This is clarified in the 1999 report drafted by the National Recreation Lakes Study Commission, which states "recreation constitutes 10.5 percent of all consumer spending and contributes more than $350 billion annually to the Gross Domestic Product" (1999).

The following is a "programmatic" survey of Recreational Resources in the LCA Study area. Due to the programmatic nature of the LCA Plan and FPEIS, the ability to do site-specific investigations and surveys in the study area is limited. For this FPEIS, existing reports, studies, and inventories are being compiled and used to compose the historic and existing conditions of recreational resources in the study area. As specific projects are identified and scheduled, impacts to resources specific to each project site/area would need to be assessed.

Much of the recreation data has been extracted from the 1993 – 1998 Louisiana Statewide Comprehensive Outdoor Recreation Plan (SCORP), which is updated at five-year intervals (SCORP 1998). The SCORP not only inventories statewide recreation resources, but also identifies and prioritizes the areas of need. While regions defined in the SCORP do not fit perfectly within the LCA Study area boundaries, the SCORP regions and LCA Study areas do generally coincide. Recreation data was also obtained from the 2000 U.S. Census and National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) by the U.S. Census Bureau, and the 2001 FHWAR completed by USFWS.

3.17.1 Historic Conditions

For the first inhabitants of southern Louisiana, and those who followed, recreation outings were times to practice customs and traditions learned from forefathers. The means by which Louisiana's early residents lived, hunting and fishing for food, utilizing high ground for camps, and building vessels for transportation, shaped what is now recognized as traditional recreation in southern Louisiana.

3.17.2 Existing Conditions

The present day recreational activities are deeply rooted in historic vocational and cultural traditions of southern Louisiana. Vocations centuries old have become today's avocations. Greatly exemplifying this are the hundreds of festivals celebrated throughout the coastal zone, many of which focus on harvests of rice, sugar cane, shrimp, crawfish, oyster, and alligator, and celebrating cultures and heritage such as Cajun, Creole, Isleno, and many European cultures.

The LCA Study area is rich in recreational resources, with nearly half of Louisiana's campgrounds, state historic sites, National historic parks, NWRs, WMAs, state parks and commemorative areas, important bird areas, and other sites of interest scattered throughout the coastal zone. From the Texas coast on the west to the Mississippi state line on the east, the recreating public has access to fresh, estuarine and marine resources for fishing, hunting, boating, swimming, camping, crabbing and crawfishing. Traditional non-consumptive recreation includes, but is not exclusive to, tennis, golf, zoos, aquariums, baseball, picnicking, biking, hiking, wildlife viewing, photography, and other activities.

Sportspersons and wildlife watchers spend $110 billion annually, 1.1 percent of the Nation's gross domestic product. Preliminary findings in the State of Louisiana, from the USFWS 2001 FHWAR, show that 970,000 sportspersons participated in fishing with expenditures of $694,978 and 333,000 participated in hunting with expenditure of $416,953. Wildlife-watching participants numbered 802,000 resident and 314,000 nonresident with expenditures of $165,746. In this region of the country, 19 percent of the population are anglers, 9 percent are hunters, and 25 percent participate in wildlife-watching activities.

Americans traveling to Louisiana spent approximately $8.1 billion in 2001. This supported over 113,000 jobs in the state with annual income of about $1.8 billion. Tax revenues associated with recreation and tourism in Louisiana were about $1.1 billion for all levels of government. Thus, tourism is an important resource in the State of Louisiana.

The Louisiana SCORP included some general needs and needs for specific regions. Some of the general needs included the need for more quality accommodations and camping facilities with more activities; the need to improve access to lakes for the average public; the need to enlarge buffer strips of timber along streams, roads, and lakes to preserve plant communities; the need for more and improved local recreational opportunities; the need for more intense trail systems; the need for more regional promotion and packaging of outdoor recreation; the need for urban wilderness parks; and the need for public education on conservation and facility use. **Table 3-11** displays Federal, state, and other important recreational resources.

Table 3-11
Federal, state, and other areas of important recreational resources

Wildlife/Recreation Areas	State Total	LCA Total	LCA Study Area			
			Delta Plain			Chenier Plain
			Subprovince 1	Subprovince 2	Subprovince 3	Subprovince 4
USFWS National Wildlife Refuges	16	9	3		3	3
Jean Lafitte National Historic Parks and Preserves	6	4	2	1	1	
Louisiana Wildlife Management Areas and Refuges	36	16	5	3	6	2
LA State Parks	17	8	3	2	2	1
State Historic Sites	12	2	1		1	
Important Bird Areas	15	10	3	1	1	5
Scenic Byways	16	7	2	1	2	2
Annualized Unit Day Value (UDV) *	$4.05 billion	$661.3 million	$55.6 million	$66.1 million	$72.3 million	$467.3 million

3.17.2.1 Subprovince 1: Eastern Mississippi River Delta, Lake Pontchartrain, and Breton Sound Basin

The Louisiana SCORP inventoried over 282,000 acres (114,210 ha) of recreational facilities (these are public facilities and acres, and do not account for private lands and leases) for SCORP Region 1 (roughly, Subprovince 1). While some of these facilities are tied more to urban settings, much is tied directly to the coastal zone. More than 196,000 acres (79,380 ha) are available for hunting. The region also has 142 boat lanes at 123 boat ramps; 395 acres (160 ha) with 1,833 tables for picnicking; 10 beaches equating to 11 acres (4.5 ha); and 320 acres (129.6 ha) for camping, with 263 tent sites and 1,739 trailer sites. These resources alone are conservatively estimated to have an annualized Unit Day Value (UDV) of over $120 million.

The SCORP prioritized needs in this region/subprovince, which include the need for improved access to roadside areas to enable fishing and boating, the need to include consumptive and non-consumptive activities on all public recreation areas with adequate funding for both user groups, the need for more wilderness/primitive camping opportunities, the need to identify and acquire large tracts of waterfront lands for large scale parks, and the need to address the dwindling state of marine resources.

3.17.2.2 Subprovince 2: Western Mississippi River and Barataria Basin

The Louisiana SCORP inventoried over 104,000 acres (42,120 ha) of recreational facilities (these are public facilities and acres, and do not account for private lands and leases) for SCORP

Region 3 (roughly, Subprovince 2). More than 107,000 acres (43,335 ha) are available for hunting. How can you have more acres for hunting than were inventoried (107,000 acres vs. 104,000 acres)? The region also has 194 boat lanes at 105 boat ramps; 131 acres (53.1 ha) with 365 tables for picnicking; 1 beach of 37 acres (14.9 ha); and 71 acres (28.7 ha) for camping with 34 tent sites and 422 trailer-sites. These resources alone are conservatively estimated to have an annualized UDV of over $286 million.

The SCORP prioritized needs in this region/subprovince, which include the need to maintain cultural heritage while increasing benefits associated with outdoor recreation and tourism, the need to promote and improve upon what is there (e.g., Terrebonne, fishing, marsh, foods, etc.), the need for more public access to marshes, the need to protect the barrier islands, and the need to provide aid to recreation-related businesses.

3.17.2.3 Subprovince 3: Teche, Vermilion, Atchafalaya, and Terrebonne Basins

The Louisiana SCORP inventoried over 690,000 acres (279,450 ha) of recreational facilities (these are public facilities and acres, and does not account for private lands and leases) for SCORP Region 4 (roughly, Subprovince 3). While some of these facilities are tied more to urban settings, much is tied directly to the coastal zone. More than 523,000 acres (211,815 ha) are available for hunting. The region also has 218 boat lanes at 138 boat ramps; 607 acres (245 ha) with 1,441 tables for picnicking; 16 beaches equating to 8 acres (3.2 ha); and 443 acres (179 ha) for camping, with 498 tent sites and 2,391 trailer sites. These resources alone are conservatively estimated to have annualized UDV of over $119 million dollars.

The SCORP prioritized needs in this region, which include the need for full funding for State Parks Capital Improvement Plan, the need for better roads and signage to recreation areas, the need to educate the public about conservation/ethical usage of land, the need to make the public aware that recreation is part of tourism and is an economic development tool, the need to educate users (locals and tourists) to the uniqueness of the region (Tabasco, salt domes, Atchafalaya Delta, swamps, etc.); the need to provide recreation to improve the quality of life, and the need to promote and interact between local, state, Federal, and private recreation programs to keep users/tourists in the area longer.

3.17.2.4 Subprovince 4 – Calcasieu/Sabine and Mermentau Basins

The Louisiana SCORP inventoried over 383,000 acres (155,115 ha) of recreational facilities (these are public facilities and acres, and do not account for private lands and leases) for SCORP Region 5 (roughly, Subprovince 4). While some of these facilities are tied more to urban settings, many are tied directly to the coastal zone. More than 134,000 acres (54,270 ha) are available for hunting. The region also has 115 boat lanes at 89 boat ramps; 153 acres (62 ha) with 1,054 tables for picnicking; 10 beaches equating to 363 acres (147 ha); and 154 acres (62.4 a) for camping, with 282 tent sites and 825 trailer sites. These resources alone are conservatively estimated to have an annualized UDV of over $2.6 billion.

The SCORP prioritized needs in this region, which include the need to promote southwest Louisiana, birding, public hunting, cycling, and hunting of underutilized species; the need to provide more and improved access to water-based recreation (roads, parking, facilities, ramps, piers, bank fishing, and improve existing wharfs); the need for more public restrooms and picnic facilities; and the need to identify cultural sites.

3.18 AESTHETIC RESOURCES

3.18.1 Historic and Existing Conditions

This resource's institutional significance is derived from laws and policies that affect visual resources, most notably NEPA. The 1988 USACE Visual Resources Assessment Procedure (VRAP) provides a technical basis for identifying the project's significant impacts. Public significance is based on public perceptions and professional analysis of the project's visual impacts (Smardon et al. 1988).

The VRAP was developed for use in the planning process as input to plan formulation, design, and operations. The VRAP is organized as a process, as if the USACE had a database on the existing visual quality of the District's area of responsibility and could draw on this to assess the impacts to aesthetics caused by various civil works projects. As this is not the case, use of the procedure to place a value on existing visual resources requires developing the information leading up to the existing visual quality conditions (i.e., the Management Classification System (MCS)).

The timing of MCS implementation, the level of detail at which visual resource information is collected and analyzed, and the nature of the MCS end products are varied considerably in response to the District's planning needs. The MCS would be done at the regional level (Chenier and Delta Plains) during the detailed planning process of any proposed LCA Plan projects.

The type of public input for aesthetics, as well as environmental issues in general, varies with the project. Indirect sources of public opinion, such as the National and state recognized scenic byways and rivers are identified and used in the professional assessments of aesthetic values representative of the Chenier and Deltaic Plains. Examples include the Louisiana Scenic Byway, River Road Scenic Byway, San Bernardo Scenic Byway, Lafourche/Terrebonne Scenic Byway, Bayou Teche Scenic Byway, Promised Land Scenic Byway, Jean Lafitte Scenic Byway, and the Creole Nature Trail. Aesthetic values of aquatic areas are derived from the natural characteristics of a particular area. Aesthetic values may include such parameters as the visual distinctiveness of the elements present, which may result from prominence, contrasts due to irregularity of form, line, color, and pattern; the diversity of elements present, including topographic expression; shoreline complexity; landmarks; vegetative pattern diversity; and waterform expression.

Historical accounts of the visual character of the Louisiana coastal area detail how hydrologic modifications due to the service needs of various industries - petroleum, maritime, agriculture and timber - and man's settlement patterns have forever changed the landscape character of the Louisiana coastal area. The most intensive petroleum development in the Nation's coastal area and Federal offshore area has been concentrated in Louisiana. Since 1926, when production was first recorded in the coastal zone, a large portion of the state's total oil and gas has been produced in this part of the state. Therefore, as the proposed coastal restoration projects approach design implementation, environmental assessment of the project's effects to existing visual resources would be utilized on an individual project basis, taking into account historical conditions.

3.19 AIR QUALITY

This resource is institutionally significant because of the Clean Air Act of 1963, as amended (CAA), and the Louisiana Environmental Quality Act of 1983, as amended (LEQA). Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS). It is publicly significant because of the desire for clean air expressed by virtually all citizens.

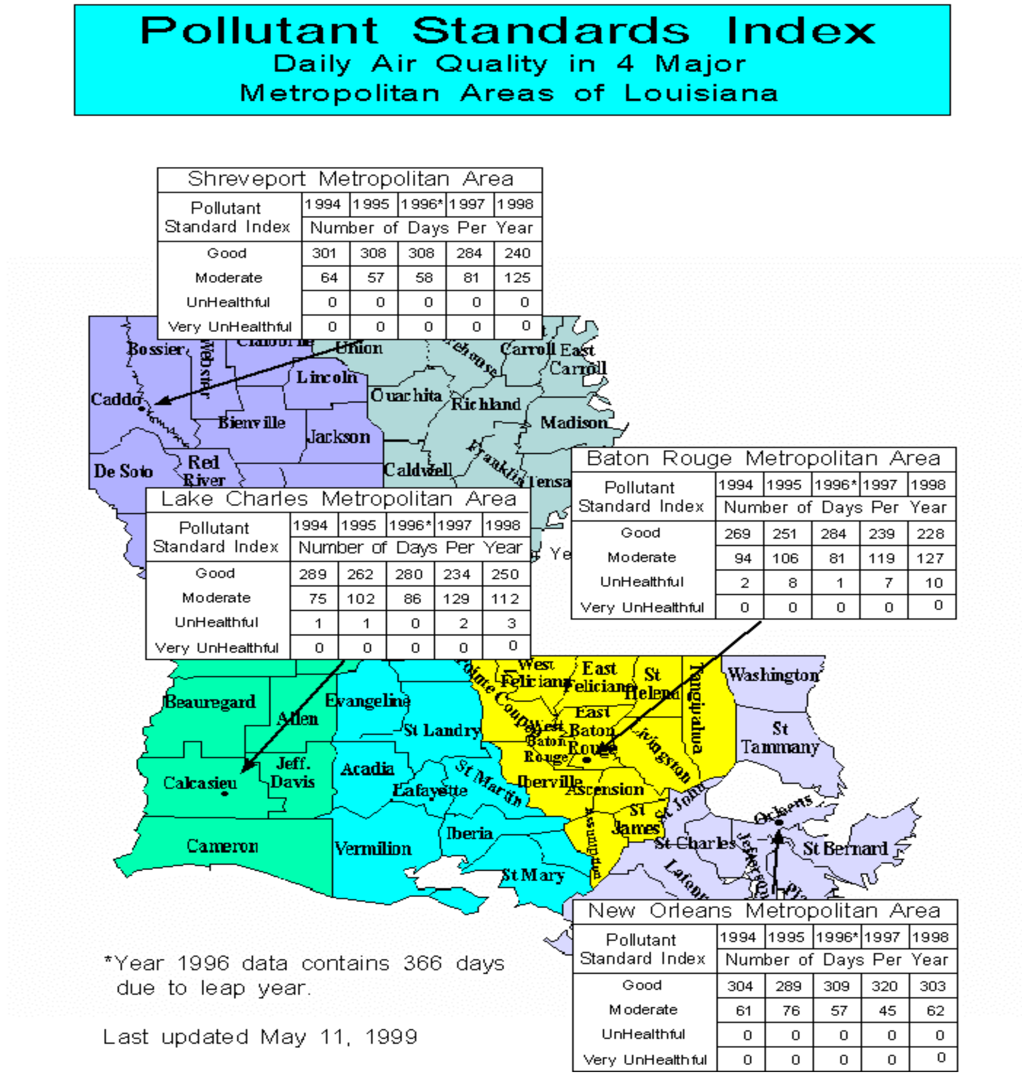
3.19.1 Historic and Existing Conditions

3.19.1.1 Criteria Pollutant Reporting

The USEPA has set national air quality standards for six common pollutants (also referred to as "criteria" pollutants). They include ozone (O_3), particulate matter, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and lead (pB). States are required by the Code of Federal Regulations (CFR) to report to the USEPA annual emissions estimates for point sources (major industrial facilities) emitting greater than, or equal to, 100 tons (per year of volatile organic compounds (VOCs), NO_2, SO_2, particulate matter less than 10 microns in size (PM-10); 1,000 tons per year of CO; or 5 tons per year of Pb. Since O_3 is not an "emission," but the result of a photochemical reaction, states are required to report emissions of VOCs, which are compounds that lead to the formation of O_3. **Figure 3-31** displays pollutant standards in four major metropolitan areas of Louisiana (LDEQ - personal communication).

In accordance with the CAA, USEPA set NAAQS for pollutants considered harmful to public health and the environment. The CAA established two types of national air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Generally, addressing potential air quality impacts concerns would be accomplished on a project-by-project basis and in coordination with the LDEQ. As required by LAC 33:III.1405 B, an air quality applicability determination would be made for each specific project. This would include consideration of each separate project item of the proposed action for the category of general conformity, in accordance with the Louisiana General Conformity, State Implementation Plan (SIP; LDEQ 1994).



Shreveport Metropolitan Area

Pollutant Standard Index	1994	1995	1996*	1997	1998
	Number of Days Per Year				
Good	301	308	308	284	240
Moderate	64	57	58	81	125
UnHealthful	0	0	0	0	0
Very UnHealthful	0	0	0	0	0

Lake Charles Metropolitan Area

Pollutant Standard Index	1994	1995	1996*	1997	1998
	Number of Days Per Year				
Good	289	262	280	234	250
Moderate	75	102	86	129	112
UnHealthful	1	1	0	2	3
Very UnHealthful	0	0	0	0	0

Baton Rouge Metropolitan Area

Pollutant Standard Index	1994	1995	1996*	1997	1998
	Number of Days Per Year				
Good	269	251	284	239	228
Moderate	94	106	81	119	127
UnHealthful	2	8	1	7	10
Very UnHealthful	0	0	0	0	0

New Orleans Metropolitan Area

Pollutant Standard Index	1994	1995	1996*	1997	1998
	Number of Days Per Year				
Good	304	289	309	320	303
Moderate	61	76	57	45	62
UnHealthful	0	0	0	0	0
Very UnHealthful	0	0	0	0	0

Figure 3-31. Pollutant standards in four major metropolitan areas of Louisiana *(Source: LDEQ).*

An air quality determination would be calculated for each project, based upon direct and indirect air emissions. Direct emissions include those resulting directly from construction of the proposed action. Generally, since no other indirect Federal action, such as licensing or subsequent actions would likely be required or related to the restoration construction actions, it is likely that indirect emissions, if they would occur, would be negligible. Therefore, the air applicability determination analysis would be based upon direct emission for estimated construction hours. Typically, however, consideration of total emissions for each work item separately (or even when all work items are summed) generally do not exceed the threshold limit applicable to VOCs for parishes where the most stringent requirement (50 tons per year in serious non-attainment parishes) is in effect, (see General Conformity, SIP, section 1405 B.2), the VOC emissions for the proposed construction would be classified as de minimus and no further action would be required.

3.19.2 Improving Air Quality via Coastal Restoration

The effects of vegetation, especially trees, on air quality is exemplified by research conducted by David J. Nowak, Project Leader, USDA Forest Service, Northeastern Research Station, 5 Moon Library, SUNY-CESF, Syracuse, NY 13210. Nowack and his associates found that urban trees remove gaseous air pollution primarily by uptake via leaf stomata as well as at the plant surface. Trees also remove pollution by intercepting airborne particles. Nowak found that air quality improvement in New York City, due to pollution removal by trees during daytime of the in-leaf season averaged 0.47 percent for particulate matter, 0.45 percent for O_3, 0.43 percent for SO_2, 0.30 percent for NO_2, and 0.002 percent for CO. In 1994, trees in New York City removed an estimated 1,821 metric tons of air pollution at an estimated value to society of $9.5 million. Air pollution removal by urban forests in New York was greater than in Atlanta (1,196 tons; $6.5 million) and Baltimore (499 tons; $2.7 million), but pollution removal per m^2 of canopy cover was fairly similar among these cities (New York: 13.7 $g/m^2/yr$; Baltimore: 12.2 $g/m^2/yr$; Atlanta: 10.6 $g/m^2/yr$).

These standardized pollution removal rates differ among cities according to the amount of air pollution, length of in-leaf season, precipitation, and other meteorological variables. Large healthy trees greater than 77 cm (30.03 in) in diameter remove approximately 70 times more air pollution annually (1.4 kg/yr [3.1 pounds/yr]) than small healthy trees less than 8 cm (3.1 in) in diameter (0.02 kg/yr [0.04 pounds/yr]). With regard to emission of VOCs, Nowak found that emissions by trees can contribute to the formation of O_3 and CO. However, in atmospheres with low nitrogen oxide concentrations (e.g., some rural environments), VOCs may actually remove O_3. Because VOC emissions are temperature dependent and trees generally lower air temperatures, increased tree cover can lower overall VOC emissions and, consequently, O_3 levels in urban areas. VOC emission rates also vary by species. Nine genera that have the highest standardized isoprene emission rate, and therefore the greatest relative effect among genera on increasing O_3, are beefwood (*Casuarina* sp.); *Eucalyptus* sp.; sweetgum ; black gum (*Nyssasylvatica*); sycamore (*Platanus* sp.); poplar (*Populus* sp.); oak (*Quercus* sp.); blacklocust (*Robiniapsuedoacacia*); and willow (*Salix* sp.). However, due to the high degree of uncertainty in atmospheric modeling, results are currently inconclusive as to whether these genera will contribute to an overall net formation of O_3 in cities (i.e., O_3 formation from VOC emissions are greater than O_3 removal). Some common genera in Brooklyn, NY, with the greatest relative effect on lowering O_3 were mulberry (*Morus* sp.); cherry (*Prunus* sp.); linden (*Tilia* sp.); and honey locust (*Gleditsiatriacanthos*).

Studies of the effects of common wetland plants and trees, such as those found in coastal Louisiana, on air pollution have yet to be done. However, it is reasonable to extrapolate from these existing studies that similar effects on air quality improvement would be likely, especially for restoration of fresh swamp and bottomland hardwood forests (David J. Nowak, Project Leader, USDA Forest Service, Northeastern Research Station, 5 Moon Library, SUNY-CESF, Syracuse, NY 13210 - personal communication)

3.20 NOISE

3.20.1 Historic and Existing Conditions

Noise, or unwanted sound, may be objectionable in terms of the health or nuisance effects it may have upon humans and the human environment, as well as upon the animals and ecological systems in the natural environment. The Noise Control Act of 1972 declares the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare. It is the purpose of the act to establish a means for effective coordination of Federal activities in noise control and to provide information to the public regarding the noise emissions.

Noise concerns are directly related to its potential negative effects upon humans and animals, and may range from annoyance to adverse physiological responses, including permanent or temporary loss of hearing, disruption of colonial nesting birds, and other types of disturbance to humans and animals. Noise is typically associated with human activities and habitations, such as operation of commercial and recreational boats, water vessels, air boats, and other recreational vehicles; operation of machinery and motors; and human residential-related noise (air conditioner, lawn mower, etc.). Generally, noise is a localized phenomenon throughout the LCA Study area.

3.21 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

A Phase I Initial Site Assessment (ISA) is required for all USACE Civil Works Projects to facilitate early identification and appropriate consideration of potential HTRW problems. Engineer Regulation ER 1165-2-132 and Division Regulation DIVR1165-2-9 describe the policies for conducting HTRW reviews for USACE Civil Works Projects. HTRW includes any material listed as a “hazardous substance” under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and any material listed as a hazardous waste under the Resource Conservation and Recovery Act (RCRA). Other regulated contaminants include those substances that are not included under CERCLA and RCRA, but may pose a potential health or safety hazard, and are regulated by other statutory authorities. Examples include, but are not limited to, many industrial wastes; naturally occurring radioactive materials (NORM); many products and wastes associated with the oil and gas industry; herbicides; and pesticides. If dredged material and sediments beneath navigable waters are within the boundaries of a site designated by the USEPA or the state for a response action under CERCLA, or if they are part of a National Priority List site under CERCLA, they will qualify as HTRW and will be treated accordingly. However, dredged material and sediments beneath navigable waters that do not qualify as HTRW, as defined in the preceding, would be evaluated for suitability for placement in waters of the U.S. in accordance with the Section 404 (b)(1) guidelines as mandated by Section 404 of the CWA, or the criteria established in Section 103 of the Marine Protection, Research, and Sanctuaries Act.

The purpose of the Phase I ISA is to ensure that HTRW and contamination issues are properly considered in project planning and implementation. The ISAs generally consist of a review of all properties in a project area to determine the potential for HTRW concerns on each property. In addition, a complete review of appropriate state and Federal environmental enforcement agencies' records is conducted, prior to a site reconnaissance, to identify any potential hazardous situation. The results of the ISA provide early detection of HTRW, and determine viable options to avoid HTRW problems and establish procedures for resolution of HTRW concerns, issues, or problems. Early detection of HTRW sites of concern within the project area would be accomplished during early planning phases, prior to land acquisition, and initiation of construction activities. HTRW problem areas would be avoided where practicable.

Should an ISA discover HTRW problems within a project area, a Phase II assessment would be conducted to further investigate areas of concern identified by the Phase I ISA. A Phase II assessment consists of sampling and testing various media (e.g., oil, water, air, soil, containers, substances, etc.), which were identified in the ISA as areas of concern. Sampling and testing would confirm the presence, characteristics, and extent of contamination. The Phase II assessment would also present recommendations on what removal and/or control actions would be necessary to mitigate potential hazards. Where HTRW contaminated areas or impacts cannot be avoided, response or remediation actions must be acceptable to the EPA and state regulatory agencies.

3.21.1 Historic Conditions

Development of oil and gas resources in the Louisiana coastal zone began in the 1920s, and in the 1940s on the outer continental shelf (OCS). Since 1921, about 75 percent of all state lands leased for petroleum development has been in the coastal zone. As the early oil and gas industry flourished, transportation and storage became a problem. Pipelines were built to the railroads, where tank cars were filled and transported. Storage presented difficulties because shipping could not keep up with production. Some elevated wooden tanks were built to store oil, but large earthen storage pits were also often dug to hold millions of barrels. In addition to these oil storage pits, earthen pits were also used to store drilling muds, brine, and by-products from daily oil and gas activities. Pipelines were later constructed to connect offshore oil and gas production platforms with onshore facilities. Today, several thousand miles (over 10 thousand km) of pipeline systems extend to virtually all points in the state.

In addition to the emergence of the oil and gas industry, two discoveries in the 19th century laid the foundation for the development of the petrochemical industry in Louisiana in the 20th century. Salt was discovered at Avery Island in 1862 and sulfur was discovered near Lake Charles around the mid- to late-nineteenth century. Brine in salt domes is used to make chlorine for bleach and water purification, computer discs, and polyvinyl chloride (PVC). Sulfur is used in making fertilizer and paper, among other products. Other industries in Louisiana produce potential HTRW substances, including synthetic rubber, refrigerants, and oxygen. A large portion of the petrochemical industry is located along major Louisiana waterways (e.g., Mississippi and Calcasieu Rivers) where there is a source of water for production activities and transportation.

3.21.2 Existing Conditions

A review of Federal and state agencies' databases reveals numerous HTRW sites of concern within the parishes in the coastal Louisiana study area. The Federal agencies' databases revealed numerous sites under the National Priority List (Superfund); CERCLA; RCRA waste generators; RCRA Corrective Action (CORRACTS) list; RCRA non-CORRACTS treatment, storage or disposal facilities; and sites listed under the National Response center for incidents involving oil and chemical spills. The state databases also revealed numerous inactive and abandoned sites, landfills, and leaking underground storage tanks. In addition to these known areas of concern, a large number of unknown/unidentified environmental sites of concern are likely located within the coastal Louisiana study area.

Compilation of a list of sites of concern for the entire LCA Study area is not practicable at this time in light of the large number of sites, funding limitations, and current time constraints. As restoration alternative plans become more defined, detailed HTRW analyses will be performed to evaluate and eliminate, where possible, potential HTRW problem sites from consideration. Addressing existing HTRW sites of concern for proposed LCA Plan projects will include a review of site-specific as well as project specific information and plans. However, preliminary sites of concern were compiled from a number of state and Federal databases. **Figure 3-32** shows the locations of a superfund site, several inactive and abandoned sites, open dumpsites, and leaking underground storage tanks known to be present within the Louisiana study area.

The USCG – National Response Center recorded over 60,000 reports of crude oil and natural gas spills in the entire state of Louisiana from 1990 to 2002. **Figure 3-33** shows the approximate locations of the spills. This figure is for HTRW information purposes only. The source of the information used in displaying spills was developed by the Louisiana Oil Spill Coordinator's Office (LOSCO)/Office of the Governor. The geographic location accuracy is highly variable from a hundredth of a mile (hundredth of km) to over one hundred miles (over 161 km), and in some cases derivation of a geographic location is not possible. The information provided is presented "as is" without warranty of any kind (contact LOSCO for the complete legal distribution liability disclaimer).

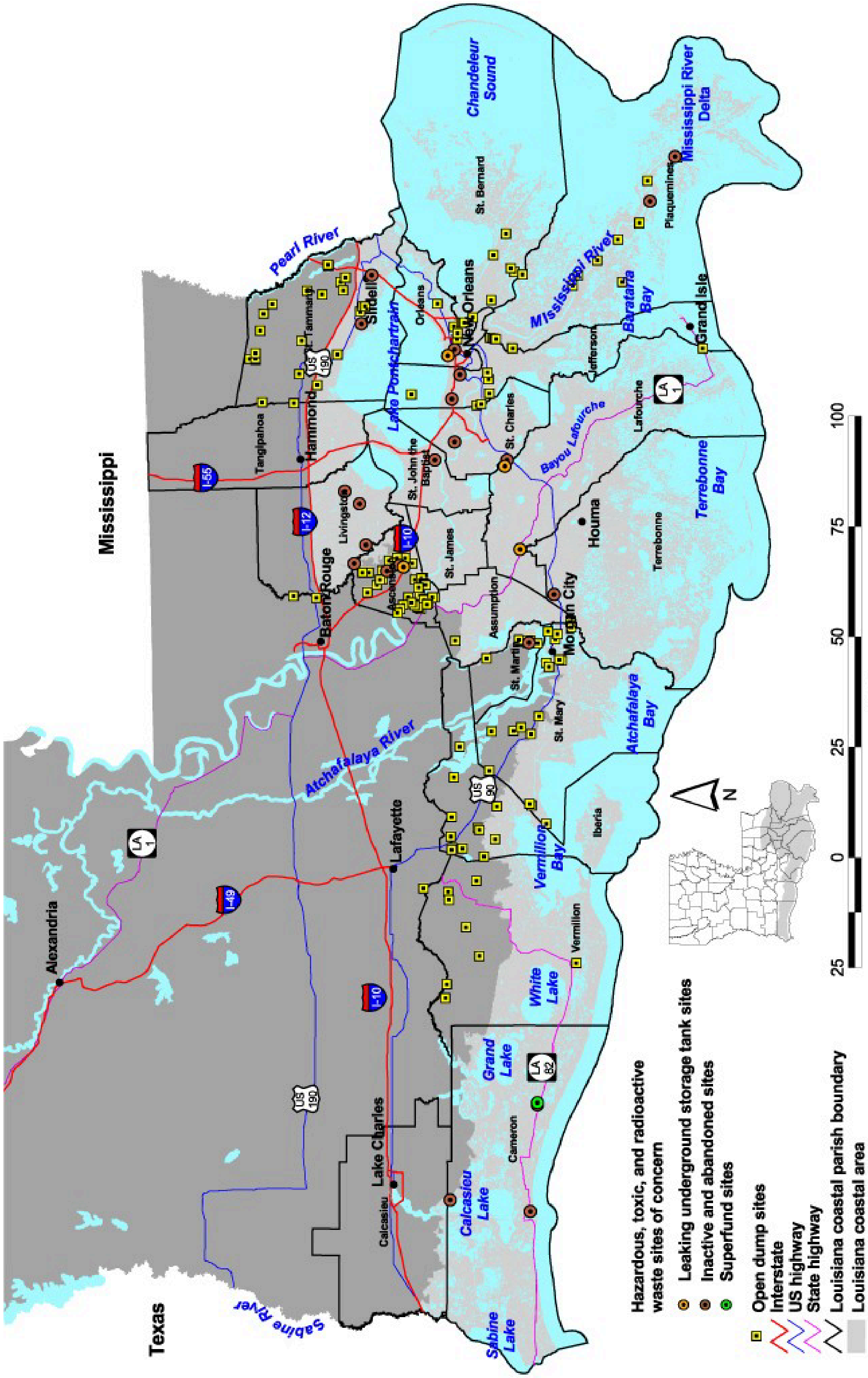


Figure 3-32. Hazardous, toxic, and radioactive waste sites of concern within the coastal Louisiana study area.

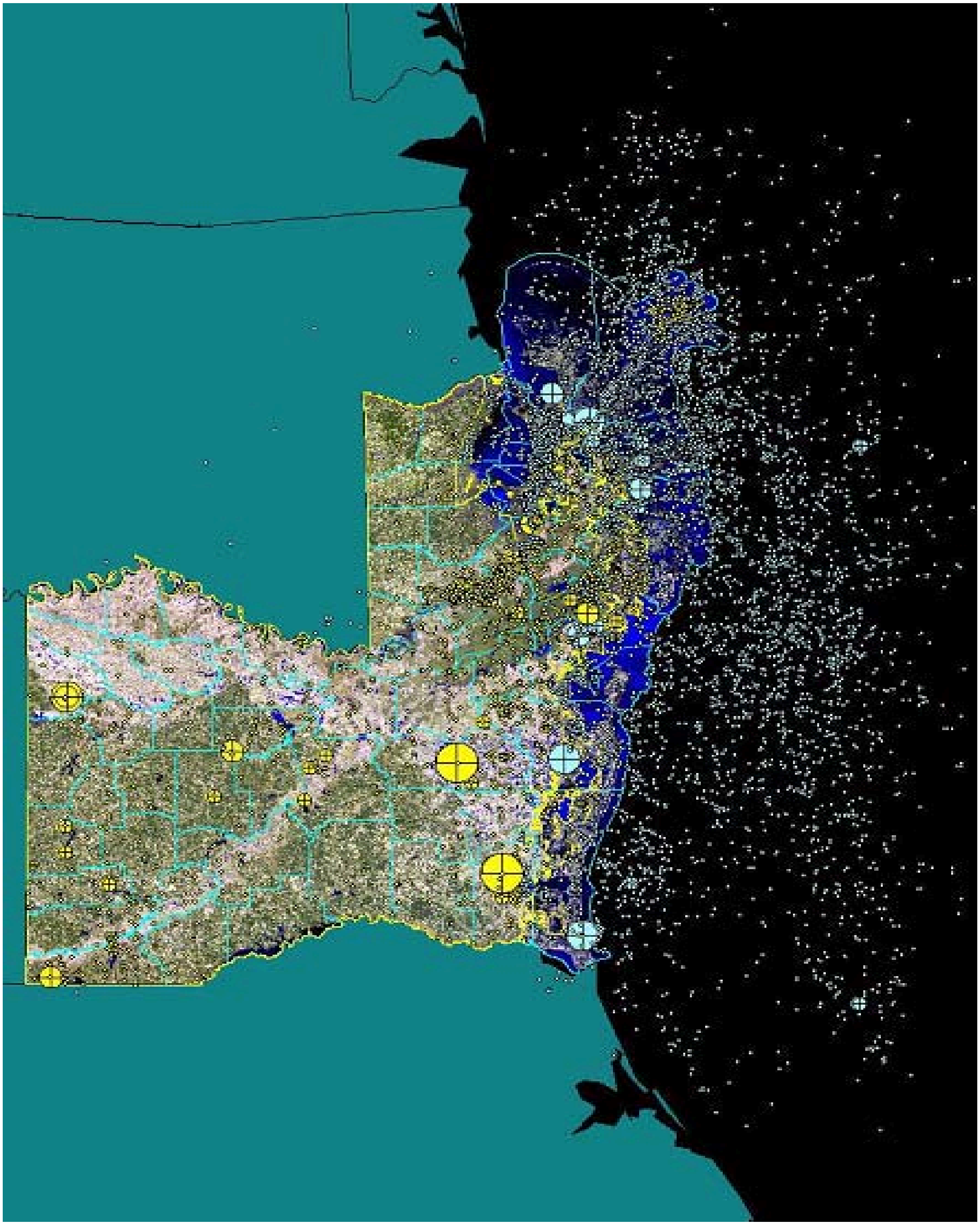


Figure 3-33. Crude oil and natural gas spills in the entire State of Louisiana from 1990 to 2002 *(from LOSCO).*

3.22 SOCIOECONOMIC AND HUMAN RESOURCES

Nearly two million people, representing approximately 43 percent of the state's population, reside within the LCA Study area. The rich soil conditions, mild climate, natural waterways, and abundance of water and other natural resources have long attracted and supported economic development in coastal Louisiana. The diversified economy that exists in the region today includes oil and gas production and transportation, navigation, commercial fishing, agriculture, recreation, and tourism. Employment has varied widely with periods of rapid growth and contraction; in 2000 there were more than 800,000 jobs in coastal Louisiana. The most influential industries for the study area's economy include oil, gas and pipeline; navigation; commercial and recreational fishing and hunting; and agriculture, all of which are essential for supporting Louisiana's economy. The following socioeconomic profile addresses historic and existing conditions within 17 Louisiana parishes of the LCA Study area. A general background of population, infrastructure, socioeconomic and human resources, commercial fisheries, oyster leases, petroleum, navigation, flood control, pipelines, hurricane protection, agriculture, forestry, and water supply are discussed below. Environmental justice issues will be assessed on a project-specific basis during follow-up feasibility level analyses. Reference to compliance with Executive Order 12898 regarding environmental justice is described in section 6.1.1.11.

3.22.1 Population

3.22.1.1 <u>Historic and Existing Conditions</u>

Population in the 20-parish study area increased from 1,556,965 to 2,247,344 from 1960 to 2000, with approximately 50.2 percent of Louisiana's population residing in the coastal area. Population in coastal parishes has remained fairly stable as a share of state population over this period. Every parish in the study area has increased in population over the period except Orleans Parish, which decreased.

3.22.2 Infrastructure

3.22.2.1 <u>Historic and Existing Conditions</u>

Table 3-12 is a summary of the infrastructure in the portions of the study area that are considered at risk.

Table 3-12 Summary of the Valuation of Assets in the LCA Study Area (*source: Waldemar S. Nelson & Co 2003)*	
Asset Category	**Value**
Oil and Gas Production Facilities	$3,207,180,000
Pipelines	3,203,947,000
Highways	5,981,038,000
Railroads	385,770,000
Navigable Waterways	3,639,743,000
Ports	869,376,000
Industrial and Manufacturing Facilities	30,818,728,000
Transmission Lines	416,844,000
Municipal and Parish Utility Infrastructure	4,295,777,000
Municipal and Parish Private Buildings	42,756,136,000
Agricultural Interests –Lands	160,680,000
Agricultural Interests –Products	163,424,000
Total Asset Value	$95,898,643,000

The estimation methods used include replacement costs (for pipelines, highways, and railroads) and fair market value (for agriculture and private buildings). Also, the value of the navigable waterways in the study area was calculated by using operation and maintenance costs. It was assumed that the costs paid for the navigable waterways in the system are justified (i.e., that the value of the waterways system is equal to what is being paid to maintain them). The estimated total asset value that would be at greater risk if coastal erosion continues is between $95 billion and $100 billion.

3.22.3 Employment and Income

3.22.3.1 <u>Historic and Existing Conditions</u>

Employment in the study area has varied widely, with several periods of rapid growth and shrinkage as the job base varied. For example, strong growth in the early 1980s was followed by sharp job declines during the mid and late 1980s. This decline was brought about by shrinkage in oil field production and employment, caused by dropping oil prices.

The diversification of the southern Louisiana economy increased after the local recession of the late 1980s, as resources were channeled from the oil and gas industry into other areas, including tourism. However, many jobs still depend on the oil and gas industry. For example, much of the construction employment is oil and gas dependent, since a lot of construction activity is done in support of that industry. The leading employers are transportation; oil and gas; seafood; tourism; and the finance, insurance, and real estate sectors.

The highest income parishes in the area are consistently those in the New Orleans metropolitan statistical area (MSA), including St. Tammany, Jefferson, St. Charles, and Orleans Parishes. The most influential industries for the study area economy, and the ones most likely to be impacted by coastal wetland losses, include oil, gas, and pipeline; navigation (transportation); and commercial and recreational fishing and hunting. These industries are covered in the following sections, along with flood control, which is a major issue for study area inhabitants.

3.22.4 Commercial Fisheries

3.22.4.1 Historic and Existing Conditions

Louisiana’s coastal wetlands are the richest estuaries in the country for fisheries production. Commercially and recreationally important species such as brown and white shrimp, blue crabs, eastern oysters, and menhaden are abundant, but these species populations are threatened if land loss continues. Louisiana has historically been an important contributor to the Nation’s domestic fish and shellfish production, and is one of the primary contributors to the Nation’s food supply for protein. While Louisiana has long been the Nation’s largest shrimp and menhaden producer, it has also recently become the leading producer of blue crabs and oysters.

Total landings in Louisiana were 1.2 billion pounds (0.54 billion kg)in 2001. The percentage contribution of total landings for the gulf region was 74 percent and for the Nation was 12.5 percent. Dockside revenues for commercial fisheries in coastal Louisiana were $343 million in 2001 (NMFS 2003b). These revenues were the largest for any state in the contiguous United States, second only to Alaska. **Figure 3-34** shows the trend in total landings for Louisiana, the gulf region, and the Nation attesting to the substantial productivity of Louisiana’s coastal marshes (NMFS 2003b).

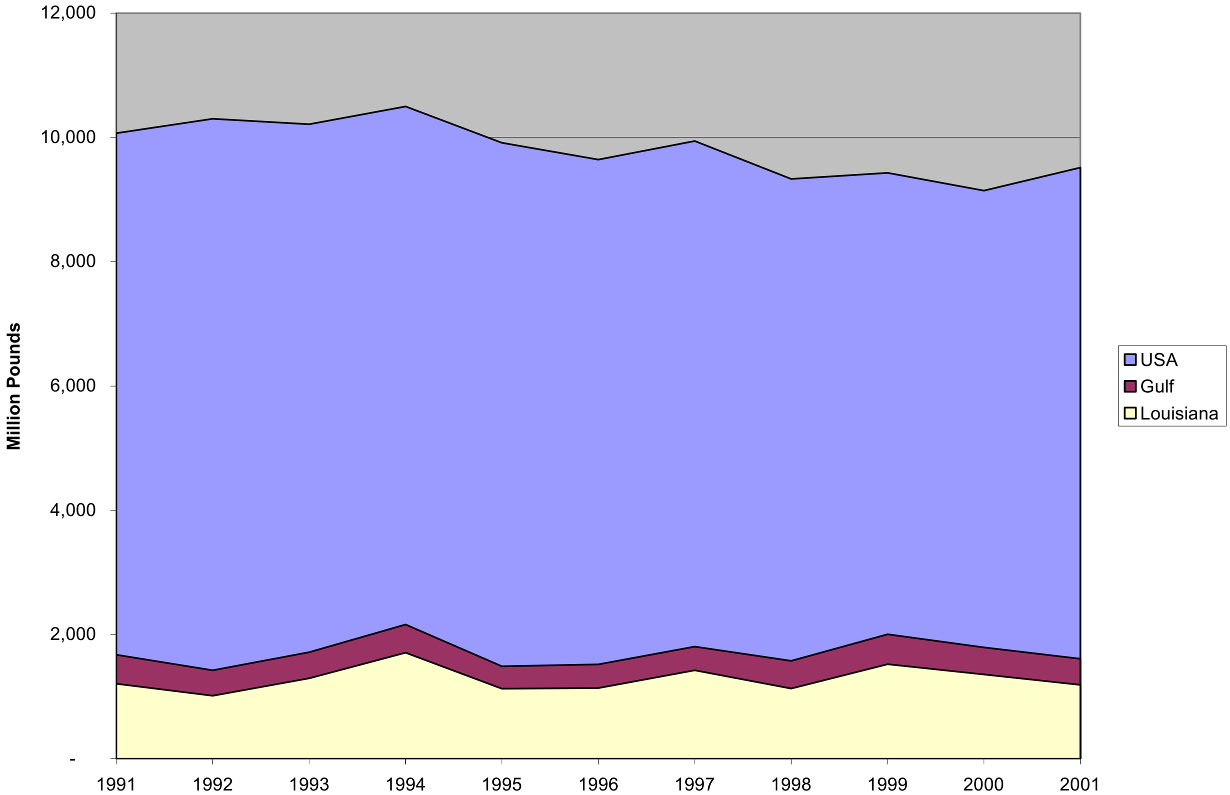


Figure 3-34. Historical trend in commercial landings for Louisiana, the gulf region and the Nation (*source: NMFS 2003b*).

The most important species, in terms of Louisiana dockside revenue in 2001, was shrimp. Louisiana caught approximately 125 million pounds (56.3 million kg) of shrimp in 2001, which is over 45 percent of United States' total landings, and more than what was caught in any other state. In 2000, the gulf region landed over 77 percent of the total United States' shrimp catch and Louisiana landed over 57 percent of shrimp caught in the gulf. Almost all of the shrimp caught in Louisiana and along the gulf coast have spent an important part of their life living and growing in the Louisiana coastal marshes.

Another important species harvested in the area is menhaden. Menhaden is processed to produce both fishmeal and fish oil. Fishmeal is used as a high protein animal feed. The broiler (chicken) industry is currently the largest user of menhaden meal, followed by the turkey, swine, pet food, and ruminant (cattle/livestock) industries. The Louisiana menhaden fisheries landings were the largest in the Nation, landing twice as much as the next closest state. The percent of dockside value from Louisiana to that of the rest of the Nation was over 57 percent.

In 2002 alone, Louisiana had 44 percent of the Nations oyster catch (58 percent of the Nation's eastern oysters) by pounds with 36 percent of the value (or 49 percent of the value for the Nation's eastern oysters). Louisiana also has led the United States in eastern oyster production, contributing just under half of the U.S. production. Louisiana also produced about 26 percent of the Nation's blue crabs in 2001. As with eastern oyster production, the trend has been for Louisiana to become the largest producer of blue crabs in the Nation, surpassing other states that were the dominant producers in the 1990s. The dockside value for blue crabs landed in Louisiana in 2001 was $35.9 million for landings of 41.7 million pounds (18.7 million kg).

3.22.5 Oyster Leases

3.22.5.1 Historic Conditions

In 1892, Act 206 established the first public oyster grounds open to all Louisiana residents. Act 206 also adjusted the closed season, increased the size of a lease to 10 acres (4 ha), and authorized the office of oyster inspector to enforce the laws. Ten years later, Louisiana's first comprehensive oyster law was passed with the Act of 1902. The Louisiana Department of Conservation issued the first private oyster lease in 1903 in Plaquemines Parish (Laiche 1993).

3.22.5.2 Existing Conditions

Louisiana is the top producer of the eastern oyster (*Crassostrea virginica*) in the United States, averaging approximately 11.4 million pounds (5.1 million kg) per year, with an average value of $25.8 million. The fishery has two main sources - privately leased grounds, and public seed grounds. The State of Louisiana owns the water bottoms, and leases out acreage to oyster fishermen. The public grounds are open to harvesting by all licensed fishermen, but are only open during the public season, which runs from September through March. Oysters can be harvested from the private grounds throughout the year.

The LDWF and the Louisiana Wildlife and Fisheries Commission manage over 1 million acres (over 405,000 ha) of public grounds. Extensive reefs are located on the east side of the Mississippi River, particularly in Black Bay, Lake Borgne, and the Biloxi Marsh. Special areas in the public grounds are managed as Oyster Seed Reservations, which generally have more strict harvest limitations. These are located in Bay Gardene, Hackberry Bay, Sister Lake, and Bay Junop. Vast areas of public seed grounds are located in Vermilion Bay, East and West Cote Blanche Bays, and a special tonging-only area is located in Calcasieu Lake.

These public grounds provide seed oysters (less than 3 inches [7.6 cm]) that can be transplanted to leases to grow up to legal sacking size. The public grounds also provide sack oysters that can be brought directly to market. Prior to 1993, sales from private leases comprised around two thirds of the total oyster production. Beginning in 1993, approximately half of the oysters brought to market in Louisiana now come from public grounds. In recent years, the market for oysters has been stagnant, which is in part due to illness associated with the consumption of raw oysters. The Louisiana Oyster Task Force has contracted with a marketing firm to try to expand the market for Louisiana oysters, and counteract negative publicity.

Approximately 420,000 acres (170,100 ha) are currently under lease in Louisiana, compared to less than 250,000 acres (101,250 ha) during the mid 1970s and early 1980s (Diagne and Keithly 1998). The leases have 15-year terms and are leased from the state for $2 per acre per year. Using data from NMFS for the period from 1985 through 2001, the average value of the harvest from private leases is $17,149,464. Dividing this number by the average total acreage leased over this same period gives the annual harvest per acre. Assuming 360,172 acres (145,869 ha), the average acre of oyster lease produces approximately 27 pounds (12.2 kg) of oysters and $48 in gross sales. However, the quality of water bottoms varies widely, with the harder substrates generally providing the better oyster productivity. In a recent bottom side-scan sonar survey of 9,600 acres (3,888 ha) of leases in the Barataria Basin, approximately 6.6 percent of the leased area was found to have a suitable bottom for growing oysters (Wilson and Roberts 2000). The remainder of the leased area lacked enough hard bottom to support commercial farming of oysters. It is unknown if this leased area is representative of the entire leased area in the state.

Leasing in the Barataria Basin has shown a northward trend over the years, with an increased acreage being leased in the upper estuary as salinities increased (van Sickle et. al. 1976). Oysters in high salinity waters are susceptible to infection with *Perkinsus marinus*, or "dermo," a parasitic protozoan. Predation by the oyster drill (*Stramonita haemastoma*) and other predators also causes increased oyster mortality in high salinity water. Leases are presently located as far north as Little Lake, Turtle Bay, Round Lake, and Lake Laurier. Areas east of the Mississippi River, and the Barataria Basin dominate oyster production in Louisiana. St. Bernard and Plaquemines Parishes encompass virtually all of the oyster producing areas east of the river, and Plaquemines Parish also includes part of the Barataria Basin. From 1988 through 1997, these two parishes accounted for approximately 50 percent of the oysters landed in Louisiana, and approximately 47 percent of landings from private leases in Louisiana. Monitoring data from the existing Caernarvon diversion structure has shown that production of both oysters and menhaden has increased.

The feasibility and cost of creating oyster habitat can be examined through past experience of the LDWF. The LDWF has conducted numerous shell plants over the years in areas that have favorable growing waters. Barges of clamshell or other suitable cultch material are towed slowly across the area, and the shell is pushed off of the barges by high-pressure hose. Such shell plants can be highly productive for many years. The cost of LDWF's 1994 and 1995 shell plants was approximately $2,000 per acre.

A more recent effort was made to estimate the cost of preparing water bottoms for oyster cultivation for cases where the water bottom used would not necessarily be a firm one, as was typically used by LDWF for shell plants. The cost was estimated to be approximately $7,200 per reef acre. The difference in cost is related to the higher volume of cultch used per acre (185 cy/acre vs. 81 cy/acre), and the increased cost of cultch since 1995 ($37.35/cy vs. $24/cy).

3.22.6 Oil, Gas, and Minerals

3.22.6.1 <u>Historic and Existing Conditions</u>

The petroleum industry in the state accounts for almost 25 percent of the total state revenues and employs more than 116,000 people (about 6 percent of the state's total workforce). These workers earn almost 12 percent of the total wages paid in Louisiana. Indirect employment levels in support industries make this economic sector more important than is indicated by the direct employment figures.

Dependence on imported oil and gas is driven by domestic petroleum production and consumption. Until the 1950s, the United States produced nearly all of the petroleum it needed. The gap between production and consumption began to widen, so that imported petroleum has become a major component of the U.S. petroleum supply. The U.S. produces less crude oil than it did 20 years ago and from 1993 onward, the U.S. has imported more petroleum than it produced. In 2000, U.S. petroleum net imports reached an annual record level of 10.6 million barrels per day (3.8 billion barrels per year).

Louisiana plays an important part in the production of crude oil for the Nation. Louisiana's production of crude oil has declined by about 30 percent since 1980, although production in the Louisiana OCS has increased steadily since 1990 and now greatly exceeds the onshore production rate. In 2000, Louisiana produced more crude oil than any other state. Louisiana's oil resources come from wells on land, from state waters within three miles (4.8 km) of shore, and from Federal waters greater than three miles (3.8 km) from shore. The amount of oil produced by Louisiana can be put into perspective by comparing it to what is consumed by the entire Nation. Energy consumption can be divided into five sectors: transportation, industrial, electric power generation, residential, and commercial. Over the past 20 years, Louisiana crude oil production alone has been greater than what has been consumed nationally in three of these sectors: residential, commercial, and electric power generation (LDNR and U.S. Department of Energy 2001). Louisiana production has increased in the past 10 years so that in 2000 it produced enough crude oil to meet the needs of all three of these sectors. Louisiana provides over 27 percent of the total oil produced in the U.S. If Louisiana did not produce oil, the U.S. would have to import 30 percent more oil from the Organization of the Petroleum Exporting Countries (OPEC) than it currently does. Any significant decrease in Louisiana production would affect citizens in all states.

Natural gas has been the second largest source of energy for the U.S. since 1988. The United States had large natural gas reserves until the late 1980s when consumption began to significantly outpace production. Imports rose to make up the difference, nearly all coming by pipeline from Canada. Three states (Texas, Louisiana, and Oklahoma) account for over half of all natural gas produced in the U.S. The amount of natural gas produced by Louisiana can be put into perspective by comparing it to what is consumed by the entire Nation in five economic sectors. Over the past 20 years, Louisiana's gas production has been greater than what has been consumed in four of the five sectors: transportation, commercial, electric power, and residential sectors (LDNR and U.S. Department of Energy 2001). Louisiana currently provides over 26 percent of the total natural gas produced in the U.S. Over the past 20 years, Louisiana has produced more natural gas than what was imported by the Nation. If Louisiana did not produce natural gas at the same level of consumption, the U.S. would have to import 133 percent more gas from other countries than it currently does. Any significant decrease in Louisiana's natural gas production would have a significant impact on the U.S. economy.

Based on a recent study entitled "Economic Impact Assessment Louisiana Coastal Area Comprehensive Coastwide Ecosystem Restoration Study" conducted jointly by the USACE and the LDNR, drilling and production activities in the state amount to a direct economic impact of over $730 million per year.

Indirect impacts equal about $250 million per year. The direct economic impacts create 3,400 jobs with an average wage of $42,330 per year (total annual direct impact wages of $144 million). The indirect impact jobs create another 3,100 jobs at an average wage of $27,300 per year (total annual indirect impact wages of $84 million).

All of the oil and gas produced along Louisiana's coast and wetlands comes from a highly interdependent network of core and supporting industries. The core businesses, along with their suppliers, contractors, services and research departments sprung up around each other and formed a huge cluster of businesses linked to each other and to other industries throughout the region. Port Fourchon is the geographic and economic hub of this cluster. Hundreds of offshore drilling rigs in the Gulf of Mexico send oil and gas to the mainland through Port Fourchon. For example, Port Fourchon alone supports a number of businesses ranging from restaurants that provide food and catering to offshore workers, shipbuilders that fabricate drill ships and oil well service vessels, air and water transportation firms, as well as petroleum extraction companies. Most major and independent oil and gas companies operating in the gulf have a presence at Port Fourchon. Damage to infrastructure caused by increased storm surge impacts and associated land losses would threaten the supply base that keeps these offshore facilities operating at peak efficiency and reliability.

The total net collections by the Louisiana Department of Revenue have been in the $5.5 to $6 billion range. Since the value of the direct and indirect economic impacts is nearly $1 billion, this means that the oil and gas industry contributes approximately 17 percent of the total revenue collected each year. Since these collections fund all state operations, an impact to the oil and gas industry would have a significant negative impact on the state.

3.22.7 Pipelines

3.22.7.1 <u>Historic and Existing Conditions</u>

The total assessed value of interstate pipelines alone in Louisiana is over $600 million and the pipeline industry employs 4,855 persons with an annual payroll of $250 million. Louisiana is laced with thousands of pipelines conveying oil, gas, and other liquid and gaseous materials for short and long distances. Included are 25,000 miles (40,250 km) of pipe moving natural gas through interstate pipelines; 7,600 miles (12,236 km) of pipe carrying natural gas through intrastate pipelines to users within the state's boundaries; 3,450 miles (5,554 km) of pipe transporting crude oil and crude oil products; and thousands of miles of flowlines carrying oil and gas from the wellhead to separating facilities. Some of the most prominent sites related to oil and gas interests lie within the state, notably the Henry Hub where the national price of natural gas is set, the Louisiana Offshore Oil Port, and two of the major components of the Nation's Strategic Petroleum Reserve. Louisiana is home to two of the four Strategic Petroleum Reserve storage facilities: West Hackberry in Cameron Parish and Bayou Choctaw in Iberville Parish. Louisiana's oil production is currently equivalent to 30 percent of OPEC imports to the U.S. If Louisiana did not produce oil, the U.S. would have to import 30 percent more oil from OPEC countries than it currently does.

Of interest to the coastal degradation issue are those pipelines that exist within the coastal areas that are vitally important as a conveyance means to move oil, gas, or chemical products from point of production to refineries, gas plants, and intrastate and interstate pipelines. Many thousands of miles of pipelines can be found in coastal Louisiana ranging from small gathering lines connecting production wells with storage tanks to larger pipelines carrying very large quantities of gas or oil.

Louisiana has 13 major crude oil pipelines, 9 major product pipelines, and 13 Liquefied Petroleum Gas pipelines in the state. Eighteen petroleum refineries distill a combined crude oil capacity of more than 2.7 million barrels per calendar day - the second highest in the Nation after Texas. Louisiana's oil production affects all states. It provides a significant portion of total U.S. production, and its production is equivalent to a significant portion of total imports and total OPEC imports. Any reduction of Louisiana oil would have obvious adverse effects on all U.S. consumers.

3.22.8 Navigation

3.22.8.1 <u>Historic and Existing Conditions</u>

Annual U.S. port tonnage statistics consistently rank the Ports of New Orleans, South Louisiana, and Baton Rouge fourth, first, and ninth, respectively. Primary inbound cargos at the Port of Baton Rouge are petroleum and chemicals. Outbound cargos are grain, chemicals, and petroleum products. Primary inbound cargos at the Port of South Louisiana are crude oil and petroleum products, while corn, wheat, and animal feed dominate the port's exports. At the Port of New Orleans, principal inbound cargos consist of steel, crude, and refined petroleum products and outbound cargos include grain, forest products, and steel.

The major waterways in the study area are:

The Louisiana portion of the GIWW, stretches from the Texas – Louisiana state line in the west to the Louisiana – Mississippi state line in the east. The GIWW Alternate Route operates from Port Allen to Morgan City. This waterway totals 366.4 miles (589.9 km). The GIWW is the lifeline for industries in Louisiana, with both small and large craft using the route to reach channels flowing into the gulf. It is at the Port of New Orleans where the GIWW has its major connection with the interior of the country. There, it joins with the Mississippi River system. Combined, the Mississippi River ports of south Louisiana are rated number one in the Nation in total tonnage and number one in the world in grain exports. When ranked by waterborne tonnage, Louisiana is number one when compared to other states.

The MRGO connects the Gulf of Mexico with its inner harbor docks, as well as providing access to the Mississippi River through the Inner Harbor Navigation Canal lock. The MRGO is coterminous with the GIWW for the innermost reaches, thus it serves as a vital link for inland navigation traffic. The channel is authorized at 36 feet (10.9 m) deep by 500 feet (805 km) wide from mile 0 to mile 66. Peak traffic for the channel was realized in 1978, when 9.4 million short tons were reported. Annual tonnage for the year 2002 was 3.3 million short tons.

Bayou Lafourche is located about 60 miles (96.6 km) upstream from New Orleans near Donaldsonville, Louisiana, and empties into the Gulf of Mexico approximately 100 miles (161 km) west of the Mississippi River Delta. In 1904, a dam was placed across the distributary as a flood protection measure for Donaldsonville (Doyle 1972). While the dam fulfilled its authorized purpose to help prevent flooding in the city, its construction severed what remained of the hydrologic connection between the Mississippi River and the wetland of Barataria Basin and eastern Terrebonne Basin. Port Fourchon is situated near the mouth of this bayou where the oil and gas industry, and both recreational and commercial fishermen work side by side. The Port of Fourchon serves as a terminal for much of the oil activities in South Louisiana. Supply boats, oil drilling vessels, oil field personnel, repair docks, and labor crews all work out of this area.

The Barataria Bay Waterway, which is located in southeast Louisiana, is approximately 41 miles (66 km) from the GIWW to the Gulf of Mexico with a side channel to Grande Isle, Louisiana. Similar to Bayou Lafourche, marine traffic on this waterway primarily services oil company activities in south Louisiana, as well as the commercial fishing industry.

The Calcasieu River and Pass, which is located in southwest Louisiana, is approximately 110 miles (177 km) long beginning at Phillips Bluff, Louisiana and ending at the 42-foot (12.8 m) contour in the Gulf of Mexico. Located on the waterway is the Port of Lake Charles, the 11th largest seaport in the United States, accommodating 4.5 million tons of cargo annually at its public facilities.

The Sabine-Neches Waterway serves the Ports of Port Arthur, Beaumont, and Orange in Jefferson and Orange Counties, Texas. The Sabine-Neches Waterway is attributed with 128 million short tons of freight traffic cargo in 2001, ranking fourth in the U.S. in tonnage volume. Over 90 percent of this cargo is associated with petroleum and chemical products. Sixty-three percent of the 2001 tonnage consisted of deep-draft ocean-going movements. This waterway extends from the Gulf of Mexico for 86.8 miles (139.7 km) into turning basins at West Port Arthur, Beaumont, and Orange, Texas. The deepest channel, Sabine Pass, is maintained at 40 feet (12.2 m), with Port Arthur and Beaumont channels maintained at 37 and 39 feet (11.3 and 11.8 m), respectively.

The megaports of New Orleans, South Louisiana, and Baton Rouge line 172 miles (277 km) of both banks of the lower Mississippi River. The Port of Lake Charles is located on the Calcasieu River and Pass in southwest Louisiana.

There are four additional Federal navigation projects and related waterways that have an impact on the LCA Study area. These are the Lower Atchafalaya River; Bayous Chene, Boeuf, and Black; Houma Navigation Canal; and Acadiana Gulf of Mexico Access Channel (Port of Iberia to the gulf). These waterways, along with Bayou Lafourche and Barataria Bay Waterway, have considerable marine activity, but do not carry cargo. The relevant commerce is derived from oil and gas rig fabrication, delivery, and offshore services.

3.22.9 Flood Control

3.22.9.1 Historic and Existing Conditions

Prior to the construction of the Mississippi River Levee (MRL) system, periodic floods from the Mississippi River caused tremendous damage to residents, industry, and public infrastructure. The construction of the MRL and a series of other riverine flood control systems have largely reduced this level of damages, but at the expense of reducing sediment distribution into the alluvial plain. Flood losses currently occur mainly as a result of rainfall events. The typical pattern has been for these damages to increase as development continues since increases in development densities tends to reduce flood storage areas while increasing the stock of assets at risk to flooding.

3.22.10 Hurricane Protection Levees

3.22.10.1 Historic and Existing Conditions

Over one million people currently live within areas protected by existing hurricane protection projects. Numerous communities exist in the study area dominated by the Greater New Orleans metropolitan area. The deltaic area is subject to rainfall, tidal, and hurricane flooding, which results in structural, agricultural, and environmental damages. The relatively flat terrain, and large urbanized areas at or below sea level aggravate flood damages. The study area is very low in elevation, comprised primarily of sea-level marsh, swamp, and open water, with relief provided by the alluvial ridges of the present and abandoned courses and distributaries of the Mississippi River. The elevations vary from as low as –10 feet (–3.1 m) NGVD in developed areas that have been protected by levees and drained by pumps, to about +25 feet (+7.6 m) NGVD along the ridges of the Mississippi River. St. Tammany Parish, located on the north shore of Lake Pontchartrain, has ground elevations of up to +200 feet (60.9 m) NGVD. An extensive system of Federal and local levees has been constructed in southern Louisiana to protect against hurricane surge and flooding from the Mississippi River.

The study area contains five existing authorized hurricane protection projects plus three hurricane studies that are in various stages of the study process. The existing authorized projects are Lake Pontchartrain, Louisiana and Vicinity; New Orleans to Venice, Louisiana; West Bank and Vicinity, Louisiana; Larose to Golden Meadow, Louisiana; Morgan City and Vicinity, Louisiana, and Grand Isle and Vicinity, Louisiana. Ongoing studies include Morganza to the Gulf feasibility study; Lake Pontchartrain west shore feasibility study; and Donaldsonville to the Gulf reconnaissance study. Because none of these existing hurricane protection projects provide protection against Category 4 or 5 storms, mass evacuations are required when hurricanes threaten the area.

Although there are five existing hurricane protection projects in the study area, these projects were not designed to protect against Category 4 or 5 storms. In 1998, Hurricane Georges caused great concern in the southeast Louisiana area and forced the evacuation of hundreds of thousands of people. Although this storm did not strike the study area directly, its close passage made many people aware of the potential disastrous impact of a high strength storm. Based on the

Southeast Louisiana Hurricane Preparedness report completed by the USACE in 1994, a slow moving Category 3 hurricane would put approximately 1,131,369 people at risk that would need to evacuate. A Category 5 storm would put 1,154,700 people at risk in southeast Louisiana that would need to evacuate. After Hurricane Georges, it was estimated that 300,000 people evacuated. For Hurricane Ivan, in September 2004, which was projected to hit as a Category 4 or 5, state and local officials estimate that 600,000 people evacuated. Both of these evacuations severely stressed the highway systems. There is great potential for catastrophic loss of life due to a major hurricane storm surge.

3.22.11 Agriculture

3.22.11.1 <u>Historic and Existing Conditions</u>

Agriculture is an important component of coastal Louisiana's economy. More than $2.8 billion of crops and livestock were produced in Coastal Louisiana in 2001. The rich deltaic soil and mild climate are conducive to the production of a wide variety of crops, including sugar cane, rice, and soybeans. Approximately 20 percent of the Nation's rice and 37 percent of the Nation's sugar are produced in Louisiana. Most of this production is in the coastal areas of the state and many of these areas are experiencing either direct land loss or increasing salinities of waters that are used for crop irrigation.

Agricultural production in the study area is dominated by sugar cane in the eastern portion and rice in the western portion. Significant income is also derived from livestock production, primarily cattle and horses. Rice production in the area has traditionally been supported by water obtained from local bayous. These bayous have recently begun to experience higher salinity levels, which is detrimental to crop production. Much of the saltwater intrusion has taken place because of navigation channels and oil and gas canals. In the sugar producing areas, production has been hampered by subsidence resulting in flooding and drainage problems. Even in areas where saltwater intrusion has not occurred, the loss of adjacent wetlands makes croplands more susceptible to storm damages.

3.22.12 Forestry

3.22.12.1 <u>Historic and Existing Conditions</u>

Timber production in Louisiana's forested wetlands is an important renewable resource. The forest products industry is the second largest manufacturing employer in Louisiana, employing about 26,000 people with earnings of more than $900 million (Louisiana Forestry Association 2000). The harvest and transportation of timber provides jobs for an additional 8,000 people. Bottomland forests in southern Louisiana serve as a source for lumber. In 1996, the south delta region of Louisiana (Stratton and Westbrook 1996) produced about 22 million cubic feet (660,000 million cubic meters) of lumber. Presently, Louisiana's forestland covers about 13.8 million acres (5.6 million ha), which is about 2,000,000 acres (810,000 ha) less than the early 1960s forestland area. Private, non-industrial companies own over 60 percent of Louisiana's forestland, while forest-product industries and the public own the remaining 40 percent of forestland. Louisiana forests landowners received $680 million in 1999 from the sale of timber.

3.22.13 Water Supply

3.22.13.1 Historic and Existing Conditions

While coastal Louisiana has abundant sources of freshwater, increases in salinity due to coastal erosion could have serious economic effects in some areas. Of the water used in the LCA Study area in coastal Louisiana, about 97 percent is from surface sources and about 3 percent is from groundwater sources. The Mississippi River and its distributaries are the largest source of surface water, contributing 96 percent of the total surface withdrawals. Other major sources include Bayou Lafourche, the GIWW, Mermentau River, and Bayou Lacassine. Surface water is used for various purposes, including industry (46 percent), power generation (42 percent), public supplies (11 percent), and agriculture (2 percent). Industrial withdrawals are primarily for petroleum refining and chemical manufacturing. Withdrawals for agricultural use are primarily in southwestern Louisiana. Of the three percent of water use in the LCA Study area coming from groundwater supplies, most of this supply was used for chemical manufacturing, sugar refining, and shipbuilding.

3.23 GULF HYPOXIA

Hypoxia exists when dissolved oxygen (DO) concentrations are less than those necessary to sustain animal life (operationally defined as < 2mg/L). Hypoxia results when oxygen consumption during decomposition of organic material exceeds oxygen production through photosynthesis and replenishment from the atmosphere (CENR 2000). Organic matter comes primarily from within the marine ecosystem through algal growth, stimulated by nutrients. Hypoxia in the northern Gulf of Mexico is caused primarily by excess nitrogen delivered from the Mississippi-Atchafalaya River Basin in combination with stratification of gulf waters (CENR 2000).

Gulf ecosystems and fisheries are affected by hypoxia. Mobile organisms leave the hypoxic zone for waters with higher dissolved oxygen concentrations, and those that cannot leave die or are seriously harmed. Fish, shrimp, and zooplankton are less abundant in hypoxic waters (CENR 2000), as are aerobic benthic organisms in sediments under hypoxic waters.

Hypoxia is a major environmental problem affecting coastal Louisiana and the northern Gulf of Mexico. It is also a problem of National importance, which will require action throughout the Mississippi River Basin to solve. While hypoxia is not a cause of land loss in coastal Louisiana, it is highly relevant to the broader coastal Louisiana ecosystem. The January 2001, “Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico” (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2001) describes a National strategy to reduce the frequency, duration, size and degree of oxygen depletion in the northern Gulf of Mexico. The Action Plan describes, in general, actions that are needed throughout the Mississippi River Basin to address gulf hypoxia, including restoring de-nitrification and nitrogen retention in the coastal plain of Louisiana.

Although the primary purpose of the LCA Plan is to address Louisiana’s coastal wetland loss crisis, it also has the potential to contribute to National efforts to reduce gulf hypoxia. By restoring the flow of Mississippi River waters to deltaic wetlands, the LCA Plan could provide these wetlands with the freshwater, sediment, and nutrients they need to become productive again, while also making use of the wetland capacity to remove nutrients that cause hypoxia. It should be noted, however, that uncertainty remains regarding the efficacy of diversions with respect to nutrient removal, as well as the potential for adverse water quality impacts. Further assessment of this nutrient retention capacity and the potential for adverse effects would be conducted during the development and review of specific projects.

3.23.1 Historic Conditions

Gulf hypoxia has been monitored consistently on an annual basis since 1985 (Rabalais et al. 1999). For the period 1985 to 1992, the bottom area of the hypoxic zone averaged 2,730 to 3,510 mi^2. Bottomwater hypoxia was continuous across the Louisiana shelf in mid-summer 1993 to 1997, and the bottom area was twice as large as the 1985 to 1992 average (Rabalais et al. 1999). **Figure 3-35** displays the frequency of occurrence of hypoxia that has been mapped from mid-summer "snapshots" obtained by sampling a 60- to 80-station grid in the gulf annually from 1985 to 1999 (Rabalais et al. 1999).

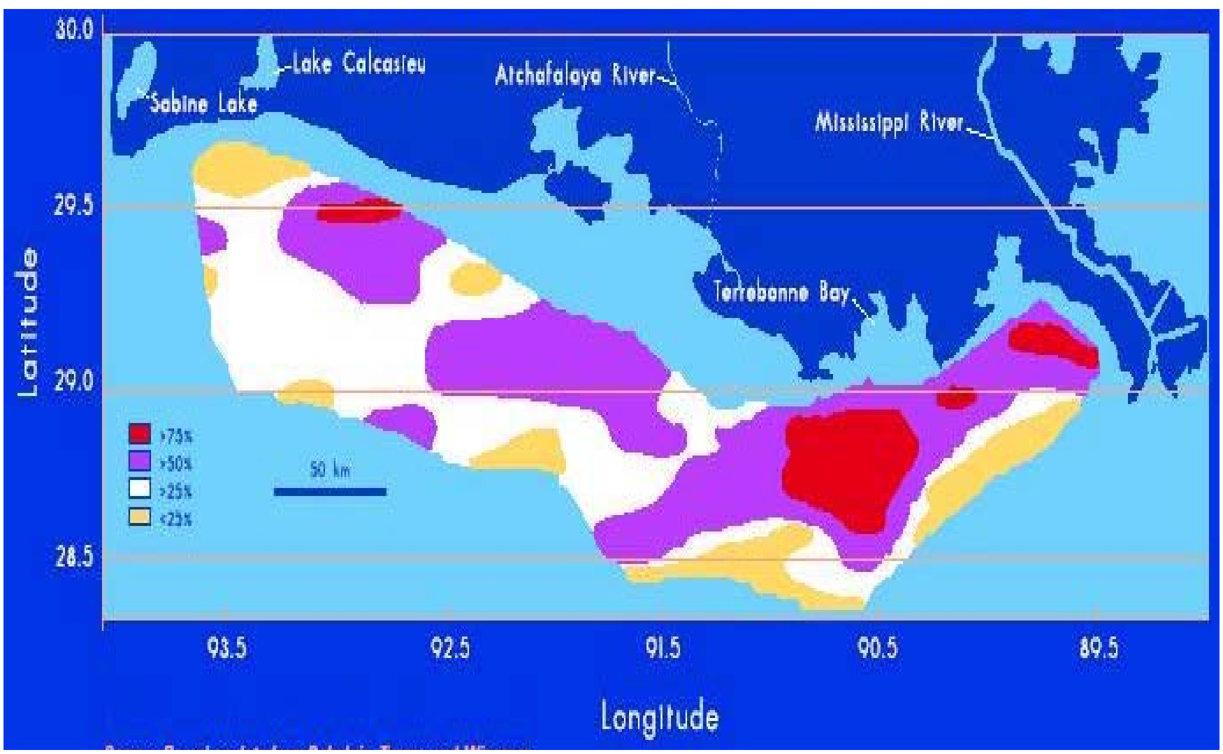


Figure 3-35. The frequency of occurrence of hypoxia has been mapped from mid-summer "snapshots" obtained by sampling a 60- to 80-station grid in the gulf annually from 1985 to 1999 (*Source: Rabalais et al. 1999*).

Sediment cores from the hypoxic zone show that algal production and deposition, as well as the area of low DO, were much less (smaller) in the early 1900s, and that significant increases occurred in the latter half of the 20th century (CENR 2000). During this period, there were three major changes in the drainage basin affecting the river nutrient flux (CENR 2000). First, landscape alterations, such as deforestation and artificial agricultural drainage, removed most of the river basin's nutrient buffering capacity. Second, most of the river channelization for flood control and navigation was completed prior to the 1950s. Third, major increases in fertilizer nitrogen input to the basin occurred between the 1950s and 1980s. Since 1980, the Mississippi and Atchafalaya Rivers have discharged, on average, about 1.6 million metric tons of total nitrogen to the gulf each year (CENR 2000). Total nitrogen load has increased since the 1950s, due primarily to an increase in nitrate nitrogen. Nitrate flux to the Gulf of Mexico almost tripled between the periods of 1955 to 1970 and 1980 to 1996 (CENR 2000).

3.23.2 Existing Conditions

In general, the size of the hypoxic zone continues to hover near its historic maximum, but with much year-to-year variation. For example, during the summer of 2002, the bottom area of the hypoxic zone was the largest ever measured, over 8,500 mi^2, roughly the size of the State of New Hampshire (Rabalais 2002). During the summer of 2003, it was only half as large as the average over the previous 10 years (3,300 mi^2) (Rabalais 2003). Such year-to-year variations are typically due to variation in stratification of the water and to variations in river discharge. No trend in dissolved inorganic nitrogen or total nitrogen flux has been observed since 1980, but these fluxes have become highly variable, depending on river discharge (CENR 2000).

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CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

This chapter presents the environmental consequences of restoration features of the LCA Plan on significant resources. Restoration opportunities that were initially considered, but were eliminated from further consideration and detailed analysis are described in chapter 2 ALTERNATIVES. The following analysis compares the Future Without-Project conditions or the No Action Alternative to the following restoration opportunities: Alternative Plan B (ALT B) was developed by considering restoration of critical deltaic processes; Alternative Plan D (ALT D) was developed by considering restoration of geomorphic structures; and the LCA Plan was developed by considering all the sorting and critical needs criteria. These restoration opportunities are described in more detail in chapter 2 and the Main Report.

A comparison of the direct, indirect, and cumulative impacts for each restoration opportunity and the LCA Plan is presented. Direct impacts are those effects that are caused by the action and occur at the same time and place (section 1508.8(a) of 40 CFR Parts 1500-1508). For example, the beneficial use of dredged material would directly create acres of marsh habitat or barrier island habitat. Indirect impacts are those effects that are caused by the action and are later in time or further removed in distance, but are still reasonably foreseeable (section 1508.8(b) of 40 CFR Parts 1500-1508). An example of this would be diversions that indirectly result in land building and nourishment. Cumulative impacts are the effects on the environment that result 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 actions. Cumulative impacts can result from actions that individually are minor, but collectively result in significant actions taking place over time (section 1508.7 40 CFR Parts 1500-1508). For example, the incremental impacts of hydrologic restoration at several localized areas could significantly modify an entire basin's hydrology. The cumulative impact analysis followed the 11-step process described in the 1997 report by the Council of Environmental Quality entitled "Considering Cumulative Effects Under the National Environmental Policy Act".

This programmatic environmental analysis evaluates and compares these three alternatives from a qualitative perspective, commensurate with the conceptual level of detail within which these restoration opportunities were developed. Impact analysis described in this chapter is based on a combination of professional judgment and preliminary desktop modeling outputs for base and Future Without-Project conditions. The three near-term alternative plans were not modeled in their current composition, but as components of the larger coast wide alternative plans. Models are based on simplifying assumptions, subject to uncertainty and error, and are only approximations of real conditions. The models used in this study have not been fully validated. See appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING for a more detailed description of the assumptions and limitations of the modeling effort.

4.1 SOILS

4.1.1 Future Without-Project Conditions – the No Action Alternative

Soil erosion and land loss would continue into the future. Natural and man-made levees would continue to subside and organic soils would not be able to maintain their elevations due to subsidence, decreased plant productivity, and wave erosion. Delta formation would continue at the mouth of the Mississippi and Atchafalaya Rivers. As erosion continued, there would be a continued loss in primary productivity due to loss of vegetated wetlands. Waterbodies would grow larger and wave erosion would accelerate causing further land loss, thus making coastal communities more vulnerable to tropical storms. In addition to land loss in coastal Louisiana, a large percentage of the Nation's wetlands would continue to disappear with accompanying impacts to wildlife, fisheries, coastal communities, and socioeconomic resources.

4.1.2 Restoration Opportunities – Direct Impacts

Direct impacts to soil resources would primarily result from those project-related activities that would directly use, remove, or otherwise disturb soil resources. Direct adverse impacts to soil resources would primarily result from activities associated with construction of the various features of each plan.

ALT B (deltaic processes): Long-term significant positive impacts from dedicated dredging for marsh creation would result in some new land that would also be subject to consolidation, dewatering, and subsidence. Repairing eroding banks of the GIWW would also create new land. There would be short-term, minor-to-moderate adverse impacts associated with construction of restoration features, such as, excavation of existing soil for river reintroduction structures and outflow channels. Also, soil compaction, rutting, rill, and gully erosion at construction sites, which will be kept to a minimum by use of proper construction techniques, such as silt curtains, temporary vegetative cover during construction, and regrading and permanent vegetation establishment at the end of construction.

ALT D (geomorphic structure): All restoration features in ALT D, except for the MRGO restoration feature, would result in the direct impacts of creating marsh (dedicated dredging and beneficial use), gulf shorelines, and/or barrier shorelines. Stabilization of the gulf shoreline near Rockefeller Refuge and at Point Au Fer, maintaining the land bridge between Caillou Lake and the Gulf of Mexico, and barrier shoreline restoration would result in the creation of some new land, subject to consolidation, dewatering, and subsidence. There would be short-term, minor-to-moderate adverse impacts associated with construction of restoration features, such as: dredging; temporary stockpiling of soil; dredging of access canals for barges to reach shorelines; temporary retention dikes to contain dredged material in shallow open water or on low elevation marshes; and construction of beaches or ridges. All sites would be shaped to designed grades and elevations and permanent vegetation would be established at the end of construction.

LCA PLAN: Direct impacts would be a combination of both ALT B and ALT D.

4.1.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to soil resources would primarily result from long-term and far field effects of freshwater and sediment diversions, which would create new lands and nourish and protect existing wetlands. Salinity control structures would enhance bioaccumulation of organic material, thereby helping to maintain and increase the organic soil resources. Marsh creation features would increase land area and form new wetland soil resources over time.

ALT B (deltaic processes): In the Deltaic Plain, there would be river diversions of freshwater, sediment, and nutrients that would build some new land, depending on the size of diversions and topography of the receiving area. River deposits would be subject to consolidation, dewatering, and subsidence. Vegetated wetlands would be enhanced by diversions of freshwater, sediment, and nutrients, which would increase plant productivity and vertical accretion of organic soils. Dedicated dredging for marsh creation would result in some new land that would also be subject to consolidation, dewatering, and subsidence. Hydrologic restoration would improve conditions for plant growth, which would result in reduction of soil erosion and an increase in vertical accretion.

ALT D (geomorphic structure): Environmental restoration of the MRGO, shoreline restoration and stabilization, and maintaining the land bridge between Caillou Lake and the Gulf of Mexico would improve conditions for plant growth, which would result in a reduction of soil erosion and an increase in vertical accretion of organic soils. Marsh creation would increase organic soil resources and vertical accretion of organic soils.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.1.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts comparison for ALT B, ALT D, and the LCA Plan. Cumulative impacts to soil resources would primarily be related to the incremental impact of the proposed LCA Plan when added to all past, present, and future restoration efforts that have and would impact soils. With no action, a large percentage of the Nation's wetland soils would continue to disappear with accompanying impacts to wildlife, fisheries, and coastal communities.

ALT B (deltaic processes): Cumulative impacts would be the net acres of wetland soils restored with ALT B, compared to the nationwide coastal wetland loss acreage.

ALT D (geomorphic structure): Cumulative impacts would be the net acres of wetland soils restored with ALT D, compared to the nationwide coastal wetland loss acreage.

LCA PLAN: Cumulative impacts would be the net acres of wetland soils restored with the LCA Plan, compared to the nationwide coastal wetland loss acreage.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Soils	U.S. & SA: Natural processes of parent material, climate, organisms, relief, and time factors in soil formation.	U.S.: Formation of Soil Conservation Service later to become Natural Resources Conservation Service. SA: Louisiana coastal land loss of over 1.22 million acres within the last 70 years.	U.S. & SA: Continued erosion of soil resources. SA: Continued coastal land loss with desktop model prediction of nearly 328,000 acres of habitat loss over next 50 years.	U.S.: Continued technical assistance and cost-sharing programs for soil conservation to reduce soil losses. *ALT B*: River diversions would build and/or nourish land; dedicated dredging would build new land; hydrologic restoration improves conditions for plant growth resulting in reduction of soil erosion. *ALT D:* Marsh creation and barrier system restoration would build new land. *LCA Plan:* Combination of both ALT B and ALT D.
Offshore Sand Resources	U.S. & SA: Natural processes of erosion, tides, longshore transport, etc. build and deplete offshore sand deposits.	U.S. & SA: Natural and human activities build and deplete offshore sand deposits.	U.S. & SA: Continued natural and human activities build and deplete offshore sand deposits.	U.S.: Competition and multiple uses of offshore areas and sand resources (e.g., oil & gas exploration, and other restoration and construction projects). *ALT B:* Cumulative impacts similar to future without-project conditions. *ALT D:* Use of offshore sand resources for restoration would compete with other uses. Potential short-term moderate to significant adverse impacts to gulf water bottoms by removal of sand resources. All restoration features would have similar impacts. These impacts would be in comparison to nation-wide natural and human multiple use impacts to offshore sand resources. *LCA Plan:* Similar to ALT D.
Barrier Systems: Barrier Shorelines, Headlands, and Islands	U.S. & SA: Barrier systems naturally build and erode dependent on deltaic cycle and other geomorphic processes. SA: Beginning with 1927 flood control of Mississippi River, and subsequent construction of jetties and other structures alters natural sediment availability and land building processes.	U.S.: Barrier systems continue building and eroding depending on human disruptions of natural geomorphic processes. SA: Disruption of Deltaic Cycle, thereby changing natural geomorphic processes of barrier systems resulting in net losses of all Louisiana coastal barrier systems in study area.	U.S.: Barrier systems continue building and eroding depending on human disruptions of natural geomorphic processes. SA: Continued disruption of deltaic cycle prevents rebuilding of barrier shorelines, headlands, and islands; eventual loss of many barrier islands and shoreline.	U.S.: Barrier systems continue building and eroding depending on human disruptions of natural geomorphic processes. *ALT B:* Cumulative impacts similar to future without-project conditions. *ALT D:* Long-term significant restoration of about 32miles of barrier shorelines compared to continued shoreline losses for the remaining 267 miles of Louisiana barrier systems. *LCA Plan:* Synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Salinity Regimes	U.S.: Continued geomorphic and marine processes facilitate saltwater intrusion into upper estuaries. SA: Salinity regimes in subprovinces naturally fluctuate in response to deltaic cycle building and erosion phases.	U.S.: Continued geomorphic and marine processes would facilitate saltwater intrusion into upper estuaries. SA: Human disruption of deltaic cycle, navigation, and oil and gas channels leads to higher salinities and saltwater intrusion into interior of estuaries.	U.S.: Continued geomorphic and marine processes would facilitate saltwater intrusion into upper estuaries. SA: Continued human disruption of deltaic cycle; other geomorphic and marine process allow saltwater intrusion into upper estuaries; navigation and oil and gas channels would facilitate saltwater intrusion.	U.S.: Continued geomorphic and marine processes would facilitate saltwater intrusion into upper estuaries. *ALT B:* Long-term minor-direct to long-term minor-to-moderate indirect impacts of localized freshening due to diversions could have cumulative impacts on wetlands types, plankton, benthic, and fish populations in adjacent coastal waters potentially changing species abundances, species compositions, and species distributions. *ALT D:* Similar, but to a much lesser degree, ALT B. *LCA Plan:* Synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.
Barrier Reefs	U.S. & SA: Natural processes form barrier reefs.	U.S. & SA: Barrier reefs endangered by pollution, and other human activities.	U.S. & SA: Continued ocean pollution and other human activities would lead to continued degradation of barrier reefs.	U.S.: Continued ocean pollution and other human activities would lead to continued degradation of shell reefs. *ALT B:* Same as the future without-project conditions as this restoration opportunity does not include any barrier reef restoration features. *ALT D:* Same as the future without-project conditions as this restoration opportunity does not include any barrier reef restoration features. *LCA Plan*: Same as the future without-project conditions as this restoration opportunity does not include any barrier reef restoration features.
Total Vegetated Wetlands	U.S. & SA: Natural processes form vegetated wetland habitat.	U.S.& SA Deterioration and loss of total vegetated wetland habitat acreage.	U.S.: Continued loss due to natural processes and development. SA: Accelerated coast wide loss. Most severe loss in Nation.	U.S.: Implementing LCA Plan would result in a small reduction to the rate of loss of vegetation habitat. *ALT B*: Minor reduction in rate of loss of vegetation habitat and small increase in sustainability. *ALT D:* Minor reduction in rate of loss of vegetation habitat and slight increase in sustainability. *LCA Plan:* Small reduction in rate of loss of vegetated habitat and small increase in sustainability.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Fresh Marsh	U.S. & SA: Natural processes form fresh marsh.	U.S.& SA: Deterioration and loss of fresh marsh acreage through direct loss and transition to more salt-tolerant habitat types.	U.S.: Continued loss due to natural processes and development. SA: Accelerated coast wide loss. Most severe loss in Nation.	U.S.: Implementing the LCA Plan would result in minor-to-significant reduction to rate of loss of fresh marsh *ALT B:* Minor-to-significant reduction in rate of fresh marsh loss and small increase in sustainability. *ALT D:* Minor reduction in rate of fresh marsh loss and slight increase in sustainability. *LCA Plan:* Minor-to-significant reduction in rate of fresh marsh loss and small increase in sustainability.
Intermediate Marsh	U.S. & SA: Natural processes form intermediate marsh.	U.S. & SA: Deterioration and loss of intermediate marsh acreage through direct loss and transition to more salt-tolerant habitat types.	U.S.: Some loss due to natural processes and development. SA: Accelerated coast wide loss. Most severe loss in Nation.	U.S.: Implementing the LCA Plan would result in minor-to-significant reduction to rate of loss of intermediate marsh. *ALT B*: Minor-to-significant reduction in rate of intermediate marsh loss and minor-to-significant increase in sustainability. *ALT D:* Minor-to-significant reduction in rate of intermediate marsh loss and minor-to-significant increase in sustainability. *LCA Plan:* Minor-to-significant reduction in rate of intermediate marsh loss and small increase in sustainability.
Brackish Marsh	U.S. & SA: Natural processes form brackish marsh.	U.S. & SA: Conversion of fresher marshes to brackish marsh as coastal areas become exposed to higher salinities; but these land areas are now being subjected to land loss processes and conversion to more salt-tolerant habitat types.	U.S.: Some loss due to natural processes and development. SA: Accelerated coast wide loss. Most severe loss in Nation.	U.S.: Implementing the LCA Plan would result in minor-to-significant reduction to rate of loss of brackish marsh. *ALT B:* Minor-to-significant reduction in rate of brackish marsh loss and small increase in sustainability. *ALT D:* Minor-to-significant reduction in rate of brackish marsh loss and slight increase in sustainability. *LCA Plan:* Minor-to-significant reduction in rate of brackish marsh loss and small increase in sustainability.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Saline Marsh	U.S. & SA: Natural processes form saline marsh.	U.S. & SA: Conversion of fresher marshes to saline marsh as coastal areas become exposed to higher salinities; but these land areas are now being increasingly subjected to land loss processes.	U.S.: Some loss due to natural processes and development. SA: Accelerated coast wide loss. Most severe loss in Nation.	U.S.: Implementing the LCA Plan would result in small reduction to rate of loss of saline marsh. *ALT B:* Minor reduction in rate of saline marsh loss and small increase in sustainability. *ALT D:* Minor reduction in rate of saline marsh loss and small increase in sustainability. *LCA Plan:* Small reduction in rate of saline marsh loss and small increase in sustainability.
Swamp - Wetland Forest	U.S. & SA: Natural processes form swamp-wetland forests.	U.S. & SA: Deterioration and loss of swamp-wetland forests.	U.S.: Some loss due to natural processes and development. SA: Accelerated coast wide loss. Most severe loss in nation.	U.S.: Implementing the LCA Plan would result in minor reduction to current rate of loss of swamp-wetland forests. *ALT B:* Small reduction in rate of swamp-wetland forest loss and small increase in sustainability *ALT D:* Minor reduction in rate of swamp-wetland forest loss and slight increase in sustainability *LCA Plan:* Small reduction in rate of swamp-wetland forest loss and slight increase in sustainability.
Barrier Shoreline Vegetation	U.S. & SA: Natural processes form barrier shoreline vegetation.	U.S. & SA: Deteriorating and loss of barrier shoreline vegetation.	U.S. & SA: Accelerated coast wide loss of barrier islands/shoreline vegetation.	U.S.: Implementing the LCA Plan would result in slight reduction to accelerated rate of loss of barrier shoreline vegetation. *ALT B:* Negligible reduction in rate of barrier shoreline vegetation loss. *ALT D:* Minor reduction in rate of barrier shoreline vegetation loss and slight increase in sustainability. *LCA Plan:* Minor reduction in rate of barrier shoreline vegetation loss and slight increase in sustainability.
Amphibians & Reptiles	U.S. & SA: Populations would respond to natural population-regulating mechanisms.	U.S. & SA: Decline in populations.	U.S. & SA: Continued decline in populations.	U.S.: Continued decline in populations. *ALT B:* Increase the quantity and quality of available habitat types over the future without-project conditions. *ALT D:* Increase the quantity and quality of available habitat types over the future without-project conditions. *LCA Plan:* Increase the quantity and quality of available habitat types the greatest over the future without-project conditions.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Mammals	U.S. & SA: Populations would respond to natural population-regulating mechanisms.	U.S. & SA: Decline in populations.	U.S. & SA: Continued decline in populations.	U.S.: Continued decline in populations. *ALT B:* Increase the quantity and quality of available habitat types over the future without-project conditions. *ALT D:* Increase the quantity and quality of available habitat types over the future without-project conditions. *LCA Plan:* Increase the quantity and quality of available habitat types the greatest over the future without-project conditions.
Birds	U.S. & SA: Populations respond to natural population regulating mechanisms.	U.S. & SA: Decline in populations.	U.S. & SA: Continued decline in populations.	U.S.: Continued decline in populations. *ALT B:* Increase the quantity and quality of available habitat types over the future without-project conditions. *ALT D:* Increase the quantity and quality of available habitat types over the future without-project conditions. *LCA Plan:* Increase the quantity and quality of available habitat types the greatest over the future without-project conditions.
Plankton	U.S. & SA: Populations respond to natural conditions.	U.S.: Populations respond to natural and human-induced perturbations. SA: Populations in interior and upper portions of subprovinces are becoming more saline-dominant species as land loss and saltwater intrusion into these interior regions continues.	U.S.: Populations would continue to respond to natural and human-induced perturbations. SA: Increased land loss and saltwater intrusion would lead to more saline-dominant populations.	U.S.: Populations would continue to respond to natural and human-induced (restoration projects) perturbations. *ALT B:* In the Deltaic Plain, freshwater diversions result in localized species switching from saltwater-dominant to freshwater dominant. *ALT D:* Restoration of geomorphic structure only would result in negligible impacts. *LCA Plan:* Synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Benthic	U.S. & SA: Populations respond to natural conditions.	U.S.: Populations respond to natural and human-induced perturbations. SA: Populations in interior & upper portions of subprovinces are becoming more saline-dominant species as landloss and saltwater intrusion into these interior regions continues.	U.S.: Populations would continue to respond to natural and human-induced perturbations. SA: Increased land loss and saltwater intrusion would lead to more saline-dominant populations.	U.S.: Populations would continue to respond to natural and human-induced perturbations. *ALT B:* In the Deltaic Plain, freshwater diversions result in localized species switching from saltwater-dominant to freshwater dominant. *ALT D:* Short-term disturbance to sensitive benthic animals due to construction of restoration features. *LCA Plan:* Synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.
Fisheries Resources	U.S.: Fisheries habitat was reduced, while catch increased. SA: Reduction in sustainability of fisheries habitat, while access (marsh edge) increased; increased productivity and catch. Where freshwater flow was limited (particularly SP4) habitat building and access to estuarine environment was restricted.	U.S. & SA: Formation of the NMFS. Regulated catch; habitat loss decreased by coastal restoration efforts, continued net habitat loss. SA: Sustained to increasing populations.	U.S. & SA: Would have a net loss in fisheries population size and diversity.	U.S.: See LCA Plan. *ALT B:* Similar to the LCA Plan below. *ALT D:* Although this plan would help preserve some of the habitat and fishery productivity expected to be lost with no action within the Louisiana coastal ecosystem, it is unlikely that impacts would be measurable for the U.S. *LCA Plan:* In the Louisiana coastal ecosystem, a long-term increase in fishery productivity would be expected and a shift in species composition from those generally more tolerant of higher salinities to those generally more tolerant of lower salinities. A decrease would be expected in production of species, such as brown shrimp and speckled trout, in areas most influenced by freshwater diversions. The U.S. would benefit by maintaining the productivity and diversity of marine fisheries.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Essential Fish Habitat (EFH)	U.S. & SA: General decrease in quality and quantity of EFH.	U.S. & SA: Institutional recognition of decline in EFH (Magnuson-Stevens Fishery Conservation and Management Act). Coastal restoration aids some EFH.	U.S. & SA: Continued loss and degradation of EFH.	U.S.: See LCA Plan. *ALT B:* Maintain productive forms of EFH that would be lost in SA with no action, maintaining the ability of U.S. to support Federally managed species. There are no habitat areas of particular concern in the LCA Study area. *ALT D:* Maintain productive forms of EFH that would be lost in SA with no action, maintaining the ability of U.S. to support Federally managed species. There are no habitat areas of particular concern in the LCA Study area. *LCA Plan:* Maintain productive forms of EFH that would be lost in SA with no action, maintaining the ability of U.S. to support Federally managed species. There are no habitat areas of particular concern in the LCA Study area.
Threatened & Endangered Species	U.S. & SA: General decrease in populations and critical habitat of was eventually institutionally recognized as threatened or endangered species and their critical habitat.	U.S. & SA: Institutional recognition of decline in threatened and endangered species (Endangered Species Act). SA: Loss of America's wetlands, portions of which provide critical habitat such as gulf shoreline, that are critical piping plover habitat.	U.S.: Institutional recognition of decline in threatened and endangered species (Endangered Species Act); continued National loss of wetlands. SA: Continued decline in populations and loss of critical habitat.	U.S.: Individual species restoration plans to maintain or increase populations and critical habitat. *ALT B:* Generally increase and enhance all coastal wetland habitats. *ALT D:* Increase and enhance piping plover critical habitat and would generally enhance all habitats. *LCA Plan:* Synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.
Flow and Water Levels	U.S. & SA: Increase in flow due to increase in precipitation. Increase in sea level.	U.S. & SA: Increase in flow due to increase in precipitation. Level is increasing. Rates increasing over historic.	U.S. & SA: Rates would continue to increase.	U.S.: Rates continue to increase. *ALT B:* SP1-3, increased freshwater flow to study area. Decreased Mississippi River flow. Water level changes not known in coastal area. *ALT D:* Similar to ALT B, but to a lesser extent. *LCA Plan:* Similar to ALT B.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Suspended Sediments	U.S.: Decrease due to reduction of erosion on land, reservoirs, and bank stabilization. SA: Sediment delivery by crevasses in SP1, SP2, and SP 3. Ended after 1928-flood control act.	U.S.: Decreasing due to reduction of erosion on land, reservoirs and bank stabilization. SA: Inflow of suspended sediments reduced in SP1-3; limited amount occurs through Atchafalaya River.	U.S.: Decreasing due to reduction of erosion on land, reservoirs, and bank stabilization. SA: Sediment supply does not offset land loss.	U.S.: Decreasing due to reduction of erosion on land, reservoirs, and bank stabilization. *ALT B:* Increased sediment input. Decreased sediment transport in Mississippi below diversions. *ALT D:* Similar to ALT B, but to a lesser extent; sediment output decreases. *LCA Plan:* Similar to ALT B and ALT D, but greater; sediment input is increased, sediment output is decreased.
Water Use & Supply	U.S. & SA: Increased withdrawals of both surface and ground water in the coastal area have resulted from continued population and commercial growth.	U.S. & SA: Continued withdrawals. SA: Surface-water withdrawals are periodically reduced due to saltwater inundation in some areas	U.S. & SA: Continued withdrawals. SA: Some coastal areas, saltwater intrusion events continue & increase in frequency and magnitude. Result is reduced surface supplies & increased reliance on ground water, which is limited in many coastal areas.	U.S. Continued withdrawals. *ALT B:* Less loss of fresh surface supplies compared to future with no action. Possible decrease of availability in Mississippi River. *ALT D:* Negligible, if any, impacts. *LCA Plan:* Similar to ALT B.
Groundwater	U.S.: No direct impact to ground water. SA: No direct impact to ground water.	U.S. & SA: Continued withdrawals.	U.S. & SA: Continued withdrawals.	U.S: Continued withdrawals. *ALT B:* No project-induced cumulative impacts expected. *ALT D:* Similar to ALT B. *LCA Plan:* Similar to ALT B.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Water Quality	U.S. & SA: Degraded waterbodies due to untreated and uncontrolled discharges, especially in urbanized and/or industrialized areas.	U.S. & SA: Enactment of Federal and state legislation beginning in the 1970s to restore and protect waterbodies, especially with respect to point sources. Nonpoint sources still unregulated.	U.S. & SA: Continued Present Action. SA: Continued Present Action and increasing potential for accidental discharges due to exposed infrastructure because of coastal land loss.	U.S.: Continued Federal and state programs that require and/or encourage protection of waterbodies. *ALT B:* Long-term minor-to-moderate positive/adverse effects of introducing river water from diversions into receiving basins; similar to what occurred naturally prior to construction of levees. Sediments introduced into the receiving basins from diversions or from direct placement (dredge material disposal) would add some constituents, but would not have unacceptable, adverse impacts. *ALT D:* Sediments introduced into the receiving basins from diversions or from direct placement (dredge material disposal) would add some constituents, but would not have unacceptable, adverse impacts. *LCA Plan:* Synergistic positive result over and above the additive combination impacts and benefits of ALT B and ALT D.
Gulf Hypoxia	U.S. & SA: Extent of hypoxia likely less than current conditions.	U.S. & SA: Gulf hypoxia recognized as a National problem.	U.S.: Continued nutrient loading into Mississippi River, possible abatement. SA: Continued nutrient loading in the gulf, possible upstream abatement.	U.S.: Continued nutrient loading in Mississippi River with possible abatement. *ALT B:* Small reduction in nutrients discharged into Gulf of Mexico. *ALT D:* No effects. *LCA Plan:* Similar to ALT B.
Historic & Cultural Resources	U.S. & SA: Historic & cultural resources subjected to natural processes and man made actions	U.S. & SA: Institutional recognition via National Historic Preservation Act (and others). Human activities as well as natural processes can potentially destroy historic & natural resources	U.S. & SA: Potential loss of resources due to natural and human causes.	U.S.: In the long-term, arresting land loss would protect cultural resources from coastal erosion, etc. *ALT B*: There is insufficient survey data of existing cultural resources in the proposed project areas and detailed project plans are unavailable. Cultural Resources surveys would be necessary. Required identification of resources prior to construction and restoration activities may provide some protection by preventing land loss. *ALT D:* Same as ALT B. *LCA Plan:* Same as ALT B.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Recreation Resources	U.S. & SA: Not an issue.	U.S. & SA: Land loss causing dramatic changes in recreation opportunities.	U.S. & SA: Potential loss of recreational resource base due to coastal land loss.	U.S.: Slowing or reversing land loss and coastal erosion may protect recreation resources. *ALT B:* Overall, ALT B would support and sustain a greater number of freshwater-based recreational opportunities, provide for a more stable freshwater-based recreation economy, and possibly increase the Louisiana recreation industry compared to the without-project conditions. *ALT D:* Overall, ALT D would support and sustain a greater number of saltwater-based recreational opportunities, provide for a more stable saltwater-based recreation economy, and possibly increase the Louisiana recreation industry. *LCA Plan:* Similar, but greater than, ALT B and ALT D.
Aesthetics	U.S. & SA: Technical recognition via 1988 USACE Visual Resources Assessment Procedure. Institutional recognition via Wild and Scenic Rivers Act, Scenic Byways, and others. Visual resources have been destroyed, enhanced, or preserved by human activities.	U.S. & SA: Numerous scenic byways exist within the Louisiana Coastal Area. Visual Resource Assessment Procedure needed to determine other aesthetic resources that exist within the coastal area.	U.S. & SA: Continued human population growth and development and other human activities have the potential to destroy, enhance, or preserve visual resources.	U.S. & SA: Continued human population growth and development and other human activities have the potential to destroy, enhance, or preserve the quality of scenic byways and other undetermined visual resources. *ALT B:* Cumulative impacts of maintaining visually appealing resources systems would further support tourism as one travels Louisiana's Scenic byways and remote areas of visual interest. *ALT D:* Impacts similar to ALT B. *LCA Plan:* Impacts similar to ALT B.
Air Quality	U.S. & SA: Not an issue.	U.S. & SA: Institutional recognition via Clean Air Act; deterioration of air quality due to increases in human populations and industry.	U.S. & SA: Continued deterioration of air quality despite legislative attempts to address.	U.S.: Continued deterioration of air quality despite legislative attempts to address. *ALT B:* Slight increase in vegetated wetlands aid in removal of carbon dioxide and other air pollutants; this would be in comparison to nation-wide natural and human-induced (restoration projects) impacts to air quality. Short-term minor adverse impacts due to construction of restoration features. *ALT D:* Similar to ALT B except fewer restoration features would result in less absorption of air pollutants. *LCA Plan:* Synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Noise	U.S. & SA: Not an issue.	U.S. & SA: Institutional recognition-Noise Control Act of 1972 generally applicable only to areas of human development; although boats, airboats and other human activities may cause disturbances to fish and wildlife in remote regions of the study area.	U.S. & SA: Continued human population growth & development, recreation activities, industry, and other human activities typically have some noise pollution. Further institutional recognition likely to be enacted.	U.S.: Similar to future without-project conditions. *ALT B:* Noise would typically only be associated with actual construction activities. All legal requirements for noise abatement would be followed. No significant cumulative impacts anticipated. These impacts would be in comparison to nation-wide natural and human-induced (restoration projects) noise impacts. *ALT D:* Similar, but less than ALT B, since ALT D has fewer restoration features. *LCA Plan:* Impacts similar to ALT B and ALT D.
HTRW	U.S. & SA: Not an issue.	U.S. & SA: Institutional recognition by USACE regulations for Phase 1 investigation.	U.S. & SA: Continued human population growth &development, industry, and other human activities would typically have some HTRW associated with them. Further institutional recognition would likely be enacted.	U.S.: Continued human population growth and development, industry, and other human activities typically have some HTRW associated with them. Further institutional recognition likely to be enacted. *ALT B:* Phase 1 investigations conducted on project-by-project basis; if necessary more intensive investigations performed. Potential HTRW would be avoided or removed. All plans would be investigated for HTRW. *ALT D:* Same as ALT B. *LCA Plan:* Same as ALT B.
Population	U.S. & SA: Not an issue.	U.S. & SA: Increased population in urban, suburban and rural coastal areas.	U.S. & SA: Increasing population in urban and suburban areas, retreating population in rural coastal areas.	U.S.: Increased population in urban and suburban areas *ALT B:* Decrease in retreat of population from coastal areas. *ALT D:* Impacts would be similar to ALT B, but less due to fewer restoration features. *LCA Plan:* Impacts would be similar to ALT B and ALT D.
Infrastructure	U.S. & SA: Increasing infrastructure in the form of roads, bridges, pipelines, homes, and businesses.	U.S.: Heavy concentration of infrastructure. SA: Heavy concentration of infrastructure in several parts of the study area.	U.S.: Heavy concentration of infrastructure. SA: Increasing damage to infrastructure, reduced level of infrastructure development in areas nearest to coast.	U.S.: Heavy concentration of infrastructure. *ALT B:* Reduced level of increases in infrastructure damages and long-term relocations. *ALT D:* Impacts would be similar to ALT B, but less due to fewer restoration features. *LCA Plan:* Impacts would be similar to ALT B and ALT D.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Socio-Economic & Human Resources	U.S. & SA: Increased habitation, employment, and tourism.	U.S. & SA: Large population centers and employment and tourist activities.	U.S. & SA: Continued population growth with some population retreat in areas nearest to coast.	U.S.: Continued population growth and related resources. SA: Increased population in urban and suburban areas and decrease in coastal areas subject to increased flooding. Decrease in jobs in coastal area. *ALT B:* Decrease in retreat of population and related jobs from coastal areas. *ALT D:* Impacts would be similar to ALT B, but less due to fewer restoration features. *LCA Plan:* Impacts would be similar to ALT B and ALT D.
Commercial Fisheries	U.S. & SA: Increases in fisheries industry, due to advancing technologies and increased fishing pressure.	U.S. & SA: Regulation of fishing maintains a billion dollar industry.	U.S.: Some decline expected as vulnerability of habitat increases. More regulation would be necessary to maintain a sustainable industry. SA: Severe decline as land loss continues.	U.S.: Decline expected as vulnerability of habitat increases. *ALT B:* Industry would be more sustainable and less vulnerable. *ALT D:* Impacts would be similar to ALT B, but less due to fewer restoration features. *LCA Plan:* Synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.
Oyster Leases	U.S.: Only major leasing program is in LA. SA: General increase in acreage leased, production limited by saltwater intrusion in areas with no freshwater introduction.	U.S.: Only major leasing program is in LA. SA: Leveling off of acreage leased, production limited by saltwater intrusion in areas with no freshwater introduction. Production limited in areas by mortality from over freshening by diversions.	U.S.: Only major leasing program is in LA. SA: Gradual loss of production from leases. Increased production in bands of intermediate distance from freshwater introduction.	U.S.: Only major leasing program is in LA. *ALT B:* Gradual displacement of production to areas of intermediate distance from freshwater introduction. Possible overall decline due to over freshening of best reef habitat in Subprovince 1. *ALT D:* Leveling off of acreage leased, production limited by saltwater intrusion in areas with no freshwater introduction. *LCA Plan:* Gradual displacement of production to areas of intermediate distance from freshwater introduction. Possible overall decline due to over freshening of best reef habitat in Subprovince 1.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Oil, Gas, & Mineral	U.S. & SA: Increasing development of refineries, wells, and other oil and gas producing facilities and equipment.	U.S. & SA: Large investment in refineries, wells, and other oil and gas producing facilities and equipment.	U.S. & SA: Increased damages to refineries, wells, and other oil and gas producing facilities and equipment; probable relocations of these assets.	U.S.: Same as future without-project conditions, except implementation of LCA Plan would slightly reduce damages to oil and gas producing facilities and equipment; and reduced relocations of these assets (as compared to the without-project condition) *ALT B:* Reduced damages to oil and gas producing facilities and equipment; and reduced relocations of these assets (as compared to the without project condition) *ALT D:* Similar to ALT B, but would also provide increased protection to the LOOP facility. *LCA Plan:* Similar to ALT B and ALT D.
Navigation	U.S. & SA: Increasing port facilities and inland waterways and traffic.	U.S. & SA: Large investment in port facilities and inland waterways and traffic.	U.S. & SA: Probable damages to and relocation of port facilities and inland waterways and traffic.	U.S. & SA: Greater investment in port facilities and inland waterways (as compared to the without-project condition). *ALT B:* Increased dredging costs expected as a result of multiple diversions. *ALT D:* Certain MRGO measures could cause long-run negative impacts to navigation traffic. *LCA Plan:* Impacts expected to be similar to R01 and R02.
Flood Control	U.S. & SA: Construction of flood control levees, pump stations, and control structures.	U.S. & SA: Large investment in flood control levees, pump stations, and control structures.	U.S. & SA: Increased investment in flood control levees, pump stations, and other flood control facilities to prevent damage due to land loss.	U.S.: Reduced investment in flood control facilities (as compared to without-project conditions). *ALT B:* Reduced investment in flood control facilities. *ALT D:* Would have impacts similar to ALT B. *LCA Plan:* Would have impacts similar to ALT B.
Pipelines	U.S. & SA: Development of extensive network of oil and gas pipelines.	U.S. & SA: Large investment in extensive network of oil and gas pipelines; increasing damages to and some relocation of these assets.	U.S. & SA: Increased damages and probable relocations of pipeline assets.	U.S.: Same as future without-project conditions, except implementation of the LCA Plan would reduce losses of pipelines (as compared to future with no action). *ALT B:* Reduced losses of pipelines. *ALT D:* Similar to ALT B. *LCA Plan:* Similar to ALT B and ALT D.

Table 4-1
Comparison of Cumulative Impacts

*Includes Spatial/Geographic Extent (Continental United States [U.S], and Study Area [SA], and Temporal (Past, Present, and Future Without-Project)
** Identifier Code: ALT B (deltaic processes); ALT D (geomorphic structure), and the LCA Plan

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Present Action (Existing Conditions)	Future Without-Project The No Action Alternative	Cumulative Impacts (Comparison of Future With Proposed Action Impacts for each Restoration Opportunity and the LCA Plan)
Hurricane Protection Levees	U.S. & SA: Construction of hurricane protection levees and pumping capacity.	U.S. & SA: Large investment in hurricane protection levees and pumping capacity.	U.S. & SA: Increasing investment in hurricane protection facilities to prevent damage due to land loss.	U.S.: Same as future without-project conditions, except implementation of the LCA Plan would reduce losses of levees (as compared to future with no action). *ALT B:* Reduced investment in hurricane protection facilities because levees would be more protected. *ALT D:* Slight reduction of storm surge. *LCA Plan:* Similar to ALT B.
Agriculture	U.S. & SA: Not an Issue.	U.S. & SA: Institutional recognition. SA: Saltwater intrusion, especially in Chenier Plain problem for rice farmers.	U.S.: Continued institutional recognition. SA: Continued coastal land loss and saltwater intrusion reduces opportunities for agriculture.	U.S.: Continued institutional recognition. *ALT B:* Reduced damages to coastal agricultural areas. *ALT D:* Similar to ALT B. *LCA Plan:* Similar to ALT B.
Forestry	U.S. & SA: Not an Issue.	U.S.: Institutional recognition via regulations on forest harvest practices. SA: Institutional regulation of forest harvest practices. Continued coast wide forest deterioration, especially swamp and wetland forests.	U.S.: Continued institutional recognition; however, increasing human populations result in continued loss of forested areas and reduces forestry opportunities. SA: Continued coastal land loss reduces forestry opportunities.	U.S.: Continued institutional recognition; increasing human population growth and continued demand for diminishing forestry resources and reduced forestry opportunities. *ALT B:* Net decrease in forestry resources; however, increase in swamp and wetland forests. *ALT D:* No cumulative impacts. *LCA Plan:* Similar to ALT B.
Water Supply	U.S. & SA: Not an issue.	U.S. & SA: Institutional recognition (Clean Water Act and others); saltwater intrusion into historically fresh water areas; industrial pollution of waters; changes to hydrology by levees affect water supply to wetlands.	U.S. & SA: Continued institutional recognition; continued saltwater intrusion; continued industrial pollution; continued changes to hydrology that affect water supply to wetlands.	U.S.: Continued institutional recognition; continued saltwater intrusion; continued industrial pollution; continued changes to hydrology that affect water supply to wetlands. ALT B: Lower salinities in some areas positively affecting industry, agriculture, and the public supply. *ALT D:* Reduction in saltwater intrusion in the MRGO area. *LCA Plan:* Similar to ALT B.

4.2 OFFSHORE SAND RESOURCES

4.2.1 Future Without-Project Conditions – the No Action Alternative

Under the Future Without-Project condition, large areas of the offshore sand shoals and nearshore sand bodies would likely continue to remain largely undisturbed from sand mining activities for coastal restoration. The distances involved, especially for removal of sands from the major offshore shoals, are generally considered too great to be cost-effective for use in any but the largest coastal restoration activities. These areas would continue to be impacted by oil and gas exploration and extraction, and possible use of sands for construction of hurricane and flood control levees, and mineral exploration activities.

4.2.2 Restoration Opportunities – Direct Impacts

Direct impacts to offshore sand resources would primarily result from those project-related activities that would directly use, remove, or otherwise disturb them. Direct adverse impacts to offshore sand resources would primarily result from sand harvesting/mining (e.g., dredging) activities associated with obtaining sediments (sands) for construction/restoration of the various features of each plan.

ALT B (deltaic processes): ALT B does not present any likely restoration opportunities for use of offshore sand resources; hence, there would be no direct impacts.

ALT D (geomorphic structure): Almost all of ALT D restoration features could potentially impact offshore sand resources including: restoration of the Barataria Basin barrier shoreline at the Caminada Headland and Shell Island; Terrebonne Basin barrier shoreline restoration at Isles Dernieres, and East Timbalier; Gulf stabilization at Point Au Fer Island; restoration of the northern shore of East Cote Blanche Bay at Point Marone; restoration of the land bridge between Caillou Lake and the Gulf of Mexico; and stabilization of the gulf shoreline at Rockefeller Refuge.

Offshore sand resources could potentially be used for restoration of barrier systems (barrier shorelines, headlands, and islands) in Subprovinces 2 and 3. For Subprovince 2, preliminary estimates of about 21,290,000 cy of sand would be required for the first lift in restoring the Caminada-Moreau Headland and Shell Island reaches in the Bayou Lafourche and Plaquemines barrier systems. For Subprovince 3, about 28,091,000 cy of sand would be required to restore most of the Isles Dernieres barrier system, and about 11,719,000 cy of sand would be required to restore the East Timbalier Island. Hence, a total of about 61,100,000 cy of sand could potentially be required for the first lift for barrier shoreline, headlands, and island restoration actions. Sand resources could also be used as an alternative to, and/or in addition to, hardened structures proposed for gulf shoreline stabilization in Subprovinces 3 and 4.

Uses of offshore sediments would require a project-by-project analysis of potential environmental impacts of the borrow sites. Use of offshore sand sources, such as Ship Shoal, in Federal waters would require coordination with the MMS for appropriate permits to use this resource. The District is presently coordinating with the MMS with regard to utilizing Ship

Shoal as a potential source of sands for restoration of the Barataria barrier islands. In addition, the District, along with other Federal and state natural resource agencies, is a participating member of the MMS Sand Management Working Group that is presently determining strategies for multiple uses of sands and other resources under jurisdiction of the MMS.

Removal of the large volumes of sand resources (about 61,100,000 cy) for restoration of barrier systems in Subprovinces 2 and 3 would result in the following long-term and short-term moderate adverse direct impacts:

- Sand resources would be unavailable for other uses;
- Removal (dredging) of offshore sand resources would destroy existing benthic community systems within the areas where sands are removed;
- Potential for cultural or historic relics to be disturbed or lost during dredging operations;
- Potential for disturbing oil and gas infrastructure (pipelines, platforms, and other structures);
- Removal (dredging) of offshore sand resources would alter gulf bottom topography;
- Removal of offshore sand resources would cause short-term turbidity and low dissolved oxygen conditions, but these conditions would return to ambient following dredge removal operations; and
- Potential for incidental takings of sea turtles during dredging operations, despite all possible precautions being taken (e.g., use of turtle exclusion devices, observers, etc.) to avoid, minimize and reduce any such impacts.

<u>LCA PLAN</u>: The LCA Plan would have direct impacts similar to, but somewhat less than ALT D.

4.2.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to offshore sand resources would primarily result from long-term and short-term adverse effects of disturbances to offshore sand sites during removal of sand sediments for construction of restoration opportunities.

<u>ALT B (deltaic processes)</u>: ALT B does not present any likely restoration opportunities for use of offshore sand resources. Hence, the indirect impacts would be similar to the Future-Without Project conditions.

<u>ALT D (geomorphic structure)</u>: Removal of the large volumes of sand resources that would be required for coastal restoration of barrier systems would indirectly have the following long-term and short-term adverse indirect impacts:

- Marine organisms that utilize the gulf bottom substrates (especially benthos) would have to adapt to changes in gulf bottom topography;
- Alteration of gulf water bottoms may change wave dynamics, thereby potentially changing onshore storm-wave impacts, leading to greater shoreline erosion;
- Potential disruption of commercial and recreational fishing; and

- Alteration of gulf water bottoms may change littoral drift dynamics.

LCA PLAN: The LCA Plan would have indirect impacts similar to ALT D.

4.2.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. Cumulative impacts to sand resources would primarily be related to the incremental impact of all past, present, and future sand resource harvesting/mining activities.

ALT B (deltaic processes): ALT B does not present any likely restoration opportunities for use of offshore sand resources; hence, there would be no cumulative impacts.

ALT D (geomorphic structure): The long-term and short-term adverse cumulative impacts of ALT D would principally be related to the competition for multiple uses of sand resources removed or otherwise impacted from offshore sand sources. In addition to estimates of about 61,100,000 cy (46,436,000 cm) of sand that would be required for restoring the barrier systems of Subprovinces 2 and 3, other restoration activities, as well as other construction activities requiring sand fill would be competing for offshore sand resources and would impact these resources. Generally, potential cumulative impacts and competing uses of offshore sand resources include:

- Offshore sand resources provide substrate and habitat for aquatic marine organisms that would be altered and/or lost during dredging operations to remove sand resources. The potential loss of about 61,100,000 cy (46,436,000 cm) of sand and the disruption of gulf bottoms by extraction (dredging) of this sand for LCA Study restoration efforts would be in addition to any other similar extraction activities of offshore sand resources.
- Offshore sand resources contain or cover other natural resources such as minerals, oil, and gas deposits. The sand resources also cover pipeline and support oil and gas infrastructure (pipelines, platforms, and other structures). Extraction of (Federal) offshore sand resources for LCA Study restoration efforts would disrupt, in the short-term, any other multiple use activities such as exploration or extraction activities by oil, gas, and mineral operations. Extraction of (Federal) offshore sand resources would have to be coordinated with the MMS so as to preclude interruption of existing and future oil and gas structures and pipelines thereby maximizing the use of potential offshore borrow sites.
- Restore nesting and resting habitat for migratory birds (Kopman 1907, 1908). Many parts of barrier islands were wooded in the early 1900s, and wooded species, even low growing ones, increase storm protection.
- The large volumes of sand required for LCA Study restoration efforts would significantly alter gulf bottoms over approximately 5,000 to 10,000 acres (2,025 to 4,050 ha). This would be in addition to other actions that would alter the gulf bottoms. The unknown longevity of sand resource may require re-mining to maintain proper project configuration.
- The removal of such large volumes of offshore sands (about 61,100,000 cy [46,436,000 cm]) over hundreds, if not, thousands of acres of gulf bottoms could potentially alter

wave dynamics that may increase the already high rates of shoreline erosion of nearby barrier shorelines, headlands, and islands. However, the removal of offshore sands would be conducted in such a manner as to avoid, minimize, and reduce the possibility of altering wave dynamics.

LCA PLAN: Cumulative impacts of the LCA Plan would be a synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.3 SALINITY REGIMES

Appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING not only describes the basis on which initial subprovince-wide modeling efforts were conducted, but also the assumptions and limitations of the modeling effort. Of particular note are the limitations of the model regarding averaging salinities over large areas (see size of "boxes" in **figures 4-1 to 4-4**). In addition, the following assumptions were made for the modeling effort: all barrier islands would still be present; the existing diversion at Caernarvon would be operated at a mean annual flow rate of 235 cfs; and the existing diversion at Davis Pond would be operated at a mean annual flow rate of 5,000 cfs.

4.3.1 Future Without-Project Conditions – the No Action Alternative

Figures 4-1 to **4-4** display modeling results for salinity patterns under the base conditions and Future Without-Project conditions for each subprovince. Models are based on simplifying assumptions, subject to uncertainty and error, and are only approximations of real conditions. The models used in this study have not been fully validated and their results should be considered within that context. Appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING of the Main Report provides a more detailed presentation of the numerical model results of salinity distributions. These models are static images (snapshots) of typical salinity distributions.

The Future Without-Project mean salinity distributions for Subprovince 1 are displayed in **figure 4-1**. The hydrologic model assumed that Caernarvon would be running all year at 235 cfs. The freshest mean salinities, 0 to 2 ppt, would be found in the interior-most portions of the subprovince in the vicinity of Lake Maurepas (boxes IA and IB) and in the general vicinity south of the MRGO and Caernarvon (boxes VA and VB). Lake Pontchartrain would grade from 2 to 4 ppt in the western portions to 4 to 6 ppt in the eastern portions of the lake. The southern portions of the Lake Borgne area (box IIIA) would have a mean salinity range of 6 to 8 ppt with the northern portions of the lake ranging from 8 to 10 ppt (box IIIB). The eastern portion of the Mississippi River Delta (box VE) would have mean salinity range of 2 to 4 ppt. The remainder of the subprovince, Chandeleur Sound and Breton Sound (boxes IV, VC, and VD), would have the greatest mean salinity ranges of greater than 10 ppt.

The Future Without-Project mean salinity distributions for Subprovince 2 are displayed in **figure 4-2**. The hydrologic model assumed that the Davis Pond Diversion would be running all year at 5,000 cfs. At the present time, such an operation scheme is not authorized. The interior-most portions of the subprovince (boxes 1A, 1B, 2A, 2B, 3A, and 3B) would have the freshest mean salinity range of 0 to 2 ppt. The region east of the Barataria Bay Waterway and extending from Myrtle Grove, south to the western portion of the Mississippi River Delta (box 4B) would have a mean salinity range of 4 to 6 ppt. The Caminada Bay and headland area (box 4A) would have the highest mean salinity range of greater than 10 ppt.

The future Without-Project mean salinity distributions for Subprovince 3 are displayed in **figure 4-3**. The freshest portions of the subprovince would be the interior portions of Terrebonne Parish (box I) with a mean salinity range of 0 to 2 ppt. The areas adjacent to the Atchafalaya River, Wax Lake Delta, and regions surrounding East and West Cote Blanche Bays would have a mean salinity range of 2 to 4 ppt (boxes IV, VIII, and IX). The area extending from Caillou Lake in the east to Point au Fer in the west (box V) and the area surrounding Vermilion Bay (box VII) would have a mean salinity distribution of 4 to 6 ppt. The interior portion of Terrebonne Bay (box II) would have a mean salinity distribution of 6 to 8 ppt. The area from Terrebonne Bay in the east to Caillou Bay in the west (boxes III and VI) would have the highest mean salinity range of greater than 10 ppt.

The Future Without-Project mean salinity distributions for Subprovince 4 are displayed in **figure 4-4**. The interior regions of the subprovince, extending from Freshwater Bayou in the eastern portion of the subprovince, north of Louisiana State Highway 82, and west of Grand Lake (boxes 2C1, 2C2, 2A1, 2B1, 2B2, 2A2, 2A4, 2A3, and 3E5), and the isolated areas west of Calcasieu Lake (boxes 3E6, 301, 306, and 3C2) would have the lowest mean salinity range from 0 to 2 ppt. The area south of White Lake (boxes 1C2 and 1B2), east of Calcasieu Lake (box 3E4), bordering the Sabine River (boxes 3B1, 3B2, 3B3, and 3B4) and bordering the western gulf shoreline (box 3A2) would have a mean salinity range of 4 to 6 ppt. The areas bordering the gulf shoreline from Freshwater Bayou, west to Lower Mud Lake (boxes 1B3, 1B1, and 1A1), and the area west of Calcasieu Lake (boxes 3C1, 3C4, and 3C5) would have a mean salinity range of 6 to 8 ppt. The area at the mouth of the Sabine River (box 3A1) and west of Calcasieu Lake (boxes 3D2 and 3D3) would have a mean salinity range of 8 to 10 ppt. The Calcasieu Lake and immediate surrounding area (boxes 3E1, 3E2, 3E4, and 3D4) would have the greatest mean salinity range of greater than 10 ppt.

Without action, salinity regimes would continue to be impacted by riverine and marine influences that have shaped their present patterns as well as other natural and human factors such as: sea level change, navigation channels, and oil and gas canals resulting in continued coastal habitat loss in both the Deltaic and Chenier Plains. Land building would continue in the Deltaic Plain at the two active deltas, as well as in areas influenced by CWPPRA projects and the Davis Pond and Caernarvon Freshwater Diversion Projects. Coastal habitats in these areas of land creation would primarily be freshwater marsh as a result of the riverine influence that formed them. Other areas in the Deltaic and Chenier Plains would experience land loss and/or habitat switching from freshwater marsh and bottomland hardwood forest (including cypress/tupelo swamp), to intermediate, brackish, saline marshes, or open water, as salinity regimes adjust with increased saltwater intrusion and marine influence.

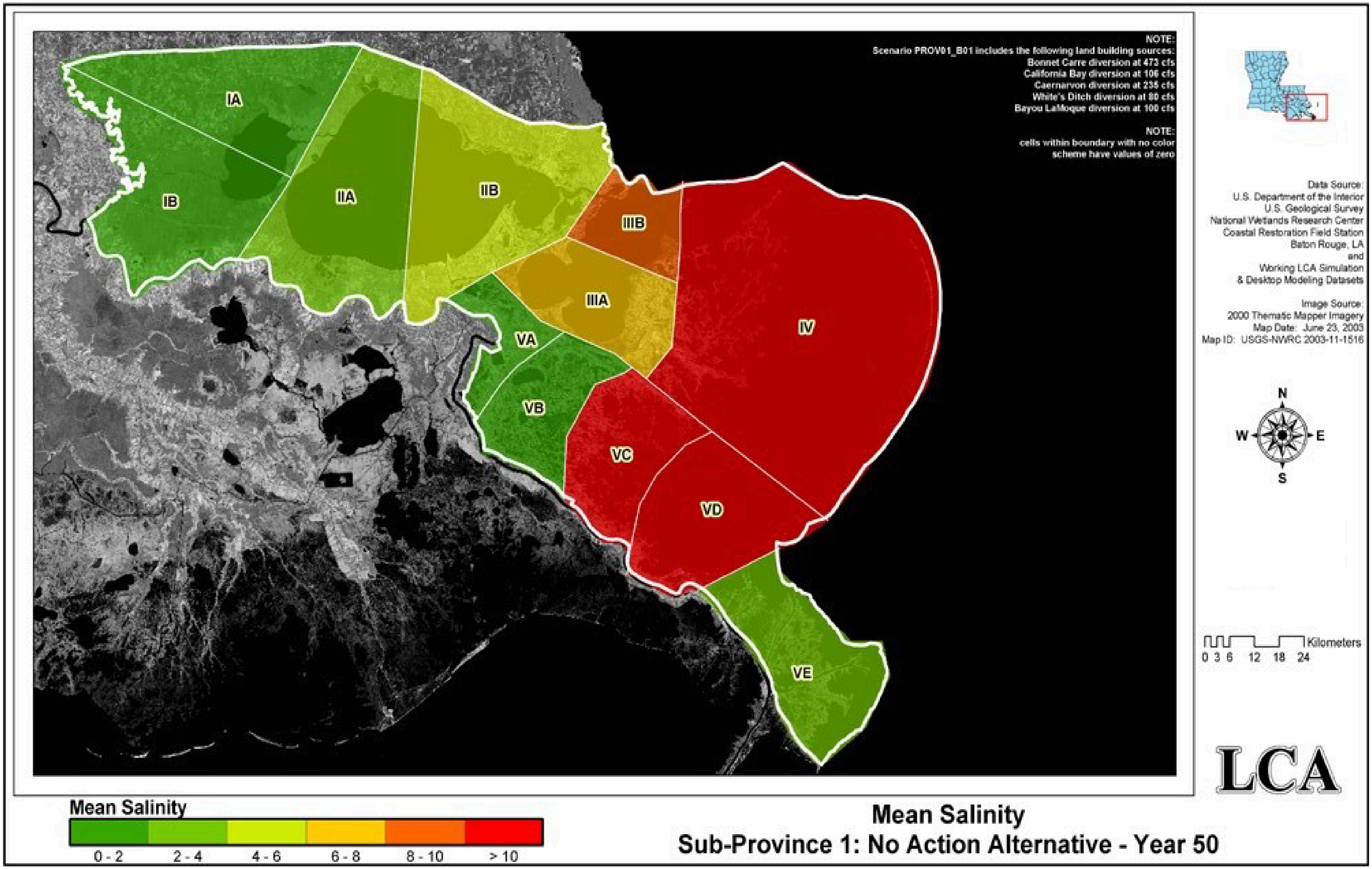

Figure 4-1. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 1.

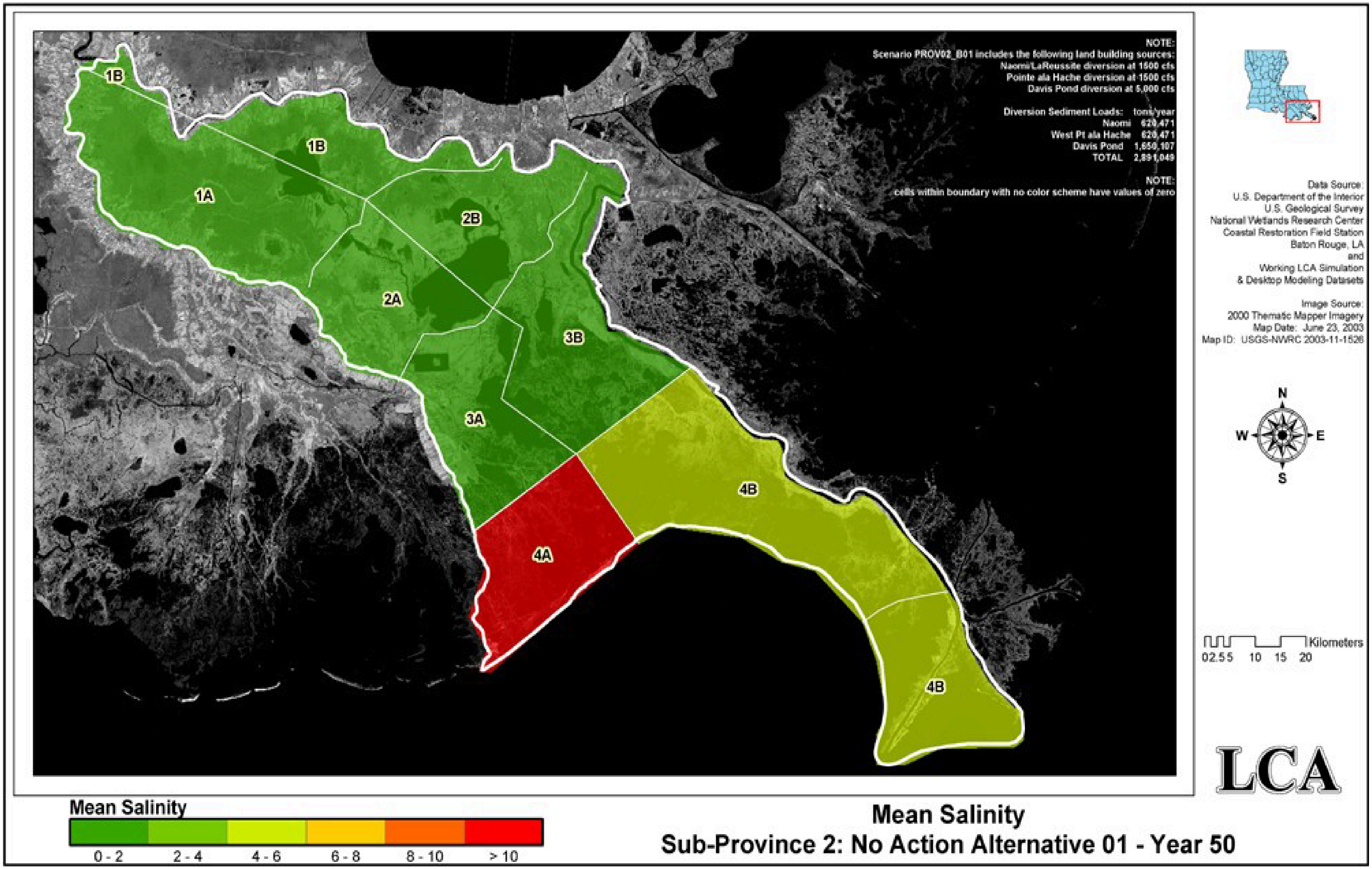

Figure 4-2. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 2.

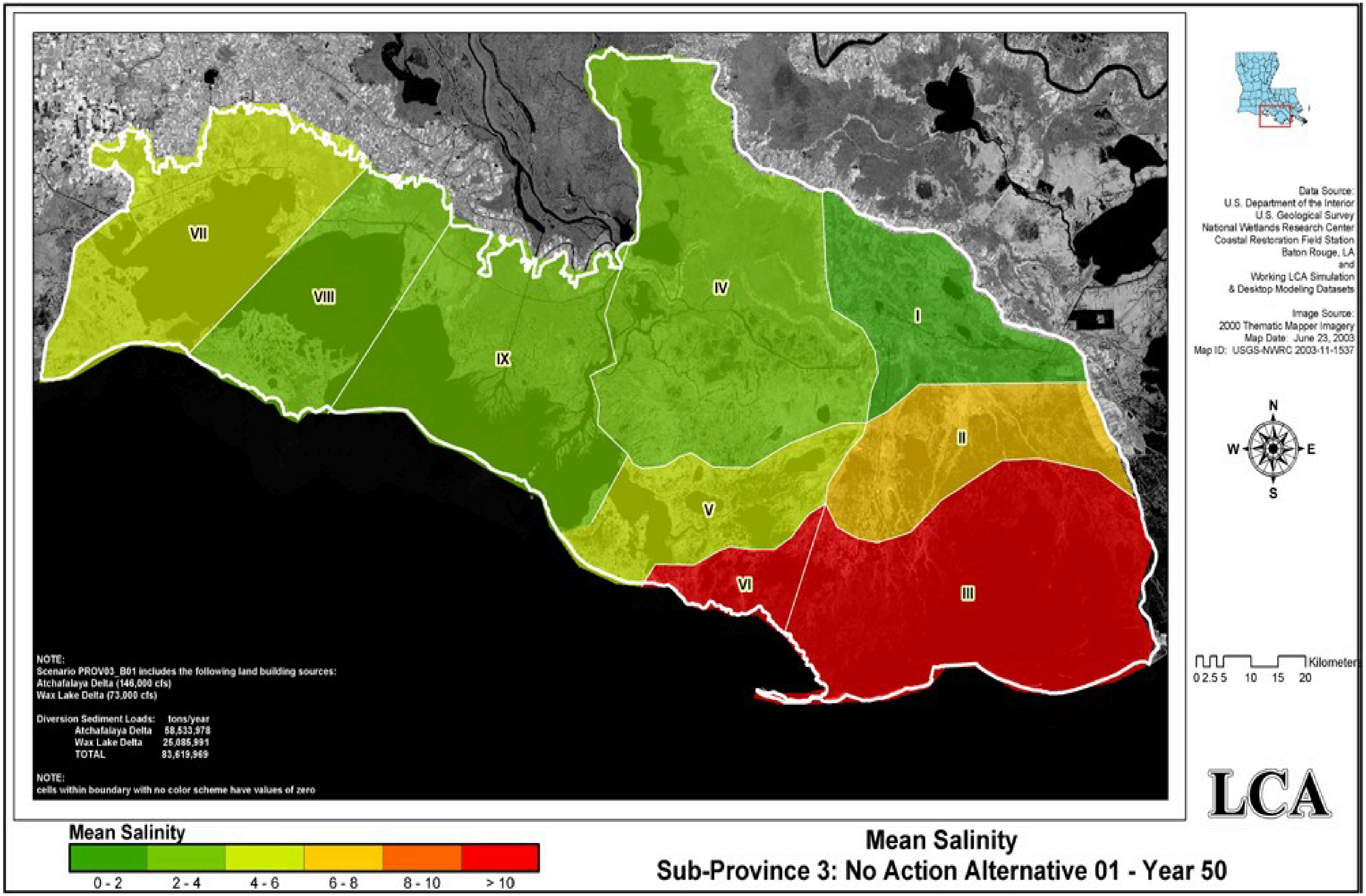

Figure 4-3. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 3.

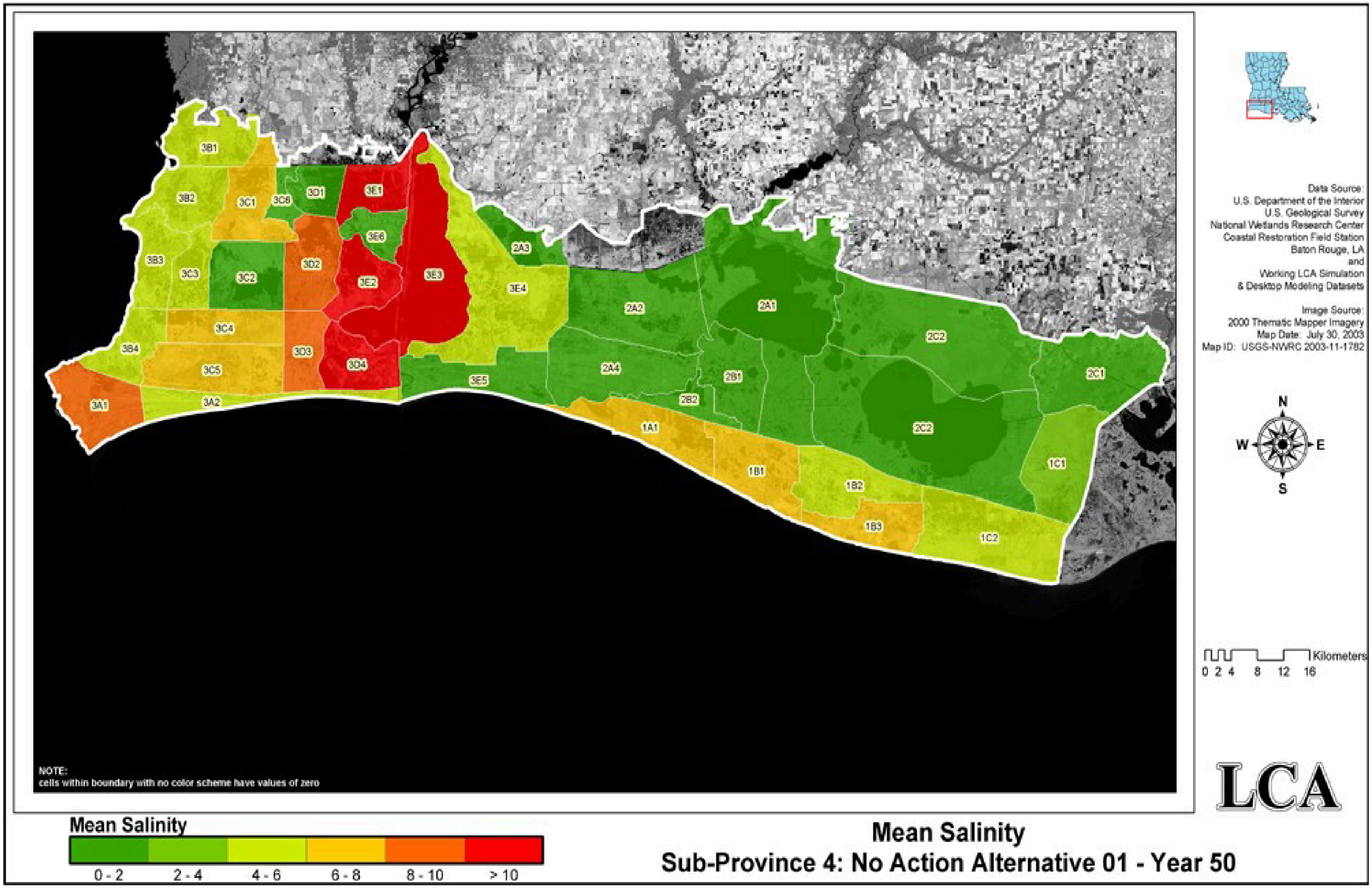

Figure 4-4. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 4.

4.3.2 Restoration Opportunities – Direct Impacts

Restoration opportunity-induced impacts to salinity regimes were determined by the interagency, interdisciplinary PDT utilizing the preliminary hydrodynamic modeling efforts for the baseline, Future Without-Project conditions, salinity comparisons of the final array of coast wide plans, and best professional judgment. **Table 4-2** displays the salinity regime impacts by subprovince.

Table 4-2. Direct Impacts on Salinity Regimes

Subprovince	ALT B (deltaic processes)	ALT D (geomorphic processes)	LCA PLAN
Subprovince 1	The salinity regime would be similar to the Future Without-Project conditions except salinities would be slightly lower in the Lake Borgne area and the northern portions of Breton Sound.	Similar to Future Without-Project conditions.	Similar to ALT B.
Subprovince 2	The salinity regime would be similar to the Future Without-Project conditions except salinities would be slightly lower in the Caminada Bay and nearby headland areas.	Similar to Future Without-Project conditions.	Similar to ALT B.
Subprovince 3	Salinity regime would be similar to the Future Without-Project conditions except salinities would be slightly lower in the upper reaches of Terrebonne and Timbalier Bays.	Similar to Future Without-Project conditions.	Similar to ALT B.
Subprovince 4	Similar to Future Without-Project conditions.	Similar to Future Without-Project conditions.	Similar to Future Without-Project conditions.

ALT B (deltaic processes): The direct impacts of ALT B on salinity regimes would be similar to the Future Without-Project conditions except for slight freshening in some areas. The most significant freshening would occur in Lake Borgne, the northern part of Breton Sound, Caminada Bay and the nearby headland areas, the upper reaches of the Terrebonne and Timbalier Bays, and the marshes directly north of these bays (see **table 4-2**).

ALT D (geomorphic structure): The direct impacts would be similar to the Future Without-Project conditions (see **table 4-2**).

LCA PLAN: The direct impacts would be similar to those described for ALT B except that implementation of some of the geomorphic features would have a minor localized effect on the salinity regime in some specific areas (see **table 4-2**).

4.3.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to salinity regimes would primarily result from long-term and far field effects of diversions and salinity control structures.

ALT B (deltaic processes): The long-term minor-to-moderate indirect impacts include the following:

- Increased volumes of fresh water from diversions may impact the receiving basin and the distribution of salinity regimes throughout the receiving basin. The medium sized diversions would have a greater impact than the smaller diversions.
- Marsh creation/restoration and increased volumes of fresh water from diversions may possibly lead to short-term stratification, principally in deeper areas of the receiving basin. The medium sized diversions would have a greater effect than the smaller diversions.
- Marsh creation/restoration and increased volumes of fresh water from diversions may have a minor impact on the tidal prism. This would have a minor indirect impact on tidal flows and the salinity regime. The medium sized diversions would have a greater impact than the smaller diversions.
- Marsh creation/restoration and increased volumes of freshwater from diversions may impact receiving basin mixing patterns. This would have a minor indirect impact on the tidal prism and tidal flows with subsequent minor impacts on the salinity regime. The medium sized diversions would have a greater impact than the smaller diversions.
- Marsh creation/restoration and increased volumes of fresh water from diversions may impact sheet flows and channel flows in the receiving basin that would indirectly impact salinity regimes. The medium sized diversions would have a greater impact than the smaller diversions.
- Diversions of colder river waters with a typical monthly average temperature differential of about $5^{o}C$ to $8^{o}C$ between the river and receiving area waters may change marsh temperature distributions. This could change the circulation patterns and density gradients (Day et al. 1989) thereby potentially impacting the salinity regime. The medium sized diversions would have a greater impact than the smaller diversions.

ALT D (geomorphic structure): Impacts would be similar to the Future Without-Project conditions. However, additional long-term, minor indirect impacts include the following:

- Marsh creation/restoration and barrier shoreline/island restoration with attendant closure of numerous existing small passes may impact the distribution of salinity regimes throughout the basin.
- Marsh creation/restoration and barrier shoreline/island restoration with attendant closure of numerous existing small passes may have a minor impact on the tidal prism. This would have a minor indirect impact on tidal flows and the salinity regime.

- Marsh creation/restoration and barrier shoreline/island restoration with attendant closure of numerous existing small passes may impact receiving basin mixing patterns. This would have a minor indirect impact on the tidal prism and tidal flows with subsequent minor impacts on the salinity regime.
- Marsh creation/restoration and barrier shoreline/island restoration with attendant closure of numerous existing small passes may have a minor impact on sheet flows and channel flows in the receiving basin. This would have a minor indirect impact on salinity regimes.

LCA PLAN: The long-term minor-to-moderate indirect impacts would be similar to those described for ALT B and ALT D.

4.3.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. Cumulative impacts to salinity regimes would primarily be related to the incremental impact of all past, present, and future salinity-altering activities.

ALT B (deltaic processes): The long-term minor direct and minor-to-moderate indirect impacts to salinity regimes described above are compared and contrasted to instances of natural and human-induced changes to salinity regimes in adjacent gulf coast states as well as coastal states nationwide. In addition, direct and indirect impacts to salinity distributions would also impact other significant resources, especially living resources, in the receiving basins. For example, introduction of fresh river water into estuarine systems could have dramatic short-term impacts on plankton, benthic, and fish populations in adjacent coastal waters. Introduction of fresh river water flows from proposed diversions would be expected to change species abundances, species compositions, and species distributions. Such cumulative impacts to other significant resources are also described in more detail under each specific significant resource.

ALT D (geomorphic structure): Cumulative impacts would be similar to ALT B, but to a lesser degree. Restoration features would include barrier shoreline/island restoration with attendant closure of existing small passes, but would not introduce any additional fresh water into the study area.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.4 BARRIER SYSTEMS: BARRIER SHORELINES, HEADLANDS AND ISLANDS

4.4.1 Future Without-Project Conditions – the No Action Alternative

The natural and human-induced land loss processes on these barrier systems would likely continue at the present rates. Marine influences and tropical storm events would be the primary factors affecting land loss of the barrier island systems. As this land loss trend continues, hydrologic connections between the gulf and interior areas would increase and exacerbate land loss and conversion of habitat type within the interior wetland communities.

With no action the following resources would continue to diminish: critical habitats for threatened and endangered species such as the piping plover, sea turtles, and brown pelican; essential and diverse habitats for migratory birds and other wildlife; and essential spawning, nursery, nesting, and feeding habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms. The continued loss of Louisiana's barrier systems would adversely impact the extraordinary scenic, scientific, recreational, natural, historic, archeological, cultural, and economic importance of these barrier islands. In addition, the continued loss of these coastal barrier systems would result in the reduction and eventual loss of the natural protective storm buffering of these barrier systems. Without the protective buffer provided by the barrier island systems, interior wetlands would be at an increased risk to severe damage from tropical storm events. Additionally, the continued shoreline recession and the movement of unstable sediments would undermine man-made structures, especially the extensive oil and gas pipelines and structures on this "working coast."

While all the barrier island systems in the study area would continue to experience varying rates of land loss, the greatest occurrence is within the Barataria/Terrebonne shoreline; this would continue. Additional information on the barrier island systems can be found in appendix D Louisiana Gulf Shoreline Restoration Team Report of the Main Report.

4.4.2 Restoration Opportunities – Direct Impacts

Direct impacts to barrier systems would primarily result from project-related activities that would immediately and directly create, restore, protect, rehabilitate, alter, or otherwise modify existing barrier systems.

ALT B (deltaic processes): There would be no direct impacts from ALT B on barrier systems, as this restoration opportunity does not include any barrier system restoration features.

ALT D (geomorphic structure): There would be long-term significant beneficial direct impacts on barrier systems and short-term minor-to-moderate adverse impacts. Beneficial impacts include: restoration of approximately 47.6 miles (76.6 km) of barrier systems including about 8.0 miles (12.9 km) of the Caminada-Moreau Headland and about 3.2 miles (5.1 km) of the Shell Island reach in Subprovince 2; and restoration of about 3.4 miles (5.5 km) of East Island, about 7.0 miles (11.3 km) of Trinity Island, about 4.3 miles (6.9 km) of Whiskey Island, about 6.3 miles (5.8 km) of East Timbalier Island, and about 15.4 miles (24.7 km) of shoreline restoration along Point au Fer in Subprovince 3. Additional long-term positive impacts include restoration and enhancement of the values and functions of these barrier systems. Short-term minor-to-moderate adverse impacts would be associated with restoration construction activities.

Barrier system restoration is based on preliminary designs developed in the presently ongoing LCA Barataria Barrier Shoreline Restoration Study. This restoration measure assumes a total 3,000-foot-wide (914-meter-wide) island footprint for restoration efforts in the Plaquemines and Bayou Lafourche barrier systems.

These areas contain some of the highest eroding barrier shorelines, headlands, and islands in Louisiana. ALT D would restore about 11 percent of Louisiana's barrier shoreline. Barrier system restoration would also result in restoration of the physical diversity of the barrier system, which in turn would be positively reflected in the indirect impacts of increased biological vigor and diversity on the islands (after Britton and Morton 1989).

LCA PLAN: Direct impacts would be similar to ALT D.

4.4.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to barrier systems would primarily result from long-term and far field effects to geomorphologic processes that influence barrier systems and the functions and values of these systems.

ALT B (deltaic processes): There would be no indirect impacts of ALT B on barrier systems as this restoration opportunity does not include any barrier system restoration features and any other project-induced indirect impacts would be negligible if any.

ALT D (geomorphic structure): Barrier system restoration, combined with interior marsh creation and restoration measures, would likely alter the tidal prism, thereby reducing formation of any additional tidal passes as well as "healing" (closing or narrowing) existing tidal passes and overwash areas. These different restoration measures would act together to retard saltwater intrusion into more northern portions of the basins.

Restoration of these barrier systems to near historic configurations, would, once again, provide natural storm buffering, limit storm surge heights, and provide protection for the interior wetlands, bays, and estuaries. In particular, restoration of the Caminada-Moreau Headland would provide protection for extensive oil and gas pipeline infrastructure and their landfall sites, especially for the nationally significant Louisiana Offshore Oil Port, Inc. (LOOP)facility.

Estimates of about 61,100,000 cy (37, 882,000 cm) of sands would be required for the first lift in restoring the Subprovince 2 and 3 barrier systems. Extraction (dredging) of offshore sand resources, such as at Ship Shoal, for restoration of these barrier systems, would indirectly impact the ecology of the borrow sites (see also section 4.2 OFFSHORE SAND RESOURCES).

The barrier shorelines and islands in Subprovince 2 and 3 support the commercial, recreational, and residential heartland of Louisiana's gulf coast. Fourchon Beach and Elmer's Island (part of

Caminada-Moreau Headland) have been Louisiana recreational areas for generations. Cheniere Caminada is the site of a historic community destroyed by the hurricane of 1893. Along the Caminada-Moreau Headland, the LOOP pipeline, the Shell Mars Pipeline, and pipelines from Amoco, BP, Chevron, Texaco, and others move millions of barrels of oil and billions of cubic feet of gas into America daily. Belle Pass is the entrance to Bayou Lafourche and Port Fourchon, the largest and fastest growing oil and gas port in the Gulf of Mexico and America. To the west, the Timbalier Islands support onshore and offshore oil and gas development and production. See also appendix D LOUISIANA GULF SHORELINE RESTORATION TEAM REPORT of the Main Report.

In addition, restoration of barrier systems would:

- Restore critical piping plover shoreline habitat;
- Restore the beach ecotone (i.e., the transition zone between the land and sea);
- Restore essential fish habitat; and
- Restore essential spawning, nursery, nesting, and feeding habitat for many different fish and wildlife species that presently must compete for these scarce barrier shoreline, headland, and island resources.

Other barrier shorelines/islands within the barrier island chain may also receive indirect benefits from the introduction of sand via littoral drift from the newly rebuilt islands.

LCA PLAN: Indirect impacts would be similar to ALT D.

4.4.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. Cumulative impacts to barrier systems would primarily be related to the incremental impact of all past, present, and future barrier system loss and restoration activities.

ALT B (deltaic processes): There would be no cumulative impacts of ALT B on barrier systems, as this restoration opportunity does not include any barrier system restoration features.

ALT D (geomorphic structure): The long-term significant beneficial cumulative impacts include restoration of about 47.6 miles (76.6 km) of eroding barrier shorelines, headlands, and islands compared to the continued loss of these critical resources if ALT D were not implemented. These potential gains in barrier system restoration are in contrast to the continued long-term significant adverse losses that would continue, to varying degrees, for the remaining 251 miles (404 km) of Louisiana barrier shorelines in addition to the continued deterioration and losses of other barrier systems along the gulf.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.5 BARRIER REEF RESOURCES

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

4.5.1 Future Without-Project Conditions – the No Action Alternative

Reefs that have been mined in the past are considered separately from unmined reef areas in this section.

4.5.1.1 Previously Mined Barrier Reefs

These reefs formed under different geological conditions than occur now. Presently, Atchafalaya Bay is filling with Atchafalaya River sediments and the bay salinities are so diluted by Atchafalaya River flows that the Point Au Fer and Point Chevreuil reefs would not re-form naturally during the period being evaluated in this study.

Indirect impacts of the previously mined reef Future Without-Project conditions would include continuation of altered estuarine hydrology, shoreline erosion in areas no longer protected by the barrier, reduced fish and shellfish productivity, reduced quality of fish and shellfish harvest areas, and improved navigation because of removed hazards to navigation.

The cumulative impact of Future Without-Project conditions in the mined barrier reef area would be negative from a coastal wetlands protection, maintenance, or enhancement viewpoint. It would also be negative from a fish and wildlife resource standpoint, from a tidal flooding standpoint, and from an infrastructure standpoint.

4.5.1.2 Natural Barrier Reefs (Unmined Barrier Reefs)

The direct, indirect, and cumulative impacts of the unmined barrier reefs would be beneficial from a coastal wetlands protection and maintenance viewpoint. Physical, chemical, and biological conditions would not be expected to substantially change in the future; thus the remaining barrier reef complex should be maintained. With the future of the reef secure, it should continue to function as it has in the past and presently does. The barrier reef would continue to protect the Marsh Island gulf shoreline and adjacent wetlands. The reefs would continue to be a valuable fish and wildlife resource and would still provide recreational fishing areas.

4.5.1.3 Created Reefs

The use of rock along barrier headlands, etc., functions in a similar manner to reefs for small organisms and provides valuable fishery habitat.

4.5.2 Restoration Opportunities

There would be no direct, indirect, or cumulative impacts of ALT B, ALT D, or the LCA Plan on barrier reefs as none of these restoration opportunities include any barrier system restoration features.

4.6 VEGETATION RESOURCES

4.6.1 Future Without-Project Conditions – the No Action Alternative

The preliminary modeling output provides predicted habitat type changes resulting from Future Without-Project conditions, expressed as acres of each of the major habitat types (**table 4-3**). The output from model calculations is a combination of two types of habitat change. The resulting acreage figures are the net result of habitat change due to land loss or gain, and habitat change due to conversion between habitat types. Separate acreage figures attributed to each type of change for each habitat are not available at this time, but may be provided as model refinement continues.

In a Future Without-Project Scenario, the model predicts a net loss of 13 percent in total acres of emergent wetland habitat coast wide. Gains and losses were forecast to occur for each habitat type that varied by subprovince, but the result on a coast wide basis was a net decline in every habitat type, except in intermediate marsh habitat. Model results show that saline marsh habitat would sustain the greatest loss, with a net decrease of 84 percent of total existing acres, followed by fresh marsh, swamp/wetland forest, and brackish marsh habitat, which were predicted to lose 15 percent, 9 percent, and 25 percent of existing acres respectively. Intermediate marsh habitat is predicted to increase a net 32 percent over existing acres.

The following subsections provide a general trend description by subprovince of the type and location of predicted habitat changes.

4.6.1.1 Subprovince 1- Pontchartrain and Breton Basins and Eastern Mississippi River Delta

More than 5 percent of the total emergent wetland acres in Subprovince 1 are predicted to be lost in 50 years. Overall, the majority of direct land loss is expected to occur in the saline and brackish marsh habitats in the outer subprovince fringing Breton and Chandeleur Sounds. In addition, a freshening influence is expected due to existing freshwater discharge in the upper and mid-subprovince areas and existing intermediate and brackish marsh habitat converting to fresh and intermediate marsh habitat, respectively.

Modeling for Future Without-Project conditions predicts that swamp/wetland forest habitat would experience a small net decrease of 7 percent in total acres. Losses are anticipated to be of two types: conversion to open water in the Lake Maurepas area, and conversion to intermediate marsh habitat, which would mainly occur adjacent to the Pearl River area.

Table 4-3. Future-Without-Project 50-year Predicted Wetland Habitat Acreage by Subprovince in Louisiana Coastal Zone (Source: Desktop Model Analysis)

	Sub Province 1			Sub Province 2			Sub Province 3			Sub Province 4			Total LCA Area		
Habitat Classes	Existing	FWO	% Chg	Existing	FWO	% Chg	Existing	FWO	% Chg	Existing	FWO	% Chg	Existing	FWO	% Chg
Fresh Marsh	71,279	207,760	191	180,876	253,975	40	341,733	33,294	(90)	346,923	312,800	(10)	940,811	798,848	(15)
Intermediate Marsh	160,752	98,156	(39)	85,267	52,318	(39)	193,569	619,079	220	284,702	238,517	(16)	724,290	956,240	32
Brackish Marsh	180,441	142,972	(21)	65,337	737	(99)	201,216	40,046	(80)	137,529	202,292	47	584,523	437,478	(25)
Saline Marsh	113,149	54,802	(51)	117,809	0	(100)	113,513	5,355	(95)	30,307	0	(100)	374,778	60,157	(84)
Swamp/ Wetland Forest	353,904	327,350	(7)	294,397	284,432	(3)	388,811	337,827	(13)	3,674	2,239	(39)	1,040,786	949,707	(9)
Total*	879,525	831,040	(5)	743,687	591,462	(20)	1,238,841	1,035,602	(16)	803,135	755,848	(6)	3,665,188	3,202,431	(13)

* Projected figures for Subprovince 2 include assumed Davis Pond operation with average annual discharge of 5,000 cfs.
NOTES: 1) All acreage figures provided for all habitat types exclude habitat that occurs within fastlands because they are hydrologically disconnected from areas that will be affected by LCA actions and are not included in the areas analyzed by the LCA Study desktop model. 2) Wetland Shrub/Scrub acreage has been distributed among the broader habitat classes used by the desktop model.

The trend predicted for fresh marsh is a large net increase as fresh marsh areas expand to almost three times the current amount of existing acres. Gains in fresh marsh acreage are expected to occur almost exclusively through a freshening of existing intermediate marsh areas. The major portion of this conversion would occur in the upper Breton Basin in the Caernarvon outfall influence area, with another small portion in the area northeast of Lake Maurepas.

An approximate 40 percent net reduction in intermediate habitat acres is predicted to occur. Modeling results indicate that nearly all of the decrease in acreage would be due to conversion to fresh marsh habitat, although a small amount is anticipated to convert to open water in the lower subprovince. Modeling results also show that some gains in intermediate habitat acres would occur, mainly as a result of the freshening and conversion of existing brackish marsh areas located chiefly in the mid-subprovince surrounding the eastern shores of Lake Pontchartrain. A small amount of intermediate marsh habitat is also expected to be gained through conversion of swamp/wetland forest habitat.

An approximate 20 percent net decrease in brackish marsh acres is predicted, chiefly due to conversion to intermediate habitat. However, model output also predicts that a small amount of increase in brackish marsh acreage would occur due to conversion of saline marsh from a freshening influence along the eastern Lake Borgne shoreline and in the expanding Caernarvon influence area.

In saline marsh habitat, an approximate 50 percent net decrease is expected. A portion of that decrease is predicted to be due to conversion to brackish habitat, and the remainder would be due to direct land loss in the outer subprovince as outlying marshes succumb to marine processes.

The proportional distribution of habitat types in Subprovince 1 is anticipated to continue to reflect a gradient salinity zone, but is predicted to be more heavily weighted in the fresh regimes. Fresh marsh and swamp/wetland forest habitats are predicted to make up the largest portion of emergent habitat acres (65 percent) and saline marshes the smallest (7 percent). Vegetative productivity is predicted to increase a very small amount.

4.6.1.2 Subprovince 2 – Barataria Basin and Western Mississippi River Delta

Approximately 20 percent of the total existing emergent wetland acres are predicted to be lost in 50 years. The majority of land loss is expected to occur throughout the lower subprovince in the saline and brackish marsh habitats, increasing in magnitude as the Gulf of Mexico is approached. Anticipated freshwater inputs are also expected to greatly expand the area of fresh conditions southward so that existing intermediate marsh habitat will convert to fresh marsh habitat, and any remaining brackish and saline habitats not converted to open water will convert to fresh and intermediate habitat respectively.

Swamp/wetland forest habitat is predicted to remain relatively stable throughout the Subprovince, with less than a net 3 percent decrease in total acres.

Some loss is expected to occur in fresh marsh habitat from fragmentation and conversion to open water, mainly in marshes in the Lake Salvador region. Regardless, a large net gain of 40 percent in total fresh marsh acres is anticipated. A major freshening trend is expected from the increasing influence of existing freshwater diversions. Nearly all existing emergent intermediate and brackish marsh acres expected to endure the next 50 years are anticipated to convert to fresh marsh habitat.

Modeling results predicted that intermediate marsh acres would have a net decrease of approximately 40 percent (with Davis Pond operating at average annual discharge of 5,000 cfs) to almost 100 percent (without Davis Pond operation). Actual decrease will be dependant upon the future operation of some existing diversions. Some loss is expected through conversion to open water but, as described above, most of the decrease in acreage is from the freshening of existing intermediate habitat and conversion to fresh conditions due to the expanding influence of freshwater discharge. Some gain in intermediate acres is also expected from the freshening of brackish and saline marshes currently existing adjacent to the Mississippi River.

Brackish marsh acres are also predicted to decrease 20 percent (without Davis Pond operation) to 100 percent (with Davis Pond operating at average annual discharge of 5,000 cfs) depending on future diversion operation. Decline in brackish marsh acreage will be largely due to conversion to fresher habitat type as described above. Nevertheless, a significant portion of the decrease in brackish marsh acres is also expected to occur due to direct loss of emergent land and conversion to open water.

A 100 percent decrease of existing saline marsh acres is expected. Direct loss of a large portion of existing acres is predicted through direct emergent land loss in the lower subprovince. Loss of saline marshes through conversion to open water is predicted to be especially severe in the southwest part of the subprovince. A portion of the saline marshes currently existing adjacent to the Mississippi River is also expected to convert to intermediate marsh as described above.

The predicted proportional distribution of habitat types throughout Subprovince 2 reflects the decrease in habitat diversity that is expected as the more saline marshes are lost or converted to fresher conditions. Of the remaining acres of emergent habitat in the subprovince, over 90 percent will be divided evenly between fresh marsh and swamp/wetland forest habitats, and the remaining 9 percent will be either intermediate or brackish marsh depending on the operation of the Davis Pond diversion. It is likely that a very narrow band of saline marsh habitat will occur along the coastal shoreline as a result of the continued estuarine influence in the lower subprovince, but would be of such a small scale that the effect is not captured in the model. Vegetation productivity is expected to decrease by 25 percent.

4.6.1.3 Subprovince 3 – Terrebonne, Atchafalaya, and Teche Vermilion Basins

Approximately 16 percent, or over 200,000 acres (81,000 ha) of existing emergent wetland habitat will be lost through conversion to open water. The model predicts that the majority of land loss will occur in the eastern subprovince, with the rate of loss increasing with proximity to the Gulf of Mexico. Habitat zones are expected to narrow and shift northward in that area in response to loss of buffering emergent marsh in the face of encroaching salinity. Considerable land gain is expected in the central subprovince due to continuing Atchafalaya River Delta development, and fresh conditions are expected to continue expanding into the western subprovince.

The desktop numerical output of the model shows a net 13 percent loss in swamp/wetland forest habitat in the next 50 years. Based on previous and ongoing studies by the USACE and comments received from land managers at the June 2003 LCA Comprehensive Study public meetings, deterioration of the swamps east of Lakes Palourde and Verret may be occurring due to sustained elevated water levels in the upper Atchafalaya Basin. Therefore, it is reasonable to expect that some loss will occur in the swamp/wetland forest habitat in this subprovince.

A net decrease of 90 percent is predicted in fresh marsh habitat. The model output indicates that this decrease in acres will be almost entirely from conversion to intermediate marsh habitat in the expanding area of Atchafalaya River influence. This may be correct within the constraints of the modeling effort because the habitat-switching module has a salinity level of 2 ppt established as the threshold between fresh and intermediate marsh. Combining parts of west Terrebonne Basin with the Atchafalaya Basin into one hydrologic unit, from which an average salinity is derived, may have yielded a salinity level slightly above 2 ppt.

A net increase of 220 percent is predicted in intermediate marsh habitat. This predicted increase is due to large areas of fresh marsh converting to intermediate habitat. All land newly built from Atchafalaya River Delta development is predicted to be intermediate marsh habitat as well. This may be correct within the threshold constraints of the modeling effort as described above. Additional gains are also predicted to occur where all brackish and saline areas in the western subprovince, in the Teche/Vermilion Basin, and in the lower southwestern Terrebonne Basin are predicted to convert to intermediate marsh as the freshening influence of the Atchafalaya River expands. Some decrease in acres of intermediate marsh habitat is also anticipated as a result of switching to a brackish habitat and direct land loss in the Terrebonne Basin, and as a result of a small amount of direct land loss in the Teche/Vermilion Basin.

A net decrease of over 80 percent in brackish marsh acres is predicted to occur in Subprovince 3. Changes in existing brackish marsh habitat will occur in the eastern and western portions of the subprovince. Predicted reduction in areas of brackish marsh habitat in the Teche/Vermilion Basin is due primarily to conversion to intermediate marsh habitat, but a small amount of direct loss will occur. In the Terrebonne Basin, the predicted decrease of brackish habitat will be due to a combination of direct land loss and shifts to other habitat types in both directions of the salinity gradient. Brackish marshes in the vicinity of Atchafalaya River influence are expected to change to intermediate marsh, while those to the east are predicted to change to saline marsh or open water.

A net decrease of over 95 percent in saline marsh acres is predicted to occur in Subprovince 3. A small amount of saline marsh acres will be converted to intermediate marsh, but the majority of loss is indicated to be direct land loss as the eastern Terrebonne marshes erode and subside from lack of freshwater and sediment input.

The anticipated freshwater and sediment inputs from the Atchafalaya River will greatly freshen the central and western areas of Subprovince 3, while fragmentation and shoreline erosion will cause all habitat types in the east to be subjected to direct loss. As a result, almost 60 percent of the acres of emergent wetland habitat that is remaining in 50 years is predicted to be intermediate marsh, 3 percent will be fresh marsh habitat, 4 percent will be brackish marsh, less than 1 percent will be saline marsh, and 33 percent will be swamp and wetland forest. Vegetative productivity is anticipated to decrease by more than 30 percent.

4.6.1.4 Subprovince 4 – Mermentau and Calcasieu/Sabine Basins

Approximately 43 percent of the total emergent wetland acres in the subprovince are fresh marsh habitat, mainly located in the northern, eastern, and mid-subprovince. Less than 1 percent of the emergent wetland acres are swamp/wetland forest habitat. Approximately 35 percent of emergent wetland acres are intermediate marsh located in the extreme western and eastern areas of the subprovince and in a few pockets transitioning between fresh marsh and brackish marsh habitat areas to the south. Approximately 17 percent of emergent wetland acres are brackish marsh habitat that mainly occurs in the marshes adjacent to Calcasieu Lake and in an inland zone parallel to the narrow band of saline marsh habitat bordering the Gulf of Mexico shoreline. Saline marsh habitat composes only 4 percent of the emergent wetland habitat in this subprovince.

Almost 6 percent loss of emergent wetland habitat is expected in 50 years throughout Subprovince 4. Increasing saltwater intrusion, particularly in the western half of Subprovince 4 and at the extreme eastern subprovince boundary, will drive transition of existing vegetated habitats to saltier regimes. Direct land loss through subsidence and increased hydrologic connection will also continue.

Nearly 40 percent of swamp/wetland forest habitat acres are predicted to decrease, although this amount is actually small due to the fact that there are fewer than 4,000 acres (1,620 ha) currently existing. The decrease will be due to increasing salinities in the western half of Subprovince 4, particularly in the northern areas east and west of Calcasieu Lake.

A net decrease of 10 percent is expected to occur in the total existing amount of fresh acreage. A large portion of that decrease will be due to increasing salinity causing eventual conversion to brackish marsh habitat in the western subprovince in the Calcasieu and Sabine Lakes system, and conversion of a small amount of fresh marsh acres to intermediate habitat between Grand Lake and Highway 82 in the central subprovince. Also, decreases are expected from direct land loss in existing emergent fresh areas between Sabine, Calcasieu, and Grand Lakes, as increasing salinity and hydrologic connections cause open water areas to expand and coalesce.

A net decrease of 16 percent of existing intermediate marsh acres is predicted. The majority of the decrease will be due to increasing salinity causing existing intermediate habitat to shift to brackish marsh habitat. Transition in habitat type is expected to occur in the Calcasieu and Sabine Lakes systems in the western subprovince, in the lower eastern subprovince south of Highway 82, and the extreme eastern end of the subprovince adjacent to Freshwater Bayou. Also, some direct loss is expected as intermediate habitat converts to open water.

Brackish marsh habitat is predicted by the model to expand northward from the Gulf of Mexico and through the Calcasieu Lake system to almost 150 percent of current acreage, but the increase will be almost entirely due to conversion of fresh, intermediate, and saline marshes. No brackish marsh acreage is expected to be gained through the formation of new land areas. Additionally, some direct loss due to conversion of brackish habitat to open water is expected south of Highway 82.

The model predicts that nearly all of the pockets of saline marsh habitat in Subprovince 4 would be converted to brackish marsh habitat in 50 years. Some direct loss through fragmentation and conversion to open water in existing saline habitats south of Highway 82 is also expected.

While much of the existing fresh marsh habitat in Subprovince 4 is predicted to remain intact in the eastern and mid-subprovince areas, brackish regimes expanding in western areas of the subprovince will somewhat reduce the combined dominance of fresh and intermediate marsh habitat in Subprovince 4. Proportionally, brackish marsh habitat is predicted to compose approximately 27 percent of the total of emergent wetland habitat acres remaining in 50 years. The composition of the balance of emergent acres will be 41 percent fresh marsh and 32 percent intermediate marsh. With the 6 percent direct loss of emergent acres, and minor changes in the proportional distribution of habitats, vegetative productivity is expected to decrease less than 4 percent.

4.6.1.5 Rare, Unique, and Imperiled Vegetative Communities – Future Without-Project Conditions

The unique communities nestled within the broader vegetative habitats are important in that they contribute to the extensive diversity of the coastal ecosystem, are the basis for its productivity, and are essential to the stability of the bionetwork. Overall, plant communities provide protection against substrate erosion, and contribute food and physical structure for cover, nesting, and nursery habitat for wildlife and fisheries. Continued degradation and loss of existing wetland area in concert with truncation of replenishing processes will accelerate decline in the interdependent processes of plant production and vertical maintenance necessary for a stable ecosystem. As environmental conditions become increasingly limited, overall biodiversity will decline.

4.6.1.6 Invasive Species – Future Without-Project Conditions

Louisiana's geographic location, features, and subtropical climate make it a portal for invasive species through several mechanisms of intentional and nonintentional introduction, as it hosts global transportation centers and corridors, a large human population of diverse ethnicity, and large expanses of disturbed ecosystems within a variety of habitat types. Expanding awareness of the threats posed by invasive species has recently resulted in increased efforts in Louisiana to mitigate, control, and prevent invasive species through institutional recognition, policy development, programmatic and private efforts by state and Federal agencies, universities, nongovernmental organizations (NGO), local organizations and citizens.

The seriousness of the problems frequently caused by invasive plants has been recognized for some time, and the ecological damage that invasive plants create or aggravate have resulted in the development of national and regional programs to respond to the challenge of reducing the harmful effects of invasive plants. The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646), although aimed primarily at the zebra mussel, *Dreissena polymorpha* (Pallas), also applies to invasive plants.

EO 13112, signed by the President on February 3, 1999, specifies that all Federal agencies must prevent the introduction of invasive species, to the extent possible within their programs, and not take actions that would cause or promote the introduction or spread of invasive species. EO 13112 also provides for the establishment of an Invasive Species Council to provide national leadership in dealing with invasive species.

The Center for Aquatic and Invasive Plants, based at the University of Florida, receives significant support from the Bureau of Invasive Plant Management, Florida Department of Environmental Protection and the Aquatic Plant Control Research Program, USACE. Public concern about the problems caused by invasive species continues growing, with many private groups and NGOs researching aspects of the invasive species problem and working toward solutions. These efforts will likely continue and probably expand, because the frequency of invasive plant introductions is increasing with the increasing volume and speed of international trade.

There are two invasive species elements of particular concern throughout coastal Louisiana (personal communication USFWS, August 23, 2004). First, Chinese tallow (*Sapium sebiferum*) is and will remain a major part of all post-restoration plans, not only for the LCA Program, but most other restoration efforts throughout coastal Louisiana. Full ecosystem restoration will not be attained until this species is controlled, or at least managed as a less dominant entity. The second element includes species such as black willow (*Salix nigra*). Although black willow is a native species to the southeastern U.S., it probably will be considered as an invasive species during many restoration programs. Cypress and water tupelo (*Nyssa aquatica*) should eventually take hold in some locations, but restoration would be greatly augmented with active measures to plant, monitor, and nurse ecosystems in light of invasive species concerns.

Nevertheless, with no action, invasive species will likely continue to pose a threat to the floristic integrity of Louisiana’s coastal ecosystems as massive landscape disturbance and deterioration is prolonged, stressing the balance that evolved between Louisiana’s native vegetative communities and their habitat. Degrading native vegetative communities will become increasingly vulnerable to infestation and, eventually, be replaced by invasive species that out-compete native species and aggressively develop dense monocultural stands. Some benefit may be realized from establishment of invasive species. For example, the robust above and belowground production of Cogon grass may provide substrate stabilization and biomass contributions, or water hyacinth may provide potential water quality improvement through nutrient uptake and retention., However, the potential benefits are not expected to outweigh the overall impacts anticipated from the proliferation of invasive species. Expected major impacts caused by spread of invasive species are reduced vegetative biodiversity, alteration of abiotic factors and coastal ecosystem processes, and reduction of wildlife food and habitat.

4.6.1.7 Summary of Future Without-Project Conditions – the No Action Alternative

Several natural and human-induced factors that recently interrupted the natural progression of coastal land building and degradation have also affected the vegetative communities. Wetland plants play a critical role in the maintenance and protection of coastal lands. If unchecked, stressors will continue to alter the conditions that affect survival and production of wetland species.

Direct loss of vegetated habitat will continue to occur as plants are physically removed by erosion from marine processes, increased water velocities, and increased herbivory pressures. Changes in environmental conditions that occur quickly or beyond the tolerance limits of plant species to adapt or allow succession, will cause conversion directly to open water. Continued subsidence and other factors that will facilitate increased flooding and saltwater intrusion will cause complete die-off of the more vulnerable plant communities. In particular, large-scale loss of protective land forms, such as elevated ridges and islands, landbridges, and contiguous fringing marshes, that buffer the rare or unique vegetative communities or vulnerable vegetative habitats formed in highly organic conditions, will result in habitat conversion or loss. Although submerged aquatic vegetative habitat was not addressed by the model, it can be speculated that increased erosion and water exchange will also cause changes in water temperatures and deepening of shallow water areas, and drive turbidity increases that will cause decreases in the presence and productivity of submerged aquatic vegetation.

The multiple benefits derived from the attributes and functions of wetland vegetation become indirectly impacted by the decline and loss of vegetative habitats. Louisiana plant species and communities vary widely in their abilities to adapt to a variety of environmental conditions. In habitats where variation in conditions becomes restricted, such as those with extreme salinity, water depths, or sediment and nutrient deprivation, species diversity will be severely reduced. Ultimately, species distribution and successional patterns of plant communities will be negatively influenced and only those communities of species that can adapt to severely limited conditions will endure. Sustained environmental stressors causing declines in plant production will also result in biomass deficits. As a result, accumulation of the decomposing organic material that contributes to the structure and vertical accretion of soils will be reduced, carbon sequestration will diminish, and the contribution that serves as the basis of the trophic chain will be curtailed. Deterioration and loss of emergent and submerged plant communities will cause a decline in protection against substrate erosion, water quality improvement, and the contribution of food and physical structure for cover, nesting, and nursery habitat for wildlife and fisheries. Loss of stabilizing vegetative cover increases the exposure of wetland soils to increased particle detachment, export out of the system, and further loss of elevation.

Continued degradation and loss of existing wetland vegetative habitats, in concert with truncation of replenishing processes will accelerate declines in the interdependent processes of plant production and vertical maintenance necessary for persistence of a stable ecosystem. Without action, future wetlands loss will continue. The model predicts that a net decrease of 462,760 acres (187,418 ha) of total wetland vegetative habitat will occur. The predicted net changes in each habitat type modeled is as follows: a decrease of 141,960 acres (57,494 ha) fresh marsh, an increase of 231,950 acres (93,939 ha) of intermediate marsh, a decrease of 147,050 acres (59,555 ha) of brackish marsh, a decrease of 314,620 acres (127,421 ha) of saline marsh, and a decrease of 91,080 acres (36,887 ha) of swamp/wetland forest. Additionally, if investment in the maintenance of existing restoration efforts is discontinued, accelerated loss may also occur in vegetative habitats currently under protection. Since the Louisiana coastal ecosystem contains 40 percent of the Nation's wetlands, and is experiencing 80 percent of the loss, the potential impacts to other significant resources dependent upon Louisiana's vegetative habitat and the associated functions and values will be cumulatively severe on a state, Gulf of Mexico regional, and national level.

4.6.2 Restoration Opportunities – Direct Impacts

Direct impacts to vegetation resources would primarily result from those project-related activities that would directly create, disturb, destroy, or otherwise harm existing vegetation resources. For example, a vegetative planting in a marsh creation area would directly create or restore vegetation resources in the planted area. Direct impacts from installation of structural measures (e.g., diversions and guide channels) or placement of dredged material on vegetative habitat would occur only where existing vegetation within the direct footprint of the construction work is disturbed, destroyed, or otherwise harmed. Impacts to vegetation within the influence area of a diversion's discharge would be considered in the indirect impacts section.

Precise calculation of the acres of wetland vegetative habitat that would be directly impacted from the construction or implementation of each plan would be performed when more detailed analysis is conducted for restoration feature-specific studies.

<u>ALT B (deltaic processes)</u>: Since this alternative's proposed features are composed almost entirely of freshwater reintroductions and provisions for freshwater redistribution, direct, long-term impacts to a negligible amount of vegetation resources are expected to occur in the construction footprint areas of diversion and water control structures, new guide levees, and channel widening excavation. Direct impacts could also occur in the footprint of bank repair work in areas where wetland vegetation now occupies eroded sections. Dedicated dredging, such as in the vicinity of Myrtle Grove, would create marsh vegetation.

The diversions and marsh creation restoration features of ALT B could potentially increase the opportunities for the spread of invasive plant species onto newly created or restored wetlands. However, proper design elevations, at marsh restoration sites, to target elevations that favor colonization by native species while reducing the elevation zone favorable to some invasive species is one method to reduce the likelihood of spreading invasive species. In addition, best management practices for vegetation restoration would include replanting utilizing native plant species for all LCA Plan restoration projects. Additional research, such as could be conducted under the auspices of the LCA Science and Technology Program, would need to be accomplished to further address this potential problem.

<u>ALT D (geomorphic structure)</u>: Because activities associated with the restoration of geomorphic structures or geomorphic structure function, comprise this alternative, a negligible amount of long-term direct impacts will occur to vegetation resources that are present within the

construction footprint of any structure. In addition, short-term, direct impacts may occur from marsh creation or barrier island restoration efforts where existing wetland vegetation is overlaid with deposited sediments. Conversely, vegetation resources would be directly created on all marsh creation or barrier island restoration areas that are planted. At this time, it is not possible to discern proportional differences or similarities between this restoration opportunity and ALT B in the amount of vegetation resources that will be directly impacted. Nevertheless, this restoration opportunity can be expected to directly create more vegetated habitat than ALT B.

Restoration of Louisiana's barrier islands, headlands, and shorelines, along with marsh creation and beneficial use of dredged material of ALT D could potentially increase the opportunities for the spread of invasive plant species onto newly created or restored wetlands. However, proper design elevations at marsh restoration sites to target elevations that favor colonization by native species while reducing the elevation zone favorable to some invasive species is one method to reduce the likelihood of spreading invasive species. In addition, best management practices for vegetation restoration would include replanting utilizing native plant species, including woody species, for all LCA Plan restoration projects. Additional research, such as could be conducted under the auspices of the LCA Science and Technology Program, would need to be accomplished to further address this potential problem.

LCA PLAN: Given that the set of measures in this alternative is equivalent to the combination of ALT B and ALT D measures, excluding one shoreline protection measure and one landbridge protection/restoration measure, the direct impacts to vegetation resources would be nearly equivalent to the combination of direct impacts that would occur from implementation of both ALT B and ALT D. In addition, the direct creation of vegetated habitat would be nearly equivalent to the combination of ALT B and ALT D created habitats.

The synergistic interactions of freshwater diversions, restoration of Louisiana's barrier islands, headlands, and shorelines, along with marsh creation and beneficial use of dredged material could potentially increase the opportunities for the spread of invasive plant species onto newly created or restored wetlands. However, proper design elevations at marsh restoration sites to target elevations that favor colonization by native species while reducing the elevation zone favorable to some invasive species is one method to reduce the likelihood of spreading invasive species. In addition, best management practices for vegetation restoration would include replanting utilizing native plant species for all LCA Plan restoration projects. Additional research, such as could be conducted under the auspices of the LCA Science and Technology Program, would need to be accomplished to further address this potential problem

4.6.3 Restoration Opportunities – Indirect Impacts

Indirect impacts are those effects that are caused by the action and are later in time or further removed in distance, but are still reasonably foreseeable. Indirect impacts may include changes in vegetation growth and productivity, changes in the pattern of vegetation zones, and other effects.

With all restoration opportunities, loss of vegetated habitat is expected to continue from natural and human induced factors in some areas, but is expected to be somewhat offset by the development of vegetated habitat in created areas or areas of land building. Nevertheless, the sediment and nutrient input measures and key structural protection of the restoration opportunities are expected to reduce mortality and decrease the loss of vegetated habitats due to flooding and saltwater intrusion. The changes to habitat type will be the result of either or both habitat change due to land loss or gain, and habitat change due to conversion between habitat types. Separate acreage figures attributed to each type of change for each habitat are not available at this time, but would be determined in future project-specific studies.

Vegetative productivity (i.e. production of organic matter) is dependent upon species/community composition and vegetative response as regulated over time by forcing functions such as salinity, inundation, and nutrient availability, among others. Consequently, the effects of the various actions on productivity are considered to be indirect impacts because changes would occur as vegetation responds over time to the changes in forcing functions.

ALT B (deltaic processes): In response to freshwater and sediment diversions, and the associated increased nutrient input and freshening of salinity regimes (see section 4.3 SALINITY REGIMES), indirect impacts of ALT B would include long-term minor to significant reduction in losses of coastal vegetation in general, and protection of fresh and intermediate marsh, and swamp-wetland forest in particular. Conversion of marsh types to fresher habitat with the associated increases in vegetative productivity is also expected in some areas compared to Future Without-Project conditions. Newly created land in diversion outfall areas adjacent to the Mississippi River and other areas receiving Atchafalaya River influence would be expected to be fresh or intermediate habitat.

In Subprovince 1, the salinities in the Lake Borgne area and those portions of the upper Breton Sound influenced by the freshwater discharges, would freshen compared to the Future Without-Project conditions thereby reducing the suitability of these areas to more saline-tolerant species. Conversion to fresher habitat types would be most likely in the Breton Sound area. Overall, freshwater and sediment input would improve vegetative productivity and reduce the rate of loss of all vegetative habitats throughout the subprovince, with the exception of barrier shoreline vegetation.

In Subprovince 2, the mid- and upper subprovince areas would remain fresh habitat, however additional sediment and nutrient input can be expected to increase productivity and reduce the rate of loss of emergent habitat. Marsh creation in the Myrtle Grove area would also offset some fresh marsh loss, help protect the mid-subprovince wetlands, and contribute additional vegetative production. In the lower subprovince, the salinities in the Caminada Bay and Caminada-Moreau Headland area would slightly freshen from the Future Without-Project conditions, thereby somewhat reducing the suitability of these areas to more saline-tolerant species. A sufficient level of freshening may drive conversion from saline and brackish marsh habitats to brackish and intermediate marsh habitats respectively, with a concurrent increase in productivity and reduction in loss rates.

In Subprovince 3, the salinities in the upper reaches of the Terrebonne and Timbalier Bays would slightly freshen from the Future Without-Project conditions, thereby somewhat reducing the suitability of these areas to more saline-tolerant species. Small inputs from reintroduction and improved distribution of freshwater and nutrients would enhance vegetative productivity and optimize conditions for maintenance of all vegetative habitats, resulting in some reduction in the rate of loss of emergent habitat, with the exception of barrier shoreline vegetation.

There would be no restoration features in Subprovince 4; hence, there would be no indirect impacts.

ALT D (geomorphic structure): Indirect impacts would include long-term minor to significant increases in coastal vegetation in general, and all vegetation types, especially barrier shoreline vegetation. Because the salinity regimes would not appreciably change from Future Without-Project conditions, contributions to all vegetative habitat types would be made as a result of new vegetative community development and stabilization of existing habitats facilitated only by the marsh creation, barrier shoreline restoration, and MRGO environmental restoration features. Contributions to vegetative productivity would come from expansion of new vegetative habitat on newly created areas and the relief from flooding and saltwater intrusion stressors that those areas would afford existing habitats.

LCA PLAN: The combination of almost all of the ALT B and ALT D features of sediment and nutrient input and key structural protection is expected to reduce vegetative mortality, increase productivity, and decrease the loss of vegetated habitats due to flooding and saltwater intrusion, as well as promote formation and development of new vegetative communities in areas of all habitat types in all subprovinces. The functional interaction of the combined measures in Subprovinces 1 through 3 is expected to yield a synergistic effect on resulting benefits in all habitat types. As a result, the increases of new habitat, vegetative productivity, and protection of existing habitat, along with the decrease in habitat loss for the LCA Plan, should be greater than the combined amount of those benefits attributed to ALT B and ALT D, individually.

4.6.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. The cumulative impact to wetland vegetation resources is the aggregate result of all incremental (i.e. additive) impacts of other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time. The net change of each vegetative habitat type is not available at this time, but would be determined in future project-specific studies.

ALT B (deltaic processes): Over the 50-year project life, a net decrease in total wetland vegetative habitats would occur, however the overall rate of loss compared to Future Without-Project conditions would be reduced. The net reduction in loss rates would likely be greatest with fresh and intermediate marsh and swamp/wetland forest habitat, where the influence of freshwater and nutrient inputs and potential for land building is greatest; however brackish and saline marsh areas would also experience some reduction in the rate of loss. The rate of loss of barrier shoreline vegetation would likely remain similar to the Future Without-Project conditions due to the fact that the ALT B features do not address the major causes of loss that have been identified in this habitat.

ALT D (geomorphic structure): Over the 50-year project life of this restoration opportunity, a net decrease in total wetland vegetative habitats would be predicted to occur, although the overall rate of loss compared to Future Without-Project conditions would be expected to be reduced. Loss rates for each habitat type would be anticipated to be reduced as the ALT D features would provide protection to some existing marsh habitats, and newly created areas would be added in all wetland vegetative habitat types (depending upon the locations of created areas).

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

The incremental impact of each plan should be considered along with that of a Future Without-Project conditions. In the Future Without-Project conditions, preliminary modeling predicts that a net decrease of 462,760 acres (187,417 ha) of total wetland vegetative habitat would occur in Louisiana. An estimate of existing coastal wetlands in the continuous United States using USFWS National Wetland Inventory Data is 4,500,000 acres (1,822,500 ha) fresh marsh habitat, 4,000,000 acres (1,620,000 ha) non-fresh marsh habitat, and 17,300,000 acres (7,006,500 ha) forest and shrub/scrub habitat, for a total of 25,800,000 acres (10,449,000 ha) (Field et al. 1991). At roughly 2.5 million acres (1,012,500 ha) of coastal marsh habitat, Louisiana accounts for approximately 30 percent of total coastal marsh habitat in the lower 48 states. Louisiana also accounts for 90 percent of the total loss of those marshes (personal communication with J. Johnston 2003, Field et al. 1991, Dahl 2000, and Barras et al. 2003).

Long-term rehabilitation and maintenance of wetland vegetative habitats would prevent decline in the interdependent processes of plant production and vertical maintenance necessary for the persistence of stable ecosystems. With implementation of a near-term course of action, vegetative habitats restored or protected by current investment in existing restoration efforts could also be enhanced and prolonged. The reduction of loss would help reduce the potential cumulative impacts and prolong other dependent resources that are significant on a state, regional, and National level.

4.6.5 Rare, Unique and Imperiled Vegetative Communities – Future With-Project Conditions

Chabreck (1988) pointed out that habitats containing a wide array of environmental conditions also contain a wide variety of plant and animal species, and hence greater species diversity. In habitats with restricted variation in conditions, such as those with extreme salinity, species diversity is reduced. Reduction in the current rate of wetland losses overall would extend the longevity of the diversity of Louisiana's vegetative habitats. Maintenance of critical landforms would prolong protection of many of the imperiled vegetative habitats that are threatened by encroaching marine processes. Inputs of freshwater, sediments, and nutrients in targeted areas would provide relief to vegetative communities from extreme salinities and nutrient limitations.

4.6.6 Invasive Species – Future With-Project Conditions

Many factors combine to influence the probability of successful establishment of invasive species. Each invasive species is uniquely regulated by a particular combination of environmental factors and an individual propensity to infiltrate an area. Also, natural vegetative communities vary in their inherent susceptibility to being invaded, which is additionally influenced by the particular level of stress impinging on an area. Therefore, at this juncture, it is not possible to accurately predict invasive species impacts resulting from implementation of the ALT B, ALT D, or the LCA Plan. Invasive species concerns will be addressed on a project-by-project basis in the feasibility phase when the detailed evaluation and development of alternative measures is conducted and potential impacts are assessed.

In general, restoration of geomorphic features, such as with ALT D, can be expected to reduce stress on existing communities by buffering marine encroachment and preventing increased hydrologic exchange, while increased delivery or improved distribution of freshwater and nutrients, as with ALT B, is anticipated to nourish, enhance production, and support diversity of natural vegetative communities as well as reduce their vulnerability to invasive species threats. Since the LCA Plan is essentially a combination of the ALT B and ALT D approaches, greater potential benefits could be expected via enhancement and protection of natural vegetative habitats, as well as improving resistance to infiltration by invasive species. Conversely, system freshening and newly created habitat may provide additional habitat where conditions are favorable for encroachment by invasive species; however, newly created areas can also provide opportunity to establish more diverse communities composed of native species.

To meet the challenge of established nonindigenous species and future introduction of nonindigenous species requires policy development, enforcement, education, and research. Implementation of a nonindigenous species policy demands a firm scientific basis, which would require the acquisition of information not currently available. Our knowledge of biology, physiology, ecology, and behavior of most nonindigenous species is rudimentary at best. Research in these areas is critical to understanding the nature of biologic invasions and how to prevent or limit their effects (Mac et al. 1998). For the LCA Plan restoration efforts, perhaps that acquisition of information for Louisiana restoration efforts could be performed through the LCA Science and Technology efforts.

The risk of invasive species will be considered in the planning process for each LCA Plan restoration feature and, where necessary, appropriate steps will be taken to reduce that risk and protect against or mitigate for invasive species impacts. These steps could include appropriate interdisciplinary coordination throughout all phases of planning and implementation; establishing the rigor of monitoring protocols necessary to stress identification, early detection, and response to invasive species dispersal; coordination with available nuisance species programs in Louisiana; and use of native species plantings to quickly establish targeted vegetative communities.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.7 WILDLIFE RESOURCES: BIRDS, MAMMALS, AMPHIBIANS AND REPTILES

See also appendix A1 U.S. Fish and Wildlife Service Planning Input, for this PEIS and appendix B4, U.S. Fish and Wildlife Coordination Act Report, regarding the comprehensive LCA Study effort, and appendix B5, U.S. Fish and Wildlife Coordination Act Report for the LCA Study near-term course of action.

4.7.1 Future Without-Project Conditions – the No Action Alternative

The projection of wildlife abundance is based almost exclusively on the predicted conversion of marsh to open water and the gradual sinking and resultant deterioration of forested habitat throughout the study area. Numerous other factors, including water quality, harvesting level, and habitat changes elsewhere in a species' range cannot be predicted and were not considered in these projections. Therefore, the projections presented are to be viewed and used with caution.

4.7.1.1 Coast Wide

Louisiana's coastal wetlands are predicted to experience extensive land loss and habitat change by the year 2050. The effect of such losses and changes will likely result in a decrease in the abundance of wildlife as marshes, forested wetlands, and their associated habitats continue to deteriorate and convert to open water. Populations of resident and migratory birds and other animals directly dependent on the marsh and swamp will decrease dramatically, an impact which will be felt in much of North America, where some of these species spend part of their life cycle.

EO 13186, signed by the President on January 10, 2001, specifies that all Federal agencies must include protection of migratory bird habitat in their planning efforts. Louisiana coastal wetlands provide essential stopover habitat for neotropical migratory birds on their annual migration route. Without places along the way that provide an adequate food supply for the quick replenishment of fat reserves, shelter from predators, and water for rehydration, migratory birds may be negatively affected. Louisiana coastal wetlands provide critical stopover habitat during both fall and spring migration by providing essential resting and foraging habitat for transgulf neotropical migrant birds. Some of the first habitats available after crossing the Gulf include Louisiana's chenier ridges. Of the few remaining ridges, only small patches support forested habitat. As the ridges continue to subside below elevations that can support forested habitat, great numbers of neotropical migrants will be negatively affected. As Louisiana continues to lose more coastal wetlands, survival of individual migrating birds may be effected, which may effect population size, and over the long term, survival potential for the species as a whole.

The fate of other species groups in coastal Louisiana will be influenced by habitat conditions. These groups include migratory birds, such as wintering waterfowl, which rely on the abundant food supply in coastal wetlands to store energy reserves for migration and nesting (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998). The Louisiana coastal zone provides wintering habitat for approximately 3.5 million ducks and geese and nesting habitat for the resident mottled duck (Michot 1996). The importance of coastal Louisiana as wintering habitat for millions of ducks and geese cannot be overemphasized. Winter habitat conditions in the Lower Mississippi Valley and in California's Central Valley have been shown to affect survival (Reinecke et al. 1987) and recruitment (Heitmeyer and Fredrickson 1981; Raveling and Heitmeyer 1989) of some waterfowl species. It is likely that conditions in Louisiana's coastal zone may have the same impact on wintering waterfowl, especially in light of the fact that the area supports 19% of the U.S. winter population of 14 species of ducks and geese which are counted during winter surveys (Michot 1996). As habitat conditions along the coast continue to deteriorate, continental populations of waterfowl, and other migratory bird species utilizing the coastal zone, may be negatively impacted.

Continuing losses of wintering habitat (Tiner 1984; Forsythe 1985) and a better appreciation of the interdependence of waterfowl requirements throughout the annual cycle (Anderson and Batt 1983) have led to a more balanced concern for the conservation of breeding, migration, and wintering habitats. The North American Waterfowl Management Plan (NAWMP) (Canadian Wildlife Service [CWS] and USFWS 1986), a multination agreement for the management of waterfowl, proposes to restore prairie nesting areas and protect migration and wintering habitat for waterfowl and other migratory bird populations in the lower Mississippi River and Gulf Coast regions, among others. The NAWMP identifies coastal Louisiana as part of one of the most important regions in North America for the maintenance of continental waterfowl populations.

The bald eagle and brown pelican are recovering from very low populations experienced over the last three decades. Increasing populations for those two species are projected to continue in the future, independent of near-term wetland changes.

4.7.1.2 Subprovince 1 – Pontchartrain and Breton Basins, and Eastern Mississippi River Delta

Habitat quality for wildlife is expected to decline as the marshes of this subprovince continue to deteriorate and convert to open water under future conditions with no action. Losses are expected to be concentrated in the middle and lower subprovince and on the land bridges. Significant losses of swamp could occur in the upper subprovince.

Brown pelican and bald eagle numbers are projected to increase in areas presently occupied, primarily as the result of nesting success projected in this subprovince and other areas of the coast. Seabird abundance is expected to decrease in the lower basin and in the Bonnet Carré and La Branche wetland area. Shorebird abundance is expected to decrease in areas of high land loss in the lower subprovince. Wading bird numbers are expected to decrease in areas surrounding Lake Borgne. The numbers of ducks are expected to decline in much of the area and to increase in the vicinity of the Caernarvon Freshwater Diversion. The abundance of other birds using marsh and open water habitats is projected to decrease in deteriorating wetlands. Furbearer and game mammal numbers are expected to decrease in the lower subprovince where high land loss is expected. Alligator abundance in the upper subprovince is expected to increase with an increase in open water and nonforested wetland habitats.

4.7.1.3 Subprovince 2 – Barataria Basin and Western Mississippi River Delta

Habitat quality for wildlife is expected to decline as the marshes of this subprovince continue to deteriorate and convert to open water under Future Without-Project conditions. Freshwater inputs through the siphons at Naomi and West Pointe a la Hache, the navigation locks at Harvey and Algiers, and the West Bay and Davis Pond Freshwater Diversions are expected to enhance conditions for wildlife in those areas.

Ducks are expected to increase or remain steady in areas receiving freshwater input, but decline in the lower region marshes where wetlands will continue to be lost. Seabird, wading bird, and shorebird abundance is expected to decrease in areas of high land loss, primarily in the lower portion of the subprovince, and is expected to remain steady in other parts of the subprovince primarily due to the West Bay and Davis Pond diversions. Goose abundance is expected to decrease in the Mississippi River Delta and the Grand Liard area, and increase in the West Bay area. The abundance of other birds using marsh and open water habitats is projected to decrease in deteriorating wetlands and increase in land-building areas such as West Bay. Brown pelican and bald eagle numbers are projected to increase in areas presently occupied, primarily as the result of nesting success projected in this subprovince and other areas of the coast. Decreased numbers of raptors and other woodland birds are expected across the subprovince, except in areas influenced by river diversions. As the few remaining wooded chenier ridges continue to subside below elevations that can support forested habitat, greater numbers of neotropical migratory birds will be negatively affected. Furbearer and game mammal abundance are projected to decrease. Generally, the loss and degradation of habitat have resulted in depletion of many reptiles and amphibians in the basin (Condrey et al. 1995). Alligator numbers are projected to decrease in areas expected to experience high land loss.

4.7.1.4 Subprovince 3 – Terrebonne, Atchafalaya, and Teche/Vermilion Basins

Forested wetlands of the Terrebonne Basin are expected to change to a more frequently flooded, less diverse community, as a result of subsidence and increasing water levels. This habitat change is expected to cause a decrease in several bird species, which utilize those habitats. However, bald eagle numbers are expected to increase as their preferred nesting habitat, cypress swamp, increases. Game mammals such as white-tailed deer, squirrels, and rabbits are expected to decline. American alligator populations are expected to increase with an increase in open water, swamp, and nonforested wetland habitats.

The greatest threat to fish and wildlife resources across Subprovince 3 is the ongoing loss of coastal wetlands in the Terrebonne Basin. In the eastern Terrebonne Basin, most wildlife populations are expected to decline due to high land loss. In the central Terrebonne Basin, waterfowl, seabirds, shorebirds, raptors, and marsh and woodland resident and migrant species are all expected to decline. Brown pelican populations are expected to increase, as are the bald eagle populations in the Penchant marshes where nesting activity is high in swamp habitat adjacent to fresh marsh. American alligator populations will likely decline in the Mechant/De Cade area, but are projected to increase in the Penchant marshes due to an increase in Atchafalaya River influence. In the extreme western portion of the Terrebonne Basin, most wildlife populations are expected to remain steady. Marshes adjacent to the Atchafalaya River will continue to receive abundant fresh water, nutrients, and sediments; hence, they will likely remain healthy and provide quality habitat for wildlife.

As the Atchafalaya Delta continues to grow, habitat value for wildlife will increase, especially for waterfowl. The brown pelican is also projected to increase, but primarily as the result of nesting success projected in other areas of the coast. American alligator populations are expected to continue increasing across this basin.

In the Teche/Vermilion Basin, projected land loss rates are expected to remain relatively low. As a result of relatively stable wetland conditions projected for most of the basin, most wildlife populations are expected to remain stable.

4.7.1.5 Subprovince 4 – Mermentau and Calcasieu-Sabine Basins

The abundance of waterfowl, seabirds, shorebirds, and resident and migrant marsh birds will generally remain steady or increase within most of the subprovince except for those areas in the Calcasieu Basin not under the protection of salinity control structures. Wading bird populations, which are presently experiencing increases in most areas, are expected to level off by 2050 and decline in a few areas (such as White, Willow, and West Black Lakes, Martin Beach, and the southeastern portion of Sabine Lake).

Furbearers, rabbits, and deer are expected to increase in Cameron Creole, remain steady in some areas (especially those areas under salinity control), and decline in others. American alligator populations are presently increasing, but are expected to level off by 2050. In the Sabine Basin, waterfowl, seabird, and shorebird populations are projected to decline generally in those areas currently experiencing the greatest land loss.

4.7.1.6 Invasive Mammalian Species

Destruction of coastal wetlands by invasive mammalian species, such as the feral hog and especially nutria, would likely continue into the future. Institutional recognition, such as the Louisiana Coastwide Nutria Control Program, will also likely continue to help address the problems caused by these animals.

4.7.2 Restoration Opportunities – Direct Impacts

Direct adverse impacts to wildlife would primarily result from those activities, which would directly harm, displace, or disturb wildlife. Direct adverse impacts to wildlife resources would primarily result from construction activities associated with the various features of each plan. Some wildlife species could be temporarily displaced from an area as disturbance from construction activities could result in unfavorable conditions for nesting, foraging, and/or other activities. However, most species would move to an area with more favorable conditions and return after construction is completed. In some instances, permanent displacement may occur with the construction of permanent project features (e.g., diversion structures).

ALT B (deltaic processes): Most wildlife species, including invasive species, would directly benefit from the wetland creation features associated with ALT B.

ALT D (geomorphic structure): Creation of coastal wetland habitats and restoration of geomorphic structures throughout all subprovinces would have an overall positive effect on wildlife resources, including invasive species.

LCA PLAN: Creation of coastal wetland habitats and restoration of geomorphic structures throughout all subprovinces would have the greatest overall positive effect on wildlife resources, including invasive species, of any restoration opportunity.

4.7.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Indirect impacts to wildlife resources resulting from ALT B would include the creation, restoration, and protection of wetland habitats utilized by those species for nesting, rearing of young, resting, and foraging activities. An increase in wetland acreage (compared to the Future Without-Project conditions) would provide nesting, brood-rearing, and foraging habitat for resident avian species. Migratory avian species would also benefit from ALT B as important stopover habitat would be protected for neotropical migrants and wintering habitat would be created/protected for waterfowl. Game mammals and furbearers would also benefit from the increase in wetland types (i.e., swamp, fresh, and intermediate marsh) favored by the majority of those species. Reptiles and amphibians, which prefer fresher wetland types, would also benefit from the projected increase in wetland acres. The invasive nutria would also likely benefit.

ALT D (geomorphic structure): Indirect impacts would be similar to ALT B except, important stopover habitat for migratory avian species would be created, restored, and/or protected; in addition, wintering habitat would be created/protected for waterfowl. The invasive nutria would principally benefit from beneficial use and marsh creation.

LCA PLAN: Indirect impacts would be a synergistic result over and above the additive combination of indirect impacts and benefits of ALT B and ALT D.

4.7.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Historically, before human intervention, populations of birds, mammals, reptiles, and amphibians responded to natural population regulating mechanisms. However, recent historic and existing conditions within the study area (i.e., loss of coastal wetland habitats) have resulted in population declines for wildlife resources and that trend is expected to continue under the Future Without-Project. Over the project life, ALT B would result in an increase of wetland acres compared to the Future Without-Project (see section 4.6 VEGETATION RESOURCES). When combined with CWPPRA and other restoration authorities, ALT B would have an even greater impact on wildlife resources, as those programs would work synergistically to improve habitat conditions for wildlife populations across the coast. Continental populations of migratory avian species, such as neotropical songbirds and waterfowl, could improve as critical migratory habitat is restored, protected, and enhanced. Although unlikely to impact their populations on a continental scale, game animals, furbearers, reptiles, amphibians, and invasive species (especially the nutria) would also benefit from the cumulative effects of ALT B and other restoration programs.

ALT D (geomorphic structure): Cumulative impacts would be similar to ALT B except, migratory avian species would also benefit from ALT B as important stopover habitat would be protected for neotropical migrants and wintering habitat would be created/protected for waterfowl. The invasive nutria would likely only benefit from beneficial use of dredged material and marsh creation restoration features.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination impacts and benefits of ALT B and ALT D. Efforts to control invasive species would be necessary.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.8 PLANKTON RESOURCES

4.8.1 Future Without-Project Conditions – the No Action Alternative

Plankton populations respond to changes in environmental conditions. In particular, changes in salinity and nutrients can result in changes in abundance and community structure. In the future, population growth in Louisiana would be likely to result in greater nutrient flux to coastal waterbodies, via an increase in sewerage discharges. However, improvements in sewerage collection and treatment could offset this trend and reduce nutrient flux. Increased development would tend to increase stormwater runoff, and application of fertilizers could increase over time as well, thus increasing the nutrient load on coastal waterbodies.

Increased nutrient concentrations would cause further deterioration of water quality in eutrophic lakes and bays, at times resulting in algal blooms, some of which would be noxious. Blooms are often characterized by a shift in community structure towards dominance by one or several species. Existing freshwater diversion projects introduce Mississippi River water into coastal waterbodies. This river water is generally high in nutrients, and some of the receiving areas are already eutrophic. To date, algal blooms resulting in hypoxic conditions have not been observed in response to diversions, but diversion projects such as Caernarvon and Davis Pond have not been used to their capacity except for pulses in Caernarvon. However, there is a potential for algal blooms when waters are diverted directly into large water bodies, as contrasted with water diversions into wetlands.

It is unknown whether flows in the 8,000 to 10,000 cfs (240 to 300 cms) range in warm weather months would result in noxious blooms of blue-green algae, but there is likely some upper limit to the assimilation of nutrients into estuarine waters, beyond which blooms would occur. The river water is also cool, turbid, and would improve flushing rates in receiving waters; factors that would tend to reduce the occurrence of blooms. Future changes in the operation of existing diversion projects may occur. Increased flows would shift the plankton community, displacing the marine species in favor of the freshwater species.

4.8.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): The introduction of river water into estuarine systems can have dramatic short-term impacts on plankton populations in adjacent coastal waters (Hawes and Perry 1978). Hence, introduction of fresh river water flows from proposed diversions would be expected to change plankton abundance and species composition. Changes in plankton species assemblages would likely be similar to what is observed along present day estuarine salinity gradients except that increased freshwater flows would shift the plankton community, displacing marine species in favor of fresher and more estuarine, euryhaline species.

ALT D (geomorphic structure): There would only be short-term minor adverse impacts to plankton populations during actual construction activities of restoration features due to increases in turbidity, low dissolved oxygen and introduction of dredged sediments into shallow open water areas. There would be long-term loss of shallow water habitats due to marsh creation and other land building activities. However, there is an overabundance of shallow open water habitat available for use by plankton.

LCA PLAN: Direct impacts would be a combination of ALT B and ALT D effects.

4.8.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to plankton populations would primarily result from long-term and far field effects of freshwater and sediment diversions, salinity control structures, and project-induced changes to the tidal prism such as closure of barrier passes during restoration of barrier systems.

ALT B (deltaic processes): River water is cool, turbid, and would improve flushing rates in receiving waters; factors that would tend to reduce the occurrence of algal blooms. River water contains higher concentrations of nutrients, which would contribute to increased plankton populations. It is unknown whether proposed diversion flows would result in noxious blooms of blue-green algae, but there is likely some upper limit to the assimilation of nutrients into estuarine waters, beyond which blooms would occur. To date, algal blooms resulting in hypoxic conditions have not been observed in response to diversion projects at Caernarvon and Davis Pond. However, these structures have not been used to their capacity, except for occasional pulses at Caernarvon. Adaptive management in the operation of existing and proposed diversions is recommended.

ALT D (geomorphic structure): There would be a long-term loss of shallow water habitats available for plankton populations due to marsh creation and other land building activities. However, there is an overabundance of shallow open water habitat available for use by plankton.

LCA PLAN: Indirect impacts would be a combination of ALT B and ALT D effects.

4.8.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. Cumulative impacts to plankton resources systems would primarily be related to the incremental impact of all past, present, and future actions effecting plankton resources such as existing freshwater diversions (e.g., Caernarvon, Davis Pond, West Bay, etc.); those diversions currently in planning or construction (e.g., Maurepas, etc); and similar actions.

ALT B (deltaic processes): In the Deltaic Plain, freshwater diversions would likely result in species switching from saline-dominant to more freshwater-dominant plankton species assemblages.

ALT D (geomorphic structure): The cumulative impacts would be negligible because there would be no diversions with this restoration opportunity.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.9 BENTHIC RESOURCES

4.9.1 Future Without-Project Conditions – the No Action Alternative

The species richness (variety of organisms) of the benthic community typically declines as one progresses from ocean waters upstream into lower salinities, and often reaches a minimum between 4 and 6 ppt (Day et al. 1989). Hence, it is expected that increases in benthic community species diversity would continue as land loss continues across the Louisiana coast.

Day et al. (1989) indicate the preferences of some major groups of benthic organisms:

- Suspension feeding organisms tend to favor firmer (sandier) substrates than do deposit feeders;
- Interstitial meiofauna inhabit sandy areas;
- Burrowing meiofauna inhabit silt mud; and
- Some benthic organisms require high levels of organic matter.

Intertidal and shallow subtidal environments are generally more environmentally variable and stressful than deeper water. However, specific composition and distribution of the benthic community in any given area would be a function of the response of individual species to the changing characteristics of such factors as salinity regime, sediment characteristics, oxygen levels, detritus, desiccation, extreme ranges in temperatures, dissolved oxygen, and current velocity.

4.9.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Proposed diversions and marsh creation would destroy existing benthic communities at the proposed construction sites. In addition, introduction of river water into estuarine systems can have dramatic short-term impacts on benthic populations in adjacent coastal waters. Introduction of fresh river water flows from proposed diversions would be expected to change benthic abundance, species composition, and species distribution. Changes in benthic species assemblages would likely be similar to what is observed along present day estuarine salinity gradients except that increased freshwater flows would shift the benthic plankton community, displacing marine species in favor of fresher and more estuarine, euryhaline species.

ALT D (geomorphic structure): Direct impacts caused by temporary loss of benthic community at borrow sites. Construction of geomorphic features would destroy benthos at placement sites.

LCA PLAN: Direct impacts would be a combination of ALT B and ALT D effects.

4.9.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to benthic resources would primarily result from long-term and far field effects of freshwater and sediment diversions, salinity control structures.

ALT B (deltaic processes): Species richness of benthic communities is usually greater in higher salinity waters (Day et al. 1989*)*. Freshwater diversions would likely reduce benthic species richness as greater volumes of freshwater are pushed deeper into estuarine basins. Intertidal and shallow subtidal environments are generally more environmentally variable and stressful than deeper water. Hence, shallow intertidal and subtidal habitat created by river diversions would likely reduce the quality of existing saline benthic habitats and convert them to more freshwater-type habitats.

ALT D (geomorphic structure): Suspended sediments would cause short-term disturbance to sensitive benthic animals; smothering of benthos due to resettlement of suspended sediments; depletion of oxygen would also cause temporary disturbance, and possible loss to some benthos.

LCA PLAN: Indirect impacts would be a combination of ALT B and ALT D effects.

4.9.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. Cumulative impacts to benthic resources would primarily be the incremental impact of all past, present and future actions affecting benthic resources such as existing freshwater diversions (e.g., Caernarvon, Davis Pond, West Bay, etc.); those diversions currently under construction or in planning (e.g., Maurepas, etc); and similar actions.

ALT B (deltaic processes): Cumulative impacts would be the replacement of existing saline benthic habitats across the coast with fresher benthic habitats as proposed river diversions are constructed.

ALT D (geomorphic structure): Cumulative impacts would be short-term disturbance to sensitive benthic animals due to construction of restoration features.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.10 FISHERIES RESOURCES

4.10.1 Future Without-Project Conditions – the No Action Alternative

Habitat Use modules, as described in appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING, were developed to determine impacts of fish and wildlife resources in the study area, but were not used in the analysis of fisheries resources for this FPEIS. The Habitat Use modules are being refined and may be useful in the analysis of fisheries impacts in the near future. In addition to prediction from the Coast 2050, Habitat Switching and Land-Building models were used to assess changes in fisheries habitat. Those modules predict marsh-type changes and marsh loss and gain. The analysis for fisheries Future Without-Project conditions and future with alternative conditions relied on predictions of marsh habitat changes, and consideration of seasonal habitat changes (e.g., freshwater discharge, salinity, and temperature variation).

Direct impacts to fisheries may result from events such as hypoxia, but are expected to be smaller in comparison to indirect impacts. Indirect impacts to fisheries may result from the expected continuation of land loss and further loss of habitat supportive of estuarine and marine fishery species. In the short-term, land loss and predicted sea level changes are likely to increase open water habitats available to marine species, except in the active deltas of the Atchafalaya and Mississippi Rivers; and areas otherwise influenced by river flow, such as, the Caernarvon and Davis Pond Freshwater Diversions, and to a lesser extent, Pointe a la Hache and Naomi Siphons. In the long-term, as open water replaces wetland habitat and the extent of marsh to water interface begins to decrease, fishery productivity is likely to decline (Minello et al. 1994; Rozas and Reed 1993). This may already be happening in the Barataria and Terrebonne estuaries. Browder et al. (1989) predicted that brown shrimp catches in Barataria, Timbalier, and Terrebonne Basins would peak around the year 2000 and may fall to zero within 52 to 105 years.

Other considerations on the impact to fisheries are predator/prey relationships; water quality, salinity, and temperature; harvest rates; wetland development activities (dredge/fill); habitat conversion (e.g., wetland to upland); and access blockages. Habitat suitability, diversity, population size, and harvest rates influence the future condition of fisheries. Habitat suitability for fisheries varies by species, and depends on different water quality and substrate types.

Along with indirect effects of no action on fisheries, restoration efforts in the state (e.g., CWPPRA) have aided fisheries habitat, and are likely to continue. Economic interest in fisheries and interest in Louisiana as a fishery resource for the Nation has increased significantly. The increase is expected to continue, leading to changes in fishing technology, fishing pressure, and fishing regulations in order to maintain sustainable commercial fisheries. It is likely that construction of levees, water control structures, and hurricane protection features will continue and/or increase as coastal residents protect themselves and their property from hurricane damage and flooding. All of these structures alter water flow, potentially block fisheries access, and may directly convert habitat supportive of fishery species to unsupportive areas.

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

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

4.10.2 Restoration Opportunities – Direct Impacts

The project area supports one of the most productive fisheries in the Nation. However, it is believed that with no action, sharp declines in fisheries productivity are likely (Minello et al. 1994; Rozas and Reed et al.1993). Impacts to fisheries resulting from the implementation of each plan will vary depending on the features included in the selected plan, species-specific habitat, prey, spawning requirements, and current conditions in the Deltaic and Chenier Plain estuaries.

Some considerations, such as the impacts resulting from beneficial use of dredged material/marsh creation, are common across all plans. Impacts to fisheries as a result of freshwater diversions, dredging, beneficial use/marsh creation, salinity control, shoreline protection, and barrier island restoration are summarized in **table 4-4**. Long-term beneficial effects are likely to result from the preservation of marsh in each plan.

Table 4-4
Items of consideration in the impact analysis of restoration opportunities on fisheries resources.

Past, Present & Future Actions	Habitat restoration projects continue, economic interests increasing, restrictions on fishing and fishing gear continue or are increased, natural habitat declines (e.g., subsidence and sea level rise), and structural blockages to habitat are increased.
Essential Fish Habitat (EFH)	Essential Fish Habitat (EFH) is defined as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity". Because impacts to EFH will impact fisheries species, alterations in EFH are listed below for each of the plans. In coastal Louisiana, EFH are the waters and substrates consisting of marine and estuarine (tidally-influenced) habitats (e.g., marsh); submerged aquatic vegetation; sand, mud and shell water bottoms, and water column. Coastal marsh loss is of particular concern in Louisiana, because the marshes are the most extensive in the nation and are believed to be largely responsible for the high production of estuarine-dependent species in the north-central Gulf of Mexico.
Freshwater Diversions	Direct impacts to fisheries resulting from freshwater diversions include mortality due to burial or sudden salinity changes; injury or mortality due to increased turbidity (e.g., gill abrasion, clogging of feeding apparatus); modified behavior, and short-term displacement. Indirectly, fisheries may be displaced to offshore areas. Displacement is related to the timing and volume of freshwater input proposed. These projects prevent the loss of marsh, and generally improve conditions for SAV and other highly productive forms of EFH. As a result, project areas can maintain most of their current ability to support Council-managed species (such as white shrimp, brown shrimp, and red drum), as well as the estuarine-dependent species (such as spotted seatrout, gulf menhaden, striped mullet, and blue crab) that are preyed upon by other Council-managed species (such as mackerels, red drum, snappers, and groupers) and highly migratory species (such as billfish and sharks). Potential increases in submerged aquatics will increase the habitat required for juveniles to escape predation and therefore increase quality and habitat.
Dredging	These projects, or project components, would negatively impact benthic organisms and benthic feeders in the borrow and disposal areas. Sessile and slow-moving aquatic invertebrates would be disturbed by the dredge or buried by the dredged material. Dredging and disposal activities and the resultant increased turbidity would temporarily displace other fisheries, but these species are expected to return after dredging and disposal activities are completed. Impacts include smothering of non-mobile benthic organisms in dredged material deposition sites and increased turbidity in waters near the construction sites.
Salinity/water control structures	If water control structures are designed and operated to maximize marine fishery migratory opportunities, while minimizing the worst salt water events, these projects can slow the loss of emergent marsh without severely impacting marine fishery productivity. However, care must be taken to ensure the structures do not create conditions that would adversely impact marsh habitats supportive of marine fishery resources. Additionally, operational plans should incorporate provisions to ensure the structures are open during appropriate times to allow drainage, facilitate freshwater inflow, and allow the maximum possible marine fishery ingress and egress. Without these provisions, these projects can significantly reduce the marine fishery productivity of the project area, even if the structures help maintain marsh habitats; the maintained habitats would not support production of marine fishery species, if the species do not have access to those critical nursery and foraging habitats.

Table 4-4
Items of consideration in the impact analysis of restoration opportunities on fisheries resources.

Beneficial Use/ Sediment Delivery/Marsh Creation, Restoration, or Nourishment	The use of dredged sediment would convert open water habitat to wetlands providing a more diverse habitat. The conversion would increase foraging, breeding, spawning, and cover habitat for a greater variety of fisheries species than would occur with no action, and potentially increase the marsh/water interface. The increased marsh/water interface is a greater benefit than marsh acres alone (Rozas and Minello 2001). Measures should be taken (i.e., creating tidal creeks and ponds) to maximize the fisheries productivity of the created marsh areas. Nutrients and detritus would be added to the food web, providing a benefit to local area fisheries. Fisheries access features and structure operation plans would be necessary to facilitate ingress and egress of various fisheries species to created wetlands within the proposed disposal areas. Short-term adverse impacts to fish would occur during the construction phase of these projects as a result of dredging activities (see dredging impacts).
Shoreline Protection/ Stabilization	Shoreline protection projects are likely to prevent the loss of marsh for protected areas. This helps maintain valuable fisheries habitat. Design of shoreline protection should incorporate low-sill openings, gaps, and/or allow historical channels to remain open for aquatic organism ingress and egress, and the adequate discharge of surface flow drainage.
Barrier Island Restoration	Barrier islands protect coastal marshes from storm surges and provide unique back barrier and sand bottom habitats. Barrier island restoration that involves supratidal vegetative plantings and sand retention structures alone will not directly affect fisheries species. However, the long-term impact to fisheries would be beneficial by maintaining the valuable habitats that would otherwise convert to open water. Restoration on a larger scale involving dredging of sand resources for placement on and around existing islands would impact the benthic areas of both the borrow and disposal areas. Subsequent benefits would result from the increase in back barrier shallow water and sand bottoms, and the increased protection to coastal marshes.

<u>ALT B (deltaic processes)</u>: Direct impacts to fisheries would likely include mortality due to burial or sudden salinity changes; injury or mortality due to increased turbidity (e.g., gill abrasion, clogging of feeding apparatus); modified behavior; and displacement due to changing environmental conditions. Sessile and slow-moving aquatic invertebrates may be disturbed by dredging and covered over by dredged material. Dredging and disposal activities, and the resultant increased turbidity, would temporarily displace mobile fishery organisms, but these species should return after disposal activities are completed.

American Oyster
Small diversions proposed in the upper hydrologic basins of the project area should not affect oyster populations, which were not historically, nor are presently, located in that area. The middle and lower basin diversions, and marsh creation sites could result in direct impacts through sedimentation onto oyster populations located closest to the proposed features. In addition to sedimentation, oyster populations within the influence area could be subjected to overfreshening, which can increase mortality, affect reproduction, and affect spat settlement. Mortality is anticipated to occur on oyster beds where dredged disposal is directly placed.

Localized benefits to oyster resources in the middle and lower basins in the deltaic plain may result from the proposed plan in areas that are currently too saline to sustain oysters. The extent of these impacts is dependent in part upon natural variations within basins, and the size, location, and operation of the diversion structures. Oyster surveys should be conducted to determine the spatial, temporal, and cumulative impacts to private and public oyster resources in the affected environment. These surveys could enhance management decisions regarding operation of proposed structures.

ALT D (geomorphic structure): Compared to other plans, this plan depends less on diversions of Mississippi River water (i.e., no new diversions are proposed) and more on marsh creation, barrier island restoration, and shoreline protection. Direct impacts to fisheries would likely include mortality due to burial; injury or mortality due to increased turbidity (e.g., gill abrasion, clogging of feeding apparatus); and short-term displacement associated with dredging and shoreline protection activities. Sessile and slow-moving aquatic invertebrates would be covered over by dredged material. Dredging and disposal activities, and the resultant increased turbidity, would temporarily displace fishery organisms, but these species should return after disposal activities are completed.

American Oyster
Few direct impacts to oyster resources in addition to those described for sessile and slow moving organisms mention above are anticipated.

LCA PLAN: This plan depends on a combination of marsh creation, barrier island restoration, and diversions of Mississippi River water. Direct impacts would include those discussed for ALT B and ALT D.

American Oyster
Direct impacts would include those discussed for ALT B and ALT D.

4.10.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Expected declines in fishery productivity may be reduced through the implementation of this plan, and the long-term sustainability of a productive fishery would be more likely than in the Future Without-Project conditions. Indirect benefits to fisheries should result from increased productivity, land building, and area of marsh and SAV habitats that are supportive of freshwater, estuarine, and marine fishery species. Subsidence and predicted sea level rise would be less likely to increase open water habitats.

Overall, this plan should benefit marine fishery resources in the Deltaic Plain and have minimal benefits to fishery resources in the Chenier Plain. Freshwater diversions can affect salinities in the project area significantly. Salinity is a fundamental environmental factor, because all organisms are 80 to 90 percent water, and internal salt concentrations must be maintained within a critical range. Each species, or life stage within a species, is adapted to a particular external environment. Most estuarine-dependent organisms can tolerate a wider range of external salinities than either freshwater or marine species.

Multiple diversions into single hydrologic basins have the potential to significantly freshen large areas within and possibly the entire basin and significantly reduce the diversity of habitats within that basin. Less freshwater tolerant species, such as brown shrimp and spotted seatrout, may be displaced from areas near diversions or entire hydrologic basins. The extent of this impact is dependent upon the diversion structures, location, size, and operation. Species, such as gulf menhaden, blue crab, white shrimp, and red drum that commonly utilize low to medium salinity areas and SAV habitats would likely benefit from this plan. Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish should benefit from implementation of this plan. This plan would indirectly impact species that are connected in the food chain to any directly affected species. Freshwater inflow is an important component of circulation and flushing processes in estuaries that assist in the transportation of planktonic organisms, nutrients, and detritus to the Gulf of Mexico. This would help support the aquatic food web of marine fishery species. Depending on size and operation of the structures, freshwater inflows can regulate salinity fluctuations and maintain a diversity of habitat types within the estuary, while improving marsh productivity. Inflows of sediment and nutrients create and maintain wetlands, which provide food and cover to juvenile fish, shrimp, crabs, oysters, and other biota. Transportation of beneficial sediments and nutrients to the estuary, and flushing of metabolic waste products from living organisms through the estuary, are other benefits of freshwater inflows. However, freshwater diversions affect water quality in ways that could disrupt the nursery functions of an estuary by affecting food and habitat availability. Some fishery species would be impacted by anticipated decreases in salinity and water temperature, and increased turbidity associated with some ALT B restoration features.

American Oyster
Indirect impacts to oysters may result from a decrease in productivity due to sedimentation and overfreshening. The decrease in productivity could increase the vulnerability of oyster populations to seasonal stresses, storm events, and predation. Continued sedimentation and overfreshening could reduce the ability of oyster populations located in influence areas to recover, which could result in permanent loss of oyster resources while the structures are operating. Some oyster populations located outside the overfreshening areas could benefit from the plan as saline waters become more estuarine. The extent of these impacts is partly dependent upon natural variations within water bodies, and the size, location and operation of the diversion structures. Oyster surveys and modeling where appropriate should be conducted to determine the spatial, temporal, and cumulative impacts to private and public oyster resources in the affected environment. These surveys could enhance management decisions regarding operation of proposed structures.

ALT D (geomorphic structure): Compared to other plans, ALT D depends less on diversions of Mississippi River water (i.e., no new diversions are proposed) and more on direct marsh and barrier island creation. Therefore, ALT D would have less impact in terms of habitat changes than other plans. ALT D will have less impact on those species, such as brown shrimp and spotted seatrout, which prefer more saline conditions than other estuarine-dependent species.

American Oyster
Few indirect impacts to oyster resources are anticipated.

LCA PLAN: Indirect impacts would include those discussed for ALT B and ALT D. Depending on how the diversions are operated, there could be a shift in species composition in portions of Subprovinces 1 and 2 to those more tolerant of fresher conditions. This may adversely impact production of spotted seatrout and brown shrimp, and improve the productivity of many other fishery species.

4.10.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. **Table 4-4** describes items considered in the impact analysis of restoration opportunities on fisheries resources. **Table 4-5** compares direct, indirect, and cumulative impacts of the restoration opportunities on fisheries resources.

ALT B (deltaic processes): Restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) have aided fisheries habitat and are likely to continue to do so. Economic interest in fisheries, and interest in Louisiana as a fishery resource for the Nation, has increased significantly in the recent past. This increase is expected to continue and lead to changes in fishing technology, fishing pressure, and fishing regulations, in order to maintain sustainable commercial fisheries. It is likely that the construction of levees, water control structures and hurricane protection features, which can result in direct loss of habitat, alter water flow, and have the potential to block fisheries access to habitat, are likely to continue and/or increase, as coastal residents protect themselves and their property from hurricane damage and flooding. With this plan there should be an overall benefit to fisheries compared to the future with no action.

American Oyster
This plan may adversely impact growing conditions within a large area of oyster grounds, due primarily to numerous and/or large-scale freshwater diversions. The diversions would have the potential to reduce salinities within receiving areas to levels, which are lethal to oysters across large areas of water bottom. As previously stated, this is partly dependent upon natural variations within water bodies; the size, location, and operation of the diversion structures; and the proximity of oyster grounds to the diversions. In addition to overfreshening, this plan could adversely impact oysters as a result of sedimentation and the disposal of dredged sediments. Each of these actions could bury oysters or clog filters through which they feed. Sedimentation impacts could be more localized than freshwater impacts, which could reduce the aerial extent of damage to oysters located near marsh creation sites.

Although significant negative impacts are foreseeable within the influence areas of diversions and sediment placement, localized benefits to oysters may be achieved, as estuarine conditions are created in areas previously too saline to support oyster production. Oyster surveys should be conducted to determine the spatial, temporal, and cumulative impacts to private and public oyster resources in the affected environment.

Table 4-5. Direct, indirect and cumulative impact of restoration opportunities on fisheries resources.

	Plans Components	Fisheries Resources			Essential Fish Habitat (EFH)
		Direct Impacts	**Indirect Impacts**	**Cumulative Impacts**	
ALT B	**Diversions=11, +5 diversions w/o structural impacts** **Dredging=1** **Beneficial Use/Marsh creation= 1** **Salinity/Water Control=1** **Shoreline Protection= 1** **Barrier Is. Restoration = 0**	Possible adverse impacts to benthic organisms as a result of marsh creation, sediment delivery, and dedicated dredging measures.	Diversity of habitat increased and productivity maintained compared to no action. Displacement of some species and habitat preservation from the 38,000 to 110,000 cfs freshwater introductions. Habitat preservation from shoreline protection and salinity control components of the Terrebonne marsh restoration opportunity.	In the LCA, a long-term increase in fishery productivity would be expected and a shift in species composition from those generally more tolerant of higher salinities to those generally more tolerant of lower salinities. A decrease would be expected in production of species, such as brown shrimp and speckled trout, in areas most influenced by freshwater diversions (reintroductions). The U.S. would benefit by maintaining the productivity and diversity of marine fisheries.	This plan would preserve some highly productive categories of EFH expected to be lost with no action.
ALT D	**Diversions=0** **Dredging=0** **Beneficial Use/Marsh creation= 4** **Salinity/Water Control=0** **Shoreline Protection= 4** **Barrier Is. Restoration = 2**	Possible adverse benthic impacts as a result of marsh creation, beneficial use and shoreline protection measures.	Habitat preservation from the barrier island restoration, marsh creation, shoreline protection, salinity control, and beneficial use components of all opportunities.	Although this plan would help preserve some of the habitat and fishery productivity expected to be lost with no action within the LCA, it is unlikely that impacts would be measurable for the U.S.	This plan would preserve some highly productive categories of EFH expected to be lost with no action in isolated areas of the LCA. This preservation is not expected to be sustainable.
LCA PLAN	**Diversions= 8, +3 diversions w/o structural impacts** **Dredging=1** **Beneficial Use/Marsh creation= 2 (1 each)** **Salinity/Water Control=0** **Shoreline Protection= 3** **Barrier Is. Restoration= 2**	Possible adverse impacts to benthic organisms as a result of marsh creation, barrier island restoration, shoreline protection and sediment delivery measures.	Displacement and habitat preservation from the 34,000 to 90,000 cfs freshwater introductions. Diversity of habitat increased and productivity maintained compared to no action. Habitat preservation from barrier island and shoreline protection projects.	In the LCA, a long-term increase in fishery productivity would be expected and a shift in species composition from those generally more tolerant of higher salinities to those generally more tolerant of lower salinities. A decrease would be expected in production of species, such as brown shrimp and speckled trout, in areas most influenced by freshwater diversions (reintroductions). The U.S. would benefit by maintaining the productivity and diversity of marine fisheries.	Of the near term plans, this plan best preserves some highly productive categories of EFH expected to be lost with no action.

Louisiana has a far more extensive and productive oyster lease program than any other state in the United States. Providing more than 50 percent of the Nation's oysters, any project that adversely impacts oyster resources in Louisiana would impact nationwide oyster harvest, in addition to reducing the contribution of this industry to the local, state, and national economy. Although in the long-term, oyster populations are anticipated to benefit from large-scale coastal restoration, significant impacts could affect the industry for the foreseeable future.

ALT D (geomorphic structure): Restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) have aided fisheries habitat and are likely to continue to do so. Economic interest in fisheries, and interest in Louisiana as a fishery resource for the nation, has increased significantly in the recent past. This increase is expected to continue, and lead to changes in fishing technology, fishing pressure, and fishing regulations, in order to maintain sustainable commercial fisheries. It is likely that the construction of levees, water control structures and hurricane protection features, which can result in direct loss of habitat, alter water flow, and have the potential to block fisheries access to habitat, are likely to continue and/or increase as coastal residents protect themselves and their property from hurricane damage and flooding. Although this plan would help preserve some of the habitat and fishery productivity expected to be lost with no action within the Louisiana coastal ecosystem, it is unlikely that impacts would be measurable for the U.S.

American Oyster
Few impacts to oyster resources are anticipated.

LCA PLAN: Cumulative impacts would include those discussed for ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.11 ESSENTIAL FISH HABITAT (EFH)

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." In coastal Louisiana, those waters and substrate consist of estuarine (tidally-influenced) marsh, submerged aquatic vegetation (SAV), sand, mud, and shell water bottoms, and estuarine water column; and marine sand, mud and shell water bottoms, beaches, and marine water column. Marsh loss is of particular concern in Louisiana, because the coastal marshes are the most extensive in the Nation and are believed to be largely responsible for the high production of estuarine-dependent species in the north-central Gulf of Mexico. Therefore, impacts to EFH are largely described by consideration of impacts to marsh.

All plans are projected to preserve marsh. No plans are likely to result in a significant net loss or gain of EFH, as the plans mainly consist of converting one type of EFH to another (e.g., water bottoms and water column to marsh or SAV). The best plan for preserving EFH, and Federally managed species dependent on EFH, would increase marsh area the most, while maintaining the greatest diversity of marsh types and maintaining the most land-water interface. In general, the LCA Plan and ALT B would protect categories of EFH for those Federally managed fishery species that are more freshwater tolerant or utilize SAV. In contrast, ALT D would protect categories of EFH for those Federally managed species that are more saltwater tolerant.

4.11.1 Future Without-Project Conditions – the No Action Alternative

Although previous restoration efforts in the LCA Study area have helped maintain some categories of EFH, the cumulative impacts of land loss, conversion of habitats, sea level change, increased storm intensity, etc., are expected to lead to a net decrease in the habitat most supportive of estuarine and marine species (**table 3-4**). The direct losses of highly productive forms of EFH would lead to losses of shallow habitat, due to the exposed nature of the shallow open water bottoms that are being formed. Shallow waters are likely to become deep waters, and salinity gradients would be less estuarine, with a sharper distinction between saline and freshwater habitat, as coastal residents further attempt to protect self and property with levees, flood gates, and other water control structures.

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

Without implementation of the proposed action, the conversion of categories of EFH, such as inner marsh and marsh edge, to estuarine water column and mud, sand, or shell substrates is expected to continue. Over time, the no action alternative would result in a substantial decrease in the quality of EFH in the project area, and reduce the area's ability to support Federally managed species.

The Future Without-Project conditions would indirectly impact species that are linked in the food chain to directly affected species. Population reductions in directly affected species, such as brown shrimp and white shrimp, affect species dependent on shrimp for food. As marsh, barrier islands, and other EFH are directly lost, less protection would be available to remaining EFH. These areas would be more susceptible to storm, wind, and wave erosion. A decrease in species productiveness would result as populations are stressed by habitat displacement and reduction.

The effect of human activity, coupled with natural forces, has been substantial to EFH. Water quality degradation, invasive species introductions, storms, and fishing activities contribute to the negative impacts on EFH. Water quality regulations and coastal restoration efforts are believed to minimize some of these negative impacts to EFH. A reduction in suspended sediment load of the Mississippi River and mining of river sediments reduces the net supply available to coastal marshes, and contributes to their loss. Artificial levees confining the river restrict river flow and reduce nourishment to barrier islands and delta building. Coupled with coastal degradation, subsidence, sea level change, shoreline erosion, and saltwater intrusion the no action alternative substantially decreases the quality of EFH and the ability of the LCA Study area to support Federally managed species.

4.11.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Some EFH would be lost due to the construction of water control features, diversion structures and ridges, where current forms of EFH (marsh, shallow open water, etc.) would be converted to uplands (i.e., nontidally influenced ridges) or cement structures. However, the loss of this EFH is in isolated areas and generally would be offset by increases in high quality EFH (e.g., marsh) over much larger areas.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B.

LCA PLAN: Direct impacts would be similar to ALT B.

4.11.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): ALT B is most likely to maintain the extent of marsh in the project area somewhat near present day conditions. These marshes are largely responsible for the high production of estuarine-dependent species in the north-central Gulf of Mexico. ALT B would improve the quality of some categories of EFH in some areas by reestablishing marsh, and protecting existing marsh. Categories of EFH, such as inner marsh and marsh edge, would not be converted to less productive forms of EFH (e.g., estuarine water column; and mud, sand, or shell substrates) as is expected with no action.

Some restoration features in ALT B, such as Terrebonne marsh restoration would have some localized adverse impacts to some categories of EFH. However, ALT B would maintain most categories of EFH that have been designated for white shrimp, brown shrimp, red drum, Spanish mackerel, and bluefish. In addition, categories of EFH that are maintained or improved in quality would be supportive of estuarine-dependent species such as spotted seatrout, gulf menhaden, striped mullet, and blue crab. Some of these species serve as prey for other species managed under the Magnuson-Stevens Act (e.g., mackerels, red drum, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). An increase in SAVs would increase the amount of habitat available for juvenile life stages to escape predation and therefore increase the quality of habitat. Freshwater diversion flow regimes, where multiple diversions would be discharging into single hydrologic basins, would have to be coordinated to minimize the displacement of marine fishery organisms and to maintain a diversity of types of EFH.

ALT B would help to ensure the long-term sustainability of important habitats and the managed species that depend on those habitats during some stage in their life. Over time, ALT B would preserve some highly productive categories of EFH in the project area and therefore enhance the ability of the LCA Study area to support Federally managed species. ALT B has the potential to displace brown shrimp from EFH by reducing salinities in many areas to a sub-optimal range for that species. White shrimp and red drum EFH may improve from the maintenance of marsh and SAV habitats beneficial to those species.

As marsh, barrier islands, and other EFH are protected and enhanced, more protection would be provided to other categories of EFH as they would be less susceptible to storm, wind, and wave erosion.

ALT D (geomorphic structure): This plan consists of beneficial use/marsh creation, shoreline protection, and barrier island restoration activities. ALT D would prevent the conversion of some marsh that would be expected to convert to less productive categories of EFH under the no action scenario. This conversion would be prevented in isolated areas of the Louisiana coastal ecosystem. ALT D is least likely to preserve the diversity and sustainable productivity of EFH.

LCA PLAN: Indirect impacts would include those discussed for ALT B and ALT D.

4.11.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes cumulative impacts to significant resources. Section 4.6 VEGETATION RESOURCES, further describes impacts to vegetative forms of EFH (e.g., marsh and submerged aquatic vegetation). The effect of human activity, coupled with natural forces, has been substantial to EFH. Water quality degradation, invasive species introductions, storms, and a general reduction in marsh, barrier island, and other habitats contribute to negative impacts on some categories of EFH (e.g., estuarine water column and marsh edge). Cumulative impacts of water quality regulations, land use regulations, and coastal restoration efforts are also discussed in subsection 4.10.4 FISHERIES RESOURCES. The LCA Plan may reduce adverse impacts to some categories of EFH on a local or larger scale.

ALT B (deltaic processes): ALT B protects some categories of EFH (e.g., marsh edge, inner marsh, SAV, and beaches) and the ability of the LCA Study area to support Federally managed species. ALT B would prevent the conversion of valuable inner marsh and marsh edge (i.e., categories of EFH for species such as brown shrimp, white shrimp, and red drum) to shallow open water and mud bottoms; decrease the vulnerability of and preserve some categories of EFH (e.g., SAV, beaches, mangroves, sand, silt, and mud bottoms) expected to be lost with no action. Freshwater diversion (reintroduction) flow regimes, where multiple diversions would be discharging into single hydrologic basins, would have to be coordinated to minimize the displacement of marine fishery organisms and to maintain a diversity of types of EFH.

ALT D (geomorphic structure): ALT D would preserve some categories EFH expected to be converted to less productive EFH with no action in isolated locations in the Louisiana coastal ecosystem. ALT D would create, restore, and/or preserve marsh, mangroves and beaches; all of which are categories of EFH of particular concern in Louisiana.

LCA PLAN: By increasing freshwater, sediment, and nutrient input to the Deltaic Plain and reducing shoreline erosion, LCA Plan would likely result in the least loss of coastal marshes in the LCA Study area. Cumulative impacts would include those discussed for ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.12 THREATENED AND ENDANGERED SPECIES

Appendix B1 contains a Programmatic Biological Assessment of threatened and endangered species and the potential impacts of each plan in the final array of coast wide plans. Appendices B2 and B3 contain copies of coordination letters from the USFWS and NMFS, respectively, for the Federally protected species under the jurisdiction of these agencies. The District would continue to work closely with those agencies with jurisdictional oversight (the USFWS and the NMFS) with regard to consultation requirements under Section 7 of the ESA. The LCA PDT would continue to aggressively avoid, minimize, rectify, reduce or eliminate the impact, or if unavoidable, compensate for the impact, in this order as specified in 40 CFR Part 1508.20. An additional Biological Assessment/Biological Evaluation would be prepared when individual projects tiered to the Final Plan and FPEIS could affect a Federally-listed threatened or endangered species and/or could adversely affect designated critical habitats.

4.12.1 Future Without-Project Conditions – the No Action Alternative

Generally, continued coastal land loss and deterioration of critical coastal habitats, especially barrier shorelines/islands, is anticipated to impact all threatened and endangered species, which utilize coastal Louisiana. In particular, the brown pelican, bald eagle, piping plover, and all sea turtles would most likely be impacted to the greatest extent, as these species utilize the rapidly deteriorating barrier islands.

4.12.2 Restoration Opportunities – Direct Impacts

Direct impacts to threatened and endangered species would be generally confined to actual construction activities of any of the restoration features. For example, direct impacts would include the short-term, unavoidable disruption and displacement of species during construction activities (e.g., the potential incidental takes of sea turtles during dredge and placement operations during barrier system restoration). However, it is unlikely that any of the restoration opportunities would have any significant adverse, direct impacts to any threatened or endangered species. On the contrary, all restoration measures would provide a net increase of coastal wetland habitats used by these species.

ALT B (deltaic processes): There would be no direct impacts of ALT B.

ALT D (geomorphic structure): Direct adverse impacts of the ALT D would be principally confined to actual construction activities of any of the restoration measures. This is most applicable to the following species:

- Critical habitat (beach habitat on barrier islands/shorelines) for wintering populations of the piping plover. However, construction would be accomplished in reaches. These highly mobile birds would likely depart the restoration construction sites and return following completion restoration of the site. The District is presently coordinating with the USFWS regarding procedures and activity windows (time frames best suitable for construction to minimize disturbance to species).

- Sea turtles may be found on Louisiana coastal shorelines as well as in various coastal waters. The District has a long history of dredging and dealing with avoiding adverse impacts to sea turtles during dredging operations. In addition, we would maintain close coordination with NMFS to avoid potential impacts to sea turtles during dredging operations for restoration.
- Restoration of brown pelican nesting sites (islands) would be similar as described for piping plover critical habitats. The District has previously succeeded in restoring brown pelican nesting habitat on Queen Bess Island as part of a joint effort between the CWPPRA and Barataria Channel maintenance dredging operations.

LCA PLAN: Direct impacts would be a synergistic similar to ALT D.

4.12.3 Restoration Opportunities – Indirect Impacts

Indirect impacts to threatened and endangered species would primarily result from long-term and far field effects of restoration measures. For example, construction of restoration structures such as freshwater and sediment diversions would unavoidably alter existing salinity regimes and the vegetation patterns in some areas. Barrier system restoration would alter the configuration of barrier shorelines, headlands, and islands. However, it is unlikely that any of the restoration opportunities would present significantly adverse indirect impacts to any threatened or endangered species. On the contrary, all restoration measures would likely provide a net increase of coastal wetland habitats used by these species.

ALT B (deltaic processes): There would be negligible, if any, indirect impacts with ALT B.

ALT D (geomorphic structure): ALT D would provide an opportunity for the USFWS and NMFS to partially meet some of their objectives in the Restoration Plan for each of these respective species. In particular, it is likely that restoration of barrier shorelines, headlands, and islands in Subprovince 2 and 3 would significantly reduce the local competition for these scarce and eroding barrier system habitat types and the resources they provide. Reduction in inter- and intra-species competition would positively impact barrier shoreline-dependent species such as the piping plover, brown pelican, and sea turtles.

LCA PLAN: Indirect impacts would be similar to ALT D.

4.12.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan. Cumulative impacts to threatened and endangered species would primarily be related to the incremental impact of all past, present, and future restoration activities, such as the beneficial use of dredged material for creation of bird islands; other Federal, state, local and private restoration actions such as CWPPRA restoration projects; Civil Works Section 204/1135 restoration projects; mitigation actions; and others.

ALT B (deltaic processes): There would be negligible, if any cumulative impacts with ALT B. Hence, based upon the potential direct, indirect, and cumulative impacts, implementing ALT B is not likely to adversely affect threatened or endangered species or their critical habitat.

ALT D (geomorphic structure): ALT D would significantly enhance, as well as create critical piping plover beach habitat in Subprovince 2 and 3. In addition, piping plovers, brown pelicans, and sea turtles would likely benefit from increases in available coastal wetland habitats, especially barrier shorelines, headlands, and islands. Most other species would not be impacted. Louisiana coast wide ecosystem restoration would help moderate impacts experienced nationwide for these three species in particular. However, these gains would be contrasted with the continued loss of the Subprovince 1 barrier system (e.g., Chandeleur Islands barrier system) as well as other gulf barrier system habitats. Hence, based upon the potential direct, indirect, and cumulative impacts, implementing ALT D is not likely to adversely affect threatened or endangered species or their critical habitat.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D. Hence, based upon the potential direct, indirect, and cumulative impacts, implementing the LCA Plan is not likely to adversely affect threatened or endangered species or their critical habitat.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.13 HYDROLOGY RESOURCES

4.13.1 Flow and Water Levels

4.13.1.1 Future Without-Project Conditions – the No Action Alternative

Should the trend of increased precipitation and period of climate warming continue, there would be continued increase in runoff, which may affect the total volume of freshwater in each subprovince, as well as flood peaks. Increased urbanization could also increase runoff, especially in Subprovince 1. Construction of oil and gas canals, flood protection works, navigation channels, coastal storms, increased vessel traffic, subsidence, and loss of vegetation due to saltwater intrusion can increase land loss, which in turn would affect hydrologic processes. Clearing forested land, conversion of forested wetlands to marshland and marshland to open water, and change in agriculture can also affect runoff. Coastal wetlands generally subside at a different rate than the adjacent ridges, which can increase the peak of the runoff. The loss of coastal wetlands would increase the influence of gulf waters during low to average runoff periods.

In Subprovince 3, the growth and development of the Atchafalaya deltas and the natural evolution of the Lower Atchafalaya River would increase water levels along the river, which in turn would increase the volume of water being conveyed by the GIWW to the east and west of the floodway.

4.13.1.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would be minimal, provided that measures are taken during construction to minimize impacts to drainage within the construction site and that the designs of the features account for disruptions to existing flow patterns during the construction period.

ALT D (geomorphic structure): Direct impacts would be similar, but less than ALT B, because there would be fewer restoration features.

LCA PLAN: Direct impacts would be similar to ALT B.

4.13.1.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): The major indirect impact would be the increase in the volume of water entering the receiving area for each diversion in Subprovinces 1,2, and 3. The increase in volume of water entering the receiving area may result in changes to water levels. The magnitude of the water level change would depend on the location of the diversion, the magnitude of the diversion, the operational plan of the diversion structure, the physical characteristics of the receiving area, and what changes to the receiving area are incorporated into the design. All diversions would have the potential of increasing water levels over time over some part of the receiving area. Receiving areas with direction connections to the Gulf of Mexico would experience small changes to water levels unless the flow is channelized. In the receiving areas, over time, water levels may decrease in the proximate area of the diversion structure and increase in an area some distance away from the diversion structure. These impacts would be a result of the development of the distribution channels.

Depending on the operational plan for the diversion structures, this plan would decrease flow in the Mississippi River and could decrease flow year-round. The decrease in flow in the river would increase the tidal prism entering the river system through Southwest Pass, and as a result, tidal velocities in Southwest Pass may increase. This plan would lower water levels on the Mississippi River below the diversions as a result of the reduced flow. Water levels would initially decrease, and then rise over time. Deposition in the Mississippi River channel would result in an overall smaller river channel. As the channel gets smaller in response to the lower flow, water levels on the Mississippi River would rise and could ultimately be higher than existing water levels.

The volume of water moving through the passes of the Mississippi River would decrease, due to the additional number of diversions upriver. This may increase the amount of time the passes would be influenced by tidal exchange and may increase the tidal prism and the velocities associated with the tides.

Gapping dredged material disposal banks on the Amite River Diversion Canal would generally lower water levels along the river in the vicinity of the gaps, and improve the movement of water. During rainfall events, runoff would reach the river faster due to the presence of the gaps and may have the potential of reducing peak stages in the backswamp area. The shape of the Amite River hydrograph would be affected such that peak stages along the river may increase.

Water levels in Bayou Lafourche may increase, depending on channel size. The operation of the HNC Lock structure may increase water levels on the freshwater side of the structure, and may increase the movement of gulf waters into other areas of the subprovince.

The altered hydrology may also increase the amount of time that it would take to evacuate storm surge waters that overtop levees or ridges, or runoff from significant rainfall events.

ALT D (geomorphic structure): There would be localized changes in water flows and sediment deposition patterns due to each individual geomorphic restoration feature of ALT D.

LCA PLAN: Indirect impacts would be similar to both ALT B and ALT D with the exception that diversions do not have direct connections to the Gulf of Mexico. Changes to water levels will therefore depend on the capacity of the channels in the receiving area to convey the increased flow.

4.13.1.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Cumulative impacts would primarily be related to the incremental impact of all past, present, and future actions affecting flow and water levels, such as: existing freshwater diversions (e.g., Caernarvon, Davis Pond, West Bay, etc.); those diversions currently in planning or under construction (e.g., Maurepas, etc); and similar actions. Hence, the cumulative impacts of ALT B would be the incremental increase of freshwater supply and the decrease of saltwater supply to the coastal area.

ALT D (geomorphic structure): Cumulative impacts would be similar, but less than ALT B in that water and sediment transport out of the system would decrease whereas in ALT B water and sediment flows into the system would increase.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.13.2 Sediment

4.13.2.1 Future Without-Project Conditions – the No Action Alternative

Changes in sediment transport and deposition patterns would reflect, in part, changes to flow conditions. In the future, where flow increases, suspended sediment load is likely to increase. Deposition would increase where the flow is conveyed. Should the trend of increased precipitation and period of climate warming continue, overall flow in the rivers and channels would remain above long-term averages, which in turn would result in maintaining an increased sediment load.

In the estuarine areas, changes in deposition patterns of silts and clays would be influenced by changes in velocity and salinity. In the areas where decreased velocity or increased salinity is predicted, deposition would increase. This could result in shifting deposition away from present depositional areas to these new depositional areas. Rivers north of Lake Pontchartrain would continue to convey sediments into Lake Pontchartrain, as would the Bonnet Carré Spillway.

With the exception of the new West Bay Diversion Channel, the existing subdelta channels of the Mississippi River would continue to be essentially ineffective in transporting sediment of sufficient quantity and type to offset subsidence. Existing freshwater diversions, such as Caernarvon and Davis Pond, would continue to provide some sediments to Subprovinces 1 and 2, and the effectiveness of these diversions should be essentially the same as today.

As the Atchafalaya River grows and develops, its ability to transport sediment would decrease. Sediment delivered to the Atchafalaya Bay would be lower than existing conditions, and the sediment would be finer. Additional sediment would be conveyed in the GIWW east and west of the Atchafalaya as flow increases.

4.13.2.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would be minimal, provided that erosion protection measures would be utilized during construction to minimize impacts to drainage within the construction site, and the design of the restoration features would account for disruption to existing sedimentation patterns during the construction period. Dedicated dredging and beneficial use of dredged material could also disrupt sedimentation patterns. However, dedicated dredging and beneficial use would be conducted to meet all requirements of the CWA and the Inland Testing Manual.

ALT D (geomorphic structure): Direct impacts would be similar to but fewer than ALT B, because there would be fewer features.

LCA PLAN: Direct impacts would be similar to ALT B.

4.13.2.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): All diversions in ALT B would increase the volume of sediment entering the receiving area. Such increases in the sediment volumes would depend on the location and physical characteristics of the diversions, as well as the time of year that the diversion would operate. The concentration of sediment in the Mississippi River would decrease in the downstream direction. Diversions at such locations as Whites Ditch may convey a greater concentration of sediment than at American/California Bays. Diversions located on the inside of bends would have deeper channels and would, therefore, divert a greater percentage of the river bedload material (sands).

Sediments entering the receiving area would have the potential to enhance or increase wetland acreage depending upon the following factors. The location and extent of sediment deposition, and the development of subaerial land would depend upon the physical characteristics of the receiving area and the type of sediment diverted. For the majority of diversions, sediment deposition could occur in wetlands, channels, lakes, and bays. Silts and clays would more likely be trapped in wetlands, and in those areas where salinity levels would be high enough to aggregate the clay particles. Sands would initially deposit in close proximity to the diversion site. However, as bifurcations developed, sand deposition would extend farther away from the diversion site. Sand deposition would enhance subsidence. The presence of canal networks in the receiving area could confine sediments to the channels, increasing sediment deposition and reducing the effectiveness of the diversion in creating wetlands. Sediment deposition would occur naturally in estuaries. However, many restoration features would likely alter the natural characteristics of estuaries, thereby affecting the locations for estuarine sediment deposition.

For some of the features of ALT B, channels would be constructed to direct sediment to targeted areas. As long as the transport capacity of such channels equal or exceed the volume of sediment to be transported, the sediments would be transported to the targeted area. However, it is likely that deposition may occur within these channels during part of the year. Also, depending on the head across the diversion structure, scour may actually occur downstream of the structure in the diversion outflow channel if velocities are high enough to scour the channel bed. Until the channel bed stabilizes, this would result in increased sediment delivery initially, but would also result in a flatter channel slope, which could affect the overall transport capacity of the outflow channel. Over time, the effectiveness of the outflow channel to convey sediments would decrease.

Diversions have the potential for increasing sediment deposition in the parent stream, downstream of the diversion. All diversions from the Mississippi River would have the potential of adversely affecting river navigation, as generally, sediment deposition would occur in the Mississippi River downstream of the diversion. The magnitude and extent of the sediment deposition, and its effect on navigation, would depend on the location and physical characteristics of the diversion.

ALT B would also show a minor potential for increased tidal effects in the Mississippi River passes; but, the location and extent of shoals would likely change from those presently observed.

Sediment deposition is likely in the Amite River Diversion Canal and Hope Canal if transport capacity is insufficient to convey sediments.

Sediment deposition would likely occur in Bayou Lafourche if the channel were not capable of transporting the additional sediment accompanying the increased flow. The operation of the HNC Lock structure may increase sediment deposition on the freshwater side of the structure and may increase scour due to increased tidal effects in channels on the gulf side. However, sediment from such scour would continue to deposit in the estuarine area. Sediment deposition may occur on the freshwater side of salinity control and freshwater introduction structures and the lock. In addition, scour may occur on the saltwater side or in the targeted area. Sediments may also be trapped in the targeted areas for freshwater introduction. In all subprovinces, sedimentation may increase in the existing channels and canals.

A well designed dedicated dredging program and beneficial use program for wetland restoration could minimize changes in sedimentation patterns as well as reduce sedimentation.

ALT D (geomorphic structure): Indirect impacts would be relocating estuarine sediment depocenters. Tidal prism modification would result in redistribution of sediments.

LCA PLAN: Indirect impacts would be similar to both ALT B and ALT D.

4.13.2.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): The cumulative impact would be an increase in sediment supply to the coastal area available for land gain, an increase in sediment supply to forested wetlands, and a decrease in sediment supply to the Mississippi River. The diversions in this alternative would decrease the volume of sediment thereby decreasing the sediment load in the Mississippi River available for diversions in the existing distributaries and in existing diversion projects, such as West Bay Sediment Diversion. Changes to sedimentation patterns by dedicated dredging and beneficial use would be in addition to ongoing navigation channel dredging and other dredging projects.

ALT D (geomorphic structure): Cumulative impacts would be similar, but less than ALT B in that sediment transport out of the system would decrease whereas in ALT B sediment supply into the system would increase.

LCA PLAN: Cumulative impacts would be similar, but greater than both ALT B and ALT D as sediment input is increased and sediment output is decreased.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.13.3 Water Use And Supply

4.13.3.1 Future Without-Project Conditions – the No Action Alternative

In many coastal areas of southeastern Louisiana, fresh surface water supplies would be limited to the Mississippi River, Atchafalaya River, and many of their distributaries. Because many of these water bodies are controlled by levees and their flows are maintained, it is doubtful that they would be affected by loss of surrounding wetlands. Because these water bodies are the major sources of freshwater in southeastern Louisiana, water use would be largely unaffected. However, Bayou Lafourche currently experiences periodic saltwater intrusion, primarily from Company Canal and the GIWW. Salinities in this bayou could increase, limiting freshwater supplies, if the surrounding area becomes saltier. Because fresh groundwater is very limited or unavailable in most of the Bayou Lafourche area, the larger water users in this area, primarily industry and public supply, would have to treat the water for salinity or find new sources of freshwater.

In southwestern Louisiana, fresh surface water and groundwater are available in most coastal areas. However, surface water in some areas, such as the Calcasieu Basin, experience periodic saltwater inundation. Much of the water use in these areas is agricultural and farmers use groundwater when surface supplies become salty. If surface water salinities increased in coastal areas because of wetland loss and erosion, it is likely that surface water withdrawals would decrease and withdrawals from groundwater would increase. Fresh groundwater is available in sufficient supplies in most areas of southwestern Louisiana to offset any losses of surface supplies. However, a saltwater-freshwater interface is present in the aquifer system, extending inland from the coast along the base of the aquifer system as a wedge. In coastal areas, freshwater overlies saltwater. Increased withdrawals in coastal areas could cause the interface to move further inland or the interface to rise toward pumping wells. This could affect agricultural use in that area resulting in increased costs for water treatment. Potentially this agricultural activity could decline, thus adversely affecting the local economy through declines in jobs, income, population, and property values.

4.13.3.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would be minimal, provided that measures are taken during construction to minimize impacts to any existing water use in the area, and that the design of restoration features account for any disruptions of water use and supply during the construction period.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B.

LCA PLAN: Direct impacts would be similar to ALT B.

4.12.3.3 Restoration Opportunities – Indirect Impacts

Both surface and groundwater are used throughout the Deltaic Plain. It is unlikely that any of the restoration opportunities would have an impact on groundwater use, unless a restoration feature would provide a more effective source of freshwater. Most of the surface water used in the Deltaic Plain is withdrawn from the Mississippi River or its distributaries. Hence, any plan that would cause Mississippi River water levels to decline below pump intakes, or would induce saltwater intrusion up the river from the Gulf of Mexico, could affect freshwater use. The southernmost intakes along the Mississippi River that are currently used for public water supply are located in southern Plaquemines Parish. In the past, these freshwater intakes have been impacted by saltwater intrusion during prolonged periods of low river flows. Consequently, water from the Mississippi River should only be diverted when the river stage and discharge rate would be sufficient to minimize the potential for the reduction or loss of water supplies to downstream users. Otherwise, alternative sources of freshwater supply to these areas would be required.

ALT B (deltaic processes): Medium diversions of Mississippi River water may negatively impact freshwater supplies to downstream users of Mississippi River water. Increased flows into the receiving areas of Subprovinces 1 and 2 may enhance freshwater supply to users in those areas. Increased flows into Bayou Lafourche and the Terrebonne marshes would enhance freshwater supplies to users in those areas. Reduced saltwater intrusion into areas, such as Houma, may prolong freshwater supply to users in those areas.

ALT D (geomorphic structure): There would be negligible, if any, indirect impacts with ALT D.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.13.3.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Cumulative impacts to water supply would primarily be related to the incremental impact of all past, present, and future actions effecting water supply such as: existing freshwater diversions (e.g., Caernarvon, Davis Pond, West Bay, etc.); those diversions currently in planning or construction (e.g., Maurepas, etc); and similar actions. Hence, for ALT B, potential cumulative impacts would be the incremental decrease of freshwater supply in areas with water intakes along the Mississippi River (e.g., Pointe a la Hache, Port Sulphur, Venice, etc.). However, any potential adverse impacts to community and industrial water supplies would be mitigated. In Subprovince 3, it is anticipated that the proposed features would increase freshwater supply to areas such as Houma.

ALT D (geomorphic structure): There would be negligible, if any, cumulative impacts.

LCA PLAN: Cumulative impacts would be similar to ALT B.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.13.4 Groundwater Resources

4.13.4.1 Future Without-Project Conditions – the No Action Alternative

In general, the impacts of wetland or coastline loss on groundwater conditions would be indirect, but could be significant in some areas. If wetland or coastline loss resulted in saltwater intrusion into current surface water supplies, users would have to find alternate sources of water and could strain or deplete limited groundwater resources in some areas. In some aquifers, such as those in the Chicot aquifer system, increased pumping of ground water near the freshwater-saltwater interface could result in saltwater encroachment into freshwater portions of the aquifers. Furthermore, the impacts of coastal land loss on groundwater resources, such as coastal aquifers would also be exacerbated by sea level rise.

4.13.4.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would be unlikely. However, should the potential exist for direct impacts to occur during construction, they could be minimal if appropriate measures were taken during construction to minimize such impacts, and if the designs of restoration features were to account for any disruptions to groundwater resources during the construction period.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B.

LCA PLAN: Direct impacts would be similar to ALT B.

4.13.4.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): It is unlikely that ALT B would have any indirect effects on groundwater, unless groundwater withdrawals were to be reduced. However, implementation of ALT B would restore coastal wetlands that would potentially reduce saltwater intrusion into surface water supplies and aquifers.

ALT D (geomorphic structure): Indirect impacts would be similar to ALT B.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.13.4.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Cumulative impacts to groundwater would primarily be related to the incremental impact of all past, present, and future actions effecting groundwater such as localized impacts to groundwater recharge. However, overall there would likely be no significant project-induced direct or indirect impacts to the aquifers throughout any subprovince; hence, no additional project-induced cumulative impacts would be expected.

ALT D (geomorphic structure): Cumulative impacts would be similar to ALT B.

LCA PLAN: Cumulative impacts would be similar to ALT B.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.14 WATER QUALITY RESOURCES

4.14.1 Future Without-Project Conditions – the No Action Alternative

Without the proposed actions of the LCA Plan, the coastal plain of Louisiana would still be affected by activities, natural and man-influenced, that would have both beneficial and detrimental effects to water quality conditions. Some of these activities include: other Federal, state, local, and private restoration efforts such as CWPPRA, USACE ecosystem restoration projects, various NRCS programs (e.g., Coastal Wetlands Restoration Program), and LDNR projects; state and local water quality management programs; national level programs to address hypoxia in the northern Gulf of Mexico; the continued erosion/subsidence of the coast; oil and gas development; industrial, commercial, and residential development; and Federal, state, and municipal navigation and flood-damage reduction projects. The future quality of Louisiana's coastal waters depends on a responsible, watershed approach to managing these activities.

There are a number of present and future activities that would continue to occur without the proposed actions of the LCA Plan and would affect surface water quality conditions in the coastal plain of Louisiana. The cumulative impact of these activities without the LCA Plan is discussed below.

Passage of the Federal Water Pollution Control Act (FWPCA) in 1948 and its amendments including the CWA and the Water Quality Act of 1987 and the establishment of state and Federal environmental protection agencies resulted in water pollution control regulations, including:

- The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution. In 1997 the USEPA granted NPDES delegation to LDEQ, which is known as the Louisiana Pollutant Discharge Elimination System (LPDES).
- LDEQ's Nonpoint Source Pollution Program is continuing to implement watershed initiatives to address nonpoint source pollution sources such as agriculture, home sewage treatment, hydromodification, urban runoff, construction activities, and resource extraction.
- LDNR's Coastal Nonpoint Pollution Program is responsible for identifying Best Management Practices (BMPs) appropriate for all applicable pollutant source categories and carrying out initiatives of public education, technical assistance, and development of enforcement protocols.
- Total Maximum Daily Loads (TMDLs)-Section 303(d) of the CWA requires states to identify, list, and rank for development of TMDLs waters that do not meet applicable water quality standards after implementation of technology-based controls.
- Barataria-Terrebonne National Estuary Program (BTNEP) is a coalition of government, private, and commercial interests active in collecting/publishing information, as well as educating the public to protect the Barataria and Terrebonne Basins.
- Lake Pontchartrain Basin Foundation (LPBF) is a local organization dedicated to restoring and preserving the Lake Pontchartrain Basin and its lands and waters. The organization is responsible for numerous programs such as water quality monitoring, habitat protection, environmental education, and public events and outreach (personal communication Andrea Bourgeois from LPBF, 2004).
- The USEPA-formed Hypoxia Task Force is leading a national task force to address hypoxia in the northern Gulf of Mexico, which is attributed to the excessive nutrients in the Mississippi – Atchafalaya River Basin. Refer to the Hypoxia section (section 3.16) of this document for further information.

The programs discussed above would continue to develop or remain in place with or without the proposed LCA Plan project features to ensure protection of Louisiana's public health and natural resources. Water quality conditions would likely improve with the programs in place. However, some activities that may potentially have negative effects on water quality would also continue to occur with or without the proposed LCA Plan. Other efforts that would probably improve water quality conditions would be the present and future Federal, state, local, and private ecosystem restoration projects.

- Industrial, commercial, and residential development along the coast. With this activity comes increased point and nonpoint source pollution from sources such as wastewater treatment facilities and urban runoff from new development. Also, activities associated with maintaining and improving navigation along the coast would continue to occur.
- Flood–damage reduction projects would continue to be planned, designed, and constructed especially in areas highly susceptible to flood damages due to hurricanes and tropical storm events. With these activities, more alterations to the hydrology of the coast would potentially occur leading to areas of degraded water quality. Some projects, such as the Morganza to the Gulf Hurricane Protection Project, are incorporating resource-sustainable design techniques that may aid in protecting significant resources such as surface waters of the state. Other projects, such as the Southeast Louisiana Urban Flood Control Project, are providing flood protection for a 10-year rainfall event. However, this is also increasing the flow of urban runoff that is diverted into Lake Pontchartrain and other surrounding water bodies without providing pollutant reduction measures as seen in many stormwater collection systems across the Nation. Unfortunately, metro New Orleans' unique geographic setting does not allow for incorporating many pollutant reduction methods; however, the NPDES Storm Water Program and the continued development of TMDLs may require stormwater professionals to find innovative methods, such as subsurface structural BMP to drain the populated areas effectively while protecting the receiving water bodies as much as practicable. Adverse impacts to water quality by these Federal projects would be mitigated as legally mandated.
- The most notable activity that would continue to occur without the proposed LCA Plan is the ongoing erosion/subsidence or land loss of the coastal areas. This would continue to unearth the expansive oil and gas infrastructure along the coast of Louisiana. This would be a precarious situation, especially during storm events and within navigable waterways. Exposed pipelines are vulnerable to navigation vessels striking them, which could lead to discharges into the Gulf of Mexico as well as other coastal, state water bodies. In the event of discharges, extensive ecological damage would probably occur. The owner(s) of the infrastructure could incur expensive fines and cleanup costs; and vessel operators could be seriously injured. There are other forms of infrastructure that could potentially be exposed due to coastal erosion including wastewater collection systems and other commercial industry related systems.

4.14.2 COMPARISON OF NEAR-TERM RESTORATION OPPORTUNITIES

Generally, four water-quality conditions could change with implementation of the proposed restoration alternative plans. However, the extent and magnitude of any such changes could vary with the particular plan. The four water quality conditions that would change include:

1. Freshwater areas would increase;
2. Salinities would remain similar to the Future Without-Project conditions, except there would be a slight freshening in the following areas: Lake Borgne, northern portions of Breton Sound, Caminada Bay and nearby headland areas, the upper reaches of Terrebonne and Timbalier Bays, and possibly in the Cote Blanche and Vermilion Bays complex;
3. Sediments in the coastal zone would increase, with accompanying minor increases in trace metals associated with bed sediments; and
4. Agrochemicals in the water could increase.

Introduction of river water into the estuarine systems would immediately change the water chemistry of receiving areas. Change may be beneficial or detrimental, depending on human perceptions and the water uses. For example, change from a less fresh to a fresher system could be perceived as beneficial to wetland nourishment, but detrimental to recreational use because of water color changes, and possible changes in fish species assemblages in the recreational area (see sections 4-10, Fisheries Resources, and 4-17, Recreation Resources). Such changes in water chemistry would, therefore, mimic what occurred naturally and prior to the construction of levees.

Potential adverse chemical effects could include an increase or decrease in the methylation of mercury in bed sediments. According to the National Institutes of Health, methylation of mercury occurs when inorganic mercury compounds become methylated, i.e. bound to a carbon atom, by microorganisms indigenous to soils, fresh water, and salt water under both aerobic and anaerobic conditions (National Institutes of Health, Dept. of Health and Human Services, U.S. National Library of Medicine 2004). Methylmercury bioaccumulates and biomagnifies in aquatic food webs and is a highly toxic substance with a number of adverse health effects associated with its exposure in humans and animals (USEPA 2001). It would be impossible to predict such increases or decreases in methylation of mercury on anything but a site-specific basis. The potential for increase in mercury methylation could occur with the creation of new wetlands. Reintroduction of river water may increase the risk of conditions favorable to the causes of methylation.

Stabilization of salinity regimes would probably aid resource managers, commercial and recreational fisheries managers, and water users in making long-term decisions. Salinity could be either beneficial or detrimental, depending on the user group. Salinity is not necessarily a pollutant in coastal waters. However, salt is highly toxic to rice in small amounts. Freshwater marshes are also sensitive to salinity levels, but varying seasonal levels of salinity have positive impacts on various commercial and recreational fisheries. On balance, the stabilization of salinities, or the relocation of saltier water zones gulfward, would benefit the majority of user groups throughout the LCA Study area.

The reintroduction of streambed sediments into the LCA study area may add some contaminants; these could include primarily trace metals and hydrophobic organic compounds from Mississippi River streambed sediments. Trace metals and hydrophobic organic compounds such as pyrenes, hexachlorobenzene, and chlorinated hydrocarbons such as DDT, or its degradates, would adsorb onto sediment particles or the organic coatings of sediment particles (Demas and Demcheck 2003). The types and concentrations of contaminants potentially released from other water body streambeds would vary with project location and would be site specific.

As mandated by Section 404(b)(1) of the CWA, the District is required to demonstrate that the reintroduction of sediments into a proposed study area "will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern." The Section 404 (b)(1) Guidelines (40 CFR 230) are the environmental criteria for evaluating the proposed discharges of dredged or fill material into waters of the United States. Compliance with these guidelines is the controlling factor used by the District to determine the environmental acceptability of disposal alternatives. The District must demonstrate through completion of a Section 404 (b)(1) evaluation that any proposed discharge of dredged material is in compliance with the guidelines. To comply with the Guidelines the proposed discharge must satisfy four requirements as follows:

1. Section 230.10 (a) – addresses impacts associated with loss of aquatic site functions and values at the proposed disposal site and requires that the discharge represent the least environmentally damaging, practicable alternative.
2. Section 230.10(b) – requires that the discharge not violate state water quality standards.
3. Section 230.10(c) – requires that the discharge not significantly degrade the aquatic ecosystem.
4. Section 230.10(d) – requires all practicable means be used to minimize adverse environmental impacts.

Section 230.60 of the guidelines provides for an evaluation of the material to be dredged using existing information on the proposed dredging and disposal sites to determine if the material proposed for discharge requires additional testing. If the conditions for exemption from testing in accordance with Section 236.60 can be met, that is, if review of existing information indicates there is no reason to believe that the proposed dredged material is a carrier of contaminants, no further testing of the dredged material would be performed. If the conditions for exemption from testing in accordance with Section 230.60 cannot be met, that is, if review of existing information indicates there is a reason to believe that the proposed dredged material is a carrier of contaminants, then physical, chemical and biological evaluations of the dredged material at Section 230.61 would be performed.

Section 230.61 mandates that the District use an effects based testing protocol to determine the impacts of proposed discharges of dredged or fill material into waters of the U.S. whether the discharge is directly into open water or into an upland confined disposal facility that results in effluent being discharged via a weir back into waters of the U.S. The protocols in the USACE/USEPA technical guidance document, "Evaluation of Dredged Material Proposed for

Discharge in Waters of the U.S. – Testing Manual," (USEPA/USACE 1998), also referred to as the "Inland Testing Manual" (ITM), constitute an "effects based" approach that depends on a preponderance of evidence acquired through physical, chemical, and biological assessments as required by Sections 230.60 and 230.61 of the guidelines. For example, sediment quality guidelines (SQGs) may be used as a simple first screen of potential effects to benthos using the chemical analysis of sediments (Steevens 2003). However, from the Society of Environmental Toxicology and Chemistry (SETAC) Pellston Workshop on the "Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments," states:

> Because of the uncertainties inherent in different SQG approaches and the unique or varied environmental and ecological conditions that characterize different freshwater, estuarine, and marine environments, sediment management decisions should be based on site-specific information generated to evaluate the predictive ability of SQGs at a site of interest" (Wenning and Ingersoll 2002). Other lines of evidence may need to be developed such as toxicity and bioaccumulation data for an accurate sediment evaluation. USACE policy is that, "

SQGs cannot be used deterministically in dredged material management decision-making" (Fuhrman 1998). Conclusions reached using the ITM guidance document are used during the Section 404 (b)(1) evaluation process to make factual determinations regarding the potential effects of the proposed discharge of dredged or fill material on the physical, chemical, and biological aspects of the aquatic environment.

The factual determinations are the basis for findings of compliance or noncompliance with relevant parts of Sections 230.10(b)(compliance with applicable USEPA WQC or state WQS) and 230.10(c)(determination of potential contaminant-related impact to aquatic resources). Disposal site monitoring and/or management measures developed based on results obtained through following the protocol in the ITM also contribute to satisfying the requirements of Section 230.10(d).

The introduction of agrochemicals into the LCA Study area from any of the restoration opportunities would be a management issue. The primary source of agrochemicals into the LCA Study area would be from the corn belt of the mid-continent United States. Currently, agricultural chemicals, primarily herbicides and fertilizers, are being introduced into the LCA Study area from the Mississippi/Atchafalaya River systems. These agricultural chemicals are then being further distributed into portions of the LCA Study area via the GIWW and Bayou Lafourche. This input of agrochemicals, known as the spring flush, would be further distributed, to varying degrees, into the LCA Study area by most of the freshwater introduction (diversions) measures that would be implemented under the various restoration opportunities. Adaptive management would be important in addressing this issue.

A water quality concern would be the herbicide atrazine, which is known to have endocrine disruption effects. The overall effect of this herbicide on the LCA Study area would be unknown. Acute effects, such as marsh plant death would not occur, as evidenced by plants in the western Terrebonne marshes that are presently exposed to atrazine-laced water from the Atchafalaya River, with no readily obvious detrimental effects. The long-term effects of prolonged, but low-level, exposure to atrazine on both plants and animals, especially amphibians, are currently being investigated. The fertilizers in the spring flush would have both beneficial and detrimental effects, depending on site-specific areas. These nutrients are strongly implicated in the formation of the hypoxic zone off the mouth of the Mississippi River. A series of reintroductions may aid in reducing the size or duration of the gulf hypoxia, but it is also conceivable that the reintroductions would cause eutrophication of specific receiving water bodies. Monitoring efforts and adaptive management actions would be key to addressing and controlling the effects, both expected and unexpected, of the nutrient pulses into various areas of the Louisiana coastal ecosystem.

4.14.3 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): River diversions could cause short- to long-term adverse impacts due to construction of restoration features including: increased total suspended sediments, turbidity, and organic/nutrient enrichment of the water column; disturbance and release of possible contaminants; decrease in water temperatures; and the possible release of oxygen depleting substances (organic or anaerobic sediments, especially with regard to dedicated dredging) as well as possibly increasing dissolved oxygen levels. Note that many of the direct impacts could also be indirect effect (see below). Dedicated dredging (Myrtle Grove) would cause similar, but principally short-term impacts. These impacts would be minimized, as much as practicable, through the implementation of stormwater pollution prevention plans (SWPPPs), the ITM protocols, and other applicable BMPs. See also section 4.14.1 COMPARISON OF NEAR-TERM RESTORATION OPPORTUNITIES.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B, but related to marsh and barrier island land building, as this plan does not include any diversion features. The impacts would be minimized, as much as practicable, through the implementation of stormwater pollution prevention plans, the ITM protocols, and other applicable BMPs. See also section 4.14.1 COMPARISON OF NEAR-TERM RESTORATION OPPORTUNITIES.

LCA PLAN: Direct impacts would be a combination of ALT B and, to a lesser degree, ALT D. See also section 4.14.1 COMPARISON OF NEAR-TERM RESTORATION OPPORTUNITIES.

4.14.4 Restoration Opportunities - Indirect Impacts

ALT B (deltaic processes): Indirect effects of changes to water quality include: nutrient enrichment could possibly lead to increased algae blooms and freshwater tolerant aquatic organisms; increased turbidity could possibly lead to disruption of freshwater and marine organisms; decreased water temperatures; increased dissolved oxygen; freshwater areas would increase thereby providing additional habitats for aquatic organisms; salinities would stabilize or decrease; sediments in the coastal zone would increase, with accompanying minor increases in trace metals associated with bed sediments; and agrichemicals in the water could increase.

Reduction in salinities could improve water quality by reducing chelating potential of metals since total dissolved solids would be decreased. Also, reduction in salinity would decrease temperature variations in the fresher waters. It should be noted that there has been some

discussion in the scientific community of the potential for negative effects due to Mississippi River diversions introducing excessive amounts of nutrients. However, monitoring and management through the adaptive management approach would be necessary to ensure that proper assimilation is occurring in the receiving areas. Coordination with LDEQ, USEPA, and other stakeholders would be necessary to insure the applicable water bodies are protected. See also section 4.14.1 COMPARISON OF NEAR-TERM RESTORATION OPPORTUNITIES.
ALT D (geomorphic structure): Marsh creation, barrier system restoration, and land building features, such as dedicated dredging at Myrtle Grove, would primarily provide long-term improvement of water quality as wetlands serve as natural filters for improving water quality.

LCA PLAN: Indirect impacts would be similar, but somewhat less than the combination of ALT B and ALT D

4.14.5 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

Implementing the LCA Plan, the coastal plain of Louisiana would be affected by other activities and programs that would have both cumulatively beneficial and detrimental effects on water quality conditions. Some of these past, present, and foreseeable future activities include state and local water quality management programs; national level programs to address hypoxia in the northern Gulf of Mexico; oil and gas development; industrial, commercial, and residential development; and Federal, state, and local navigation and flood-damage reduction projects.

The LCA Plan needs to consider these other activities, initiate an aggressive coordination plan with the stakeholders involved, and ensure that all activities including the LCA Plan complement each other. This is critical to ensure the protection of Louisiana's coastal waters and the health of the public that utilizes these waters.

The LDEQ TMDL program is an example of a present program that would be affected by the implementation of some LCA Plan project elements. Consequently, the incremental impact of both would affect water quality conditions. Section 303(d) of the CWA requires the state to identify, list, and rank for development of TMDLs waters that do not meet applicable water quality standards after implementation of technology based controls.

This is a process whereby impaired or threatened water bodies and the pollutant(s) causing the impairment are systematically identified and a scientifically-based strategy, a TMDL, is established to correct the impairment or eliminate the threat and restore the water body. An important factor in this process is the flow of water passing through the water body in question. With small, medium, and large diversions proposed for the LCA Plan in areas that have been disconnected from a main source of freshwater flow for years, it is critical for LDEQ to be aware of the proposed changes to the current hydrologic patterns. This would aid LDEQ in planning and implementation of TMDLs in water bodies to be impacted by the LCA Plan.

Other programs that could be affected by the LCA Plan and, simultaneously, cumulatively impact water quality conditions include LDEQ's LPDES program, LDEQ's Nonpoint Source program, LDNR's Coastal Nonpoint Source program and others. With proper coordination and implementation of specific projects, the activities and programs occurring along the coast may continue successfully in concert with the proposed LCA Plan.

The direct and indirect impacts discussed previously would cumulatively impact water quality conditions along with other coastal activities. The proposed diversions and freshwater introductions could independently elevate water quality constituents such as nutrients and sediment in receiving areas. Other activities such as development would potentially increase point and nonpoint source pollution in the same water bodies, therefore, causing a cumulative effect. However, continued state and Federal programs tasked with regulating water quality impacts would benefit the same water bodies. It is not possible to quantify the effects to the water bodies from all of the coastal activities; however, during the project implementation phase testing and analysis would be conducted to better assess the effects due to the proposed LCA Plan.

<u>ALT B (deltaic processes)</u>: Cumulative impacts to water quality would primarily be related to the incremental impact of all past, present, and future actions effecting water quality such as:

- Increase in freshwater areas;
- Stabilization or decrease in salinities;
- Increase in sediment introduction to the coastal zone, with accompanying minor increases in trace metals associated with bed sediments;
- Increase in agrichemicals in the water;
- Increased total suspended sediments;
- Increased turbidity;
- Increased organic/nutrient enrichment of the water column;
- Disturbance and release of possible contaminants;
- Decrease in water temperatures along with fewer water temperature fluctuations;
- The possible release of oxygen depleting substances (organic or anaerobic sediments, especially with regard to dedicated dredging);
- Less potential for chelating metals due to reduced total dissolved solids; and
- Increased dissolved oxygen levels.

<u>ALT D (geomorphic structure)</u>: Cumulative impacts would be similar, but to a much lesser extent than ALT B.

<u>LCA PLAN</u>: Cumulative impacts would be a synergistic positive result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.15 GULF HYPOXIA

4.15.1 Future Without-Project Conditions – the No Action Alternative

The extent to which failure to implement the LCA Plan might affect the hypoxic zone is difficult to predict at this time. Largely, this depends on future climatic trends and the scale of other efforts to reduce nutrient loadings to the gulf from the Mississippi and Atchafalaya River Basins.

4.15.2 Restoration Opportunities – General

As part of the modeling effort for the LCA Study effort, a team of water quality experts from academia and the Federal government was assembled to help estimate the effects of the LCA Plan on hypoxia in the northern Gulf of Mexico. This team developed a modeling approach to estimate the extent to which the various LCA Plan restoration features would reduce nitrogen entering the gulf. Given the programmatic nature of the LCA Plan, it was understood that the results of this modeling effort would serve primarily to differentiate among alternatives with respect to their relative impacts on gulf hypoxia. It was further understood that accurate, quantitative estimates of the effects of particular restoration features on gulf hypoxia would be developed at the project level, when critical information regarding the location, size, and operation of such features would be available.

Preliminary results of the LCA Study water quality modeling efforts (see appendix C HYDRODYNAMIC AND ECOLOGICAL MODELING), along with existing literature on the subject (Mitsch et al. 2001), suggest that large-scale river diversions could have the potential to contribute significantly to the national effort to reduce hypoxia in the northern gulf. Because the river diversion projects proposed in the LCA Plan near-term opportunities are relatively small, implementation of such projects would likely result in nutrient reductions that are small in comparison to total nutrient inputs from the Mississippi River to the gulf. Implementation of the near-term plan would, however, provide an excellent opportunity to add to our understanding of the effectiveness of river diversions in reducing nutrient inputs from the Mississippi River to the gulf, while also further studying any potential adverse effects of such projects. The lessons learned from implementation of the river diversion projects in the near- term plan could facilitate large-scale river diversion projects in the future, along with the potentially significant nutrient reductions such projects might provide.

As noted above, there remains some uncertainty regarding the efficacy of diversions with respect to nutrient removal, as well as the potential for adverse water quality impacts such as harmful algal blooms. Accurate assessments of nutrient retention and the potential for adverse effects depend on project-specific information regarding the size, location, and operation of the particular restoration measures. Accordingly, such assessments would be conducted during the development and review of specific projects.

4.15.3 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): This alternative would have no direct impacts on hypoxia in northern Gulf of Mexico.

ALT D (geomorphic structure): This alternative would have no direct impacts on hypoxia in northern Gulf of Mexico.

LCA PLAN: This alternative would have no direct impacts on hypoxia in northern Gulf of Mexico.

4.15.4 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): This alternative would likely result in a relatively small reduction in nutrients discharged into the northern Gulf of Mexico from the Mississippi River. Such a reduction in nutrients would have a minor positive effect on hypoxia in the northern Gulf of Mexico.

ALT D (geomorphic structure): This alternative would have no indirect impacts on hypoxia in northern Gulf of Mexico.

LCA PLAN: This alternative would likely result in a relatively small reduction in nutrients discharged into the northern Gulf of Mexico from the Mississippi River. Such a reduction in nutrients would have a minor positive effect on hypoxia in the northern Gulf of Mexico.

4.15.5 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): This alternative would likely result in a relatively small reduction in nutrients discharged into the northern Gulf of Mexico from the Mississippi River. Such a reduction in nutrients would have a minor positive effect on hypoxia in the northern Gulf of Mexico.

ALT D (geomorphic structure): This alternative would have no cumulative impacts on hypoxia in northern Gulf of Mexico.

LCA PLAN: This alternative would likely result in a relatively small reduction in nutrients discharged into the northern Gulf of Mexico from the Mississippi River. Such a reduction in nutrients would have a minor positive effect on hypoxia in the northern Gulf of Mexico.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.16 HISTORIC AND CULTURAL RESOURCES

4.16. 1 Future Without-Project Conditions – the No Action Alternative

As inland marshes and barrier islands erode or subside, cultural resources existing on them could be exposed to elements or inundated, putting them at a greater risk of damage or destruction. Resources could also be adversely impacted over time by an increased risk of storm damage as barrier islands and marshes continue to degrade. Cultural resources would continue to be affected as historical and archaeological sites are exposed to these forces.

4.16.2 Restoration Opportunities – General

Addressing potential impacts to historic and cultural resources generally requires review of the National Register of Historic Places as well as cultural resources investigations on a project-by-project basis. Such surveys and detailed feasibility-level investigations of potential restoration sites and potential borrow areas (including offshore sand sources such as Ship Shoal) would be conducted well in advance of actual construction activities to increase the certainty of determining historic or prehistoric resources (such as shipwrecks) and to avoid project construction delays. The results of any investigations also need to be coordinated with the Louisiana's State Historic Preservation Officer (SHPO). Cultural resources evaluations are made on site-specific as well as project-specific information and plans. Maps indicating the location of cultural resources and cultural resources survey coverage are checked against the location of the proposed wetlands restoration projects. Cultural resource investigations may have been previously conducted in some portions of the LCA Study area (such as for CWPPRA projects), which may have identified the locations of archeological and historical sites.

A cultural resources evaluation of each of the proposed wetlands restoration projects including borrow areas would need to be conducted as soon as plans and specification are known and well in advance of actual construction to avoid project delays. In some cases, project designs could destroy, damage, or obscure archeological sites by construction activities. These cultural resource investigations would identify any significant cultural resources, which may be at risk, and allow time for project design changes to avoid adverse impacts. The site-specific nature of these resources demands this type of action. In some instances, the proposed action may actually help to preserve and protect cultural resources. Coastal lands are eroding rapidly and the protection of these lands by the various coastal restoration projects may protect sites in the long run by stopping or slowing down land erosion.

Records from the Louisiana SHPO and the District would be reviewed to determine the locations of any previously recorded cultural resources and the extent of cultural resources survey coverage for each alternative. In addition, preliminary archaeological and geologic data would be analyzed to determine the probability of encountering additional significant cultural resources. Cultural resources surveys may be required to achieve compliance with the National Historic Preservation Act and NEPA.

4.16.3 Restoration Opportunities – Direct Impacts

Direct, indirect, and cumulative impacts to historic and cultural resources would be further developed on a project-by-project basis.

ALT B (deltaic processes): For the most part, three major types of actions that predominate within these proposed restoration measures are: river diversions, dredging of some type, and construction of structures. River diversions and associated increased sedimentation may or may not have an adverse impact on historical and archaeological sites. Increased sedimentation may cause a direct impact on any site in the immediate area, while in some cases it could provide sediment around an area acting as a buffer to further erosion. Depositing sediment on top of a known site can change the environment in which a site has survived. This may or may not be an adverse impact. An assessment would need to be made on a case-by-case basis for each restoration measure of this plan. Dredging may impact any prehistoric or historic shipwrecks in the area. Submerged cultural resources surveys are conducted in areas with a high probability of containing shipwrecks. Dredging can also impact prehistoric and historic cultural resources. Construction of erosion control devices, such as water control structures (i.e., weirs), dikes, or canal spoil banks can impact any prehistoric or historic site in the immediate impact area. In all cases these actions need to be examined on a project-by-project basis.

ALT D (geomorphic structure): Direct impacts to cultural resources could result in the area of immediate construction of restoration features. Direct impacts on historic or prehistoric resources may also occur at the offshore sand borrow site if such resources are present.

LCA PLAN: Direct impacts to cultural resources could result in the area of immediate construction of structures, otherwise, same as ALT B and ALT D.

4.16.4 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Indirect impacts to historic and cultural resources would be further developed on a project-by-project basis. Indirect impacts to cultural resources from project plans would include change in the conditions of the environment in which the cultural resource exists. Changes in the amount of water covering a cultural resource can change the environment in which the archeological, historic and cultural resources site has been preserved and cause increased decay. A change in the salinity in which the cultural resource exists destroys plant life around which the archeological, historic, and cultural resources site exists and can cause increased erosion leading to the destruction of sites.

ALT D (geomorphic structure): Indirect impacts would be associated primarily with far field effects, such as the movement of barrier island building and shoreline protection sediments from initial restoration sites.

LCA PLAN: Indirect impacts would be the same as ALT B and ALT D.

4.16.5 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Cumulative impacts to historic and cultural resources would be further developed on a project-by-project basis. A cultural resources evaluation of each of the proposed plans would be conducted. In some cases, project designs could destroy, damage, or obscure archeological, historic and cultural resources sites by construction activities. Cultural resource investigations would identify any significant cultural resources, which may be at risk and allow time for changes to the project designs to avoid adverse impacts. The site-specific nature of archeological, historic and cultural resources demands this type of action. In some instances the proposed action may actually help to preserve and protect cultural resources. Coastal lands are eroding rapidly and the protection of these lands by this plan may protect archeological, historic, and cultural resources sites in the long run by stopping or slowing down land erosion.

ALT D (geomorphic structure): Cumulative impacts would be the same as ALT B.

LCA PLAN: Cumulative impacts would be the same as ALT B.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.17 RECREATION RESOURCES

4.17.1 Future Without-Project Conditions – The No Action Alternative

Much of the recreational activities occurring in Louisiana consist of hunting, fishing, and wildlife viewing. Recreational resources in the Louisiana coastal zone that would be most affected in the future without action are those related to loss of wetlands/marshes and habitat diversity. The general trend in wildlife abundance has been a decrease in wildlife numbers in areas experiencing high land loss and an increase in areas of freshwater input or land building due to restoration projects. Populations of migratory birds and other animals directly dependent on the marsh and swamp would decrease dramatically, an impact which would be felt in much of North America, where some of these species spend part of their life cycle. With the continued conversion of marsh to open water, much of the fishery productivity would be expected to peak followed by a sharp decline.

The coastal zone's changing environment would affect the recreational resources within that area. As existing freshwater wetland/marsh areas convert to saltwater marsh, then to open water, the recreational opportunities would change accordingly. Where populations of freshwater and/or saltwater species decline, so would the fishing (including crawfishing, crabbing, oyster harvesting, and recreational shrimping) opportunities. In areas where the populations of game species flux, so would the hunting opportunities. As populations of migratory birds are affected, so would the opportunities for viewing.

Another major impact of land loss is the possible loss of facilities and infrastructure that support or are supported by recreational activities. Land loss can literally result in the loss of boat launches, parking areas, access roads, marinas, and supply shops. The loss of access features, such as roads and boat launches, directly impacts an individual's ability to recreate in particular areas. The economic loss felt by marinas and other shops may be two-fold. One is potential loss of the actual facility or access to the facility; the other is change in opportunities. Habitat change and resulting changing recreation opportunities (i.e., fresh to marine) may for example severely impact a marina specializing in services to particular types of recreation (i.e., loss of freshwater opportunities).

4.17.1.1 Subprovince 1 – Pontchartrain and Breton Basins, and Eastern Mississippi River Delta

Without action, the recreation needs identified by the 1993–1998 Louisiana Statewide Comprehensive Outdoor Recreation Plan (SCORP) in this area may be expected to become greater, particularly for recreation opportunities dependent on estuarine species. Predicted land loss may impact access to recreation opportunities.

4.17.1.2 Subprovince 2 – Barataria Basin And Western Mississippi River Delta

Without action, the recreation needs identified by the SCORP for this area may become greater. Land loss in general, particularly the potential loss of barrier islands and conversion of marsh to open water, may be the largest impact to recreation resources. Over time, conversion of marsh to open water may result in a decline of estuarine-dependent recreation. Access to marsh recreation opportunities, another identified need, may be impacted by predicted land loss.

4.17.1.3 Subprovince 3 – Terrebonne, Atchafalaya, and Teche/Vermilion, Basins

Without action the recreation needs identified by the SCORP for this area may or may not be affected. Freshwater dependent opportunities in areas influenced by the active delta and freshwater from the Atchafalaya River should remain steady and possibly increase. In these same areas, saltwater opportunities may move farther out into the gulf.

4.17.1.4 Subprovince 4 - Mermentau and Calcasieu/Sabine Basins

Without action the recreation needs identified by the SCORP for this area may or may not be affected.

4.17.2 Restoration Opportunities – General

Without more specific project details and more detailed surveys and analysis, it is only possible to give general projections of the impacts of certain types of projects. Each restoration opportunity includes various project types. The impacts may vary greatly depending on location, size, and scope of each particular project. Extensive recreation resources exist within the conceptual project footprint for all the alternatives. The possible impacts to these resources may or may not enhance recreational opportunities in the study area.

Recreation resources and opportunities are dependent upon many variables and many significant resources. Restoration activities may affect these resources in very different ways. In general, with the proposed restoration opportunities in the Louisiana coastal area, there would be a minor localized freshening over the Future Without-Project action. Overall, wildlife resources may benefit from all the proposed actions. Soil and vegetative resources are generally improved by the proposed restoration opportunities to varying degrees. Introduction of freshwater may alter recreational opportunities immediately at and near diversion sites. The magnitude may vary relative to the size and location. For example, in the location of a freshwater diversion, freshwater opportunities may increase, while saltwater opportunities may be displaced. Where marsh/wetland habitat is sustained, increased or improved, the associated recreational opportunities may be sustained and possibly increase, such as hunting, fishing, and wildlife viewing. In areas with minimal salinity changes and where existing resources are sustained, it is expected that associated recreation activities may be sustained. In areas with reduced land loss and possible land building, valuable infrastructure, access roads, and facilities may be protected. Some immediate, short-term effects of restoration activities may have a negative impact on recreation opportunities, although over the course of the study period, the overall impact is expected to be more positive than Future Without-Project conditions.

Recreational feature opportunities may develop as further detailed studies are conducted. If that should occur, the proper estates (e.g., fee, excluding minerals), would be acquired from private landowners for all areas including access areas.

4.17.2.1 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would primarily be displacement of recreationists due to construction of diversions and marsh creation.

ALT D (geomorphic structure): Direct impacts would primarily be displacement of recreationists due to construction of restoration features.

LCA PLAN: Direct impacts would be a combination of ALT B and ALT D.

4.17.2.2 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): ALT B would have long-term localized minor changes to salinity regimes over Future Without-Project conditions. River diversions would increase vegetative growth (especially in fresh habitats) and promote land building in Subprovinces 1,2, and 3 thereby leading to increased recreation opportunities. The localized reduction of salinities (see section 4.3 SALINITY REGIMES) and the increased acres of fresher habitats would result in a concomitant increase of freshwater recreation activities and a decrease of saltwater recreation activities in areas of freshwater reintroduction; as well as an overall positive effect on most wildlife-dependent recreation activities.

Reducing land loss and possible land building may protect valuable infrastructure that supports certain recreation activities. Potentially this plan could therefore reduce loss of recreation-based infrastructure and access thereby decreasing expenses related to relocation, repair, or replacement. Economic impact on recreational fishing could be minimal because of species change.

Wildlife-dependent recreation activities may be maintained and possibly increase. Recreation activities dependent upon freshwater habitat would be maintained and possibly increase. Saltwater recreation activities may be displaced, somewhat, and therefore decrease, somewhat, in areas where freshwater is being introduced. The recreationist may have to travel farther to enjoy recreation dependent on saltwater/marine habitat. Possible protection of infrastructure may insure the access roads and facilities remain intact to support associated recreational activities.

There could be some economic impacts due to changing recreational activity patterns. The saltwater recreationist may incur minor additional expenses due to traveling farther to reach saltwater opportunities. Marinas and facilities specializing in particular recreation activities may be somewhat affected by increased costs or possible loss of business related to lost/displaced recreation opportunities. Some facilities may adapt to changing recreational opportunities and clientele. Facilities able to adapt to changing demand may see positive economic impacts.

ALT D (geomorphic structure): Salinities would be similar to Future Without-Project conditions. There would be long-term positive benefits to saltwater recreation activities primarily due to stabilization and restoration of barrier shorelines/islands. ALT D would also benefit recreation by restoring beaches, especially the Caminada Headland which has high recreational use due to accessibility. Gulf shoreline protection in the Chenier Plain would also benefit beach users. There are also unique fishing opportunities associated with the barrier islands and shorelines.

LCA PLAN: Indirect impacts would be a combination of ALT B and ALT D.

4.17.2.3 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Overall, ALT B would support and sustain a greater number of freshwater-based recreational opportunities, provide for a more stable freshwater-based recreation economy, and possibly increase the Louisiana recreation industry.

ALT D (geomorphic structure): Overall, ALT D would support and sustain a greater number of saltwater-based recreational opportunities, provide for a more stable saltwater-based recreation economy, and possibly increase the Louisiana recreation industry.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.
Actual calculation of recreation impacts and benefits would require additional surveys based on specific project(s).

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.18 AESTHETICS

4.18.1 Future Without-Project Conditions – the No Action Alternative

Prominent visual changes to the Louisiana coastal area can best be determined by analyzing how lost land and changes in vegetation affects the visual distinctiveness of Louisiana's Scenic Byways. Scenic Byways display various combinations of archeological, cultural, historic, natural, recreational, and scenic qualities that make them regionally significant. Therefore, the loss or diminishment of these qualities weakens the significance of the Scenic Byways. There may also be future developmental actions that cause change in the natural environment along the Scenic Byways. The focus of this analysis is on how visual changes to the Scenic Byways, located in close proximity to the Gulf of Mexico, affects their significance.

4.18.1.1 Deltaic Plain

Louisiana State Highway 1 is a Louisiana Scenic Byway whose visual distinctiveness is characterized by the contrasting elements found at its southernmost portion. Homogeneous wetlands are viewed amongst meandering landforms, unnaturally straight canals, and the open water of the Gulf of Mexico. Land loss occurring along this Scenic Byway may result in diminished visual complexity, as there is a relatively uniform view of open water along most of State Highway 1.

4.18.1.2 Chenier Plain

Louisiana State Highway 82 is a National Scenic Byway whose visual distinctiveness is based on the contrasts caused by the diversity of elements present. Views are of homogeneous wetlands intermingling with meandering landforms, water, and linear elevated oak-covered cheniers. Visual changes along this Scenic Byway would be caused by subtle wetland vegetative changes due to saltwater intrusion. These changes in wetland types would, most likely, not diminish the visual complexity surrounding State Highway 82.

4.18.2 Restoration Opportunities – Direct Impacts

With implementation of the proposed action, work associated with the development of each restoration opportunity may directly cause long-term and temporary impacts to the Louisiana Coastal Zone's visual resource base. Direct impacts to visual resources would primarily result from construction activities associated with the various features of each proposed restoration opportunity. Construction activities (e.g., diversion structures and associated canals) may permanently reduce or destroy the visual complexity (as defined in existing section 3.19 AESTHITIC RESOURCES conditions) of scenic byways or undetermined visual resources (see existing conditions) that lie within the conceptual footprint of each restoration opportunity.

Construction activity may also be visually distressful as heavy equipment's activity temporarily reduces visual experiences along the scenic byways and other undetermined visual resources.

Without more specific project details and more detailed surveys and analysis, it is only possible to give general projections of the direct impacts of certain types of projects. The impacts may vary greatly depending on location, size and scope of each particular project. What follows is a brief assessment in general terms of where construction activities may directly affect the visual complexity of the scenic byways.

ALT B (deltaic processes): Construction activities associated with the Convent/Blind River and Hope Canal freshwater diversions may negatively impact undetermined visually complex areas. These diversions occur in proximity to the River Road Scenic Byway (LA Highway 641). Construction activities associated with the Donaldsonville, Pikes Peak, and Edgard freshwater diversions may also negatively impact undetermined visually complex areas. These diversions occur in proximity to the River Road Scenic Byway (LA Highway 405).

ALT D (geomorphic structure): The beneficial use of dredge material may result in visually interesting landforms that would benefit primary viewpoints found along Louisiana's Scenic Byways (see section 3.19 AESTHETICS).

LCA PLAN: Direct impacts are similar to ALT B and ALT D.

4.18.3 Restoration Opportunities – Indirect Impacts

With implementation of the proposed action, work to develop each alternative's plan may indirectly affect the Louisiana coastal zone's visual resource base. Indirect impacts to visual resources would primarily result from the possibility that newly developed—or restored—vegetative habitats (see section 4.6 VEGETATION RESOURCES) would enhance—or develop—visually complex areas alongside scenic byways or undetermined visual resources (see Existing Conditions).

Without more specific project details and more detailed surveys and analysis, it is only possible to give general projections of the indirect impacts of certain types of projects. The impacts may vary greatly depending on location, size, and scope of each particular project. What follows is a brief assessment in general terms of where the conceptual footprint of each alternative's plan may indirectly affect the visual complexity of the scenic byways.

ALT B (deltaic processes): Indirect benefits to visual resources would primarily result from the possibility that newly developed—or restored— vegetative habitats would enhance—or develop—visually complex areas alongside scenic byways (e.g., River Road or Creole Nature Trail/Jean Lafitte) or undetermined visual resources.

ALT D (geomorphic structure): The beneficial use of dredge material may result in visually complex features as restored or enhanced vegetation is combined with constructed landforms. These newly formed visually complex features may benefit primary viewpoints found along scenic byways.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.18.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Human population growth, developmental actions, and other human activities have destroyed, enhanced, or preserved visual resources. Overall trends shown by models may be interpreted as reversing some of the damage caused by the above human actions and supporting visually complex aesthetic resources healthier than in future without-project. Cumulative impacts of maintaining visually appealing resources systems would further support tourism as one travels Louisiana's Scenic Byways and remote areas of visual interest.

ALT D (geomorphic structure): Cumulative impacts are similar to ALT B.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.19 AIR QUALITY

4.19.1 Future Without-Project Conditions - The No Action Alternative

Air quality would continue to be subject to institutional recognition and further regulations. However, air quality in the LCA Study area would likely decline for the following reasons: continued population growth, further commercialization and industrialization, increased numbers of motor vehicles, and increased emissions from various engines. These impacts would be coupled with the continued loss of Louisiana coastal wetland vegetation that would no longer be available to remove gaseous pollutants. There would likely be associated increases in respiratory aliments (such as asthma) in the human populations. Air pollution would also have adverse aesthetic impacts on coastal viewscapes. These impacts would probably also have some impacts on the respiratory health of terrestrial wildlife, but information on such impacts is not readily available.

The Union of Concerned Scientists (http://www.ucsusa.org/global_environment/global_warming/page.cfm?pageID=973) predict that global warming will also increase some health risks in the Gulf Coast region. The ability of the health care system to reduce these health risks in the face of climate change, however, is an important consideration in any projections of vulnerability during the 21st century. The concentration of air pollutants such as ozone is likely to increase in the Gulf Coast region. Ground-level ozone has been shown to aggravate respiratory illnesses such as asthma, reduce lung function, and induce respiratory inflammation.

4.19.2 Restoration Opportunities – General

Generally, all restoration opportunities and the LCA Plan would have similar direct, indirect, and cumulative impacts on air quality.

Potential air quality impacts concerns would be accomplished on a project-by-project basis and in coordination with the LDEQ. As required by LAC 33:III.1405 B, an air quality applicability determination would be made for each specific project. This would include consideration of each separate project item of the proposed action for the category of general conformity in accordance with the Louisiana General Conformity, State Implementation Plan (SIP). Generally, an air quality applicability determination would be calculated for each project within each plan based upon direct and indirect air emissions. See also section 3.20 AIR QUALITY.

4.19.3 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): There would be two primary direct impacts of ALT B on air quality:

1. Direct air emissions by machinery during actual construction activities. An air applicability determination analysis would be based upon direct emission for estimated construction hours. It has been the experience of the USACE that total emissions for each work item separately (or even when all work items are summed) generally do not exceed the threshold limit applicable to volatile organic compounds (VOC) for parishes where the most stringent requirement (50 tons per year in serious non-attainment parishes) is in effect, (see General Conformity, SIP, Section 1405 B.2). The VOC emissions for the proposed construction would be classified as *de minimus* and no further action would be required.

2. Indirect air emissions by engines used for operating equipment. Generally, since no other indirect Federal action, such as licensing or subsequent actions would likely be required or related to the restoration construction actions, it is likely that indirect emissions, if they would occur, would be negligible.

ALT D (geomorphic structure): Direct impacts would be similar, but less than ALT B.

LCA PLAN: Direct impacts would be the combined effects of ALT B and ALT D.

4.19.4 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Principal indirect impacts would be related to the potential improvement in air quality that increasing vegetated wetlands would provide. Improvement of air quality would provide positive benefits for humans suffering from health problems such as asthma and other respiratory problems.

Restoration of vegetated wetlands over the 50-year project life of ALT B would help to improve air quality by reducing particulates and gaseous air pollutants (see section 3.20 AIR QUALITY). Studies of the effects of common wetland plants on removing or reducing air pollution in the coastal Louisiana area have yet to be done. However, it is reasonable to extrapolate from the findings of researchers such as David J. Nowak (personal communication, David J. Nowak, Project Leader, USDA Forest Service, Northeastern Research Station, 5 Moon Library, SUNY-CESF, Syracuse, New York) that the trees and vegetation in coastal Louisiana would improve air quality. Hence, over the 50-year project life of ALT B*,* there would be a potential for the removal of tens of thousands of tons of air pollution at a potential value to society in the tens of millions of dollars. Detailed research into the potential air pollution removal capacity of the various wetland plants in coastal Louisiana, and the potential value to society (in Louisiana and nationwide) would be necessary before serious consideration is given to utilizing such information in any decision making.

ALT D (geomorphic structure): Indirect impacts would generally be similar to ALT B, but to a lesser degree.

LCA PLAN: Indirect impacts would be the combined effects of ALT B and ALT D.

4.19.5 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Primary cumulative impacts would be the potential improvement of air quality due to the removal of air pollutants by vegetation; other cumulative impacts include the cumulative effects of similar Federal, state, local, and private wetland restoration efforts that would also contribute to reduction of air pollution; as well as other technological efforts such as scrubbers on smoke stacks, more stringent emissions standards on motors, etc. From the cumulative impacts perspective, this potential improvement in air quality by LCA Plan restoration efforts would be in contrast to continued air pollution by other sources.

ALT D (geomorphic structure): Cumulative impacts similar to ALT B, but to a lesser degree.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.20 NOISE

4.20.1 Future Without-Project Conditions

Localized and temporary noise impacts would likely continue to affect animals and the relatively few humans in the remote coastal wetland areas. Potential noise impacts concerns may be expected for those human workers at oil and gas extraction sites, recreationists, and construction activities. Additional noise impacts would be associated with the villages, towns, and clusters of human habitations. Institutional recognition of noise, such as provided by the regulations for

Occupational Noise Exposure (29 CFR Part 1910.95) under the Occupational Safety and Health Act of 1970, as amended, would continue.

4.20.2 Restoration Opportunities – General

Generally, addressing potential noise impacts concerns would be accomplished on a project-by-project basis using the following six step conceptual approach (after Canter 1996):

- Step 1—identification of noise impacts;
- Step 2—preparation of description of existing noise environment conditions;
- Step 3—procurement of relevant noise standards and/or guidelines;
- Step 4—impact prediction;
- Step 5—assessment of impact significance; and
- Step 6—identification and incorporation of mitigation measures.

A similar approach would be used for those projects that may require addressing potential vibration impacts.

Noise impacts would likely affect relatively few humans in the remote coastal wetland areas. Potential noise impacts concerns may be expected for those human workers at restoration construction sites. However, as provided by the regulations for Occupational Noise Exposure (29 CFR Part 1910.95) under the Occupational Safety and Health Act of 1970, as amended, when employees are subjected to sound exceeding those described under the Occupational Safety and Health Standards, feasible administrative or engineering controls shall be utilized via effective hearing conservation programs. Further, in accordance with the standards, if such controls fail to reduce sound levels within acceptable levels, personal protective equipment shall be provided and used to reduce sound levels.

It is anticipated that, in some instances, noise impacts may be an important issue for their potential effects on wildlife, such as disruption of normal breeding patterns and abandonment of nesting colonies. However, tolerance of unnatural disturbance varies among wildlife. Therefore, these issues shall be addressed by identifying the key species of concern and following feasible administrative and or engineering controls, determining and implementing appropriate buffer zones, and implementing construction "activity windows" (i.e., project construction initiation and completion dates to minimize disturbance to nesting birds) (see Martin and Lester 1991; Mendoza and Ortiz 1984). The District has utilized activity window restrictions with great success when restoring the endangered brown pelican nesting habitat on Queen Bess Island in the Barataria Bay.

4.20.3 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Generally, all restoration opportunities would have only short-term, and minor, direct impacts on noise. Addressing potential noise impacts would be accomplished on a project-by-project basis. Any noise impacts would likely affect relatively few humans other than those employed at or near restoration construction sites due to the typically remote locations of such sites. When employees are subjected to sound exceeding those described under the

Occupational Safety and Health Standards, feasible administrative or engineering controls shall be utilized via effective hearing conservation programs. Further, in accordance with these standards, if such controls fail to reduce sound levels within acceptable levels, personal protective equipment shall be provided and used to reduce sound levels.

In some instances, noise impacts may directly impact fish and wildlife species. These organisms would generally avoid the construction area. However, tolerance of unnatural disturbance varies among wildlife. Therefore identifying the key species of concern and following feasible administrative and or engineering controls, determining and implementing appropriate buffer zones, and implementing construction activity windows, shall address these issues.

ALT D (geomorphic structure): Direct impacts would be similar, but less than ALT B.

LCA PLAN: Direct impacts would be the combination of ALT B and ALT D.

4.20.4 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): It is anticipated that, in some instances, noise impacts may be an important issue for their potential indirect effects on wildlife, such as disruption of normal breeding patterns and abandonment of nesting colonies. However, tolerance of unnatural disturbance varies among wildlife. Therefore, identifying the key species of concern and following feasible administrative and or engineering controls, determining and implementing appropriate buffer zones, and implementing construction activity, shall address these issues. The District has utilized activity window restrictions with great success when restoring the endangered brown pelican-nesting habitat on Queen Bess Island in the Barataria Bay.
ALT D (geomorphic structure): Indirect impacts similar, but likely somewhat greater than ALT B.

LCA PLAN: Indirect impacts would be the additive effects of both ALT B and ALT D.

4.20.5 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): The cumulative impacts would principally be related to the potential short-term disruption of fish and wildlife species and similar impacts by other similar Federal, state, local and private restoration activities as well as other human-induced noise disruptions to these organisms.

ALT D (geomorphic structure): The cumulative impacts would be similar to ALT B, but with somewhat greater potential impacts on those fish and wildlife species that utilize barrier system habitat.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.21 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

4.21.1 Future Without-Project Conditions – the No Action Alternative

Land loss is expected to continue and there would be further erosion along the Louisiana coast. There are a number of known hazardous, toxic and radioactive waste (HTRW) sites of concern that may be directly impacted through coastal land loss. In addition to these known sites of concern, coastal erosion, and coastal flooding would impact a large number of unknown/unidentified HTRW sites of concern. These sites include, but are not limited to: waste disposal facilities; landfills; open pits, ponds or lagoons for waste treatment or associated with oil and gas drilling activities; wastewater treatment facilities; and underground storage tanks. An extensive oil and gas industry along the Louisiana coast has created a large number of potential HTRW problems. Coastal erosion of oil and gas fields, and flooding of structures and facilities may exacerbate these problems. The exposure of pipelines and loss of protection for gas processing facilities from coastal erosion would likely increase risk of ruptured pipelines and accidental spills, and therefore, cause further damage to the environment.

4.21.2 Restoration Opportunities – Direct Impacts

HTRW impacts would be addressed on a project-by-project basis, via a Phase I Initial Site Assessment (ISA). A Phase I ISA is required for all USACE Civil Works Projects, to facilitate early identification and appropriate consideration of potential HTRW problems (see section 3.21 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)).

Addressing existing HTRW sites of concern for proposed LCA Plan projects would require a review of site-specific, as well as project-specific, information and plans. As strategies become more defined, more detailed HTRW analyses will be performed to further evaluate and eliminate potential HTRW problem sites within the LCA Study area.

ALT B (deltaic processes): An HTRW Phase I ISA addressing potential direct impacts would be accomplished on a project-by-project basis. Any HTRW discovered during the Phase I ISA would be avoided to the maximum extent practicable, to minimize potential direct impacts.

ALT D (geomorphic structure): All restoration features would be investigated for potential HTRW. See ALT B.

LCA PLAN: All restoration features would be investigated for potential HTRW. See ALT B.

4.21.3 Restoration Opportunities – Indirect Impacts

Addressing existing HTRW sites of concern for proposed LCA Plan projects would require a review of site-specific, as well as project-specific information and plans. As strategies become more defined, more detailed HTRW analyses will be performed to further evaluate and eliminate potential indirect impacts resulting from HTRW problem sites within the LCA Study area.

ALT B (deltaic processes): An HTRW Phase I ISA addressing potential indirect impacts would be accomplished on a project-by-project basis. Any HTRW discovered during the ISA would be avoided to the maximum extent practicable, to minimize potential indirect impacts.

ALT D (geomorphic structure): All restoration features would be investigated for potential HTRW; see ALT B.

LCA PLAN: All restoration features would be investigated for potential HTRW; see ALT B.

4.21.4 Restoration Opportunities – Cumulative Impacts

Addressing existing HTRW sites of concern for proposed LCA Plan projects would require a review of site-specific, as well as project-specific information and plans. As strategies become more defined, more detailed HTRW analyses will be performed to further evaluate and eliminate potential cumulative impacts resulting from HTRW problem sites within the LCA Study area.

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): An HTRW Phase I ISA addressing potential cumulative impacts would be accomplished on a project-by-project basis. Primary cumulative impacts would be the avoidance or removal of hazardous and toxic waste through early identification. Discovery of previously unknown HTRW sites of concern would allow avoidance of contaminated areas or removal of hazardous materials prior to initiation of construction activities.

ALT D (geomorphic structure): All plans would be investigated for potential HTRW. See ALT B.

LCA PLAN: All plans would be investigated for potential HTRW. See ALT B.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22 SOCIOECONOMIC AND HUMAN RESOURCES

The purpose of this section is to review direct, indirect, and cumulative impacts on significant economic resources of each plan in the final array compared to taking no Federal action. **Table 2-21** summarizes the comparison of restoration opportunities among significant environmental resources. **Table 4-1** summarizes cumulative impacts of significant socio-economic and human resources. Environmental justice issues will be assessed on a project-specific basis during follow-up feasibility level analyses. Reference to compliance with EO 12898 regarding environmental justice is described in Section 6.1.1.11

4.22.1 Population

4.22.1.1 Future Without-Project Conditions – the No Action Alternative

As inland marshes and barrier islands erode or subside in the Future Without-Project conditions the resultant threatened population in the coastal communities is expected to shift to the more northern portions of the coastal parishes. As these populations get dispersed and absorbed into other geographic areas, their heritage and cultural way of life could also be threatened.

Overall, the population of the 20-parish area increased from 1,556,965 to 2,247,344 from 1960 to 2000, with approximately 50.2 percent of Louisiana's population residing in the coastal area. It is expected that this growth rate will occur with or without the LCA Plan in place. The exact location of the population growth and shift would be influenced by many factors including land availability, flood protection, and improvements to the transportation network.

4.22.1.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): The population shift farther inland and to urban and suburban areas would be slower than in the future without project conditions. In addition, project implementation would change salinity levels in fisheries areas, causing some species to relocate. As a result, subsistence fishermen would potentially have to relocate to follow these resources. This would result in relocation costs and potential changes in community cohesion as existing communities are lost, and could result in employment shifts as some fishermen changed to other means of subsistence.

ALT D (geomorphic structure): Direct impacts would be similar, but less than ALT B, due to fewer restoration features. However, there would likely be no relocations of subsistence fishermen associated with this restoration opportunity.

LCA PLAN: Direct impacts would be similar to ALT B.

4.22.1.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Coastal population patterns should remain more intact than with the Future Without-Project conditions.

ALT D (geomorphic structure): Indirect impacts would be similar but less than ALT B, due to fewer restoration features.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.22.1.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): The population shift away from the coastal areas would be slower than the Future Without-Project conditions.

ALT D (geomorphic structure): Cumulative impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.2 Infrastructure

4.22.2.1 Future Without-Project Conditions – the No Action Alternative

Louisiana's coastal wetlands are the richest estuaries in the country for fisheries production. They are also some of the richest in oil and gas activities. Infrastructure related to these activities as well as navigation, pipelines, agriculture, etc. have a total asset value of approximately $95 billion. If no further restoration activities are implemented in coastal Louisiana, these assets, to varying degrees, are at risk. On a local community level, land loss can result in the loss of boat launches, marinas, access roads, supply shops, and local flood protection. Such losses can lead to a community's inability to sustain itself economically as they have to invest more money in infrastructure repairs and relocations.

On a national and international level, the impacts of coastal erosion would be felt in the oil, gas, and pipeline industry. For example, as barrier islands and coastal wetlands continue to erode, open water has scoured away land protecting pipelines. Exposed pipelines are at increased risk of damage and failure. Disruption of flows could affect the Nation's energy supplies and energy security. There is also potential for ecological damage from damage and failure of these facilities.

Navigation infrastructure is already being impacted by coastal erosion. Three areas of the GIWW are experiencing problems. Increased shoaling causes traffic moving on the waterway to slow down which increases the time and cost of moving commodities. It also increases the annual dredging maintenance cost to keep the channel at authorized depths.

4.22.2.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): ALT B would probably reduce the erosion, damage, and necessity for relocation, repair, or replacement to infrastructure nearest the coast, than with the Future Without-Project conditions.

ALT D (geomorphic structure): Direct impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Direct impacts would be similar to ALT B and ALT D.

4.22.2.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): There would probably be fewer relocations of infrastructure than with the Future Without-Project conditions.

ALT D (geomorphic structure): Indirect impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.22.2.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): There would be a reduced level of infrastructure damages and relocations than with the Future Without-Project conditions.

ALT D (geomorphic structure): Cumulative impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.3 Employment and Income

4.22.3.1 Future Without-Project Conditions – The No Action Alternative

Slow growth in employment is expected to occur as the economy improves without the proposed LCA Plan in place. The prospects of income opportunities may decline as well in the rural areas if they experience continued depletion of their natural resources. Without the implementation of the LCA Plan, residents and businesses may decide to move further inland to avoid the effects of periodic hurricanes and tropical storms. Economic activity related to wetland resources would also be aversely affected by the depletion of these resources.

4.22.3.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): The loss of income and jobs would be slower than with the Future Without-Project conditions.

ALT D (geomorphic structure): Direct impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Direct impacts would be similar to ALT B and ALT D.

4.22.3.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Coastal jobs, property values, and population could be better protected than with the Future Without-Project conditions.

ALT D (geomorphic structure): Indirect impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.22.3.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Continued population growth with less population out-migration in rural coastal areas is probable than with the Future Without-Project conditions.

ALT D (geomorphic structure): Cumulative impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.4 Commercial Fisheries

4.22.4.1 Future Without-Project Conditions – the No Action Alternative

Concurrent with projected land loss would be an increase in saltwater intrusion into some of the upper estuaries as barrier islands and marshes degrade. This would result in a shift in the populations of fishes and invertebrates, with more saline-dominated species replacing freshwater species in some areas. The band of intermediate salinity necessary for oyster production would likely narrow significantly, and essential fish habitat for many commercial fishery species would likewise decline, leading to a net loss in fisheries population size and diversity.

Wetland habitat losses would decrease the productivity of Louisiana's coastal fisheries. The seafood industry would likely suffer significant losses in employment as estuaries that are necessary to produce shrimp, oysters, and other valuable species, erode. Job losses would occur in the areas reliant on fishing, harvesting, processing, and shipping of the seafood catch. Thus, changes in existing fisheries habitat caused by wetland loss, saltwater intrusion, and reduced salinity gradients would likely increase the risk of a decline in the supply of nationally distributed seafood products from Louisiana's coast.

The connections between coastal estuaries and offshore populations vary geographically. Approximately 32 percent of the commercial fish landings off the northeastern states depend upon estuaries during some life stage. The dependence figure jumps to 98 percent along the Gulf of Mexico, where marshes support menhaden and shrimp populations.

It is estimated that over 75 percent of Louisiana's commercially harvested fish and shellfish populations are dependent on these wetlands during at least some portion of their life cycle. Wetland habitat losses would decrease the productivity of these fisheries. Marsh loss and associated habitat changes may have already affected blue crab populations. Moreover, menhaden depend upon the estuary for a critical stage in their life cycle.

The seafood industry would likely suffer significant losses in employment as resources, which are necessary to produce shrimp, oysters, and other valuable species (mainly estuaries), begin to erode. Job losses would occur in the areas of fishing, harvesting, processing, and shipping of seafood catch.

4.22.4.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would be primarily related to construction of restoration features with minor adverse impacts due to entrapment during construction of diversions, and as a result of marsh creation, sediment delivery, and dedicated dredging restoration features.

ALT D (geomorphic structure): Direct impacts would be primarily related to construction of restoration features such as marsh creation, sediment delivery, and dedicated dredging restoration features.

LCA PLAN: Direct impacts would be similar to ALT B and ALT D.

4.22.4.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Construction and operation of ALT B restoration features could cause displacement of some species with resultant changes in fishing patterns, including location and species harvested compared to the Future Without-Project conditions. Diversity of habitat would increase and productivity would be maintained compared to future without-project. There would likely be habitat preservation for commercial fisheries species from salinity control components of the Terrebonne wetland restoration features.

ALT D (geomorphic structure): Habitat preservation from the barrier island restoration, marsh creation, shoreline protection, salinity control, and beneficial use features.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.22.4.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Overall, the industry would be more stable than with the Future Without-Project conditions. A long-term increase in fishery productivity would be expected and a shift in species composition from those generally more tolerant of higher salinities to those generally more tolerant of lower salinities. Multiple diversions into a single hydrologic basin have the potential to significantly freshen large areas within and possibly the entire basin. A decrease would be expected in production of commercially important species such as brown shrimp in areas influenced by freshwater diversions. The U.S. would benefit by maintaining the productivity and diversity of marine fisheries.

ALT D (geomorphic structure): This plan would help preserve some habitat and fishery productivity expected to be lost under the Future Without-Project conditions. Impacts for the entire U.S. would probably not be measurable.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.5 Oyster Leases

4.22.5.1 Future Without-Project Conditions – the No Action Alternative

In the future without or no action conditions, saltwater intrusion would continue, except in areas where existing freshwater diversion projects are able to reverse that trend. Production from leases would be likely to decline gradually, as areas of suitable salinities move inland and begin to overlap with areas closed due to fecal coliform near sewerage sources in developed areas. At the same time, level or increased production would be likely to occur from leases in bands of intermediate distance from freshwater introduction, where salinities are favorable. Salinities could be stabilized by existing freshwater diversions in two of the most productive basins, the Breton Sound and Barataria Basins. Leases in these basins would be likely to continue at current levels of productivity. As oyster production from leases decline, it would likely result in lower oyster supply, higher oyster prices, and loss of income and jobs in the oyster industry.

4.22.5.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): While each of the restoration opportunities may have direct impacts to oysters (such as marsh creation at Myrtle Grove), the impacts to the actual leases would be considered indirect, except in cases where existing leases would be acquired from the leaseholder as a project cost. Some oyster leases would likely be acquired from the leaseholder if the ability to harvest oysters from the lease would be adversely impacted by the proposed action.

Payments will be made for just compensation, in accordance with Louisiana and Federal law. If oyster leases will be adversely impacted by a project, then such leases will be acquired and just compensation will be made.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B.

LCA PLAN: Direct impacts would be similar to ALT B.

4.22.5.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Oyster leases would be negatively impacted in Subprovince 1, with salinities unfavorable for oyster survival likely to occur in much of the Breton Sound Basin, but slightly enhanced conditions for oyster growth and survival in the Pontchartrain Basin. In Subprovince 2, oyster leases would be negatively impacted by low salinities, although leases in some areas could maintain production. Lease productivity, based on bedding of seed oysters from public grounds, could also be negatively impacted due to decreased seed availability from the Breton Sound Basin. Impacts to oyster leases in Subprovince 3 would be minimal overall, with some spatial shifts in production due to changes in hydrology and resultant changes in salinity. There are no oyster leases in Subprovince 4. Any negative impacts on oysters would result in lower oyster supply, higher oyster prices, and loss of income and jobs.

ALT D (geomorphic structure): There would be minimal, localized impacts to oyster leases in areas where construction occurs, due primarily to increased turbidity and siltation caused by dredging and disposal activities.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.22.5.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Louisiana has a far more extensive and productive oyster lease program than any other state in the U.S. Maryland, Texas, and Virginia have leasing programs, but none produces close to the amount of oysters produced from leases in Louisiana. Therefore, any project that adversely impacts oyster leases in Louisiana would impact nationwide oyster harvests from leases.

ALT B would be likely to adversely impact the growing conditions on a large acreage of leases, due primarily to the large-scale freshwater diversions. The diversions would have the potential to produce salinities that are lethal to oysters across large areas of waterbottoms. Existing freshwater diversion projects with capacities of approximately 8,000 to 12,800 cfs (240 to 384 cms) have been found to induce oyster mortality in some areas, but have enhanced oyster production overall. Approximately 9,200 acres (3,726 ha) of leases were acquired from the leaseholders by the state of Louisiana in anticipation of the impacts of the Davis Pond Freshwater Diversion Project, which has a capacity flow of 10,650 cfs (319 cms). ALT B includes diversions of a combined capacity that could potentially result in the loss of production from a significant percentage of the total leased acreage in Louisiana. It is unknown whether increased harvest from other areas in Louisiana could offset this lost production. Any negative impact on oysters would result in lower oyster supply, higher oyster prices, and loss of income and jobs.

ALT D (geomorphic structure): Cumulative impacts would be minimal with this alternative, affecting only a small percentage of active leases located near project sites.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.6 Oil, Gas, And Minerals

4.22.6.1 Future Without-Project Conditions – the No Action Alternative

Most of Louisiana's onshore oil and gas production occurs in the Louisiana coastal ecosystem. This area is at an elevated risk due to the land loss and ecosystem degradation. Loss of wetland, marsh, and barrier islands presents a range of threats to inshore and offshore oil and gas infrastructure. Existing inshore facilities are not designed to withstand excessive wind and wave actions, which would become more commonplace as existing marshes are lost or converted into open bays. In addition, erosion and the subsequent disappearance of barrier islands would allow gulf type swells from tropical storm events to travel farther inland. The combination of these factors would increase the risk to inshore facilities. To address this risk, the oil and gas industry will be faced with the decision to invest in improvements in order to maintain production/transmission or conversely the closure and abandonment of infrastructure.

The offshore oil and gas industry in the coastal zone is an important component in meeting national energy requirements. Coastal land losses have, and will continue to have, a negative effect on the extensive pipeline network located in coastal areas. As the open water areas behind the barrier islands increase in size, the tidal exchange volumes and velocities increase in the tidal passes and channels. This action can lead to the scouring away of sediments atop buried pipelines, exposing the pipelines and increasing the risk of failure or damage due to lack of structural stability, anchor dragging, and boat collisions. Resulting production or transmission shortfalls may result in disruptions in the availability of crude oil or natural gas to a significant part of the U.S.

The impact to these nationally important resources would be felt in numerous ways depending upon location (i.e., whether onshore or offshore).

Onshore Facilities. In the year 2000, onshore production of oil accounted for 16 percent of statewide production and onshore production of natural gas accounted for approximately 26 percent of statewide production. Statewide production includes onshore, Louisiana state waters, and Louisiana Outer Continental Shelf (OCS). Most of this onshore production of oil and gas occurs in the southern part of the state, in areas most at risk due to the degrading coastal landscape. Representatives in the oil and gas industry have indicated that these onshore facilities were not designed to accept wind- and wave-type forces that would be experienced in open bays or worse, gulf-type swells. The owners of these facilities would therefore be faced with the decision of whether to protect these facilities from these types of forces or curtail the production. For the most part, these onshore facilities represent the older production facilities in the state and, absent significant reserves being discovered due to improved exploration techniques, are on the downside of their production. The major oil companies have recognized this trend, and many have already sold off these assets to independent operators who can operate these reserves more profitably since they operate at lower overhead levels. Even with lower cost factors, the expenses incurred in adapting these facilities from a relatively protected marsh-type environment to one where significant wave action would or could occur would probably force some of the operators to shut in that production.

Offshore Facilities. The offshore oil and gas industry is becoming increasingly important to the national energy picture. The impact to this sector would not be to the structures themselves, but to the supply base that keeps them operating at peak efficiency and reliability. There are only a few supply bases serving the deepwater oil and gas industry in the state, with the largest one being Port Fourchon in Lafourche Parish, near the Gulf of Mexico. These bases provide not only the necessary supplies and maintenance services to the offshore platforms, but are also the "jumping-off" spot for the company employees that work on the platforms on rotating schedules. If one of these important bases were severely impacted as a result of coastal degradation, such as increasing storm surges, the operational cost of this offshore production would go up significantly.

4.22.6.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): ALT B would provide protection to the refineries, wells, and other oil and gas producing facilities and equipment, and potentially avoid some of the costs of relocation.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B; however, restoration of the Caminada-Moreau Headland would provide increased level of protection to the LOOP facility and Port Fourchon.

LCA PLAN: Direct impacts would be similar to ALT Band ALT D.

4.22.6.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Restoration features could reduce the necessity of relocation as well as protect jobs.

ALT D (geomorphic structure): Indirect impacts would be similar to ALT B.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.22.6.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): There would be a potential for reduced damages to oil and gas producing facilities and equipment. Relocations would also be reduced.

ALT D (geomorphic structure): Cumulative impacts would be similar to ALT B.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.7 Pipelines

4.22.7.1 Future Without-Project Conditions – the No Action Alternative

Coastal land losses have, and would continue to have, a significant negative effect on the extensive pipelines traversing coastal areas. These pipelines are used for bringing oil/gas onshore from the numerous production facilities offshore; transporting oil/gas from onshore production facilities; and in some cases, connecting with large pipelines used for interstate transport of oil and gas. Louisiana's pipelines carry oil to refineries located in the gulf coast, midwestern, and eastern seaboard states and natural gas to consumers in most of the states east of the Mississippi River. As the open water areas behind the barrier islands increase in size due to coastal erosion, the tidal exchange volumes and velocities increase in the tidal passes and channels. In many instances, this has led to the scouring away of sediments atop these buried pipelines and in some cases, has undermined them. This action subjects these pipelines to increased risk of damage or failure due to anchor dragging or lack of structural stability. Any impact to the price of crude oil or natural gas would ripple through the economy, since it is the preferred fuel for area power plants, cogeneration facilities, and a major feedstock for many types of industries. For example, Hurricane Ivan, which occurred in September 2004, has caused a disruption in U.S. oil supplies. 27 percent of oil output in the Gulf of Mexico was shut down due to extensive damage from the hurricane and resultant speculation over the availability of supplies drove up the price of oil to a record high of nearly $52 a barrel in October 2004 (CNNMoney 2004).

4.22.7.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Diversions and marsh creation could be expected to increase protection for pipelines from potential damages from storms, wave action, boats, anchor dragging, and saltwater exposure.

ALT D (geomorphic structure): Direct impacts would be similar to ALT B. Under ALT D barrier islands and shoreline protection can be expected to increase protection for pipelines from these potential damages.

LCA PLAN: Direct impacts would be a combination of ALT Band ALT D.

4.22.7.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): The costs of repairing or relocating pipelines would be reduced.

ALT D (geomorphic structure): Indirect impacts would be similar to ALT B.

LCA PLAN: Indirect impacts would be a combination of ALT Band ALT D.

4.22.7.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): The potential risks of damage would be reduced, lessening the potential costs of repair or relocation.

ALT D (geomorphic structure): Cumulative impacts would be similar to ALT B.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.8 Navigation

4.22.8.1 Future Without-Project Conditions – the No Action Alternative

A majority of Louisiana's navigable waterways would be adversely impacted without action as marshes and barrier islands that protect waterborne traffic on inland waterways continue to erode. As land adjacent to and connecting these waterways disappears, waterways currently protected would be exposed to wind, weather, and waves found in open bays and the Gulf of Mexico. Additionally, navigation channels that cross open bays may silt in more rapidly or begin to shoal in less predictable ways. The potential impacts to these waterways and the vessels that use them include increased maintenance costs (e.g., dredging), the necessity for higher horsepower vessels to counteract increased currents and wave forces, and increased risk of groundings, collisions or storm damage to vessels and cargo. Moreover, shoaling causes the thousands of tows that traverse this area annually to slow down, thereby increasing both the transit time and cost of transportation. Due to increased safety concerns, alternate methods of transportation may have to be taken by hazardous commodities now utilizing the GIWW. These impacts would have a corresponding effect on cargo rates, which would affect the local and national economies.

Continued coastal erosion in south Louisiana could also increase the risk of obstruction or closure of the lower Mississippi River Navigation Channel because of siltation or the loss of channel due to hurricane damage. Any closure of the river would result in increased operating costs of the ships waiting to enter or leave port as well as possible higher costs for inventory, additional storage costs, commodity flow restrictions, etc. It is estimated that a 7-day closure of the lower Mississippi River Navigation Channel would result in a loss of approximately $50 million, and a 14-day closure would result in a loss of approximately $200 million. These estimates only include increased operating costs of the ships waiting to enter or leave port. Additional costs would likely occur because of value of inventory, additional storage costs, commodity flow restrictions, etc. (Waldemar Nelson and Company 2003).

All the ports and waterways noted in the previous sections have projected positive annual growth rates over the next 50 years. Estimated growth for cargo moving on the Mississippi River System is about 1 percent annually. This estimate was derived from the growth rates used in the Upper Mississippi River Illinois Waterway Navigation Study. Growth rate estimates for the Louisiana GIWW is 0.78 percent (this is the midlevel estimate from a commodity forecast from the Calcasieu Lock Replacement Study). Average annual growth for the activity associated with the rig fabrication and offshore service industry is 1.67 percent (this estimate comes from a forecast prepared for the Houma Navigation Canal (HNC) Deepening Study). Positive economic impacts associated with the navigation industry would continue over time in the Future Without-Project conditions. Any environmentally negative impacts to navigation in the study would worsen over time without any projects in place.

4.22.8.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Repairs and improvements to the GIWW would result in positive direct impacts for navigation traffic. It could allow two-way traffic in areas that otherwise required one-way traffic, and transportation times could be reduced as a result of improved channel conditions. Both of these factors would result in lower transportation costs.

ALT D (geomorphic structure): None of the near-term environmental restoration features would have direct negative impacts to navigation traffic, but there may possibly be some short-term impacts during the construction of the features.

LCA PLAN: The direct impacts to navigation related to MRGO restoration measures from this restoration opportunity are expected to be the same as those described in ALT D. As in ALT B, GIWW improvements are expected to produce positive direct impacts for navigation.

4.22.8.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): In Subprovince 1, assuming no changes to the Mississippi River current that require navigation aids, no indirect effect would be anticipated for navigation. However, it is possible that this restoration opportunity would result in decreased flow velocities, increases in maintenance dredging costs, and decreased channel size. The magnitude of impacts to navigation would need to be further investigated. Changes to the operation of the HNC Lock for environmental purposes are not expected to have a significant impact to navigation.

ALT D (geomorphic structure): There are not expected to be indirect impacts to navigation from this restoration opportunity.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.22.8.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): The cumulative effects of diversions are expected to increase the amount of and the cost of dredging to maintain existing channel depths. There could be some favorable indirect effects of individual diversions for certain river distances in the short term as described in the previous section. However, in the long run, the cumulative effect of all of the diversions is expected to increase shoaling downstream resulting in greater net dredging costs to maintain existing channel depths.

ALT D (geomorphic structure): None of the near-term environmental restoration features would have any cumulative negative impacts to navigation traffic.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.9 Flood Control

4.22.9.1 Future Without-Project Conditions – the No Action Alternative

The continuing erosion of the Louisiana coastline has increased the potential for flood damages from the surges of hurricanes and tropical storms throughout southern Louisiana. Future Without-Project damages, as shown in **table 4-6**, were estimated for each of the subprovinces based on the stages associated with the 100-year storm event. Failure to maintain coastal wetlands would result in a significant level of increases in damages from storm surges that are currently reduced by coastal wetlands. There would also be damages to the levees themselves, which would require increased expenditures to raise, repair, and replace the hurricane protection levees.

4.22.9.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Marsh restoration can be expected to have negligible reduction in flood damages for those areas outside the protection levees.

ALT D (geomorphic structure): Barrier island restoration can be expected to have negligible reduction in flood damages for those areas outside the protection levees.

LCA PLAN: Direct impacts would be a combination of ALT B and ALT D.

4.22.9.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Flood damage could be reduced, thereby reducing repair costs and possibly preventing relocations. Diversions could be expected to reduce storm surge and require less investment in flood protection infrastructure. Additional adverse effects could result from the Donaldsonville diversion. Flood stages could be increased due to sediment causing a smaller channel.

ALT D (geomorphic structure): Barrier island rebuilding could be expected to reduce storm surge and require less investment in flood protection infrastructure.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.22.9.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): In addition to existing diversions Caernarvon and Davis Pond, the proposed LCA Plan diversions could cumulatively be expected to reduce storm surge and require less investment in flood protection infrastructure. Water levels in Bayou Lafourche may increase, depending on channel size; however, this and any other diversion would be designed, implemented, and operated in a way that minimizes the potential for flooding.

ALT D (geomorphic structure): In addition to the existing CWPPRA barrier island rebuilding efforts, the LCA Plan barrier island restoration could be expected to reduce storm surge and require less investment in flood protection infrastructure.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.10 Hurricane Protection Levees

4.22.10.1 Future Without-Project Conditions – the No Action Alternative

While the Lake Pontchartrain and Vicinity, Louisiana and West Bank and Vicinity, Louisiana projects provide significant protection against large hurricanes, they cannot protect against slow moving Category 3 or higher strength storms. The remaining hurricane protection projects provide much lower levels of protection. In addition, the project area is experiencing high levels of coastal wetlands losses which is likely increasing the threat from hurricanes. Although coastal restoration projects have been constructed, these have not significantly reversed the current rate of losses. Additional projects have been proposed and are under study to address the coastal land loss problem, but these projects have not moved beyond the study stage at this time. Other conditions that could impact hurricane protection issues are sea level rise and apparent subsidence issues. These issues were not considered in the feasibility studies that resulted in the authorization of some of the existing hurricane protection projects. In future studies, sea level rise must be considered in the planning, design, and construction of any hurricane protective structure.

The near miss of Hurricane Georges in September 1998 heightened local concerns about the level of hurricane protection in the study area. State and local emergency operations managers have stated that evacuation of all of the people at risk is not possible in the short amount of time prior to landfall of a major hurricane. Based on the Southeast Louisiana Hurricane Preparedness report completed by the USACE in 1994 a slow-moving Category 3 hurricane would put approximately 1,131,369 people at risk that would need to evacuate. After Hurricane Georges it was estimated that 300,000 people evacuated. For Hurricane Ivan, September 2004, which was projected to hit as a Category 4 or 5, state and local officials estimate that 600,000 people evacuated. A Category 5 storm would put 1,154,700 people at risk in southeast Louisiana that would need to evacuate. Both of these evacuations severely stressed the highway systems. Because much of the area is below sea level, there is great potential for catastrophic loss of life due to a major hurricane storm surge. The American Red Cross does not operate shelters in any parishes south of Lake Pontchartrain due to the fact that there are, at present, no structures in the metropolitan area that are certified as a shelter that could withstand a Category 4 or 5 hurricane (Southeast Louisiana Hurricane Preparedness Study 1994).

In addition, overtopping of the existing protection areas would flood vast areas of the metropolitan area. Analysis of this possibility has shown that draining the flooded areas would take many months. With large areas of the metropolitan area flooded for long periods of time, extremely high damages to infrastructure, businesses, and homes can be expected. In addition, severe impacts to the Port of New Orleans, New Orleans International Airport, the major facilities owned by the U.S. Navy, and the NASA facility at Michoud can be expected.

Structural and agricultural damages were estimated for the existing and Future Without-Project conditions. Sea level change and subsidence were incorporated into the estimation of future condition damages. Future Without-Project damages were estimated for each of these subprovinces based on the stages associated with the 100-year storm event provided by New Orleans District Hydrology and Hydraulics (H&H) Branch. It was assumed that the 100-year stage, under existing and future conditions (2050), would not overtop the Lake Pontchartrain Hurricane Protection levees, the hurricane levees protecting Morgan City, and the authorized levees currently being constructed south of Houma as part of the Morganza to the Gulf, Louisiana project. These hurricane protection levees are built to an elevation that is equal to, or greater than, the stage associated with the existing condition 100-year storm event, and periodic levee lifts have been incorporated into their construction schedules. However, it was assumed that the hurricane protection levees protecting the Larose to Golden Meadow and the New Orleans to Venice study areas are subject to overtopping by the future condition 100-year stage.

Sea level rise and subsidence has accelerated since the time these levees were authorized and constructed in the 1960s and 1970s.

Stage-damage data developed as part of the Flood Damage Estimation System (FDES) in 1980 for the Mississippi River and Tributaries (MR&T) project were used to estimate the flood damages that are expected to occur in Subprovinces 1, 2, and 3. The structural damage categories included: residential, commercial, industrial, public, and farm buildings. The damage values for the structural damage categories were adjusted to current price levels by using the Marshal and Swift building cost indices for southern Louisiana. However, it should be noted that damages would reflect the development that existed in 1980 and no adjustments were made to reflect any growth that has occurred since then. Based on data provided by the USACE MVN Geotechnical Branch, it was assumed that both the developed and agricultural land in the area would subside approximately 0.6 foot between 1980 and 2050. This predicted subsidence, which does not include the ongoing subsidence of marshland, was used with the future 100-year stage to calculate the future condition structural and agricultural damages.

For the agricultural damages, the cleared acreage flooded was provided by stage. These acres were multiplied by the damage rate per acre in order to determine the Future Without-Project agricultural damages. The damage rates per acre were developed by the Louisiana State University Agricultural Center for each Louisiana parish based on the actual agricultural damages that occurred as a result of Tropical Storm Isidore and Hurricane Lili in 2002. Each of these storm events generated storm surges and heavy rainfall that affected the coastal Louisiana area. The average agricultural damage rate per acre for Subprovince 1 totaled $166, for Subprovince 2 totaled $192, and for Subprovince 3 totaled $361. The structural and agricultural damages were added to get the total existing and Future Without-Project flood control damages for each of the subprovinces.

The data were not available for the Louisiana parishes west of the city of Lafayette to the Texas border in Subprovince 4. Thus, 2000 Census data were used to estimate the number and value of structures; while USGS quad maps containing 5-foot (0.15-m) contour intervals and benchmarks were used to assign average ground elevations to the structures. The first floor elevations of these structures were assigned based on previous field experience in the study area. Structures are generally built to an elevation that is within 1 foot of the stage of the existing condition 100-year storm event. Since most of the structures near the Gulf of Mexico are built on piers several feet above the ground, they were assumed to have a total elevation of 9 to 10 feet. The structures farther inland from the Gulf of Mexico were assumed to be built approximately 1 to 2 feet (0.3 to 0.6 m) off the ground with a total elevation of 6 to 7 feet (1.8 to 2.1 m).

The Future Without-Project condition stages were then compared to the height of the structures to calculate a depth of flooding for each structure. As discussed previously, the elevation of the houses was lowered by the subsidence of the land, 0.6 foot (0.18 m) by 2050 to calculate future condition damages. Once the depth of flooding was determined, the depth-damage relationships developed for the Lake Pontchartrain and Vicinity Hurricane Protection Project were used to calculate the percentage of the structures and their contents damaged by flooding. These are the same curves that had been used to calculate damages for a previous hurricane protection feasibility study within the Louisiana coastal area. The damages were calculated and totaled for all structures to get the total existing and future condition without project structural damages.

The average depreciated value assigned to residential buildings in Subprovince 4 was determined to be $48,000 in Cameron Parish and $54,000 in Vermilion Parish. This value was assigned based on the average 2000 Census value for residential structures in each of these parishes, and then reduced by 20 percent for the value of the land and the depreciation of the structures. The average depreciated value, $214,000, assigned to nonresidential structures in Subprovince 4 was based on the average value of nonresidential structures calculated for the Houma area in the Morganza to the Gulf, Louisiana Feasibility Study. A contents-to-structure value ratio (CSVR) of 0.57 was applied to the residential structures and 1.13 for nonresidential structures in order to determine the total value of the contents for residential and nonresidential structures. The CSVRs used for Subprovince 4 were taken from those developed for the Lake Pontchartrain and Vicinity Hurricane Protection Project and are consistent with those used to develop the stage-damage data and were used for a previous hurricane protection feasibility study within the Louisiana coastal area.

The agricultural acres were estimated using quad sheets and the 100-year surge levels provided by New Orleans District H&H Branch. These acres were then multiplied by the damage rate per acre to determine the existing and Future Without-Project agricultural damages. The average agricultural damage rate per acre for Subprovince 4 totaled $159. The structural and agricultural damages were added to get the total existing and future without project flood control damages for Subprovince 4.

The structural and agricultural damages for the Future Without-Project condition are shown by subprovince in **table 4-6**. Also displayed in the table are the number of structures, the total value of these structures, and the number of acres that are susceptible to flooding by the future condition 100-year stage.

Table 4-6 Future Without-Project Condition 2002 Price Level						
Sub-province	**Number of Structures**	**Total Value ($1,000s)**	**Structural Damages ($1,000s)**	**Acres of Cropland**	**Agricultural Damages ($1,000s)**	**Total Damages ($1,000s)**
1	**12,329**	**$ 5,593,026**	**$ 727,213**	**67,054**	**$ 16,570**	**$ 743,783**
2	**18,256**	**4,254,614**	**871,444**	**90,056**	**16,947**	**888,391**
3	**17,418**	**3,296,641**	**574,165**	**208,368**	**70,680**	**644,845**
4	**12,992**	**1,345,351**	**512,249**	**142,000**	**22,578**	**534,827**
Total	**60,995**	**$ 14,489,632**	**$ 2,685,071**	**507,478**	**$ 126,774**	**$ 2,811,845**

4.22.10.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): There would be short-term minor direct impacts, primarily associated with construction activities.

ALT D (geomorphic structure): There would be no direct impacts on hurricane levees, as this restoration opportunity does not include any feature such as diversions that would directly impact a levee.

LCA PLAN: Direct impacts would be similar to ALT B.

4.22.10.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): ALT B would incorporate diversions and marsh creation that would help preserve and rebuild marsh buffer zones that, in turn, would protect hurricane protection levees.

ALT D (geomorphic structure): Marsh creation, barrier system, and barrier shoreline restoration would provide some protection from storm surge.
LCA PLAN: Indirect impacts would be a combination of ALT B and ALT D.

4.22.10.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): ALT B would incorporate diversions and marsh creation that would help to preserve and rebuild the marsh buffer zone that would, in turn protect hurricane protection levees.

ALT D (geomorphic structure): There would be cumulative storm surge protection provided by marsh creation, barrier system, and barrier shoreline restoration.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.11 Agriculture

4.22.11.1 Future Without-Project Conditions – the No Action Alternative

The impact to agriculture if no action is taken would be negative and result in an increase of saltwater intrusion, erosion of coast, and increased damages from storms. The loss to agriculture opportunities could cause a decrease in total acreage and yields of crops in the study area. Salinity levels in water used for crop irrigation are expected to increase and, with continued land loss, the risk of storm damage to agricultural resources would also increase. As the coastal landscape erodes and tidal surges force higher salinity waters farther inland, many areas would have to counteract this effect by relocating water intakes to more northerly locations or by installing saltwater barriers to protect their existing intakes. These expenses would undoubtedly be passed on to consumers. Agricultural damages, including losses to crops such as sugar cane, rice, soybeans, pastureland, etc. associated with Future Without-Project conditions were estimated along the Louisiana coast. This study indicated that continued loss of barrier islands and wetlands would increase the risk of storm damage to agricultural resources. The loss of agricultural productivity associated with reduced amounts of freshwater available for crop irrigation and increased risk of storm damages would result in adverse economic impact to Louisiana and the Nation.

4.22.11.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): ALT B would cause minor losses of agricultural lands due to the footprint of diversions channels.

ALT D (geomorphic structure): There would be no adverse direct impacts.

LCA PLAN: Direct impacts would be similar to ALT B.

4.22.11.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): ALT B would benefit agriculture by limiting saltwater intrusion into bayous and canals.
ALT D (geomorphic structure): There would be no adverse indirect impacts on agriculture. There would be some storm surge protection provided by marsh creation, barrier system, and barrier shoreline restoration.

LCA PLAN: Indirect impacts would be similar to ALT B and ALT D.

4.22.11.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): There would be a potential for minor reduction to storm damages from hurricanes.

ALT D (geomorphic structures): Cumulative indirect impacts would be similar, but less than ALT B, due to fewer restoration features.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.12 Forestry

4.22.12.1 Future Without-Project Conditions – the No Action Alternative

There would be a loss of forestry opportunities in the Future Without-Project. By taking no action the coast of Louisiana would continue to erode, which would lower the potential acreage of forestland. Lower acreage would decrease productivity and decrease yields of timber. There is also a potential for increased damages from storms and saltwater intrusion to forestry. Overall, taking no action could produce negative impacts to forestry. As a result of taking no action, the economic implications could be negative. If there is a decrease in acreage and yields of timber, jobs in the forestry industry could decrease, which could increase the unemployment rates in the study area. Also, income for forestry landowners would decline if no action were taken. The loss of forestry productivity would result in adverse economic impact to Louisiana and the Nation.

4.22.12.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): There would be no significant direct impacts, except to the degree that forest acres may be used for project construction, which is not anticipated at this time.

ALT D (geomorphic structures): There would be no direct impacts.

LCA PLAN: Direct impacts would be similar to ALT B.

4.22.12.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): There may be an increase in productivity of timber due to inputs of freshwater, nutrients, and sediments. If timber production increases, then there could be a potential to increase forestry-related jobs, employment, and income.

ALT D (geomorphic structures): Indirect impacts are unlikely.

LCA PLAN: Indirect impacts would be similar to ALT B.

4.22.12.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): There is the possibility to reduce storm-related damages and increase opportunities for forestry-related activities. There could be positive economic opportunities for forestry-related jobs, employment, and income. These positive cumulative impacts would be in contrast to negative cumulative impacts associated with the continued harvesting of wetland forests areas, such as the present timber harvesting operation occurring near Maurepas swamp.

ALT D (geomorphic structure): Cumulative impacts to forestry are unlikely.

LCA PLAN: Cumulative impacts would be similar to ALT B. These positive impacts would be in contrast to the continued timber harvesting of wetland forests areas, such as the present forest harvest operations occurring near Maurepas swamp.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.22.13 Water Supply

4.22.13.1 Future Without-Project Conditions – the No Action Alternative

In many coastal areas of southeastern Louisiana, fresh surface water supplies would be limited to the Mississippi River, Atchafalaya River, and many of their distributaries. Because many of these water bodies are controlled by levees and flows are maintained, it is doubtful that they would be affected by loss of surrounding wetlands. Also, because these water bodies are the major sources of freshwater in southeastern Louisiana, water use would be largely unaffected. However, Bayou Lafourche currently experiences periodic saltwater intrusion, primarily from Company Canal and the GIWW. Salinities in this bayou could increase, limiting freshwater supplies, if the surrounding area became saltier. The economic effects would be felt by industry, agriculture, and the public supply in this area. Because fresh groundwater is very limited or unavailable in most of the LCA Study area, the larger water users in this area, primarily industry and public supply, would have to treat (desalinate) the water for salinity or find new sources of freshwater. This could affect public water supply, agricultural use, and industrial use in this area, resulting in increased costs for water treatment (desalination). Businesses could be forced to relocate, thereby potentially adversely affecting jobs, income, population, and property values.

In southwestern Louisiana, fresh surface water and groundwater are available in most coastal areas. However, surface water in some areas, such as the Calcasieu Basin, experience periodic saltwater inundation. Much of the water use in these areas is agricultural and farmers use groundwater when surface supplies become salty. If surface water salinities increased in coastal areas because of wetland loss and erosion, it is likely that surface water withdrawals would decrease and withdrawals from groundwater would increase. Fresh groundwater is available in sufficient supplies in most areas of southwestern Louisiana to offset any losses of surface supplies. However, a saltwater-freshwater interface is present in the aquifer system, extending inland from the coast along the base of the aquifer system as a wedge. In coastal areas, freshwater overlies saltwater. Increased withdrawals in coastal areas could cause the interface to move further inland or the interface to rise toward pumping wells. This could affect agricultural use in that area resulting in increased costs for water treatment. Potentially this agricultural activity could decline, thus adversely affecting the local economy through declines in jobs, income, population, and property values.

4.22.13.2 Restoration Opportunities – Direct Impacts

ALT B (deltaic processes): Direct impacts would be minimal, provided that measures are taken during construction to minimize impacts to any existing water supplies in the area, and that the design of restoration features account for any disruptions of water supply during the construction period.

ALT D (geomorphic structures): Would cause little, if any, direct impacts on the water supply.

LCA PLAN: Direct impacts would be similar to ALT B.

4.22.13.3 Restoration Opportunities – Indirect Impacts

ALT B (deltaic processes): Indirect impacts would primarily result in a decrease in saltwater intrusion. Diversions of Mississippi River water may negatively impact freshwater supplies to downstream users of Mississippi River water. Increased flows into the receiving areas of Subprovinces 1 and 2 may enhance freshwater supply to users in those areas. Increased flows into Bayou Lafourche and the Terrebonne marshes would enhance freshwater supplies to users in those areas. Reduced saltwater intrusion into areas, such as Houma, may prolong freshwater supply to users in those areas.

ALT D (geomorphic structures): Indirect impacts of ALT D could primarily be a decrease in saltwater intrusion in the MRGO area.

LCA PLAN: Indirect impacts would be a combination of ALT B and ALT D.

4.22.13.4 Restoration Opportunities – Cumulative Impacts

Table 4-1 summarizes the cumulative impacts for ALT B, ALT D, and the LCA Plan.

ALT B (deltaic processes): Cumulative impacts to water supply would primarily be related to the incremental impact of all past, present, and future actions effecting water supply such as existing freshwater diversions (e.g., Caernarvon, Davis Pond, West Bay, etc.); those diversions currently in planning or construction (e.g., Maurepas, etc); and similar actions. Hence, for ALT B, potential cumulative impacts would be the incremental decrease of freshwater supply in areas with water intakes along the Mississippi River (e.g., Point a la Hache, Port Sulfur, Venice, etc.). However, any potential adverse impacts to community and industrial water supplies would be mitigated. In Subprovince 3, it is anticipated that the proposed features would increase freshwater supply to areas such as Houma. Salinity in lower Bayou Lafourche would be reduced.

ALT D (geomorphic structures): Cumulative impacts would primarily be a decrease in saltwater intrusion in the MRGO area.

LCA PLAN: Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of ALT B and ALT D.

These general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis.

4.23 OTHER CUMULATIVE IMPACTS

The primary purpose of this chapter is to present the direct, indirect, and cumulative impacts of the conceptual LCA Plan restoration opportunities on significant resources. However, 40 CFR 1508.7 defines cumulative impacts as:

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

The emphasis has been added. The April 2002 USEPA-hosted workshop on "The NEPA: Conducting Quality Cumulative Effects Analysis," indicated that considering the past, present, and reasonably foreseeable future provides a needed context for assessing cumulative impacts. The inclusion of other actions occurring in the proximity to the proposed action is a necessary part of evaluating cumulative effects. Agencies should identify activities occurring outside their jurisdiction that are affecting the same resources being affected by their actions. Hence, this section summarizes other cumulative impacts to the Louisiana coastal ecosystem by other Federal, state, local, and private coastal restoration efforts and the District's water resources development projects.

4.23.1 Federal, State, Local, and Private Restoration Efforts

4.23.1.1 General

This section describes other Federal, state, local, and private restoration efforts in the Louisiana coastal area. The CWPPRA acreage for wetland creation projects was collected from the Coast 2050 report (LCWCRTF & WCRA 1998). Information on the Water Resources Development Act wetland creation projects was compiled from the "Water Resources Development in Louisiana 1998" by Saucier (1998). Other information was derived from web sites including www.lacoast.gov for CWPPRA input, www.coast2050.gov for LCA Study input, and www.savelawetlands.org for LDNR input. The Regulatory Branch of the District provided information for each parish on the acres of jurisdictional waters (and wetlands) of the United States requested to be permitted, the acres actually permitted, and the number of acres mitigated. Wetland acreage created or planned to be created by the beneficial use of dredged material was gathered from the Beneficial Use Monitoring Program (BUMP) (USACE 2001) which examined the beneficial use of dredged material disposal history along selected navigational channels in Louisiana and the cumulative landscape history for the beneficial use monitoring program sites in 1985–2000. Other data acreages were collected from phone conversations with agencies of the LDNR, NRCS, and the Soil and Water Conservation Committee (SWCC) for the coastal parishes of Louisiana.

CWPPRA ("Breaux Act") Restoration Projects: As of January 2004, 13 priority lists have been approved, of which 127 active projects were approved and 61 have been completed. These projects include gulf and inland shoreline protection, sediment and freshwater diversions, terracing, vegetative plantings, marsh creation, hydrologic restoration, marsh management, and barrier island restoration. CWPPRA provides $5 million annually for coastal restoration planning and roughly $50 million each year for the construction of coastal protection and restoration projects. When constructed, all of the projects authorized to date would create, restore, protect, or enhance approximately 134,146 acres (54,329 ha). Despite the acres gained by implementation of the CWPPRA-funded projects, these acres and those preserved by the existing freshwater diversions from the Mississippi River would prevent only about 25 to 30 percent of the predicted future marsh loss in Louisiana. Hence, there is a need for a coast wide, ecosystem-level restoration effort that would require significantly greater funding than was conceptualized and is authorized for CWPPRA because the state would suffer a net loss of approximately 513 square miles of coastal wetlands by 2050.

In addition to the impacts of creating, restoring, protecting, and/or enhancing approximately 134,146 acres, there are other impacts of CWPPRA restoration projects:

- Typical short-term project construction-related impacts such as increased turbidity and decreased dissolved oxygen associated with placement of fill material; disturbance of terrestrial and aquatic organisms during construction, etc.
- Conversion of shallow open water sites to marsh.
- Visual aesthetic impacts related to placement of structures in otherwise naturalistic viewscapes.

- When real estate interests are acquired over real property as necessary for the construction, operation, and maintenance of a project feature, e.g., perpetual flowage easement/servitude or a perpetual wetlands creation and restoration easement/servitude, the landowner is paid just compensation for such rights. The landowner may not thereafter exercise rights over the land, if such activities will interfere with the full use and enjoyment of the real estate interests that were acquired for the project.
- Illegal fishing, hunting, and other trespass activities on restored areas.
- Restoration of large tracts of private lands with public funds.

Water Resources Development Act (WRDA) Restoration Projects: The Water Resources Development Acts (WRDA), the first of which was passed in 1976, authorizes the Secretary of the U.S. Army and the District to study and/or implement various projects and programs for improvements to rivers and harbors of the United States and for other purposes. A number of Water Resources Development Acts contain general environmental provisions pertinent to the Civil Works water resources development program or to the management of environmental resources. A number of sections from these Acts pertain to specific projects or studies for environmental purposes. For example, Caernarvon and Davis Pond are two WRDA-authorized, large-scale, freshwater diversion projects which divert freshwater (and to a lesser extent sediment and nutrients) to counteract saltwater intrusion, help offset marsh subsidence, and enhance fish and wildlife. These projects would benefit over 40,000 existing acres (16,200 ha) of wetland habitat.

Section 1135 (PL 99-662) of WRDA 1986 authorizes the District to review the operation of its existing water resources projects to determine the need for modifications in structures and operations for the purpose of improving the quality of the environment in the public interest. A $25 million annual limit was authorized for this section with 25 percent of the cost of any modification to be paid by a non-Federal sponsor.

Section 204 (PL 102-580) of the WRDA 1992 authorized the Secretary of the U.S. Army to carry out projects for the protection, restoration, and creation of aquatic and ecologically related habitats, including wetlands, in connection with dredging for construction, operation, or maintenance of an authorized Federal navigation project. Any project undertaken pursuant to this section shall be initiated only after non-Federal interests have entered into a cooperative agreement.

Together, Section 1135 and Section 204 projects have created about 6,245 acres (2,529 ha) in Louisiana.

Other typical impacts or trade-offs associated with Section 204 and 1135 projects include:

- Temporary increase in turbidity, noise pollution, and air pollution from machinery exhaust during restoration, and temporary decrease in dissolved oxygen.
- Displacement of fish and wildlife during restoration.
- Conversion of shallow water habitat to emergent marsh.
- Loss of ingress and egress for fisheries to interior marsh due to wetland creation.
- Limited public access during construction.

- Possible change is public use policy after restoration (i.e. limited future development, possible usage fees, restricted access, etc.).
- Changes in salinity distribution.

Louisiana State Restoration Projects: The State of Louisiana is partnered with private companies and agencies within the state and Federal Government to create, restore, and protect wetlands and shoreline from degradation. The types of projects include hydrologic restoration, beneficial use of dredged material, marsh management, marsh creation, shoreline protection, freshwater diversion, vegetation planting, sediment and nutrient trapping, sediment diversion, and barrier island restoration. These projects are scattered within the four subprovinces of the coastal zone of Louisiana. As of 2003, the total acreage created, restored, or protected for Subprovince 1 is 2,443 acres (989 ha), Subprovince 2 is 9,143 acres (3,702 ha), Subprovince 3 is 4,865 acres (1,970 ha), and Subprovince 4 is 4,574 acres (1852 ha); for a total of 21,025 acres (8515 ha).

The LDNR provides the following description regarding other impacts of Louisiana state restoration projects (personal communication Jean Cowan, September 27, 2004). Definition of negative impacts is complicated by several factors. First, what typically indicates a negative impact in certain ecosystems, such as filling shallow water to construct land or introducing turbid nutrient rich water to aquatic ecosystems, may be an intended purpose or action within the wetland restoration program. Second, the Louisiana coastal ecosystem is degrading rapidly, with rapid landward shifts of isohalines and habitat conversions. Restoration projects designed to reverse these trends may negatively impact a given resource or habitat type on the project scale in the near-term, but overall, the health of the ecosystem will be improved compared to Future Without-Project conditions once the system reaches a new equilibrium. It is important to keep this in mind when defining negative impacts. Some impacts have been observed, however, and include wetland destruction for diversion outfall channels, temporary displacement of terrestrial and aquatic life, disruption of benthic habitats, turbidity due to construction activities, and construction noise. These impacts are generally temporary in nature and when necessary, have been mitigated.

Vegetation Restoration Projects: The LDNR, NRCS, and Soil and Water Conservation Committee (SWCC) are the agencies involved with vegetative plantings in coastal Louisiana. The NRCS Plant Materials Center, located near Golden Meadow, was established specifically for development and assessment of species varieties for use in coastal marsh habitats. Within the four subprovinces, there were 193 vegetation projects as of 2003. The total acreage benefited for each subprovince is as follows: Subprovince 1 had 486 acres (196 ha), Subprovince 2 had 1,004 acres (406 ha), subprovince 3 had 1,785 acres (723 ha), and Subprovince 4 had 1,973 acres (799 ha) created, restored, and/or protected. The types of vegetation planted include smooth cordgrass (*Spartina alterniflora*), giant cordgrass (*Zizaniopsis miliacea*), seashore paspalum (*Paspalum vaginatum*), California bulrush (*Schoenoplectus californicus*), roseau cane (*Phragmites australis*), bitter panicum (*Panicum amarum*), marsh hay cordgrass (*Spartina patens*), salt grass (*Distichlis spicata*), baldcypress (*Taxodium distichum*), common bermuda (*Cynodon dactylon*), panic grass (*Panicum* sp.), gulf cordgrass (*Spartina spartinae*), and black mangrove (*Avicennia germinans*). These plantings have rehabilitated fresh, brackish, intermediate, and saline marsh, swamp, and barrier islands.

Other impacts typically associated with vegetation restoration projects include (personal communication Marty Floyd and Cindy Steyer, NRCS, October 5, 2004):

- Temporary increase in turbidity during planting.
- Temporary displacement of fish and wildlife during planting restoration.
- Conversion of shallow water habitat to emergent marsh and conversion of mud and/or sand flats, dune, and other unvegetated bare ground to vegetated habitat.
- Planted vegetation in shallow open water would trap sediments thereby helping to create land.
- Planted vegetation on barrier islands and headlands would trap windblown particles thereby helping to stabilize sediments and increase or maintain elevation.
- Planted vegetation in shallow open water would reduce fetch lengths and water energy thereby creating conditions conducive to establishment of submerged aquatic vegetation.
- Potential loss of ingress and egress for fisheries to interior marsh due to wetland creation.
- Limited public access during planting operations.
- Possible change in public use policy after restoration (i.e., limited future development, possible usage fees, restricted access, etc.).
- Conversion of monotypic habitats or communities to areas with higher diversity of vegetation species.
- Plantings increase the diversity of nesting habitats, especially on barrier islands; plantings on barrier islands reduces available bare ground/beach for ground-nesting birds while providing vegetated nesting habitat for birds that require vegetation within which to nest.

<u>Louisiana Parish Coastal Wetland Restoration Program (PCWRP)</u>: The Parish Coastal Wetlands Restoration Program (PCWRP), also known as the "Christmas Tree Program," is designed to encourage public involvement and participation in coastal restoration. Wooden enclosures are filled with recycled Christmas trees that have been donated by the public. These structures are built in close proximity to the shoreline and absorb wave energy, protecting existing marsh or vegetation. Sediment accumulates behind these structures and promotes subsequent colonization and growth of new marsh vegetation. Christmas tree fences are relatively inexpensive, with an average cost of $50 per linear foot.

<u>Federal Emergency Management Agency (FEMA)</u>: FEMA provides aid to people and areas that have been adversely affected by Presidentially declared natural disasters. Aid provided by FEMA includes vegetative plantings, beneficial use of dredged material, sand fences on barrier islands, repairing water control structures, and bank repair. As of 2003, FEMA assisted the state of Louisiana after several hurricanes, tropical storms, and flooding events with 8 projects, which benefited over 5,379 acres.

<u>Mitigation in the Coastal Zone</u>: From 1 January 1998 to 23 October 2003, the Regulatory Branch of the District received requests for permitting (including standard, general, and nationwide permits) a total of about 15,202 acres (6,156 ha) of jurisdictional waters (and wetlands) of the United States located within the 17 parishes comprising the Louisiana Coastal Plain (**table 4-7**). **Table 4-7** also shows that a total of about 12**,**355 acres (5,003 ha) were actually permitted, with about 15,228 acres (6,167 ha) of compensatory mitigation. Acreages of

wetlands impacted under permits for Section 404 of the CWA include directly and indirectly affected wetlands. This includes not only coastal marsh impacts, but also all impacts to waters of the United States.

Table 4-7
Standard, General, and Nationwide Permits
Acres Requested to be Permitted, Acres Actually Permitted, and
Acres Mitigated in the Louisiana Coastal Zone.
(Source: The District's Regulatory Branch database)

Parish	Entirely (E) or Partially (P) Within Coastal Zone	Acres Requested	Acres Permitted	Acres Mitigated
Calcasieu	P	2,118	1,846	2,087
Cameron	E	883	862	896
Iberia	P	264	252	227
Jefferson	E	828	715	641
Lafourche	P	1,283	1,064	1,829
Livingston	P	816	696	960
Plaquemines	E	1,262	1,055	2,084
St. Bernard	E	269	219	237
St. Charles	E	822	533	481
St. James	E	231	223	248
St. John the Baptist	E	410	315	494
St. Martin	P	451	429	512
St. Mary	P	613	535	576
St. Tammany	P	2,754	1,966	2,248
Tangipahoa	P	451	353	388
Terrebonne	P	1,310	919	918
Vermilion	P	437	373	402
TOTAL		**15,202**	**12,355**	**15,228**

Mitigation of Federal civil works projects (e.g., flood and hurricane protection projects) in the LCA Study area includes approximately 5,537 acres (2,242 ha). Mitigation of civil works flood and hurricane protection projects include the following:

- Larose to Golden Meadow project mitigation was the hydrologic restoration of Pointe au Chien WMA preserving about 4,600 acres (1,863 ha).
- New Orleans to Venice, Louisiana project mitigation to compensate for project-associated wetland losses on Reach B has been constructed. This consists of five crevasses in the Mississippi River Delta to promote marsh creation (one constructed in 1986 and the remaining four constructed in 1995). These five crevasses created approximately 225 acres (91 ha) of fresh marsh. Remaining mitigation for Reaches A, C, and West Bank River Levee WBRL, consisting of creating and preserving marsh in the

Pass a Loutre State Waterfowl Management Area, was completed in 1997. This remaining mitigation created approximately 105 acres (42.5 ha) of marsh and nourished and preserved approximately 1,230 acres (498 ha) of wetlands.

- Lake Pontchartrain project mitigation involved construction of a breakwater to prevent breakthrough of Lake Pontchartrain into the Manchac WMA. It preserved about 3,400 acres (137 ha).
- West Bank and Vicinity, New Orleans, Louisiana project mitigation to compensate for marsh losses has been constructed. This consists of a tire/timber pile breakwater to stop a projected 370 acres (149 ha) of wave-induced coastal erosion at the Netherlands area on the west side of Lake Salvador at the Salvador Wildlife Management Area (WMA). The breakwater was completed in 1991. The remaining mitigation to compensate for wooded land losses has not been constructed, due to design changes and expansion of the project. This mitigation will consist of the acquisition, preservation, and habitat development of wooded wetlands; and is currently being documented in a Mitigation Report.
- Louisiana State Penitentiary project mitigation was reforestation of about 166 acres (67 ha) on Angola lands. (Note: this project is not in the coastal zone.)
- Mississippi River Levees project mitigation was the reforestation of about 30 acres (12 ha) of land in the Bonnet Carré Spillway.

In addition to impacts associated with the creation and restoration of wetlands described above, there are other impacts associated with the mitigation of civil works flood and hurricane protection projects and permitted actions.

- Impacts associated with the construction of the mitigation area include: increased turbidity, altered hydrology, conversion of open water areas, etc., (personal communication on September 21, 2004, Mr. Rocky Hinds, Coastal Use Permits Section, LDNR).
- Structures rendered ineffective due to discontinued maintenance or damage are often left in place. Such structures pose navigation risks and unknown hydrologic effects (personal communication Mr. Robert Bosenberg, Biologist, the District).

- Existing water resources project designs and operational schemes have likely created a very complex patchwork of localized hydrologic regimes. (personal communication Mr. Robert Bosenberg, Biologist, the District).
- The mosaic of existing restoration/management projects might have actually accelerated the rate at which coastal marshes have been piecemealed and fragmented, (personal communication Mr. Robert Bosenberg, Biologist, the District).
- Some areas brought under management or restoration efforts have experienced illegal fishing and hunting, trespass, requests for captive mariculture, added costs for surveillance and informant. (personal communication Mr. Robert Bosenberg, Biologist, the District).
- Socioeconomic Impacts.
    - Property used for mitigation banks and projects require perpetual easements, which take them out of future commercial usage and community growth (personal communication on September 21, 2004, Mr. Rocky Hinds, Coastal Use Permits

Section, LDNR. Personal communication on September 22, 2004 with Dr. James Barlow, Regulatory Branch of the District),

- Public and private funds were expended on wetland projects that might have been funneled into other economic development streams (personal communication Mr. Robert Bosenberg, Biologist, the District).
- Permit holders and beneficiaries of other restoration/management efforts could well have their projects modified by LCA Plan restoration efforts. Depending upon the perceived consequences, some of these individuals might be moved to file damage claims or seek reimbursement for alleged, sight-specific benefits denied them (personal communication Mr. Robert Bosenberg, Biologist, the District).
- Tax Base: The tax rate for forested wetlands is generally much less than that of cropped or pasture lands. If bank lands are eventually sold or turned over to a state or Federal agency or a non-profit conservation organization, there may be no land taxes (personal communication on September 22, 2004 with Dr. James Barlow, Regulatory Branch of the District),
- Loss of Jobs: The loss of agricultural lands to conversion to wetlands could adversely impact the number of permanent and seasonal jobs in the agricultural industry (personal communication on September 22, 2004, with Dr. James Barlow, Regulatory Branch of the District).
- Reduced Economic Viability in the Farming Community: With the loss of jobs, less money to spend within the community (personal communication on September 22, 2004 with Dr. James Barlow, Regulatory Branch of the District),

Non-Governmental Organizations (NGOs): Public and private parties - nongovernmental organizations (NGOs) - privately manage wetlands and other coastal habitats to enhance, preserve and/or restore coastal wetlands throughout the LCA Study area. NGOs include: private individual landowners, family estates, and corporations; non-profit organizations; and academic institutions. NGOs manage coastal wetlands for many different reasons, including: to enhance, preserve or restore wetland habitat functions and values; to attract waterfowl and game fish for their ecological importance and/or aesthetics; to prevent property damage and/or land loss; for agriculture and aquaculture; and for various other reasons. Typical land and water management practices that NGOs apply throughout coastal Louisiana include: shoreline stabilization; plugging oilfield canals to prevent saltwater intrusion; gapping spoil banks to increase fresh water exchange; rebuilding spoil banks to prevent erosion and saltwater intrusion; and earthen terracing to create wetland habitat and reduce erosion. In addition, water level management practices are commonly used to enhance water quality and habitat for fish, waterfowl, and wildlife. Aside from recognition of a few individual conservation organizations' restoration efforts, a comprehensive accounting of the various NGO restoration activities in coastal Louisiana is lacking. However, the positive cumulative benefits of NGO coastal restoration efforts are valuable to overall coastal Louisiana restoration efforts.

Examples of public and private parties involved in wetlands preservation or restoration activities in coastal Louisiana include: Coastal America, Corporate Wetlands Restoration Partnership, Gulf Coast Joint Venture, Audubon Society, National Fish and Wildlife Foundation, The Nature Conservancy, National Wildlife Federation, the North American Wetlands Conservation Act

(NAWCA), administered by the USFWS; and the Wisner Foundation. Specific examples of coastal restoration activities performed by public and private NGOs include:

The Nature Conservancy of Louisiana, a non-profit organization, uses private donations to purchase large tracts of land for the purpose of preserving important and rare natural areas.

Ducks Unlimited, Incorporated, through private contributions, has constructed earthen terraces in 3,226 acres (1,306 ha) of open water in the Cameron Creole Watershed on both private and public lands, and is committed to constructing other similar terracing projects in the near future, including a project during the summer of 2004 in Cameron and Vermilion Parish, a project near Boggy Bayou in Cameron Parish, and a project on the Pointe au Chien Wildlife Management Area (Source, personal communication with Chad J. Courville, Regional Biologist, Ducks Unlimited, Incorporated, 27 May, 2004).

The Wisner Foundation, in a community-based partnership with the University of New Orleans, Morris P. Hebert, Incorporated, the Barataria-Terrebonne Estuary Program, Restore America's Estuaries Program, Chevron and two Federal Government Organizations, have implemented a 2,000-acre (810 ha) project within the 35,000-acre (14,175 ha) Wisner Foundation land, which includes 45 acres (18.3 ha) of brackish marsh, shoreline and spoil bank protection, plantings and sediment diversions (The Lafayette Daily Advertiser, May 16, 2003).

One of the more significant contributions to the restoration and enhancement 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 (12,376 ha) of restoration and 340,348 acres (137,341 ha) of enhancement in coastal Louisiana wetlands.

4.23.1.2 Impacts of Restoration Opportunities on Other Coastal Restoration Efforts

From a programmatic and conceptual perspective, the potential cumulative impacts of each restoration opportunity on other Federal, state, and local restoration efforts would generally be similar and would be the sum total restored acres (and the associated functions and values) of these other restoration efforts plus the total acres (and associated functions and values) protected, created and/or restored by each plan in the final array of coast wide plans compared to the continued and accelerated loss of wetlands throughout the United States.

The cumulative impacts of the near-term plans on other Federal, state, and local restoration efforts would generally be the net restored acres (and the associated functions and values) of each feature in each near-term plan plus the net acres (and associated functions and values) protected, created and/or restored by these other Federal, state, local and private restoration efforts, compared to the continued and accelerated loss of wetlands throughout the United States. **Table 4-8** displays the net acres created, restored, and/or protected by other Federal, state, local, and private restoration efforts.

4.23.2 Other Cumulative Impacts: Natural and Human Activities Affecting Coastal Land Loss

4.23.2.1 General

The following description of cumulative impacts of coastal land loss factors in the Mississippi River Deltaic Plain and Chenier Plain is based, respectively, on Penland et al. (2000) and the October 2002 report prepared for the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, entitled "Hydrologic Investigation of the Louisiana Chenier Plain" (HILCP). (LCWCRTF and WCRA 2002). Although these studies represent the most recent comprehensive treatment of the subject, there is some disagreement regarding the findings of both of these studies, especially since neither of these studies was peer reviewed. The Argonne National Laboratory, Gas Research Institute, the District, and the USGS sponsored The Penland et al. (2000) study, with authors from the University of New Orleans, Louisiana State University, the District, USGS and the Plaquemines Parish Government. The HILCP study was prepared by the LDNR with contributing authors from the University of Louisiana at Lafayette, USGS, USFWS, and the CWPPRA study which includes input from the USFWS, NMFS, NRCS, USEPA, and the District.

4.23.2.2 Delta Plain – Cumulative Impacts of Coastal Land Loss Processes

Penland et al. (2000) provide the only known comprehensive coastal land loss process classification scheme for the Mississippi River deltaic plain. Although there is some disagreement regarding the findings of this study, Penland et al. (2000) emphasize that their analysis describes local processes which occurred over a 60-year period and may not fully reflect the contribution of important regional processes such as river control, subsidence, and eustacy (change in global sea level) which were active even prior to the acceleration of land loss rates in the late 1960s. Although these regional processes play an important role in shaping coastal Louisiana, no studies have specifically quantified the contribution related to each.

Table 4-8
Net Acres* Created, Restored, and/or Protected by
Other Federal, State, Local, and Private Restoration Efforts

	Subprovince 1 (acres)	**Subprovince 2** (acres)	**Subprovince 3** (acres)	**Subprovince 4** (acres)	**Totals** (acres)
***Breaux Act CWPPRA**	33,690	44,913	25,057	30,486	134,146
State	2,543	9,043	5,200	1972	18,758
PCWRP	14	41	371	31	457
****Mitigation Civil Works Projects**	4,990	0	5,000	0	9,990
***Mitigation Regulatory Permits**	6,411	3,199	2,635	2983	15,228
Vegetation	535	878	1,785	1,931	5,129
Section 204/1135, Beneficial Use	226	414	1,293	3,525	5,458
WRDA	16,000	33,000	0	0	49,000
*****Other**	0	2,000	50,000	3,226	426,132
TOTALS	64,410	93,490	91,344	44,158	664,298

Source: The state, parish, FEMA, vegetation, WRDA, Sections 1135/204, and /beneficial use are from the state book: "Coastal Restoration Division Annual Project Reviews, Dec 2002". CWPPRA (Breaux Act) acres are from the District's November 2003 Task Force book and have been furnished by USFWS. Permit mitigation is from the District's Regulatory Branch database. Civil works mitigation is from the District's files. Other is 50,000 acres (20,250 ha) of non-mitigation land bought in fee in the Atchafalaya Basin by the District.
*CWPPRA acreages are based upon 20-year project life; all other acreages are 50 years.
**In the best-case scenario, compensatory mitigation (for civil works projects and regulatory permits) results in no net loss of wetlands. Hence, it is not the intent to imply that compensatory mitigation acreages would contribute to a net increase in wetlands as a result of the Clean Water Act Section 404 program. Rather, these figures represent an accounting of the various cumulative impacts to coastal wetlands from Federal, state, local, and private restoration efforts.
***Includes 30,558 acres (12,376 ha) restored and 340,348 (137,840 ha) acres enhanced by North American Wetlands Conservation Act (NAWCA), administered by the USFWS; unable to determine exact locations.

Table 4-9 (adapted from Penland et al. 2000a) displays the acres of coastal land lost in the Deltaic Plain between 1932 and 1990 due to three primary land loss processes: erosion, submergence, and direct removal. Penland et al. (2000a) identify two major causes of these processes: natural and cultural (human-induced). Natural actions include phenomena such as wind-generated wave erosion along the outer gulf shoreline and within inland waters, channel flow erosion due to the currents generated during the ebb and flow of the tides, natural waterlogging, and faulting. Cultural actions include human activities such as navigation, channel dredging, building of impoundments, resource extraction, and excavation of ponds.

Table 4-9
Cumulative Coastal Land Loss in the Deltaic Plain Between 1932 and 1990.
(Source: Penland et al. 2000a)

Process of Coastal Land Loss	Acres
EROSION	
Natural Wave	181,090
Navigation Wave	21,821
Channel Flow	10,369
Subtotal	213,280
SUBMERGENCE	
Altered Hydrology- Oil and Gas	172,174
Altered Hydrology- Multiple	148,666
Natural Waterlogging	21,069
Failed Land Reclamation	16,403
Altered Hydrology- Impoundments	7,992
Altered Hydrology- Roads	4,825
Faulting	3,921
Herbivory	561
Subtotal	375,612
DIRECT REMOVAL	
Oil/Gas Channel	76,978
Navigation Channel	11,293
Borrow Pit	11.130
Access Channel	1,312
Burned Area	729
Sewage Pond	308
Agricultural Pond	179
Drainage Channel	109
Subtotal	102,039
TOTAL	**690,931**

4.23.2.3 Chenier Plain – Cumulative Impacts of Coastal Land Loss

The HILCP study (LCWCRTF and WCRA 2002) describes impacts in the Mermentau and Calcasieu-Sabine Basins in the Chenier Plain. The findings of this study (summarized below) are based upon an analysis of long- and short-term hydrographic records, recent marsh elevation data, landscape change analysis, and hydrologic modeling.

Mermentau Basin

Historical causes of landscape change in this basin include causes of loss other than prolonged marsh flooding. Human activities related to drainage improvements, navigation projects, saltwater intrusion mitigation, water control structures, agriculture irrigation improvements, highway construction, access canals for the oil and gas industry, flood control, and wetland and wildlife management practices have altered the hydrology of the Mermentau Basin.

The lower Mermentau Basin comprises two subbasins: the Lakes subbasin (located south of the limit of the coastal zone and north of Louisiana Highway 82 and the Gulf of Mexico), and the Chenier subbasin (located between Louisiana Highway 82 and the Gulf of Mexico).

In the Lakes subbasin, construction of navigation channels, locks, and water control structures has altered the historical north-south river and tidal-driven hydrology and shifted it to an east-west system that drains through the GIWW. The Mermentau Lakes subbasin now functions more as a freshwater reservoir and less as the low-salinity estuary that it was prior to these alterations. Many natural resource managers believe that the District-operated locks and control structures have resulted in elevated water levels and prolonged marsh flooding that is slowly drowning the marsh in this subbasin. However, analysis of historical records shows that the rates of rise are irregular both over time and among the structures. Furthermore, rates of water level rise in the Mermentau Lakes subbasin do not exceed the reported ability of fresh and intermediate marshes to maintain elevation in response or relation to a rising sea.

Impacts

Drainage, Navigation, and Water Control Structures: Drainage improvements (clear, deepen, and straighten) of the upper Mermentau River and its four major tributaries, enlargement of the Mermentau River, and dredging of seven cutoffs have facilitated the movement of rainwater and agricultural discharge from the upper portion of the basin into the lower portion of the basin and resulted in more rapid drainage into the Lakes subbasin following rain events. Over time, wake erosion has progressively widened the major Federal navigation projects (GIWW, the Inland Waterway (old GIWW), and the Freshwater Bayou Canal) in this basin. This widening was accompanied by the breaching of dredged material disposal banks thereby allowing saltwater intrusion into previously fresh areas consequently compromising the freshwater reservoir relied upon by the region’s rice farmers.

Five water control structures in the Mermentau Basin are operated to moderate water levels, to allow for limited floodwater drainage, and to prevent saltwater intrusion from navigation channels and the Gulf of Mexico. The HILCP Study (LCWCRTF and WCRA 2002) states that the goals of maintaining water levels for navigation and controlling salinity are mutually exclusive under certain conditions. Water levels appear to be rising both inside and outside of all five water control structures. The rates of rise are within the range of vertical organic matter accretion, so that it seems likely that vertical accretion in this area would be sufficient to keep pace with the rate of relative sea level rise in this region. Prolonged flooding (greater than 30 days), such as happens during operation of the Calcasieu Lock, and especially with the Schooner Bayou and Catfish Point control structures, can adversely affect wetland primary productivity and sustainability. Prolonged flooding may increase marsh edge erosion and could stress less flood-tolerant plant species. Habitat shifts in the Mermentau Basin from 1949 through 1997 show a long-term trend toward freshening of the Lakes subbasin, and increasing salinity in the Chenier subbasin. However, despite preliminary evidence that prolonged marsh flooding occurs in the vicinity of Catfish Point, there are no clear research findings linking high water levels in the Lakes subbasin to marsh loss or to increased shoreline erosion in the Mermentau Basin. The HILCP study (LCWCRTF and WCRA 2002) concludes that the general understanding of the relationship between marsh stability, marsh elevation, and surface flooding is, at best, inconclusive. The HILCP study (LCWCRTF and WCRA 2002) recommends that basic applied research in this area is needed.

Access for Estuarine Organisms: The historic oligohaline estuary of the Mermentau Basin has been converted to the current freshwater reservoir. The existing shrimp and crab fisheries viability depends upon the operation of the locks and water control structures. The HILCP study (LCWCRTF and WCRA 2002) reports that during years when high navigation traffic is reported through the structures fishermen report excellent harvests. When structures are closed, established organism access routes are closed and shrimp and crab landings fall. However, the District regularly operates the structures to allow organisms access to the basin.

Agricultural Runoff and Turbidity: Irrigation improvements such as the Bell City Drainage Canal and the Warren Canal were dredged to supply freshwater from the Lakes subbasin to rice farmers in the Upland subbasin. However, agricultural runoff from these canals contributes to turbidity problems in Grand and White Lakes. Agricultural runoff increases the turbidity in Grand and White Lakes thereby reducing the habitat quality for submerged aquatic vegetation and for the fishery species that depend on it. The Louisiana Cooperative Extension Service and the NRCS are currently working with Mermentau rice farmers to institute a series of best management practices to reduce sediment runoff into the system.

Oil and Gas Industry Access Canals: All of the oil and gas access canals have facilitated saltwater intrusion into brackish and intermediate marshes and have been cited as a major cause of land loss.

Highway Construction: Louisiana Highways 82 and 27 disrupt historical drainage patterns. A drainage system of 32 culverts and 12 bridges on Highway 82 were constructed to address landowner concerns about obstruction of drainage. However, this system does not have the capacity to effectively drain the Lakes subbasin.

Storm Flooding: Some area residents feel that water levels in the Lakes subbasin are too high due to water control structures. Drainage improvements to the Upland subbasin may have decreased retention time in this subbasin and exacerbated flooding in the Lakes subbasin, while downstream water control efforts restrict the drainage potential and lead to frequent flooding.

Salinity: Salinity records from the Schooner Bayou and Catfish Point control structures for the period 1 January 1995 - 31 December 1998 shows that salinity outside of the structures rises in April, increases to a September peak, then declines through December and into the following March. This pattern is mimicked inside of the structures, but the increases are somewhat muted.

Calcasieu-Sabine Basin

The Calcasieu-Sabine Basin was historically interconnected with the Mermentau Basin. However, hydrologic alterations (navigation corridors, e.g., Calcasieu Ship Channel (CSC) and Sabine-Neches Ship Channel) have made these two basins more hydrologically distinct. In contrast, the Gum Cove Ridge historically was a hydrological barrier separating the Calcasieu and Sabine basins. Construction of the GIWW connected the Calcasieu Ship Channel and the Sabine-Neches Ship Channel. This hydrologic coupling altered the hydrologic circulation by disrupting the historical north-south estuarine gradient and diverting to the east and west riverine inflows and saltwater intrusion induced via navigation channels.

Hydrology in this basin has been altered by three principle means: channeling saltwater into the historical low-salinity estuary, at times creating a circulation pattern between Calcasieu and Sabine Lakes by way of the GIWW; creating a more rapid channelized loss of riverine inflows when the tide ebbs; and increasing tidal amplitude.

Impacts

Navigation Channels, Saltwater Intrusion, and Salinity Control: The CSC has been maintained for navigation since 1874 and has been enlarged to a current width of 400 feet (121 m) and current depth of 40 feet (12 m). Removal of the natural channel mouth bar, and subsequent widening and deepening of the CSC, allowed increased saltwater and tidal intrusion into the estuary. This resulted in marsh loss, tidal export of organic marsh substrate, and an overall shift to more saline habitats. Completion of the Calcasieu River Saltwater Barrier in 1968 minimizes the flow of the saltwater wedge into the upper reaches of the Calcasieu River to protect agricultural water supplies.

Habitat: Changes in the historical patterns of habitat in the Calcasieu-Sabine basin are all directly tied to human activities, primarily those associated with the exploration, development, and transportation of petrochemicals. Generally, there have been no basin-wide shifts towards more saline environments since 1949. However, there have been site-specific shifts toward more saline environments adjacent to the CSC. In contrast, natural resource management activities have had a lesser effect, but include landscape changes and freshening in the present day Sabine National Wildlife Refuge impoundments and the Cameron-Creole Watershed Project, which is showing a reversal to damages done by the earlier increased salinity (Cameron-Creole Watershed Monitoring Report 1988, 1993, 1998, and unpublished 2003).

The HILCP study (LCWCRTF and WCRA 2002) states that habitats have not remained stable. Marsh plant communities are determined, in large part, by the salinity regime to which they are exposed. Saltwater intrusion induced through navigation channels, petrochemical exploration, storms, and herbivory have cumulatively caused land loss and major plant community changes over the past 50 years. This is evidenced by the loss of saw grass as the dominant wetland plant community in the late 1950s and early 1960s.

Salinity: A negative correlation between Sabine River discharge and salinity across the Calcasieu-Sabine basin suggests that Sabine River discharges may be a factor in moderating salinities in Upper Calcasieu Lake.

Chicot Aquifer Depletion: Groundwater withdrawals associated with irrigation and industrial pumping have elevated the freshwater-saltwater interface in all three of the distinct sand units that characterize the aquifer. This has resulted in reversal of the natural southerly freshwater flow and a northward movement of saltwater in the aquifer. There is evidence of northern encroachment of the saltwater wedge in northern Cameron Parish.

Potential Threats to Freshwater Inflows: Interstate demands on water may play a large role in the future status of the Calcasieu-Sabine Basin. First, the proposed expansion of the Sabine-Neches Ship Channel to 50-foot depth and 500-foot width, from the Gulf of Mexico to the Port of Beaumont would be expected to exacerbate saltwater intrusion during the flood tide and freshwater outflow during the ebb tide resulting in higher salinities in the marsh. Second, the East Texas Water Plan (Texas Senate Bill 1) presently recommended strategies do not include recommendations to address projected water shortages by inter-basin transfers of Sabine River water near Houston. However, the inter-basin transfer of water from the Sabine Basin remains a long-term strategy that could, cumulatively, impact the Calcasieu-Sabine Basin.

4.24 SUMMARY OF IMPACTS OF THE TENTATIVELY SELECTED PLAN (LCA PLAN)

This FPEIS compares the direct, indirect, and cumulative impacts for three restoration opportunities, including the LCA Plan. These restoration opportunities are directed, to varying degrees, at conservation and restoration of deltaic processes, geomorphic structures, or combinations thereof. The LCA Plan includes significant ecosystem restoration features in all four coastal Louisiana subprovinces that would address the critical needs in the near-term. In the Deltaic Plain, the LCA Plan would reintroduce freshwater and sediment from the Mississippi and Atchafalaya Rivers in multiple locations and scales. It would also restore critical geomorphic structures in all subprovinces. Of the three near-term restoration opportunities, the LCA Plan will best address the most immediate and critical needs of the ecosystem by promoting the distribution of riverine freshwater, nutrients, and sediments using natural processes and ensuring the structural integrity of the estuarine basins. Only the LCA Plan, of the three restoration opportunities, meets all study objectives. It accomplishes hydrogeomorphic objective #1 (establish dynamic salinity gradients), #2 (increase sediment input), and #3 (sustain natural landscape features). It also achieves ecosystem objective #1 (sustain diverse habitats). LCA Plan would have a minor effect in achieving ecosystem objective #2 (reducing gulf hypoxia).

However, there is future opportunity to expand on achieving this particular objective. The LCA Plan was formulated using the study guiding principles.

Thus, the study results indicate that the most effective, sustainable, and implementable plan to address the critical near-term ecosystem restoration needs in the State of Louisiana is the LCA Plan.
Multiple diversions of Mississippi River water and sediment in Subprovinces 1 and 2, as well as the improved management of Atchafalaya River water in Subprovince 3 would provide significant human and natural ecosystem improvements, connectivity, and material exchange. Salinity regimes would be similar to the Future Without-Project conditions, except there would be localized freshening in the following areas: Lake Borgne, the northern part of Breton Sound, Caminada Bay and the nearby headland areas, and the upper reaches of the Terrebonne and Timbalier Bays and marshes directly north of these bays.

Geomorphic structure restoration features of the LCA Plan are directed at the restoration and stabilization of about 47.6 miles (76.6 km) of barrier shorelines, headlands, and islands. Restoration of these features would require about 61,100,000 cy (464,366,000 cm) of sands that would likely be removed from offshore sand resource sites such as Ship Shoal and the Barataria Basin offshore sites. There would be temporary adverse impacts on benthos. Disturbance of large areas of gulf bottoms could change wave and littoral drift dynamics and require further examination.

About 328,000 acres (132,840 ha) of Louisiana's marshes and swamps could be lost by 2050. The LCA Plan would increase the acreage of all wetland habitats compared to Future Without-Project conditions. However, over the 50-year project life, a net decrease in total wetland vegetative habitats from today's acreage is predicted to occur. In the Deltaic Plain, the LCA Plan would minimally to significantly increase fresh and intermediate marsh and swamp wetland forest. It would slightly increase brackish and saline marsh. The LCA Plan would increase barrier shoreline vegetation in Subprovinces 2 and 3. There could be an increase in all marsh types, depending on the location of the beneficial use sites. Diversions and barrier island and shoreline restoration would generally have positive synergistic effects on vegetated wetlands.

Louisiana's coastal wetlands would continue suffering extensive land loss in the Future Without-Project conditions thereby decreasing the quantity and quality of habitats for amphibians, reptiles, mammals, and birds. There would be less stopover habitat for neotropical migratory birds. Endangered piping plover critical habitat would continue to be lost. The LCA Plan would benefit wildlife that prefers fresher conditions (most game mammals, furbearers, reptiles and amphibians). Wintering habitat for waterfowl would be created/protected. The LCA Plan would especially benefit migratory avian species because important stopover habitat for neotropical migrant birds would be protected. Habitat for threatened and endangered species, especially critical piping plover habitat, would also be increased. Diversions and barrier island and shoreline restoration would generally have positive synergistic effects for wildlife resources.

The LCA Study area supports one of the most productive fisheries in the Nation. Fishery resources are expected to decline in the Future Without-Project conditions as open water replaces wetland habitat and the extent of marsh-water interface begins to decrease. The multiple diversions in the LCA Plan would have the potential to significantly freshen large areas within, and possibly an entire basin. Less freshwater tolerant species, such as brown shrimp and spotted seatrout may be displaced from areas near diversions or entire hydrologic basins. The extent of this impact is dependent on the diversion location, size and operation. Species such as Gulf menhaden, blue crab, white shrimp and red drum would likely benefit from diversions as would freshwater fishery species. With barrier island and shoreline restoration, adverse impacts to fisheries would be significantly less. All of these restoration features would have an overall benefit to fisheries compared to the Future Without-Project conditions.

Although significant negative impacts are foreseeable within the influence areas of diversions and sediment placement, localized benefits to oysters may be achieved, as estuarine conditions are created in areas previously too saline to support oyster production. Oyster surveys and modeling where appropriate should be conducted to determine the spatial, temporal, and cumulative impacts to private and public oyster resources in the affected environment.

There would be continued loss and degradation of essential fish habitat (EFH) as well as the ability of the LCA Study area to support Federally managed species in the Future Without-Project conditions. The diversions in the LCA Plan would preserve some highly productive categories of EFH that would be lost in the Future Without-Project conditions. Restoration of barrier islands and shorelines would also preserve some highly productive forms of EFH; however, this preservation is not expected to be sustainable.

Continued coastal land loss and deterioration under Future Without-Project conditions would also adversely impact threatened and endangered species that utilize the study area. The piping plover, brown pelican, and sea turtles would be the most impacted. The diversions from the LCA Plan would have little impact on these species. In contrast, barrier island and shoreline restoration features of the LCA Plan would significantly enhance and create piping plover critical habitat. Sea turtle beach habitat would also benefit. Diversions and barrier system restoration features would generally have positive synergistic impacts for threatened and endangered species.

In the Future Without-Project, should the trend of increased precipitation and climate warming continue, there would be increased runoff which may affect the total volume of freshwater in each subprovince. Overall flow in rivers and channels would remain above long-term averages, which would maintain an increased sediment load. Increased urbanization and construction could also increase runoff and sedimentation. The diversion features of the LCA Plan would cause an increase in the volume of water and sediment entering each diversion receiving area, which may result in changes in water levels. Barrier island and shoreline restoration features of the LCA Plan would have minimal impacts on water levels; however, construction of restoration features may relocate sediment depocenters. Diversions and barrier system restoration features would generally have positive synergistic impacts on water and sediment flows.

Most fresh surface water supplies would be from the Mississippi and Atchafalaya Rivers and their distributaries in the future. However, salinities could increase in Bayou Lafourche, which would mean users would have to treat water for salinity or find new freshwater sources in the Future Without-Project. Diversion features of the LCA Plan could negatively impact freshwater supplies to users downstream of medium diversions. It would increase flows into receiving areas of Subprovinces 1 and 2, Bayou Lafourche and the Terrebonne marshes, which would increase freshwater supplies to these users. Barrier island and shoreline restoration features would have negligible impacts on water supplies.

The LCA Study area, in the Future Without-Project, would still be affected by other activities that would have both beneficial and detrimental effects on water quality. Diversion features of the LCA Plan would increase sediments in the coastal zone with accompanying minor increases in trace metals and also increase agrochemicals. Nutrient enrichment could possibly lead to increased algal blooms. Barrier island and shoreline features of the LCA Plan would have negligible effects on water quality.

Gulf hypoxia would continue, in the Future Without-Project, to present the problems it does today. Diversion features of the LCA Plan would result in a relatively small reduction in nutrients discharged into the northern gulf from the Mississippi River. Such a reduction would have a minor positive effect on hypoxia. Barrier island and shoreline restoration features of the LCA Plan would have no impact on hypoxia.

In the Future Without-Project conditions, historic and cultural resources in the study area would continue to be impacted by the same forces impacting them today. A cultural resources survey would need to be done on a project-by-project basis for each restoration feature of LCA Plan.

As the existing wetlands convert to open water in the Future Without-Project conditions, recreation opportunities would decline accordingly. Another major impact under Future Without-Project conditions could be the loss of facilities and infrastructure that support or are supported by recreational activities. Diversion features of the LCA Plan would result in an increase in freshwater recreation activities and a displacement and decrease in saltwater activities in areas of freshwater reintroduction. There would be an overall positive effect on most wildlife dependent recreation. Reduction of land loss and land building may protect valuable infrastructure that supports certain recreation activities. Barrier island and shoreline restoration features of the LCA Plan would have long-term positive benefits to saltwater recreation activities. Diversions and barrier system restoration features would generally have positive synergistic impacts on recreation opportunities.

Populations in coastal communities are expected to shift inland in the Future Without-Project conditions. With the loss of current wetlands that provide storm surge protection it is likely that coastal infrastructure would suffer increased damages. Slow growth in employment is also expected to occur. Economic opportunities related to wetland resources would be adversely affected as these resources are depleted. With the LCA Plan the inland population shift would be slower. Subsistence fishermen would potentially have to relocate to follow fisheries as salinities change. Diversion features of the LCA Plan would also reduce the necessity for relocation, repair or replacement of infrastructure. Coastal jobs, property and population would probably be better protected than if nothing were done. Construction of the barrier island and shoreline features of the LCA Plan would not require fishermen to relocate. Diversions and barrier system restoration features would have positive synergistic impacts on populations.

The seafood industry would likely suffer significant losses in employment in the Future Without-Project conditions as shrimp, oysters, and other valuable species decline. Diversion restoration features of the LCA Plan would cause changes in fishing patterns, including fishery relocations and species harvested; whereas, the barrier island and shoreline restoration features of the LCA Plan would not cause fishery relocations.

Saltwater intrusion would continue in the Future Without-Project conditions, except in areas where existing freshwater diversions are able to reverse that trend. Production from oyster leases would decline gradually as areas of suitable salinity move inland and overlap with areas closed due to fecal coliform. The LCA Plan includes diversions of a combined capacity that could potentially result in the loss of production on a significant percentage of the total leased acreage in Louisiana. It is unknown whether increased harvest from other areas could offset this loss. The barrier island and shoreline restoration features of the LCA Plan would have minimal, localized impacts in areas where construction occurs. Diversions and barrier system restoration features of the LCA Plan would generally have synergistic impacts (probably both negative and positive) on oyster leases, the extent of which is difficult to predict at this time.

Onshore oil and gas facilities and pipelines are generally not designed to accept wind and wave forces that could be experienced in the Future Without-Project conditions. The owners would be faced with the decision to protect these facilities or curtail production. If any of the supply bases that service the offshore industry were impacted as a result of future erosion, the operational cost of offshore production could increase. Impacts to the price of crude oil or natural gas could ripple through the national economy. Diversion features of the LCA Plan would provide some protection to these assets, potentially avoid the cost of relocation, and protect jobs. Barrier island and shoreline protection features of the LCA Plan would provide an increased level of protection to the LOOP Facility by restoration of some of the Caminada-Moreau Headland. Diversions and barrier system restoration features would have positive synergistic impacts on oil, gas, and pipelines.

All Louisiana's major ports and waterways are projected to have positive annual growth over the next 50 years. The LCA Plan would repair and improve the GIWW, which would have positive impacts to navigation. If the final MRGO restoration features in the LCA Plan were to include a closure or restriction, there would be direct negative impacts to navigation traffic.

Most hurricane protection levees would be at greater risk under Future Without-Project conditions, than they are at present. The diversion restoration features of the LCA Plan would help preserve and rebuild some of the marsh that reduces storm surge thereby providing some protection to hurricane protection levees. Restoration of barrier systems also would help reduce storm surge thereby providing some protection to levees. Together, diversions and barrier system restoration features would have positive synergistic impacts on hurricane protection levees

Impacts to agriculture and forestry under Future Without-Project conditions would be negative, and would include continued saltwater intrusion, continued coastal erosion, and increased damages from storms. Diversions features of the LCA Plan would benefit agriculture and forestry by reducing saltwater intrusion into bayous and canals. Barrier system restoration features of the LCA Plan would indirectly offer some protection to agricultural lands. Together, diversions and barrier system restoration features would have positive synergistic impacts on agriculture and forestry resources.

In addition, the LCA Plan successfully meets the USACE Environmental Operating Principles.

CHAPTER 5 PUBLIC INVOLVEMENT AND COORDINATION

This chapter documents details of the LCA Study's public involvement and coordination efforts, including a description of the scoping process; public involvement; and the coordination efforts with Federal, state, local agencies and entities, parishes, and other interested parties such as Indian Tribes and Nations.

5.1 THE SCOPING PROCESS

Scoping is a critical component of the overall public involvement program to solicit input from affected Federal, state, and local agencies, Indian Tribes, and interested stakeholders. The NEPA scoping process is designed to provide an early and open means of determining the scope of issues (problems, needs, and opportunities) to be identified and addressed in the DPEIS. Scoping is the process used to: a) identify the affected public and agency concerns; b) facilitate an efficient DPEIS preparation process; c) define the issues and alternatives that will be examined in detail in the DPEIS; and d) save time in the overall process by helping to ensure that relevant issues are adequately addressed. Scoping is a process, not an event or a meeting; it continues throughout the PEIS (draft and final) process and may involve meetings, telephone conversations, and/or written comments. Many of the scoping comments regarding the comprehensive plan are still applicable to the near-term course of action and are described below.

A Notice of Intent (NOI) to refocus and modify the draft Programmatic Supplemental EIS for the LCA Comprehensive Study and prepare a DPEIS for the LCA Study near-term course of action was published in the *Federal Register* (Volume 69, No. 68) on April 8, 2004. This was a modification of the NOI published on April 4, 2002, in the *Federal Register* (67 FR 169093). The intent was to describe the rationale for revising the purpose and need for action, the scope of the analysis, and the intent to prepare a DPEIS for the near-term LCA Study course of action.

5.1.1 Scoping the LCA Comprehensive Study–April/May 2002

The April 4, 2002, NOI to prepare a draft Programmatic Supplemental EIS (DPSEIS) for the LCA Comprehensive Study informed the public that the District would hold a series of public scoping meetings throughout the LCA Comprehensive Study area in early spring 2002. A series of public scoping meetings regarding the LCA Comprehensive Study were held at 7:00 PM on the following dates and at the designated locations: April 15, 2002, at the Louisiana State University (LSU) Agriculture Center Extension Office, Abbeville, Louisiana; April 16, 2002, at McNeese State University, Lake Charles, Louisiana; April 17, 2002, at the Belle Chasse Auditorium, Belle Chasse, Louisiana; April 18, 2002, at Southeastern Louisiana University, Hammond, Louisiana; April 22, 2002, at Peltier Park, Thibodeaux, Louisiana; and April 24, 2002, at the Morgan City Municipal Auditorium, Morgan City, Louisiana.

The scoping comment period for the LCA Comprehensive Study was April 4, 2002, until May 9, 2002. The scoping comments were documented in a Scoping Report and describe the public’s concerns about the scope of the LCA Comprehensive Study and identify strategies suggested as "keystone" to restoration efforts. This information has been considered both in the study process and in preparation of the DPEIS and FPEIS. A total of 301 comments were received during the comment period; 287 comments were expressed at the 6 scoping meetings, and 14 written (letter, fax, and email) and verbal (telephone) comments were received during the comment period. All registered scoping meeting participants, as well as those providing written or verbal comments, were provided a copy of the Scoping Report. In addition, the Scoping Report was posted on the study web site located at http://www.coast2050.gov. The Scoping Report for the LCA Comprehensive Study is incorporated by reference.

Scoping comments regarding the LCA Comprehensive Study? are also pertinent to the LCA Study near-term course of action and have been incorporated into the near-term course of action formulation process. Scoping comments for the LCA Comprehensive Study are described in subsequent sections of this chapter and characterized by the PEIS subject matter headings: Purpose and Need for Action, Alternatives, Affected Environment, Environmental Consequences, and Consultation and Coordination.

The 287 comments expressed at the 6 public scoping meetings and the 14 written or verbal comments are summarized below. A brief description of those comments most often expressed is described. Generally, the most numerous comments and concerns were expressed regarding project alternatives, followed by environmental consequences, consultation and coordination, affected environment, and purpose and need for action.

Scoping Comments Regarding the Purpose and Need for Action

Of the 301 total scoping comments on the Comprehensive Study, 87 comments relate to the purpose and need for the proposed action. Typical comments related to the purpose and need included: protection of infrastructure; revamping the state and Federal laws that hinder restoration efforts; and suggestions regarding the need to restore specific areas, such as the Barataria-Terrebonne estuary system, barrier islands, and land bridges.

Scoping Comments Regarding the Alternatives

Of the 301 total scoping comments on the Comprehensive Study, 207 comments regarding project alternatives and strategies were expressed. Reestablishment of wooded barrier islands and barrier headlands was an alternative mentioned repeatedly at each scoping meeting. In addition, the use of the Third Delta Conveyance Channels Alternative to divert freshwater was mentioned repeatedly and was considered an alternative applicable to several different basins. One strategy common throughout the Lake Charles, Thibodaux, and Belle Chasse areas is the process of dredging and use of sediment.

Scoping Comments Regarding the Affected Environment

Of the 301 total scoping comments on the Comprehensive Study, 113 comments related to the affected environment. In general, the most often presented scoping comment related to the need to do something for the widespread coastal land loss and saltwater intrusion across the Louisiana coastal zone. Other comments common across all scoping meetings include: the problem of saltwater intrusion adversely impacting existing fresh, intermediate, and brackish marshes; and the deterioration and loss of inland marshes. Another comment regarding the affected environment common across all scoping meetings was the loss of barrier islands and headlands.

Scoping Comments Regarding the Environmental Consequences

Of the 301 total scoping comments on the Comprehensive Study, 116 comments related to the environmental consequences. One concern common to all areas is the restoration of barrier islands and headlands because these areas protect inland areas and serve as habitats for neotropical, migrating birds. Another shared concern is the effect of freshwater diversion on oyster populations. For example, at the Belle Chasse scoping meeting, one comment considered the maintenance of target salinities to sustain oysters and marine fisheries.

Scoping Comments Regarding Consultation and Coordination

Of the 301 total scoping comments on the Comprehensive Study, 113 comments related to consultation and coordination. Typical comments relating to consultation and coordination included the importance of simplistic public notification procedures explaining projects and involvement of public special interest organizations and public figures.

5.1.2 Scoping the Near-Term LCA Study–April/May 2004

A Scoping Meeting Announcement requesting comments regarding the scope of the near-term LCA Study was mailed to 3,111 Federal, state, and local agencies as well as interested groups and individuals on April 7, 2004. News Releases announcing the scoping meetings were mailed to 264 outlets including radio, broadcast, and print media; 21 coastal zone managers; and 92 electronic notifications were sent to private citizens, organizations, media, universities, and local governments. Notices announcing the public scoping meetings appeared in the *New Orleans Times Picayune, The Vicksburg Post, Thibodaux Daily Comet* and the *Baton Rouge Advocate*, all on April 10, 2004, and the Breaux Act Newsflash on April 14, 2004. The public scoping meetings were held on April 19, 2004, at the Houma Municipal Auditorium, Houma, Louisiana; April 20, 2004, at the Belle Chasse Auditorium, Belle Chasse, Louisiana; April 21, 2004, at the Morgan City Auditorium, Morgan City, Louisiana; April 22, 2004, at the Lake Charles Civic Center, Lake Charles, Louisiana; and April 23, 2004, at the USGS National Wetlands Research Center, Lafayette, Louisiana.

The schedule for each scoping meeting was: 5:00–6:00 P.M. open house; 6:00–6:45 P.M. introductory remarks; 6:45–7:15 P.M. question and answer session; and 7:15–10:00 P.M. (or until no further comments) scoping comment session. The open house session was primarily a question and answer session that included a series of poster boards regarding the study purpose; study objectives; schedule; language from the President's FY 05 Budget directing the District to refocus and modify the study to a near-term effort; proposed significant resources; restoration toolbox; sorting and critical needs criteria; and maps displaying the restoration opportunities for each of the four subprovinces that were developed from the LCA Comprehensive Study phase and that would be used to identify the most critical restoration opportunities. The open house session also included a series of notebooks that presented the same information as presented on the poster boards, but with spaces to provide comments.

Following the open house session, the introductory remarks session, from 6:00–6:45 P.M., was when the LCA Project Manager presented introductory remarks, including the agenda, purpose of the meeting, public involvement under NEPA, a brief history of the study phases to date, and the rationale for refocusing and modifying the LCA Comprehensive Study into a study of cost-effective near-term restoration opportunities, revising the purpose and need for action, the scope of the analysis, and the intent to prepare a DPEIS for the near-term LCA Plan course of action.

Following the introductory remarks session, a packet of four handouts (with a business reply postcard) was provided to scoping meeting participants. Participants were requested to provide specific comments on the information in the handouts. Handouts consisted of:

1. A business reply postcard for scoping comments;
2. A 2-page handout listing and defining the sorting criteria and critical needs criteria;
3. A 4-page handout requesting comments on the two scoping questions, an example of using the sorting criteria procedure, and a list of each sorting and critical needs criterion with spaces to show agreement or disagreement as well as a space to provide written comments on applying the criterion; and
4. A 12-page handout requesting comments on each of the near-term restoration opportunities.

Scoping question #1 asked: What are the critical natural and human ecological needs that should be addressed in the DPEIS for the LCA Near-Term Plan? Scoping question #2 asked: What are the significant resources that should be considered in the DPEIS for the LCA Near-Term Plan?

The initial sorting criteria presented in the scoping meetings handouts included:

1. Can engineering and design be completed and construction begun in 10 years?
2. Is the restoration opportunity based upon sufficient scientific and engineering understanding of processes?
3. Can the restoration opportunity be considered independent from other restoration opportunities?

The critical needs criteria presented in the scoping meetings handouts included:

1. Does the restoration opportunity prevent future land loss where predicted to occur?
2. (Sustainability) Does the restoration opportunity restore fundamentally impaired or mimic deltaic processes through river reintroduction?
3. (Sustainability) Does the restoration opportunity restore endangered or critical geomorphic structure?
4. Does the restoration opportunity protect vital community and socioeconomic resources?
5. Does the restoration opportunity capitalize on existing infrastructure and activities?
6. Public acceptability.

A general question and answer session from 6:45–7:15 P.M. focused on the handouts and any other general questions. Afterward, an opportunity for individuals to present their scoping comments was conducted from which individuals could present their verbal comments. This was held from about 7:15 PM until no further scoping comments were given. Transcripts of all of the scoping meetings were prepared by a court reporter.

A Scoping Report was prepared that presents and summarizes the scoping comments expressed at the public scoping meetings, as well as all other scoping comments received during the comment period, beginning April 7, 2004 and ending May 20, 2004. The Scoping Report also indicates where in the DPEIS individual comments would be addressed. This report was provided to all scoping participants (who provided their address) as well as being published on the study web site located at http://www.lca.gov. The LCA Scoping Report is incorporated by reference.

The scoping comments document the public's concerns about the scope of the near-term LCA Study course of action and also identify significant resources, sorting criteria, and critical needs criteria for screening and selecting restoration efforts that comprise the near-term LCA Study course of action. This information was considered both in the study process and in preparation of the DPEIS. A total of 215 participants attended the scoping meetings, with 80 at Houma, Louisiana; 62 at Belle Chasse, Louisiana; 23 at Morgan City, Louisiana; 26 at Lake Charles, Louisiana; and 24 at Lafayette, Louisiana. A total of 104 comments were received during the comment period; 56 individual comments were expressed at the 5 scoping meetings and 48 written comments (letter, fax, postcards, and responses to handouts) were received during the comment period. A single written comment may contain several specific comments directed at multiple areas of concern. A total of 266 specific comments were expressed in the 48 written comments; these included: 15 specific comments addressed the scoping questions, 19 specific comments addressed the sorting criteria, 41 specific comments addressed the critical needs criteria, and 191 specific comments addressed the proposed restoration features.

All registered scoping meeting participants who provided an address, as well as those individuals providing written or verbal comments, were included on the study mailing list of interested parties and received copies of the Scoping Report. The study mailing list was also used for informing interested parties of the availability of the DPEIS for their review and comment.

Table 5-1 categorizes scoping comments by DPEIS subject matter, which is where an individual comment is likely addressed in the DPEIS. DPEIS categories include: Purpose and Need for Action; Alternatives; Affected Environment; Environmental Consequences; and Consultation and Coordination. Compliance with Regulations (Federal, state, and local environmental laws and regulations) is also included in this latter category. An individual scoping comment may be categorized under more than one DPEIS subject matter heading. The most numerous comments were expressed regarding project alternatives, followed by the purpose and need, consultation and coordination, environmental consequences, and affected environment. The scoping comments are summarized in the following subsections.

Table 5-1
Categorization of Scoping Comments by DPEIS Subject Matter
P&N = Purpose and Need, ALT = Alternatives, AE = Affected Environment, EC = Environmental Consequences, and C&C = Consultation & Coordination

Source of Scoping Comment	P&N	ALT	AE	EC	C&C	Totals
Scoping Meetings	36	26	0	14	27	103
Written Comments	26	40	14	22	19	121
Handouts	66	212	1	3	1	283
Totals	128	278	15	39	47	507

NOTE: A single scoping comment may be categorized under multiple DPEIS subject matter headings.

5.1.2.1 Scoping Meeting Comments

Houma, Louisiana Scoping Meeting Comments

The following individuals made comments at the Houma, Louisiana scoping meeting: Mss. Sharon Alford and Jennifer Armand; Messrs. Don Schwab, Nolan Bergeron, Ed Landgraf, Steven Peyronnin, Paul Yakupzack, W. Alex Ostheimer, Kenny Smith, Al Levron, Michael Robichaux, Barry Blackwell, Henry Richard, Windell Curole, Thomas Dardar; and an unidentified audience member. Comments from this meeting are summarized below:

1. The subprovince that includes Terrebonne Parish has lost more coastline than anywhere else in Louisiana and needs immediate action to address this, including making this an election issue and grass roots movement.
2. Need some diversions and sediment from the Atchafalaya River (or other areas) to the area between Bayous Lafourche and Terrebonne.
3. Need barrier islands to reduce saltwater intrusion.
4. The Third Delta study would bring a considerable amount of freshwater and sediment to Lafourche and Terrebonne Parishes and both parishes should work together.
5. Place more emphasis on economic impacts; especially how the state would meet their cost sharing responsibilities.
6. Immediate need for land-building projects in Barataria and Terrebonne Parishes.
7. Cooperation between the state and the USACE.
8. Integration of the LCA Study Near-Term course of action with the CWPPRA.
9. Provide for private/public partnerships and expedited regulatory permits to accomplish coastal restoration.
10. Pursue large-scale coastal restoration projects and use socioeconomic criteria as justification.
11. Concern with ongoing and potential adverse impacts to the various cultures in coastal Louisiana, including Native Americans.
12. Stop the studies, immediate action now.
13. Concern with fresh drinking water supplies.
14. This is a national problem.

Belle Chasse, Louisiana Scoping Meeting Comments

The following individuals made comments at the Belle Chasse, Louisiana scoping meeting: Ms. Linda M. Walker and Messrs. Ralph Pausina, Dan Arceneaux, Al Enos, Pet Savoye, Doug Daigle, Aaron Meredith, John Laguens, Ed Doody, Barry Kohl, Chris Holmes, Mark Davis, Julio Mayorga, and Carlton Dufrechou. Comments from this meeting are summarized below:

1. Concern that none of the LCA Plan restoration features address impacts to St. Bernard Parish; questions if the USACE understands the value of the St. Bernard area.
2. Diversions provide very little silt; it is a misconception that saltwater is killing plants.
3. Close the MRGO; maintaining the MRGO is a waste of money; the USACE has not addressed these problems for over 40 years; individuals and organizations would not support the LCA Plan if the MRGO were not closed.
4. Concern about hurricane protection levees in St. Bernard Parish withstanding the forces of storms and potential loss of life; requests the status of a contingency plan for evacuation.
5. Concern with lack of information to fill out worksheets; access to more information; the significance and purpose of scoping meetings not clearly explained to the public.
6. Encourages more public participation.
7. Stakeholder issues include: the guiding principals, river systems, science-based projects, permitting, public works projects, sediment and water quality, infrastructure, and management.
8. The restoration is about managing solutions, not programs or projects.
9. The people are frustrated with giving input over and over.
10. The process and the information presented were not conducive for the government to receive the right kind of input. Maps are needed showing the locations of populations and infrastructure. Having the public comment on each project is not going to provide the right kind of guidance.
11. No more freshwater diversions.

Morgan City, Louisiana Scoping Meeting Comments

The following individuals made comments at the Morgan City, Louisiana scoping meeting: Messrs. Bill New, Jerry Bostic, Cullen Curole, and Randy Moertle. Comments from this meeting are summarized below:

1. The Port (Morgan City) is concerned with channel safety, economically moving goods and services to the area, providing a safe harbor, and efficiently providing goods and services to offshore industry. Additional Port concerns include: backwater flood protection programs, coordination of navigation needs and restoration — especially with regard to the Atchafalaya River.
2. Utilize CWPPRA projects that are ready for use in the near-term course of action.
3. The primary issue is about money.
4. Keep landowners informed.

5. Concern with efforts that would be counterproductive, e.g., channel deepening projects to remove sediment coupled to restoration projects that would increase the sediment loads in waterways.
6. Concern that there is so much sediment moving down the Atchafalaya River that navigation is difficult.
7. Concern with moving the navigation channel (Atchafalaya River Navigation Channel) into Shell Island Pass.
8. Need to coordinate Atchafalaya River Channel deepening and restoration.

Lake Charles, Louisiana Scoping Meeting Comments

The following individuals made comments at the Lake Charles, Louisiana scoping meeting: Ms. Carolyn Woosley and Messrs. Michael Tritico, Tom Hess, Allen Ensminger, Doug Miller, Jim Robinson, Guthrie Perry, and Charles Starkovich. Comments from this meeting are summarized below:

1. Include the introduction of freshwater into the upper part of the basin.
2. Recognize the role of sea level rise and saltwater intrusion.
3. Relocate critical infrastructure instead of restoring shorelines.
4. Implement CWPPRA projects that protect the Gulf of Mexico shoreline on Rockefeller Refuge, freshwater introduction south of Highway 82, the South Grand Chenier Hydrologic Restoration project, and a proposal to overcome bayou freshwater introduction projects. Implement Phase II of the East Sabine Lake CWPPRA project; develop a project at Oyster Bayou west of Calcasieu Lake to restore hydrology; continue beneficial use of dredged material from the Calcasieu River Ship Channel; where applicable, implement CWPPRA projects on the south banks of Grand Lake and White Lake to stop lake erosion into the surrounding levee; and maintain Highway 82 between Holly Beach and Johnson's Bayou.
5. Barrier Island restoration from Raccoon Island to the Chandeleurs is extremely important for our wading birds, pelicans, sea birds, shore birds, etc.
6. Replace the Calcasieu Lock.
7. Consider economic impacts of limiting the study area.
8. Close the MRGO.
9. Fix eroding banks of the GIWW.
10. Restore the area around Grand Lake.
11. Coordination of the LCA Study effort with the North American Waterfowl National Plan.
12. Concern about coordination with navigation interests from the Lake Charles Harbor and Terminal District.
13. Concern with negative press of the LCA Plan as discussed on the Rush Limbaugh show. Additional comment that a later caller to the show corrected previous negative comments.
14. Concern about saltwater intrusion caused by deepening the Calcasieu Ship Channel and the Sabine-Neches; involve Galveston District.

Lafayette, Louisiana Scoping Meeting Comments

The following individuals made comments at the Lafayette, Louisiana scoping meeting: Messrs. Terry O'Connor, Shane Bagala, Ted Beaulieu, Dennis Jones, Harold Schoeffler, Randy Lanctot, Mark Davis, Judge Edwards, Ben Sykes, Sherril Sagera, Mike Bagala, and Ted Loupe. Comments from this meeting are summarized below:

1. Address (preserve) brackish water, which contains the most viable life forms. Address low water levels.
2. Most pressing need is restoration of Point Chevreuil reef; hurricane protection provided by the reef, followed by river waters which have devastated Acadian Bay estuaries; allow for openings along the channel from Port Morgan City to the Gulf to divert river water to Terrebonne Parish; for long-term restoration construct the Third Delta.
3. Concern with archeological sites being lost without project and with project.
4. Consider conflicts of regulatory permits and coastal restoration projects; provide general permit for coastal restoration.
5. Look at the history (success and failures) of past projects.
6. Study area should extend to Old River and consider the headwaters of the Atchafalaya when discussing gulf hypoxia.
7. Need a comprehensive plan; USACE should have a general study for Subprovinces 3 and 4.
8. Need for a general coastal restoration permit for structures proposed in the LCA Plan so that private sector could address the problem.
9. Appreciation that concerned citizens are addressing the coastal restoration problems.
10. Sorting and critical needs criteria should focus on human life.
11. Concern with the destruction of the Camille (phonetic) Reef.
12. Need barrier islands restoration coastwide.

5.1.2.2 <u>Written Scoping Comments</u>

There were 38 written (letter, fax, and other written) scoping comments provided within the scoping comment period. Most of the comments were multiple pages long and included a wide range of topics as well as including responses to the handouts regarding scoping questions, sorting and critical needs criteria, and the proposed restoration features. Summary of the scoping responses to the handouts are provided in section 5.1.2.7 "Responses to Handouts at Scoping Meetings." Below are summaries of the written scoping comments.

By letter dated April 6, 2004, Mr. Cyrus J. Theriot, Jr., President of Harry Bourg Corporation provided a prioritized list of restoration opportunities: 1) maintain land bridge between Caillou Lake and Gulf of Mexico; 2) barrier island restoration at the Terrebonne shoreline; 3) maintain land bridge between Bayou du Large and Grand Caillou; 4) maintain Timbalier land bridge; 5) rehabilitate northern shoreline of Terrebonne/Timbalier Bays; 6) freshwater introduction south of Lake De Cade; 7) implement the Penchant Basin plan; 8) conveyance of Atchafalaya River water to northern Terrebonne wetlands; 9) small freshwater diversion to/from Bayou Lafourche; and 10) the Third Delta Study.

By letter dated April 21, 2004, the Acadian Group Sierra Club listed 30 issues of concern for members of this group including: herbicides and insecticides; permits destroying wetlands; damming natural waterways; wildflowers; Old River Control Structure; ownership of public and private lands; water quality; tidal hydrology; operation of locks; marshland wildlife; sewage; permits; educational campaign; barrier reefs; dredge and fill activities; endangered species; direct, indirect, and cumulative impacts; saltwater intrusion; produced water; barrier islands; illegal posting of water bottoms; beneficial use of dredged material; adherence to the ocean dumping laws and the Section 404(b)(1) guidelines; mineral extraction and subsidence; cost effectiveness; hurricane protection; identify zones of highest priority; evaluate past projects.

By letter dated May 3, 2004, Mr. W. Britt Paul, P.E., Asst. State Conservationist at NRCS writes: several projects developed under Public Law 646 (CWPPRA) have not fared well in the LCA Study sorting criteria, in particular the Penchant Basin project (TE-34). Mr. Paul addressed the LCA Study sorting criteria in relation to the Penchant Basin project and requests that the LCA Team reevaluate the application of the criteria in light of his information and to provide consistent application of the criteria across all measures being considered and reconsider the effectiveness of CWPPRA projects and the Penchant Basin project specifically.

By letter dated May 9, 2004, Mr. Kenneth Ragas, 34329 Hwy 11, Buras, Louisiana 70041 writes: concerning scoping question #1 — hurricane and flood protection accomplished only through coastal restoration. Scoping question #2 — the most important resource available for restoration is sediment from the Mississippi River; the method to use is mechanically moving sediment; address barrier island restoration; disagreement among the agencies on the materials used is a major problem; people want to solve the problems as quickly as possible.

By letter dated May 11, 2004, Mr. Paul Yakupzack writes: unlike other areas of the U.S., Louisiana chose to develop oil and gas at the expense of coastal erosion (which is at least partially caused by petroleum development). The entire infrastructure of south Louisiana is washing away. The USACE should help with this problem for the sake of the Nation. Without these coastal wetlands, many people in the northern U.S. will freeze in the dark and not have access to Louisiana's fish and wildlife. Mr. Yakupzack emphasizes that immediate help is needed to protect what we have left. An attachment to the letter provides comments on individual restoration project proposals.

By letter dated May 17, 2004, the Gulf Restoration Network (GRN) presents comments representing a coalition of 50 local, regional and national environmental, environmental justice, social justice and public interest groups. The letter includes a copy of Environmental Stakeholder Issues endorsed by all of the groups in the GRN. The GRN discuss the following issues: 1) Regulatory program issues regarding several specified permits that illustrate the USACE's failure to protect existing wetlands; 2) Public Works Program — the USACE must reevaluate all public works projects to ensure they do not undermine the LCA Plan; 3) Scoping process — the numerous worksheets provided at scoping meetings seems misguided to ask the public for comments on specific restoration opportunities without supplying them with more information than the name of a particular project. Failure to fully integrate the public into the development of the plan; 4) Change in plan term: a 10-year time frame is insufficient to address all of the coastal land loss issues facing Louisiana. It is vital that the USACE examines the problem comprehensively and develops a near-term plan that transitions into a necessary long-term plan.

By letter dated May 17, 2004, Mr. Brian W. LaRose writes: Terrebonne-Barataria (Subprovinces 2 and 3) is "zero ground" for coastal land loss in Louisiana, and the people in this area are exposed to the greatest threat of loss of property and life. All efforts of the LCA Plan should be focused on sustainability. With regard to scoping question #1 — the most significant weight should be given to protection of human infrastructure, including the protection of human lives especially within the Terrebonne Basin. Scoping question #2 — the most significant resource is our culture. Projects that would contribute to sustainable coast include: reintroduce Mississippi River water and sediment into Bayou Lafourche; conveyance of Atchafalaya River water to western Terrebonne marshes; implement the Penchant Basin plan; freshwater introduction south of Lake De Cade; the Third Delta Study; barrier island restoration in Terrebonne basin; maintain the Timbalier land bridge; rehabilitate the northern shores of Terrebonne/Timbalier Bays; maintain the land bridges between Caillou Lake and the Gulf of Mexico and between Bayous du Large and Grand Caillou. Projects with negative impacts: sediment transport down Wax Lake Outlet; relocate the Atchafalaya River navigation channel.

By letter dated May 18, 2004, Drs. Flynn, Manceaux, Arcement, and Pizzolato, Chiropractic and Physical Therapy Clinic reference letter by the Houma-Terrebonne Chamber of Commerce regarding restoration plans for the Louisiana coastal area and express their grave concerns with the dramatic land loss of the protective barrier islands and significant wetland erosion. They write in support of the USACE, New Orleans District beginning immediate and comprehensive plans to protect Terrebonne Parish, in general and the Barataria-Terrebonne Estuary wetlands in particular.

By fax dated May 18, 2004, the League of Women Voters of Louisiana (the League) indicates stakeholders consider the near-term planning process only the beginning and not the final plan. The League calls for identification and regulation of areas of critical concern. They believe that natural resources should be managed as interrelated parts of life-supporting ecosystems, conserved and protected to assure future availability. They advocate sharing responsibility for management of natural resources by all levels of government. They suggest human safety be the first priority of resources protected, followed by economic enterprises with natural habitat restoration being a consequence of protecting the two priorities. They suggest shelving projects that cannot show results in 10 years until resources are secured. They suggest a continuous land-building process will be the only way to sustain resources. The LCA Plan must contain pilot projects that advance the science of massive coastal restoration. The League endorses the Environmental Stakeholder Issues submitted by the coalition of environmental and citizen groups.

By letter dated May 18, 2004, the Barataria-Terrebonne National Estuary Program (BTNEP) comments on three topics: 1) Regarding the two scoping questions, the BTNEP believes that a restoration plan should include four essential measures: ecological, human, management, and linking components; 2) Those proposed projects in Subprovinces 2 and 3 that would not be consistent with the BTNEP management plan or have some uncertainty include the large freshwater diversions at Boothville, Fort Jackson, and Myrtle Grove, the Third Delta study, the

Mississippi River Delta Study, and the Old River Control Study; 3) The BTNEP provides scientific and engineering justification of using sediment slurry using the nine LCA Study sorting and critical needs criteria. The BTNEP has widespread support and represents hundreds of individuals, groups, and agencies.

By letter dated May 18, 2004, Restore or Retreat (ROR) with a membership of over 250 people, suggests that the primary goal of the LCA Plan should be construction of large-scale coastal restoration projects. The Barataria and Terrebonne areas, specifically the Lafourche and Terrebonne ridges, should be given highest priority. With regard to scoping question #1 — natural and human ecological needs achieved through barrier island restoration, Bayou Lafourche reintroduction, modification of the Davis Pond diversion, distribution of Atchafalaya River water and sediment, and proposed pipeline sediment diversions. In the long-term, Third Delta Conveyance channel is necessary. Regarding scoping question #2 — the most significant resources are the Mississippi and Atchafalaya Rivers. All nine critical needs are essential. The LCA Near-Term Plan must not resemble the current CWPPRA program.

By letter dated May 18, 2004, the CFG Mortgage Company provided a position paper by South Central Industrial Association (SCIA) with 200 member firms and over 35,000 employees. The Terrebonne-Barataria Basin suffers the most land loss for the state and Nation affecting lives, communities, homes, infrastructure, seafood, the oil and gas industry, and ecological stability. Long-term restoration efforts to sustain the coastal area are vital. Scoping question #1 — the most critical need is protection and preservation of human lives, and priority efforts to stabilize and sustain wetlands and barrier islands. Scoping question #2 — the most significant resource is our culture. Projects contributing to sustainable coast include: reintroduce Mississippi River water and sediment into Bayou Lafourche; conveyance of Atchafalaya River water to the western Terrebonne marshes; implement the Penchant Basin plan; freshwater introduction south of Lake De Cade; Third Delta Study; barrier island restoration in Terrebonne Basin; maintain the Timbalier land bridge; rehabilitate the northern shores of Terrebonne/Timbalier Bays; maintain the land bridges between Caillou Lake and the Gulf of Mexico as well as the land bridge between Bayous du Large and Grand Caillou. Projects with negative impacts: sediment transport down Wax Lake Outlet; relocate the Atchafalaya River navigation channel.

By letter dated May 18, 2004, the Lafourche Parish Council adopted Resolution No. 04-034, supporting the Third Delta Conveyance Channel Feasibility Study and urging other interested parties to offer their endorsement of this project, and Resolution No. 04-035 supporting projects for the LCA Study, including: the Third Delta Conveyance Channel; Bayou Lafourche Freshwater Diversion; Barataria Basin barrier island restoration; Modifying the Davis Pond diversion; sediment pipeline conveyance projects to replenish sediment along the Lafourche ridge.

By letter dated May 18, 2004, the Cross Group, member of the SCIA, provided a position paper of the SCIA that they support (see similar letter by CFG Mortgage described above).

By letter dated May 18, 2004, Express Title (Mr. Timothy J. Thomson, Director) writes as a member of the SCIA and attaches a position paper. See above similar letter from CFG Mortgage.

By letter dated May 19, 2004, Mr. Dudley Smith, President of Petroleum Laboratories, Inc., 109 Cleveland St., Houma, Louisiana 70363 writes: fully supports and is committed to implement the comments from the Houma-Terrebonne Chamber of Commerce on May 7, 2004. As a lifelong resident, it is Mr. Smith's belief that if we do not act quickly on key issues that have been addressed, we risk passing a point of no return.

By postcard dated May 19, 2004, J.M. Nesanovich writes: the LCA Plan must include wetland protection and controls on development to ensure effective coastal restoration efforts; discourage new development in the floodplains; promote protection of intact, functioning wetland systems; reevaluation of all state and Federal public works projects in the coastal zone and upper Mississippi River Basin; plan must include closure of the MRGO.

By fax/mail dated May 19, 2004, Mr. Jess Curole, Administrator of Lafourche Parish Coastal Zone Management writes: as a member of the Management Conference of the Barataria-Terrebonne National Estuary Program, I support the comments submitted by BTNEP regarding the LCA Near-Term Ecosystem Restoration Plan. At our most recent meeting, a cross-section of scientists, researchers, and administrators gave their input on why certain restoration techniques should be considered and which projects are most essential to rebuilding the estuary. The comments capture the sense of urgency and convey the legitimacy and feasibility of using sediment delivered via pipeline from dedicated dredging. This technology has proven successful worldwide.

By fax/mail dated May 19, 2004, Mr. David A. Bourgeois, Asst. Area Agent-Fisheries, writes: as a member of the Management Conference of the Barataria-Terrebonne National Estuary Program, I support the comments submitted by BTNEP regarding the LCA Near-Term Ecosystem Restoration Plan. At our most recent meeting, a cross-section of scientists, researchers, and administrators gave their input on why certain restoration techniques should be considered and which projects are most essential to rebuilding the estuary. The comments capture the sense of urgency and convey the legitimacy and feasibility of using sediment delivered via pipeline from dedicated dredging. This technology has proven successful worldwide.

By letter dated May19, 2004, Mr. Mark Davis, Coalition to Restore Coastal Louisiana, 746 Main St., Ste B101, Baton Rouge, Louisiana 70802 writes: the LCA Study must include these guiding principles: river systems, science-based projects, permitting, public works projects, sediment and water quality, infrastructure, and management. Restore natural deltaic processes, provide best science and engineering, hydrologic and ecologic models, wetland protection, coordinate civil works projects with the LCA Plan, sediment and water use should meet Federal/state standards, navigation and transportation needs to be reviewed for compatibility with LCA Study goals, LCA Plan must manage and effectively operate a comprehensive multi-agency.

By fax/mail dated May 19, 2004, Louisiana Hydroelectric, Vidalia, Louisiana writes: as operators of the Sidney A. Murray, Jr. Hydroelectric Station located at the Old River Control Structure, and major stakeholder in the December 13, 1989 operating agreement with the USACE, we have three major comments: 1) stakeholder participation in the draft PSEIS process; 2) stability of the Old River Control Complex; and 3) Long-term operational considerations for the Old River Control Complex.

By letter dated May 20, 2004, the Environmental Defense Fund, National Audubon Society, and the National Wildlife Federation jointly submit the following comments: this letter supplements the comments of the Coalition to Restore Coastal Louisiana. Support the implementation of early action projects, creation of demonstration projects, the establishment of science and technology programs, and a second generation of larger diversion projects over the next decade. The Near-Term Plan must include the following features: empower scientists; priority for natural processes; deadlines for large-scale projects; identify cost-effective early action projects; project operations; modify or remove existing infrastructure; consistency language; and commitments to comprehensive plan. The letter includes an attachment "Where do we go from here?" that discusses near-term project mobilization and feasibility investigations and science support.

By letter dated May 20, 2004, Yarrow J. Etheridge, Director, City of New Orleans, Mayor's Office of Environmental Affairs writes: as the largest population center in Louisiana, we are keenly aware of the risks posed by the continued deterioration of our wetlands; hope that the President's invitation to adapt the LCA Study to near-term implementation reflects an understanding of the urgency of the challenge that escalates daily in coastal Louisiana. An attachment provides responses to the scoping questions, initial sorting and critical needs criteria, and restoration opportunities (see table 7 "Worksheet Comments").

By letter dated May 20, 2004, the Lafourche Basin Levee District (LBLD) writes: coordinate the LCA Plan restoration projects with the ongoing Donaldsonville to the Gulf Study. The LBLD is a large landowner in southern Barataria Basin and they hope that the LCA Plan restoration projects would include restoration of those properties. The LBLD feels that all 21 candidate projects submitted for review in Subprovince 2 are excellent projects; the LBLD requests to be informed of all public meetings and discussions on the LCA Program.

By fax dated May 20, 2004, the non-profit Mississippi River Basin Alliance (MRBA) writes: The MRBA fully supports the restoration of the Mississippi River delta and Louisiana's coastal wetlands and have joined in efforts to educate and engage states upriver of the importance of this issue. At the Belle Chasse scoping meeting, the MRBA commented that the public does not adequately understand the change in the LCA Study process and why they were asked for further input. The MRBA believes it would have been helpful to have a local surrogate explain the study changes to the local residents. The central concern and interest of the MRBA is in the use of the river for restoration. The MRBA agrees with the statements made by the Coalition to Restore Coastal Louisiana in their comments on the DPEIS on diversions, the use of sediment, river mouth modeling, and updating bathymetry. The MRBA's major concern is hypoxia and the need for more precise data. Hurricane protection, permitting, and consistency between restoration efforts and other regulatory activities are additional concerns for the MRBA. Regarding prioritization of LCA Plan proposed projects: the MRBA believes that delaying closure of the MRGO until the projected 2013 completion date of the Inner Harbor Navigation Canal lock expansion is an unacceptable position for the USACE to take. The MRBA believes that the USACE should articulate and advocate a whole-basin perspective of restoration in conjunction with upper Mississippi River Basin restoration efforts. The shift to a 10-year restoration program from a 50-year horizon carries a risk that the real scope of the problem, which needs a 50-year horizon, will be lost.

John P. Laguens, 828 Mehl Ave., Arabi, Louisiana 70032, writes: This plan should say — close the MRGO now! Stop the dredging and deep draft navigation in the channel. Restore the MRGO in accordance with Louisiana's Coast 2050 Plan.

Capitalize On Existing Infrastructure and Activities (ACMAC) writes: Acadiana to the Gulf of Mexico Channel should be looked at in the LCA Plan. Human life should be a most critical aspect of any alternative; fish and wildlife do not vote or pay taxes, human life should take precedence over any resource. Sustainability — the most important natural features are the natural ridges and cheniers; they provide storm protection and prevent further land loss. The LCA Study toolbox should be the one alternative. Separate the toolbox into long- and short-term projects. Add the bar mouth concept to the toolbox. Capitalize on projects already implemented through the CWPPRA. Saving our wetlands should be the GOAL, for all personnel in agencies involved with coastal restoration.

Capt. James L. Robinson, USCG Ret., Port of Lake Charles writes the following comment at the Lake Charles scoping meeting: Navigation interests are represented as significant Louisiana national assets. The prospective relationship of coastal restoration and ship channel maintenance has yet to be realized due to bureaucratic restrictions, associated with cost constraints of the "Federal Standard" regarding dredged material deposition. Let's help address that through these essential planning processes.

Undated letter by Al DuVernay to Governor Blanco: buy Elmer's Isle.

William Herke, Ph.D., 555 Staring Lane, Baton Rouge, Louisiana 70810 writes: The use of water and salinity control structures is controversial and, if not properly designed, could cause marsh loss. If such structures were designed to mimic natural hydrology, they might help reduce marsh deterioration. However, there is a complexity of designing structures so that fish access would be interfered with as little as possible. Dr. Herke believes it is necessary to allow fish access 24 hours a day, 365 days a year, at all levels in the water column so that important species are not deprived access. Dr. Herke further asserts that rock weirs need to be designed so that spaces between rocks do not become plugged or these structures would have the same deleterious effects on fisheries as a conventional fixed weir.

Mr. Nolan J. Bergeron, Jr., Chairman, Terrebonne Parish CZM [Coastal Zone Management] and CR [Coastal Restoration] Committee writes: stop state loss of 25 square miles of wetlands. We need major diversions to rebuild eroding landmass in the Terrebonne-Barataria Basin. We need to rebuild the barrier islands, harden and reinforce the north shoreline of all lakes and bays, and reduce saltwater erosion. We need to correct the dead zone.

Undated letter by the St. James Parish Council, P.O. Box 106, Convent, Louisiana 70723-0106: critical need is restoration of inner area freshwater habitat. Proposes freshwater diversions into areas of low sediment and nutrients. Water quality and wetland habitat protection are the most significant resources that should be corrected first.

Mr. Chris Holmes writes: the scoping meeting process was complicated. No provisions to include any programs regarding erosion/destruction caused by the MRGO. Include and address the MRGO in the LCA Plan.

An unnamed writer at the Houma, Louisiana scoping meeting writes: need silt introduction into Terrebonne Parish to preserve seafood and provide hurricane protection. Rebuild the lost marshes and stop further erosion of marshes. Use offshore/onshore sand resources and silt-laden Mississippi River water.

An unnamed writer at the Belle Chasse, Louisiana scoping meeting writes: freshwater diversions into marshes, save maritime forests; stop human activity that worsens problems, sustainability of projects that are working; relocate adversely affected people; educate public; evaluate human impacts. Significant resources include: Mississippi River diversions, close the MRGO, cheniers, clearly communicate restoration benefits for MRGO, programmatic flexibility for restoration benefits, refocus CWPPRA funds to near-term priorities.

Mr. Kenneth Myers, 10340 Freman Dr., Keithville, Louisiana 71047 writes: relocate human and domestic livestock from below Intracoastal Waterway in Subprovinces 2 and 3. Block passes in Delta to slow flow of silt into the deeper waters of the Gulf. Remove humans from below Jean Lafitte through Naomi and Reggio. Turn these areas into wildlife areas to rebuild marsh. Need larger levees/seawalls for Morgan City and Houma. Need catch basins close to these cities to retain sediment and build new land. Relocate port facilities from Port Fourchon to Houma or Larose. Relocate pipelines that criss-cross the region. Elevate roadbed along Louisiana Hwy 82. In Subprovince 1, address what Louisiana expects the future of New Orleans to be.

Mr. Charles Savoye, 2727 Fenelon, Chalmette, Louisiana 70043 writes: at the scoping meeting, questions were not answered and material was hard to understand.

Messrs. Ralph Pausina and Mike Voisin for the Louisiana Oyster Task Force, 1600 Canal St, Ste 210, New Orleans, Louisiana 70112: all freshwater diversion projects addressed should be a large scale study program not LCA Study near-term plans, and should be part of Third Delta Study. Davis Pond: address water quality, complete cumulative area oyster lease relocation phase, this can be accomplished in less than 10 yrs. Engineering should be accurate as the structure is constructed. Barrier Island restoration: stabilize ecological conditions within western Barataria Basin. Allow water to stay in basin longer for plants to reproduce and mature, and aquatic animals to accustom themselves to salinity regimes early in their lifespan.

The Terrebonne Parish Coastal Zone Management and Coastal Restoration Committee provided general comments on the need to rebuild Barataria-Terrebonne utilizing pipeline transport and diversions. In addition, they provided detailed comments regarding each proposed restoration feature in Subprovince 3.

By letter dated May 24, 2004, the USFWS writes: in response to scoping question #1 — the most critical ecological need is to stop or reduce the 25 square mile annual coastal land loss. The USFWS recommends maintenance of proper marsh elevation and the input of sediment to maintain proper marsh elevation. The USFWS recommends that the DPEIS fully assess and summarize the effects (impacts) of proposed alternatives with respect to the following: 1) alternatives expected to restore and sustain coastal wetland fish and wildlife habitats; 2) input of suspended sediment and the sedimentation process; 3) evaluate deltaic project alternatives over at least a 100-year project life; establish that geomorphologic features to be restored are critical to the system; address and quantify direct, indirect, and cumulative impacts; assess impacts on wetland habitats and associated Federal trust fish and wildlife resources; threatened and endangered species and their critical habitat; invasive species; Federally owned lands and state-owned lands acquired with Federal funds. A Biological Assessment is required; informal and formal (if needed) consultation under the Endangered Species Act. The USFWS requests that the DPEIS explain how individual restoration features will move from the programmatic (conceptual) level to construction; and how all applicable laws and policies (e.g., NEPA, Fish and Wildlife Coordination Act, etc.) will be met. The USFWS requests that the DPEIS incorporate by reference the previously submitted LCA Coordination Act Reports (from August and September 2003), the forthcoming Near-Term Plan (NTP) [Fish and Wildlife] Coordination Act Report, and the threatened & endangered species information letter (dated September 23, 2003).

5.1.2.3 Summary of Responses to Scoping Handouts

Responses to Scoping Questions

Seven comments addressed scoping question #1: protect existing lands, reestablish freshwater and sediment into upper basins, provide barrier shoreline protection, build a levee from Bayou Lafourche to the Atchafalaya River, preserve Terrebonne Parish, stop the statewide annual land loss, and use major diversions to rebuild the eroding landmass.

Six comments addressed scoping question #2: consider water quality and marsh stabilization, set a "line in the sand" to stop erosion and land loss, prioritize ecological resources by their ability to be sustainable and to encompass multiple goals, restore barrier islands, wise use and management of freshwater to maintain healthy isohalines and stabilize existing marshes.

Responses to Sorting and Critical Needs Criteria

Seven comments addressed the sorting criteria: four of seven comments agreed with sorting criterion #1; four of five comments agreed with sorting criterion #2; two of four comments agreed with sorting criterion #3; and two of four comments agreed with sorting criterion #4.

Thirty-four comments addressed the critical needs criteria: two of four comments agreed with critical needs criterion #1; three of four comments agreed with critical needs criterion #2; four of four comments agreed with critical needs criterion #3; four of six comments agreed with critical needs criterion #4; four of six comments agreed with critical needs criterion #5; and two of five comments agreed with critical needs criterion #6.

Five "new" criteria were recommended:

1. Mr. Jody P. Chenier, Parish of St. James: "Operation & Maintenance Cost" — The operation and maintenance cost of a project should also be considered before the project is selected.
2. Mr. Jody P. Chenier, Parish of St. James: "Use of Non-Federal Funds" — Local government, private sector, and independent agency contributions, as well as in-kind services, should be considered for a project. If local tax payers are willing to help with the cost through local elections and dedicated funds then that needs to be considered.
3. Bar mouth concept.
4. Ms. Linda Walker: Private development and state/local infrastructure. Activities should also be measured for their potential to aid restoration or halt future damage. Compensatory wetlands because time delays and differences in quality cannot truly be considered sufficient mitigation. If an endeavor is going to cause damage and it cannot be considered a measure that will save human lives (such as a road), it should not be allowed to go forward until those conditions can be met.
5. Ms. Linda Walker: If restoration efforts focus on sustainability for appropriate plant life, then animal and human activities will follow.

Responses to Proposed Restoration Features in Subprovince 1

Mr. Jody P. Chenier, Parish of St. James, and Mr. Ed Doody addressed comments regarding proposed restoration features in Subprovince 1. Mr. Chenier's comments were generally favorable to proposed restoration features in this subprovince; he did not agree with the following projects: all medium freshwater diversions (White's Ditch, Bonnet Carre, and Fort St. Philip); all sediment delivery via pipeline projects (American/California Bays, Central Wetlands, Fort St. Philip, Golden Triangle, and Quarantine Bay). Mr. Chenier indicated that there are too many studies already, and what is needed are construction projects.

Mr. Doody's most numerous comments were to close the MRGO. Mr. Doody's comments regarding closing the MRGO were addressed to projects far-removed from the general vicinity of the MRGO. Generally, Mr. Doody's suggestions were not applicable to the proposed restoration feature addressed. For example, Mr. Doody's response to proposed marsh creation in the La Branche wetlands was a suggestion to repair the marsh rim of Lake Borgne, over 40 miles to the east.

Responses to Proposed Restoration Features in Subprovince 2

Mr. Jody P. Chenier, Parish of St. James, was the sole commenter regarding the proposed restoration features in Subprovince 2. Mr. Chenier's comments can be characterized as follows: favorable to small freshwater diversions except at Davis Pond; favorable to medium and large freshwater diversions except at Boothville, Edgard, and Myrtle Grove; does not agree with any sediment diversions; and there are too many studies already, need construction projects. No other individuals provided comments on specific restoration features in Subprovince 2.

Responses to Proposed Restoration Features in Subprovince 3

Comments regarding the proposed restoration features in Subprovince 3 were addressed by the following: Mr. Jody P. Chenier, Parish of St. James; the Terrebonne Coastal Zone Management and Coastal Restoration Committee, Mr. Paul Yakupzack, and unidentified scoping meeting participants.

Mr. Chenier did not support any restoration features except the following: increase sediment down Wax Lake Outlet, freshwater introduction into southwest Terrebonne wetland via Blue Hammock Bayou, stabilize northern shore of East Cote Blanche Bay at Marone Point, and stabilize shoreline at Point Au Fer Island.

Comments by the Terrebonne Coastal Zone Management and Coastal Restoration Committee and Mr. Yakupzack are similar and provide the following major prioritization of proposed restoration features: Priority #1 — Freshwater introduction into the southwest Terrebonne wetlands via the Blue Hammock Bayou. Priority #2 — Conveyance of Atchafalaya River water to northern Terrebonne wetlands. Priority #3 — Freshwater introduction into Lake De Cade. Priority #4 — rehabilitate northern shorelines of Terrebonne/Timbalier Bays. Priority #5 — Maintain land bridge between Caillou Lake and Gulf of Mexico.

Unidentified comments were generally favorable to restoration features in this subprovince.

Responses to Proposed Restoration Features in Subprovince 4

There were no handout comments regarding the proposed restoration features in Subprovince 4.

Comments Suggesting "New" Restoration Features

Three handout comments suggested "new" restoration features be considered:

1. Mr. Ed Doody: Stop doing mindless blind surveys. Stop hiding behind phony regulations. Stop being led by pork barrel politicians. Start by letting your engineers do the right things. Stop wasting tax money.
2. Captain Stu Scheer: I am on the water 250 days a year in the Terrebonne Basin estuaries and bay. The area is sinking and eroding much faster than the experts can imagine!
3. Ms. Linda Walker: (Subprovince 1) As a non-expert, but a citizen with degrees in chemistry, nursing, and environmental law, I am unqualified to comment on the advisability of each specific project. As a resident of New Orleans with family, including grandchildren, in the city, I do have personal feelings about prioritizing projects. 1) Any and all measures that would lessen the threat of flooding to Orleans and surrounding parishes — including the immediate closure of MRGO. 2) Allowances in the 10-year plan that would authorize innovative, new projects to augment river water diversion, dredging, and sediment relocation — such as breakwaters and underground injection.

5.2 THE LCA STUDY PUBLIC INVOLVEMENT PROGRAM

Due to the intense public, political, and media interest in the restoration of Louisiana's coastal wetlands, public involvement is a critical component of the LCA, Ecosystem Restoration Study. This section describes the public involvement and coordination activities associated with the study. The LCA Study Public Involvement Program is discussed in more detail in section 5 of the Main Report.

5.2.1 Public Involvement Program

Public involvement is a process by which interested and affected individuals, organizations, agencies, and governmental entities are consulted with and participate in a decision-making process. Public involvement in the LCA Study has two main functions: to inform the public about the study and to generate their input on key issues and concerns. This dialogue will guide the study making it inclusive, balanced, and comprehensive. Public involvement activities also facilitate open discussions that enhance efforts to develop a consensus on important issues. Supporting an exchange of ideas and information among interested individuals and groups is critical to resolving the challenges involved in performing the study.

The geographic area of the study is large, the issues are complex and diverse. In recognition of these factors, the USACE and the State of Louisiana, as the non-Federal sponsor, agreed on public involvement activities during the LCA Study. A public involvement program was developed that was inclusive of all interests and concerns and balanced the sometimes-competing interests of this diverse region. The program is based upon communication and collaborative problem solving with the goal of reaching better, more informed decisions. Public involvement activities included workshops, focus group meetings, educational and technical briefings, presentations to interested parties, public meetings, fact sheets, and newsletters.

Public involvement and coordination were identified as critical components of the study effort. A public participation / public outreach plan was formulated to 1) inform the public, 2) gather information, 3) identify public concerns, 4) develop consensus, and 5) develop and maintain credibility. The overall objective of all public participation and outreach activities is to ensure that Louisiana and the Nation are informed about the study and that the LCA Plan is reflective of the input received from stakeholders and the public.

Three additional objectives for public involvement have been identified:

1. Gather input from the diverse groups outside of the PDT to assist in problem identification and the formulation and evaluation of alternative plans;
2. Develop relationships critical to the success of the study and the implementation of the recommendations of the study; and
3. Promote realistic expectations within an atmosphere where there is widespread public interest about the health of Louisiana's coastal wetlands, but a lack of awareness about the LCA Study.

Further, it is the obligation of the PDT to:

1. Keep the public informed so that they can make educated choices;
2. Provide ways to participate in the process; and
3. Provide equal access to information and decision-makers, regardless of viewpoint.

5.2.2 Public Involvement for the LCA Study

The purpose of public involvement in the LCA Study effort is to help inform the public and help shape the creation and implementation of a restoration program to reestablish an ecologically functional and sustainable coast that supports the communities, cultures, economies and natural heritage of the region. Each phase of the LCA Study effort will carry with it special public participation needs and opportunities.

For the LCA Plan, the PDT developed a multi-tiered plan for public involvement:

Interaction with Local Governments: The first tier is for interaction with local governments. This represents an opportunity to discuss issues related to the study with all affected local governments. Special meetings of the group are called at key points during the study, essentially prior to decision points.

Public Meetings: The second tier is public meetings. This is the general forum for soliciting input for consideration on the study from stakeholders, Federal, state, and local governments, special interests, academia, and the general public. While recognizing that the Coalition of Coastal Parishes represents the views of local government, it is impossible for them to represent the concerns of every citizen in their constituency. Public input to the planning process is of paramount importance, so it is necessary to hold public meetings at a time amenable to the average citizen who wishes to attend. Therefore, these meetings take place after typical daytime work hours.

These first two tiers are designed to function together, with scheduling determined by the study milestones. For example, the PDT would meet with the Coalition of Coastal Parishes before a key milestone is reached, followed shortly thereafter by the public meeting.

Internet Web Site Interaction: The third tier is a web-based information system. This is updated as new information becomes available, as sections of the study are completed, and as new meetings are announced. Distribution is essentially free and unlimited, and information on the web site can be repackaged into brochures and fact sheets, if necessary. Effective use of this tier facilitates the first two. In addition, advanced distribution of meeting materials improves the quality of meeting input. Periodic web page updates provide timely and up-to-date communication, while serving as a project reference guide. The transparency this method lends to the study is essential. Credibility is increased if all interested parties are kept informed and problems are identified while there is still time to address them.

Executive Briefings: The fourth tier involves executive briefings. Experience has shown that the heads of large corporations and national interest groups do not typically participate in NEPA scoping meetings or public meetings. It is extremely important, however, to engage these groups in the planning process so they are familiar with the issues and can provide input to the plan formulation. Therefore, the executive committee invites these groups to briefings at key points during the study. The executive committee was formed to provide executive-level guidance and support for the LCA Study and may make recommendations that it deems warranted to the District Engineer on matters it oversees, including suggestions to avoid potential sources of dispute.

5.2.3 Public Meetings

In addition to scoping meetings, public meetings were also held for plan formulation and the presentation of alternative measures (**table 5-2**). Meeting notification was accomplished via mailed announcements, newspaper ads, and media contacts. Meeting participants included Federal and state agency representatives, landowners, leaseholders, other stakeholders, and concerned citizens. Additionally, the announcements included information about the web site, which presented the same material as presented in the meetings and solicited input from those who were unable to attend the public meetings.

Table 5-2
Public Meeting Dates and Locations for LCA Comprehensive Study

DATE	LOCATION	PURPOSE
2/04/2003	Belle Chasse, Louisiana	Plan Formulation
2/06/2003	Larose, Louisiana	Plan Formulation
2/10/2003	Morgan City, Louisiana	Plan Formulation
2/12/2003	Lake Charles, Louisiana	Plan Formulation
5/27/2003	Houma, Louisiana	Presentation of 32 Subprovince Alternatives
5/28/2003	Lafayette, Louisiana	Presentation of 32 Subprovince Alternatives
5/29/2003	Lake Charles, Louisiana	Presentation of 32 Subprovince Alternatives
6/02/2003	New Orleans, Louisiana	Presentation of 32 Subprovince Alternatives
8/04/2003	Belle Chasse, Louisiana	Presentation of Comprehensive Final Array
8/05/2003	Larose, Louisiana	Presentation of Comprehensive Final Array
8/06/2003	Morgan City, Louisiana	Presentation of Comprehensive Final Array
8/07/2003	Cameron, Louisiana	Presentation of Comprehensive Final Array

5.2.3.1 Summary of February 2003 Public Meetings

Four meetings were held in February 2003 to present the status, objectives, and process of the LCA Comprehensive Study to the public.

The Belle Chasse meeting, held on February 4, 2003, was attended by 129 people. Some of the major concerns expressed were: the need for public involvement, the concern for oyster lease lawsuits, the need for shoreline protection before freshwater diversion, the urgency of the situation, and representatives of St. Bernard Parish and numerous residents expressed the need to close the MRGO.

The Larose meeting, held on February 6, 2003, was attended by 99 people. Some of the major concerns expressed were: the urgency of the situation and the need to get on with restoration, the need to make the Nation aware of the problem, the need to restore barrier islands and protect Grand Isle, and the need for consistency between restoration efforts and navigation projects.

The Morgan City meeting, held on February 10, 2003, was attended by 61 people. Some of the major concerns expressed were: the ability of the state to pay its share and the need to make the public aware of the problem, the urgent need to start implementing projects, the need to rebuild the historic reef at Point Chevreuil toward Marsh Island, the need for shore protection at Point Au Fer Island, the need to look into the cost share formula, the need for consistency with the Atchafalaya navigation project, the importance of congressional authorization, a Vermilion Parish spokesman worried whether the smaller projects in Subprovince 3 would be excluded from the LCA Comprehensive Study and have to continue to seek funding under CWPPRA, a spokesman for ROR expressed support for the Third Delta Conveyance Channel Project and the need for consistency with Federal flood control projects, the need for public outreach, and the need to consider the Cypress-Tupelo Swamps in the Atchafalaya Basin Floodway in any plan to redistribute the flows at the ORCS [Old River Control Structure].

The Lake Charles meeting, held on February 12, 2003,was attended by 57 people. The major comments involved the need for consistency between the various agencies; the need for public awareness; the need to expedite implementation of restoration projects; the need to consider upstream drainage; the need for the many user groups to come together; the need to address saltwater problems in Sabine Lake, Calcasieu River, Oyster Bayou, Mud Lake, and Second Bayou; the need for national awareness of the problem; concern that Texas would not be brought into the discussions to address the effects of several of their proposed water projects; concern as to whether the smaller projects in Subprovince 4 would be excluded from the LCA Comprehensive Study and have to continue to seek funding under CWPPRA; and the need for more input from landowners since most of the wetlands are owned privately.

5.2.3.2 Summary of May and June 2003 Public Meetings

Four meetings were held in May and June 2003 to present to the public the 32 subprovince alternatives that were considered in the LCA Comprehensive Study and the process that was to be used to evaluate them.

The Houma meeting, held on May 27, 2003, was attended by 84 people. Comments generally addressed project implementation. This included coordination with landowners, funding, and permitting. Comments were also made regarding project measures, such as barrier island restoration. From a system-wide standpoint, people commented on tradeoffs between various possible endpoints and user groups, and suggestions were made regarding funding and coordination with other efforts and stakeholders, such as the navigation industry.

The Lafayette meeting, held on May 28, 2003, was attended by 52 people. Many of the comments offered related to restoration features. Some comments addressed concerns regarding environmental consequences of potential measures, including impacts to agriculture, saltwater movement, and sediment transport. Attendees also commented on programmatic issues, including funding and the need for action, as well as coordination and implementation, especially as they relate to permitting.

The Lake Charles meeting, held on May 29, 2003, was attended by 106 people. Some of the comments expressed the need to communicate and coordinate with Washington officials, and to coordinate with the Galveston District of the USACE. Many comments addressed issues related to restoration features, including environmental consequences, and concern was noted regarding the change in sea level.

The New Orleans meeting, held on June 2, 2003, was attended by 57 people. The major comments involved closing the MRGO. Other comments included the need for consistency with flood control, navigation, and regulatory issues, the need to include shoreline protection and restoration, interest in the targeted stakeholder meetings, and general concern about the schedule of implementation.

5.2.3.3 Summary of August 2003 Public Meetings

Four meetings were held in August 2003 to present the final array of plans to the public.

The Belle Chasse meeting, held on August 4, 2003, was attended by 89 people. Many comments were expressed regarding closing the MRGO. Other comments related to specific restoration features, such as the placement of diversions, and a comment was noted regarding contaminated sediments.

The Larose meeting, held on August 5, 2003, was attended by 71 people. The major comments related to the inclusion of the Third Delta Conveyance Channel. The importance of reauthorization of CWPPRA was stressed, and comments were made regarding specific restoration features. Also, implementation was a concern, especially as it related to compensation for shrimpers.

The Morgan City meeting, held on August 6, 2003, was attended by 47 people. Several comments were related to specific restoration features, such as selection of the Third Delta Conveyance Channel and the Point Chevreuil Reef. A representative from the State Legislature discussed the importance of the three Constitutional Amendments to be voted on in the fall of 2003 that would further coastal restoration efforts.

The Cameron meeting, held on August 7, 2003, was attended by 44 people. Many comments involved the need for more small projects in their area, and some comments were noted regarding larger restoration features. Comments made at this meeting included: expedite protective measures at Long Beach and Johnson's Bayou area; perform computer simulation of various reconfigurations of the jetties at Calcasieu Pass; include in Subprovince 4 supplemental plan salinity control structure (locks) at Calcasieu and Sabine Passes; consult with the Galveston District of the USACE for lessons learned at Calcasieu Pass?; and do not allow deepening of the ship channel at Sabine/Port Arthur/Beaumont/Orange which would necessitate million of dollars in remedial or protective "measures."

Additional comments that were received by mail include: concern about saltwater in the Calcasieu River; concern about the locks on the Sabine River; concern that the Vermilion Parish wetlands lack protection and restoration projects; concern that the MRGO is an ecological disaster and is not adequately addressed in the LCA Study; reintroduce fresh water into Barataria Basin from the Mississippi River; the E3 Option of the LCA Study is vital to the existence of Lafourche Parish; Lafourche Parish Council will formally object to the LCA Study if the E3 Option is not included in the LCA Plan; and a vital link in maintaining the integrity of the Mermentau Basin (SP 4) as a freshwater reservoir (a component of salinity control) is the west bank of the Freshwater Bayou Canal.

Another mail comment: in the interest of the Vermilion Parish community, it is essential and imperative that the integrity of the west bank of the Freshwater Bayou Canal be included as a significant component for any alternatives for salinity control. There was a request that future Subprovince 4 maps include the Freshwater Bayou Canal west bank. A question posed: once authorized, will the CWPPRA projects be moved to WRDA?

Email comments included: In the M1 Alternative for Subprovince 3, Items #3 and 4, combine these and take the most western lobe of the Atchafalaya River channel through Shell Island and connect to Wax Lake Outlet. This would send more sediment into the Gulf and 1) keep the channel naturally dredged, and 2) create more wetlands offshore; take immediate action; parallel conveyance channels should be of the highest priority followed closely by operation of existing diversions at design capacity and construction of additional diversions expedited; and reestablish natural ridges.

5.2.4 Stakeholder Involvement and Outreach

Executive Stakeholder Roundtable discussions were held to initiate a continuing dialogue with key decision makers of each sector of coastal stakeholders, including regional and national interests. Co-sponsored by the State of Louisiana and the district, the meetings were designed to be small, comfortable working sessions that elicited concerns and questions various stakeholder group leaders had regarding the LCA Comprehensive Study. The stakeholder groups to be targeted included: (1) natural resources (fisheries), (2) business and industry, (3) agriculture and forestry, (4) energy, (5) navigation and transportation, (6) flood control, (7) environmental, (8) recreation and tourism, (9) state and local government, (10) landowners, and (11) finance, banking and insurance. Meetings began at 10:00 AM and ended at 3:00 PM each day during a mid-July through August schedule. Stakeholder concerns were identified and have been addressed in the LCA Comprehensive Study.

5.2.4.1 Summary of Stakeholder Comments

The format for the stakeholder meetings began with a welcome from the meeting host (a representative of that stakeholder’s group who is also a member of the Governor’s Commission) and self-introductions. A brief description of the problems associated with coastal land loss and an overview of current efforts was followed by specific concerns from that stakeholder group. A large portion of each meeting was devoted to identifying key issues, opportunities and challenges associated with coastal restoration specific to that stakeholder’s interests. The meeting was adjourned after a brief discussion on continued/future stakeholder involvement in the process. A court reporter recorded the minutes and flip charts were used to capture the opportunities, key issues and challenges expressed by the stakeholder groups.

Several concerns were common to the majority of the stakeholder groups, i.e., a sense of urgency that restoration must begin soon; the importance of education and awareness both locally and nationally; the prioritization of projects; the need to determine compensation methods (legal issues) early in the process; and that consistency and coordination be present within government agencies, between government agencies, and between government agencies and other organizations regarding regulations and permitting. Also prevalent throughout most of the meetings were the issues of money—when will it be received, who will control it and how will it be spent; the awareness that experience and knowledge gathered from Coast 2050, CWPPRA, locals, the older coastal residents and the Everglades be incorporated into the process; and that the next governing administration for the State of Louisiana be onboard with restoration efforts.

The following are information and comments pertinent to each of the stakeholder groups.

5.2.4.1.1 *July 29, 2003, Stakeholder Meeting: Natural Resources*

Location: Whitney National Bank.

Eighteen stakeholders attended representing oyster farmers, shrimpers, wholesale fish houses, Mississippi Department of Natural Resources, Sea Grant, Ducks Unlimited, St. Mary Seafood, Acadiana Bay Association, Viet-American Fisheries Union, LSU Agricultural Center, Terrebonne Fisherman's Organization, and Delta Commercial Fisherman's Association. **Opportunities:** Flexibility of process, river diversion to build land, and rebuilding historic reef complexes. **Key Issues:** Pollution from diversions, small diversions needed, the importance of fish and wildlife resources, outdoor recreation/ecotourism, coordination of water allocation, hard structures considered for shoreline protection, oil and gas should pay for damages, Bayou Lafourche Conveyance Channel too large and will compound problem, and the Bayou Lafourche Conveyance Channel compared to MRGO. **Challenges:** Economic impacts from river water diversions, getting the USACE to listen, costs associated with dredging policy/placement, integration of restoration programmatic issues with flood control/protection, availability of sediments, and water rights.

5.2.4.1.2 *July 31, 2003, Stakeholder Meeting: Business and Industry*

Location: Whitney National Bank.

Seven stakeholders attended representing South Central Industrial Association, Council for a Better Louisiana, Atchafalaya River Coalition, LSU, Louisiana Association of Business and Industry, and Conrad Industries. **Opportunities:** Refute inevitability of loss with positive results, use visual tools such as super Doppler radar, use weather reports nightly as outreach tool; use oil and gas companies to educate, America's Wetland campaign can be used by businesses to promote awareness, and build projects that benefit flood control, navigation, and restoration. **Key Issues:** Flood control needs to be linked with restoration, Louisiana supplies the Nation's energy, hurricane/storm protection, brown marsh, long-term funding, hypoxia, integration of industries (shipping with coastal restoration), economic growth potential, homeowner rates/insurance, prioritization of projects, and infrastructure. **Challenges:** Awareness ("ice melting" problem), fatalistic view (nothing can be done), linking restoration with oil and gas to the rest of the Nation, bringing together the environmental and business communities, merging flood control with restoration and navigation, small storms have major impacts to communities, and inertia.

5.2.4.1.3 *August 6, 2003, Stakeholder Meeting: Agriculture and Forestry*

Location: Lindy Boggs Conference Center.

Six stakeholders attended representing the Barataria-Terrebonne National Estuary Program, Louisiana Farm Bureau, Louisiana Cattlemen's Association, and the Vermilion Parish Police Jury. **Opportunities:** Salinity barrier on west side of Freshwater Bayou, use Red River to bring fresh water to Mermentau Basin, native vegetation, make restoration "private landowner friendly," and introduce America's Wetland tools into the classroom. **Key Issues:** Water quality, saltwater intrusion, impacts to agriculture, property rights, invasive species, cypress logging, barrier islands, displacement, move meetings to growers, forum with regulatory agencies, TMDLs, and Section 404 permits. **Challenges:** Salinity, mechanism to recognize and implement small projects, sense of exclusion by Subprovinces 3 and 4, meeting stream standards, beneficial amount of fresh water into Mermentau Basin, compensation, coordination of harvesting renewable resources with restoration, and protection of Houma area.

5.2.4.1.4 *August 7, 2003, Stakeholder Meeting: Energy*

Location: Lindy Boggs Conference Center.

Thirteen stakeholders attended representing BP America, Shell, Burlington Resources, Louisiana Independent Oil and Gas Association, ATMOS Energy, Mid-Continent Oil & Gas, and Continental Land and Fur Co., Inc. **Opportunities:** Structural measures to stabilize coast, sell program on relationship with National Security, matching funds from environmental lobby, elevate science as basis for justification, use partners upstream to facilitate sale of project, and achieve balance between industry, environment and economy. **Key Issues:** Feasibility of LCA Comprehensive Study, funding responsibility "on the backs" of oil and gas industry, skepticism of getting the money and not using it to restore the coast, Louisiana's credibility (in Washington, D.C.), national security, and overburdening of regulations on the industry. **Challenges:** State matching Federal funds, media "blame game," overcoming skepticism, Louisiana's poor communication with other states, incentives and policies related to water quality, achieving balance between economy/ecology/citizenry and business with restoration plan, providing proof that restoration works, and independent financier for managing funds.

5.2.4.1.5 *August 12, 2003, Stakeholder Meeting: Navigation and Transportation*

Location: the District.

Twelve stakeholders attended representing bar pilots, Mississippi Valley Trade and Transport Council, U.S. Maritime Administration, Louisiana Department of Transportation and Development, Port Fourchon, Steamship Association of Louisiana, USACE, and the Port of New Orleans. **Opportunities:** Support from deep draft industry, ability to compromise with environmentalists, new dredging technology, beneficial use of dredged material, maritime industry to help with barrier island restoration, tap bed load, and maintain shipping without a lock. **Key Issues:** Impacts on transportation and infrastructure, maintenance and improvement of deep draft navigation, timing of loss of MRGO for deep draft navigation, clarify definitions of Jones Act vessels/issues, security (i.e., Southwest Pass), how to handle dredged material areas, upriver environment and impact, U.S. transportation system versus the world, can we be competitive while restoring the coast, and locks on Mississippi River will not work. **Challenges:** Loss of MRGO for deep-draft navigation, making MRGO work with environmental challenges—navigation wants water, environment wants mud—need to compromise, more disposal areas needed, width of Southwest Pass, and maintain #1 port.

5.2.4.1.6 *August 13, 2003, Stakeholder Meeting: Flood Control*

Location: the District.

Eleven stakeholders attended representing the Louisiana Department of Transportation and Development, Teche Vermilion Freshwater District, Lake Borgne Levee District, South Lafourche Levee District, Atchafalaya Basin Levee District, USACE, Plaquemines Parish, and the Orleans Levee Board. **Opportunities:** Compatibility with ongoing flood protection projects, publicly owned access would help in project implementation, local experience in planning, integrate local projects that have been designed for flood protection, and look at existing systems (i.e., Atchafalaya sedimentation processes). **Key Issues:** Integrate academia with real life, emphasize this is a “working wetland,” perception that flood control is bad for the environment, realistic expectation of efforts, speed of implementation should be a factor in prioritization, consider large diversions in publicly controlled impact areas, potential impacts farther north, drinking water supplies linked to coastal loss, use features of ongoing projects (Morganza/Donaldsonville to Gulf) for multiple purposes, need to have all components for effort’s success, impacts of changes in system, flood control/hurricane protection/coastal restoration must work together, need to expand on cost of doing nothing, quantify how little Louisiana receives of benefits, impacts on out-of-state consumers, we will deal with this one way or another, commitment to proceed, and solution will be “inflicted” on locals. **Challenges:** To communicate and sell the LCA Comprehensive Study to the average citizen; getting rid of flood control’s negative image; realistic perception of results; speaking with one voice; lack of understanding from Washington, D.C.; convincing Washington, D.C. of the problem; getting past bureaucracy and bias; misunderstandings and calculating costs.

5.2.4.1.7 *August 14, 2003, Stakeholder Meeting: Environmental*

Location: Lindy Boggs Conference Center.

Eighteen stakeholders attended representing the Sierra Club, The Nature Conservancy, Louisiana Audubon Council, Gulf Restoration Network, Mississippi River Basin Alliance, Pontchartrain Institute, Coastal Conservation Association, Louisiana Wildlife Federation, Lake Pontchartrain Basin Foundation, and the Coalition to Restore Coastal Louisiana. **Opportunities:** Stress natural processes of the Mississippi River, prioritize river re-introductions, integrate regulatory into the LCA Comprehensive Study, reevaluate USACE projects for consistency with the LCA Comprehensive Study, integrate current science with management, coordinate projects upstream and downstream of the Mississippi River, role of stakeholders in management, nationwide coordination, create consistency review board, sediment use from Missouri River, think out of the box, address societal impacts, and process for land purchasing. **Key Issues:** Coordinate permitting and restoration, national processes of Mississippi River in plan, diversions in first tier, consistency with the LCA Comprehensive Study, reevaluation of public works and consistency with restoration, Minerals Management Service needs to be at the table, public trust, stewardship/sustainability with state after restoration achieved, ignorance/apathy, set interim goals to keep process on track, real sustainability and functioning ecosystem, and need solution to problem of conserving and controlling growth. **Challenges:** Permits/restoration, Section 404 permitting exemptions, MRGO, coordinating programs upstream and downstream, management capacity to carry out program, “coastal” development, money, security, gap between science and public understanding and trust, state saying “no” to political constituents’ permits, apathy, mistrust, ignorance, political fallout because of consistency (or lack of), political pressure, clarity of commitment, and consensus on philosophy of plan.

5.2.4.1.8 *August 19, 2003, Stakeholder Meeting: Recreation and Tourism*

Location: the District.

Eleven stakeholders attended representing Acadiana Bay Association, Cypremort Point, Inc., ROR, Louisiana Office of Tourism, New Orleans City Council, LSU-Sea Grant, University of New Orleans, Louisiana Department of Wildlife and Fisheries, and Office of State Parks. **Opportunities:** Preemptive action/legislation to prevent future lawsuits, reconstruction of historic reef complex, create structure to prevent fresh water from entering western bays, need formula for coordinating development with restoration, readjusting and training for possible career change opportunities, adding facilities in wetlands to accommodate tourism, all data should be made available to public, negotiate trade-offs among users, science-based implementation, and show success as project progresses. **Key Issues:** Not convinced restoration will work, need methodology described and access to the plan for input, consider unintended consequences (e.g., oysters), over-freshening of bays, development challenged, maintaining culture of south Louisiana, accessibility of wetlands to tourists, reduction of wildlife habitat, coordination/state parks’ master plan, and provide data/science/information to citizens. **Challenges:** Overcoming negative legal issues and misinformation, prevent over-freshening of western bay system, loss of culture and heritage, coordination challenge, what are consequences of letting river run its course, gaining trust of citizenry, consequences must be recognized on front end, and user groups in conflict.

5.2.4.1.9 *August 20, 2003, Stakeholder Meeting: State and Local Government*

Location: Lindy Boggs Conference Center.

Twelve stakeholders attended representing LSU, Vermilion Parish, Department of Natural Resources, Louisiana Governor's Office, U.S. Maritime Administration, ROR, U.S. Department of Transportation, Louisiana Department of Wildlife and Fisheries, Jefferson Parish, Louisiana House of Representatives, Vermilion Parish, and the Barataria-Terrebonne National Estuary Program. **Opportunities:** Projects may have choice of funding streams, protecting public/fisheries/economy, utilizing "coastal brain trust" that exists in Louisiana, targeted education to specific users, pipeline slurry sediment transport for moving materials long distances, utilize nationally supported groups or mimic successful initiatives of such groups, discuss wildlife issues, professional lobbyist, must implement certain types of projects quickly, use Department of Wildlife and Fisheries to contact out-of-state sportsmen for support, and combine environmental with economic benefits. **Key Issues:** Coordination between programs, citizens/economy affected due to wetland loss, high population growth in areas of high concentration of wetlands, threat of inundation in areas with infrastructure and businesses, time limitations, operational challenges of diversion projects, public acceptance of restoration program, sediment transport, "ideal" plan/what is right, invasive species, reassurance to be included in the LCA Comprehensive Study and future programs, competition for sediment, mimicking natural conditions by pulsing diversions, specificity/level of plan detail, and habitat destruction. **Challenges:** Coordinating the LCA Comprehensive Study with CWPPRA, halting wetland loss, getting science into the process, public acceptance, moving sediments long distances, reestablishment of natural processes, prioritization of resources, competition for funds, and complexity of issues/establishing a balance.

5.2.4.1.10 *August 27, 2003, Stakeholder Meeting: Landowners*

Location: the District.

Twenty one stakeholders attended representing the Atchafalaya Basin Alliance; Harry Bourg Corp.; Community of Cypremort Point; Randy Moertle & Associates/Biloxi Marsh Lands, Inc.; Point au Fer/St. Charles Land; LSU Agriculture Center; Lake Eugenie Land and Development; Madison Land; Miami Corp.; M.O. Miller; Avery Island McIllhenny Company; Continental Land and Fur Company, Inc.; Lafourche Realty, Inc.; Williams, Inc.; Stream; and Vermilion Corporation. **Opportunities:** Continue small-scale projects, Farm Bill involved south of Interstate 10, utilize expertise of landowners, allow landowners to retain mineral rights on restored lands, legal planning to restructure co-ownership policies, sediment diversions, separate appropriation for MRGO closure/rehabilitation, MRGO in prominent place in LCA Plan, MRGO as a conduit for diversions, utilize DNR Small Dredge Program in gap closure efforts, restore historic reef complex, consider recreational development, operation of Bonnet Carre spillway on a continual basis, dredged material available for MRGO rehabilitation or closure, Calcasieu Locks in R4, landowner funding/efforts and related resource data can be used to beef up State of

Louisiana cost share for the LCA Comprehensive Study, continue CWPPRA, include Atchafalaya Basin in LCA Study area boundary/scope, devise water and sediment budget from Old River south, modify regulations regarding disposal of dredged material, stabilize Avoca Cutoff channel, flexibility in use of dredge types (beneficially) according to landowner preference, get involved, weir structures to manage tidal fluctuation, Governor's Commission/state send message of urgency to policy makers, and form a powerful stakeholder commission. **Key Issues:** Regulatory restraints for private landowners, are stakeholders really listened to, landowners as experts, retain mineral rights on eroded land in exchange for cooperation with the state, co-ownership legal issues, land building should be first priority, lack of meaningful involvement in process, lack of time for action, need stop-gap measures immediately, permitting system not in step with landowners, Chenier Plain not separated from Mississippi River – not being heard as part of Louisiana coast, expand boundaries of LCA Comprehensive Study, lack of input from Galveston District on effects of Sabine River on Chenier Plain, need accurate figures on non-market value for matching fund credits, decrease in private lands, liability insurance rates triple and going up, tax relief incentives for landowners, mechanism needed for proactive involvement by stakeholders, acceleration of Orphan Well program, assess damage to bottomland hardwood forests north of LCA Comprehensive Study boundaries, plan must contain flexible language, fear of being left out of program, and how is science developed and applied in program. **Challenges:** Loss of smaller projects, difference between system and unit, lack of laws on books to do what is right on property, essential fish habitat a major stumbling block to restoration projects, balancing near- and long-term access, use freshwater diversion to build land, meaningful involvement in process, sedimentation in bays, development in wetlands (i.e. recreation), regulatory support for landowners, Chenier Plain inadequately addressed, miss a meeting and you may lose your project, agency-dominated system, and what happens to our comments and concerns.

5.2.4.1.11 *August 28, 2003, Stakeholder Meeting: Finance, Banking and Insurance*

Location: the District.

Six stakeholders attended representing Professional Insurance Agents Association of Louisiana, Gray Insurance Co., Weston Solutions, Charles Theriot-CPA, Louisiana Bankers Association, and Whitney Bank. Stakeholders at this meeting decided to change the format of the meeting, doing away with Opportunities and Challenges and focusing on key issues and methods of obtaining stakeholder involvement. **Key Issues:** Need to coordinate lobby for restoration, coordinate between programs, specific information pertaining to special interests, socioeconomic problems difficult to get past, restoration should/must transcend administrations, and absence of Federal Emergency Management Agency in Louisiana restoration. **Stakeholder Involvement:** Upgrade involvement – call/visit or write to inform, coordinate bankers on local level with project restoration, identify forums available for the LCA Comprehensive Study to tap national insurance commission meetings, American Insurers Association regional meeting, Certified Public Accountants national meeting, trade journals, Louisiana supplies line bureaus, target legislators to "lead charge" with certain groups, use initial stakeholders to spread message, specific impacts to industry built into invitations/information, and keep message simple.

5.3 COMMENTS ON THE DRAFT REPORT

Volume III PUBLIC COMMENTS AND USACE RESPONSES describes the public's comments and the District's responses regarding the draft programmatic Environmental Impact Statement (DPEIS) for the Louisiana Coastal Area (LCA), Louisiana - Ecosystem Restoration Study. Volume III also presents comments of the National Technical Review Committee (NTRC), which provided external, independent technical review of the LCA Study. The purpose of the NTRC was to ensure quality and credibility of the results of the planning process. Volume III is incorporated in its entirety into this FPEIS. In accordance with the NEPA, the District issued a Notice of Availability, dated July 2, 2004, inviting public participation to comment on the DPEIS and draft LCA Study report. In addition, the U.S. Environmental Protection Agency (USEPA) issued in the July 9, 2004 *Federal Register* Volume 69, Number 131 a notice of availability to comment on the LCA DPEIS and draft Study Report.
This document presents the public's comments and the U.S. Army Corps of Engineers, New Orleans District (the District) responses regarding the draft programmatic Environmental Impact Statement (DPEIS) for the Louisiana Coastal Area (LCA), Louisiana - Ecosystem Restoration Study. In accordance with the National Environmental Policy Act (NEPA) of 1969 the District issued a Notice of Availability, dated July 2, 2004, inviting public participation to comment on the draft programmatic Environmental Impact Statement (DPEIS) and draft Louisiana Coastal Area (LCA), Louisiana - Ecosystem Restoration Study. In addition, the U.S. Environmental Protection Agency (USEPA) issued in the *Federal Register* Volume 69, Number 131, a Notice of Availability to comment on the LCA DPEIS and draft Study Report.

Comments on the DPEIS and the draft Study Report were requested during the 45-day comment period from July 9, 2004 to August 23, 2004. In addition, written comments on the DPEIS and the draft Study Report were requested by letter postmarked not later than 23 August 2004. Distribution of the DPEIS for review and comment included mailing the document to Federal, state, and local agencies; Tribes; libraries; and other interested parties. During this public comment period, six public meetings were held throughout the Louisiana coastal area; additional meetings were conducted in Texas, Mississippi, and Tennessee. A total of 355 people attended and a total of 77 individuals offered oral comments at the nine public meetings. The District received 82 comment letters postmarked within the comment period.

All substantive comments received on the draft statement are included in this report whether or not the comment is thought to merit individual discussion in the text of the statement.

The oral testimonies and letters were reviewed by the LCA Planning Development Team and were considered in the study process, in the preparation of the final PEIS (FPEIS), and in the final LCA Study report. Salient comments, questions, and concerns expressed in both the oral and written comments were identified. Several comments warranted revision to the FPEIS and final LCA Study report. Although no major changes to the document content were warranted or conducted as a result of the public review, revisions to the text included minor clarifications and inclusions of updated and additional information. None of the changes made to either the FPEIS or the final LCA Study Report are believed to have any profound effect on the findings and conclusions that were presented in the DPEIS and the draft LCA Study Report.

All registered comment meeting participants, as well as those providing written comments, will be provided a copy of the FPEIS and this report. In addition, the final LCA Report will be posted on the study web site located at http://www.lca.gov.

5.4 COORDINATION

This section describes the coordination between Federal, state, local agencies and entities, parishes, Indian Tribes and Nations, and other interested parties.

For this study effort, the LDNR is the 50-50 cost-share partner with the District. They have provided half of their share as in-kind services, such as in project management, contract management, engineering, real estate support (including access and indemnification for state-owned lands), and report preparation. Coordination was achieved through various meetings with the Vertical Team, the Framework Development Team, and the PDT. Functional Team Leaders (FTLs) headed the functional units of research (e.g., Engineering Division, Real Estate Division, Project Management, etc.). Additional meetings and conference calls were arranged as necessary.

5.4.1 Federal Agencies

The following Federal agencies were coordinated with during the course of this study:

U.S. Environmental Protection Agency *
Gulf of Mexico Program
U.S. Coast Guard
U.S. Department of Transportation and Energy
U.S. Department of Agriculture
    Natural Resources Conservation Service *
Forest Service
U.S. Department of Commerce
    National Marine Fisheries Service *
U.S. Department of the Interior
    Fish and Wildlife Service *
    U.S. Geological Survey *
    Minerals Management Service
    National Park Service

** Representatives of these agencies were collocated at the District, helped formulate alternatives, and prepare the report.*

5.4.2 State Agencies

The following state agencies were coordinated with during the course of this study:

Governor's Office *
Governor's Task Force Advisory Committee on Coastal Restoration

Louisiana Department of Wildlife and Fisheries
Louisiana Department of Transportation and Development
Louisiana Department of Environmental Quality
Louisiana Department of Natural Resources *
Louisiana State Historic Preservation Officer
** Representatives of these agencies were collocated at the District, helped formulate alternatives, and prepare the report.*

5.4.3 Parishes

The following parishes were coordinated with during the course of this study:

Ascension	Livingston	St. John the Baptist	Terrebonne
Calcasieu	Plaquemines	St. Martin	Vermilion
Cameron	St. Bernard	St. Mary	
Jefferson	St. Charles	St. Tammany	
Lafourche	St. James	Tangipahoa	

5.4.4 Indian Tribes and Nations

The following Federally recognized Indian Tribes and Nations will be coordinated with during the course of this study: the Chitimacha Tribe of Louisiana, the Alabama-Choushatta Tribe of Texas, the Choushatta Tribe of Louisiana, the Mississippi Band of Choctaw Indians, and the Tunica-Biloxi Indians of Louisiana. In addition, the state-recognized United Houma Nation will be contacted and notified of projects that may be selected to move forward under the LCA Plan. Given the Programmatic nature of these actions, full consultation will be conducted as the project progresses. Joey Strickland, the Director of the Governor's Office of Indian Affairs and the Inter-Tribal Council of Louisiana, Inc., will be sent copies of the study. This document serves as an initial coordination document.

5.4.5 Various Groups

The following were coordinated with during the course of this study:

Barataria-Terrebonne National Estuary Program
Environmental Defense Fund
Coalition to Restore Coastal Louisiana
Restore or Retreat

CHAPTER 6 COORDINATION AND COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

This chapter documents the coordination and compliance efforts regarding statutory authorities including: environmental laws, regulations, Executive Orders (EO), policies, rules, and guidance. Consistency of the LCA Plan with other efforts is also described.

6.1 ENVIRONMENTAL COORDINATION AND COMPLIANCE

As reported in the *Federal Register* volume 69, number 180, on September 17, 2004, the USEPA rated the LCA draft PEIS (DPEIS) as LO – Lack of Objections; having no objections to the selection of the Tentatively Selected Plan of Action, and fully supporting the primary restoration strategies.

Following completion of the final PEIS (FPEIS), the Assistant Secretary of the Army for Civil Works will issue a written Record of Decision (ROD) concerning the proposed action. The ROD will be issued within a framework of laws, regulations, and EOs. These authorities establish regulatory compliance standards for environmental resources that pertain directly to USACE management of water resources development projects, or provide planning guidance for the management of environmental resources. Relevant Federal statutory authorities and EOs are listed in **table 6-1**. Relevant State of Louisiana statutory authorities are listed in **table 6-2.**

6.1.1 Compliance with Statutory Authorities

Full compliance with statutory authorities will be accomplished upon review of the FPEIS by appropriate agencies and the public and the signing of a ROD. Tiering from and Programmatic updates to the FPEIS will be made in individual future decision documents and their associated NEPA compliance documents (EAs and EISs).

6.1.1.1 Clean Water Act – Section 404(b)(1)

The USACE is responsible for administering regulations under Section 404(b)(1) of the Clean Water Act (CWA) and other Federal authorities. Potential project-related impacts subject to these regulations would be evaluated on a project-by-project basis. Individual restoration plan project components' compliance with Section 404(b)(1) of the CWA would be closely coordinated with the District's Regulatory Branch and/or the Environmental Planning and Compliance Branch throughout planning and design phases. Section 401 of the CWA would be closely coordinated with the LDEQ.

Table 6-1
Relevant Federal Statutory Authorities and Executive Orders
(Note: this list is not complete or exhaustive.)

Abandoned Shipwreck Act of 1987 American Indian Religious Freedom Act Antiquities Act of 1906 Archeological Resources Protection Act of 1979 Archeological and Historical Preservation Act Bald Eagle Protection Act Clean Air Act Clean Water Act Coastal Barrier Improvement Act of 1990 Coastal Barrier Resources Act of 1982 Coastal Wetlands Planning, Protection, and Restoration Act Coastal Zone Management Act of 1972 Comprehensive Environmental Response, Compensation, and Liability Act Consultation and Coordination with Indian Tribal Governments (EO 13175) Emergency Planning and Community Right-to-Know Act of 1986 Emergency Wetlands Restoration Act of 1986 Endangered Species Act of 1973 Environmental Quality Improvement Act of 1970 Estuary Protection Act Farmland Protection Policy Act Federal Actions to Address Environmental Justice in Minority Populations & Low-Income Populations (EO 12898) Federal Facilities Compliance Act Federal Land Policy and Management Act of 1976 Federal Water Pollution Control Act of 1972 Federal Water Project Recreation Act of 1965 Fish and Wildlife Conservation Act of 1980 Fish and Wildlife Coordination Act Flood Control Act of 1944 Floodplain Management (EO 11988) Food Security Act of 1985 Greening of the Government Through Efficient Energy Management (EO 13123) Greening of the Government Through Leadership in Environmental Management (EO 12148) Greening of Government Through Waste Prevention, Recycling, and Federal Acquisition (EO 13101) Historic Sites Act of 1935 Historical and Archeological Data-Preservation Invasive Species (EO 13112)	Land & Water Conservation Fund Act of 1965 Magnuson-Stevens Fishery Conservation and Management Act of 1996 Marine Mammal Protection Act of 1972 Marine Protection, Research, and Sanctuaries Act of 1972 Migratory Bird Conservation Act Migratory Bird Treaty Act Migratory Bird Habitat Protection (EO 13186) National Environmental Policy Act of 1969 National Historic Preservation Act of 1966 Native American Graves Protection and Repatriation Act Noise Control Act of 1972 North American Wetlands Conservation Act Pollution Prevention Act of 1990 Prime and Unique Farmlands, 1980 CEQ Memorandum Protection and Enhancement of the Cultural Environment, 1971 (EO 11593) Protection and Enhancement of Environmental Quality (EO 11991) Protection of Children from Environmental Health Risks and Safety Issues (EO 13045) Federal Compliance with Pollution Control Standards (EO 12088) Protection of Cultural Property (EO 12555) Protection of Wetlands (EO 11990) Recreational Fisheries (EO 12962) Resource Conservation and Recovery Act of 1976 Rivers and Harbors Act of 1899 River and Harbor and Flood Control Act of 1970 Safe Drinking Water Act Submerged Land Act Toxic Substances Control Act Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) Water Resources Development Acts of 1976, 1986, 1990, and 1992 Water Resources Planning Act Watershed Protection & Flood Prevention Act Water Pollution Control Act Amendments of 1961 Wild and Scenic River Act Wilderness Act

Table 6-2
Relevant State Statutory Authorities
(Note: this list is not complete or exhaustive.)

Air Control Act Archeological Treasury Act of 1974 Louisiana Coastal Resources Program Louisiana Natural and Scenic Rivers System Act	Louisiana Threatened and Endangered Species and Rare & Unique Habitats Protection of Cypress Trees Water Control Act

6.1.1.2 Clean Water Act – Section 401 Water Quality

A copy of the FPEIS will be provided to the LDEQ for programmatic review of potential CWA Section 401 impacts. As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program compliance with Section 401would also be fully coordinated with the LDEQ Office of Environmental Services.

6.1.1.3 Coastal Zone Management Consistency

The LCA Plan, being a large and complex program with a great many component projects still in the conceptual stage, would best be served by a phased consistency approach (personal communication with the LDNR). The overall goals and methods outlined in the LCA Program would be coordinated with LDNR during the planning stage, and submitted for consistency review, once the preferred alternative has been identified. As individual projects selected to implement the LCA Plan are further conceived and designed, compliance of that phase of the program with the Coastal Zone Management Act of 1972 (CZMA) would also be fully coordinated with the state's Coastal Zone Management Program.

6.1.1.4 Fish and Wildlife Coordination Act – Report

The USFWS has been a cooperating agency and collaborative partner in the LCA Study process, with various experts on birds, mammals, amphibians, and reptiles actively participating on the various PDTs and contributing to the documentation and analysis of potential impacts by the various alternatives. A Fish and Wildlife Coordination Act Report is contained in appendix B of this FPEIS. A Fish and Wildlife Coordination Act Report would be required for all future individual projects and feasibility studies that would tier from this programmatic statement.

In their programmatic Fish and Wildlife Coordination Act Report (FWCAR) for the LCA Ecosystem Restoration Study the USFWS concurred with the findings of the LCA Study. The FWCAR recommendations state – "*Given the substantial adverse future impacts to coastal wetlands and their associated fish and wildlife resources that are expected to occur under future without-project conditions, the USFWS strongly supports authorization and implementation of the TSP (LCA Plan) as it would provide the greatest level of sustainable benefits to Louisiana's nationally significant coastal fish and wildlife resources*." The October 6, 2004, Fish and Wildlife Coordination Act Report (FWCAR) is included as Appendix B6 to this FPEIS.

The FWCAR also contained several recommendations for coordination and planning consistency under the LCA Plan. These recommendations are presented below.

1. *In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Service and the Corps, sufficient continuous funding should be provided to the Service to fulfill our responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act throughout post-authorization engineering and design studies for demonstration projects, participation in the Science and Technology Program, Near-Term Plan (NTP) projects, and planning and evaluation for long-term project feasibility studies. To facilitate that level of cooperation, the Service intends to negotiate an LCA-specific Memorandum of Agreement with the Corps (similar to that used for Florida's Everglades Restoration study) soon after the NTP is authorized.*

In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the USFWS and the USACE, the District would continue to provide funding required by the USFWS to enable their full participation throughout future detailed planning and post-authorization engineering and design studies, and to fulfill their reporting responsibilities for the LCA Plan component features under Section 2(b) of the Fish and Wildlife Coordination Act. Additionally, the District in cooperation with the USFWS, Lafayette Field Office, would draft and execute an LCA-specific Memorandum of Agreement detailing the operating guidelines for negotiating transfer funds (similar to those used for the Comprehensive Everglades Restoration Plan) and to facilitate and expedite the USFWS future involvement.

2. *Under provisions of Section 7 of the ESA of 1973, as amended, the Service will also assist the Corps and any other Federal agencies responsible for funding or implementing selected projects and/or plans to ensure that they will neither jeopardize the continued existence of threatened and endangered species, nor adversely modify any designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will tier from the current programmatic consultation, details of which are contained in the Programmatic Environmental Impact Statement (PEIS) for the NTP. In keeping with the consultation requirements of the ESA, informal and formal (if needed) consultation must be completed before the Record of Decision for the NTP and PEIS can be signed. The Service (via the Department of the Interior's August 2004 letter) has concurred with the Corps' determination that the TSP is not likely to adversely effect any currently listed threatened or endangered species or designated critical habitat for which the Service has consultative jurisdiction.*

Under provisions of the ESA, the District would continue to accomplish the required consultations on a project-by-project basis, and would tier from the current programmatic consultation, details of which are contained in the FPEIS for the LCA Plan. Further, in keeping with the consultation requirements of the ESA, informal and formal (if needed) consultation would be completed before the Record of Decision for the LCA Plan and PEIS can be signed.

3. *The Corps should coordinate closely with individual refuge managers prior to conducting any work on a National Wildlife Refuge, in conformance with the National*

> *Wildlife Refuge System Improvement Act of 1997. Such coordination will be essential to the timely completion of the Service's determination that the proposed work will/will not be compatible with the purposes for which those refuges were established, and to secure any appropriate permits that may be required. Likewise, LCA activities occurring on State-administered Wildlife Management Areas or refuges should also be fully coordinated with the Louisiana Department of Wildlife and Fisheries.*

Under provisions of the National Wildlife Refuge System Improvement Act of 1997, prior to initiating implementation of an LCA Project that would potentially affect any NWR, the District would, contact the appropriate Refuge Manager to determine if the proposed project constitutes a "refuge use" subject to a compatibility determination. If required to determine the anticipated impacts of any proposed use, the District would provide sufficient data and information to document any short-term, long-term, direct, indirect, or cumulative impacts on NWR resources. Compatibility determinations would include a public review and comment period before issuance of a final decision by the Service. To facilitate such contacts, the Louisiana Field Office would be contacted at (337) 291-3100. Likewise, the District would fully coordinate with the LDWF for those LCA Plan activities occurring on state-administered Wildlife Management Areas or refuges.

> **4.** *Because of the uncertainties regarding some of the currently proposed habitat prediction methodologies, and because many details regarding the design, operation, and associated effects of the TSP are not yet available at the current programmatic level of planning, the USFWS cannot complete their evaluation of the individual TSP features' effects on fish and wildlife resources, nor can they entirely fulfill their reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) for each of those features. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information that will be available during those planning phases, will be required so that we can fulfill our responsibilities under that Act. Additionally, improvements in the hydrologic and desktop models will be needed to predict environmental impacts and benefits of individual plan features, as indicated in our previous draft Fish and Wildlife Coordination Act Reports (Paille and Roy 2003, Grouchy and Paille 2004). Additionally, the USFWS states that the proposed Science and Technology Program should give high priority to refining the land gain/loss and habitat change models to enable determination of and evaluation of project-level effects and facilitate completion of FWCA reporting.*

The District intends to maintain the integrity of the collocated team which will afford the USFWS the ability to be intensively involved during subsequent detailed planning, engineering, design, and construction of specific LCA Plan restoration features, and provide more-definitive project information that would be available during those planning phases, in an effort to provide sufficient information to the USFWS to fulfill their responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq). Additionally, the LCA Science and Technology Program would give high priority to improvements in the hydrologic and desktop models that would better enable prediction of potential environmental impacts and benefits of individual plan features and the program manager will ensure that the S&T Office resolves any outstanding issue, or concerns regarding models or evaluation process in cooperation with the participating agency (including USFWS).

> **5.** *The USFWS has actively participated throughout the formulation and evaluation of the LCA coastwide alternatives and the selection of near-term restoration features, the large-scale studies, and the potential demonstration projects that comprise the TSP. USFWS involvement and input includes the preparation of three previous draft Fish and Wildlife Coordination Act Reports (Paille and Roy 2003a, and 2003b, and Grouchy and Paille 2004); a letter listing threatened and endangered species within coastal parishes (Appendix A of the FWCAR); assistance in preparation of the draft Biological Assessment for Comprehensive Plan effects on threatened and endangered species; a May 11, 2004, letter affirming our continued participation as a Cooperating Agency in accordance with the implementing regulations of the National Environmental Policy Act of 1969; and concurrence with the District's programmatic "not likely to adversely affect" threatened and endangered species determinations (via an August 23, 2004, Department of the Interior letter). Those documents are incorporated into the FWCAR by reference, and should be considered as integral components of the administrative record for the forthcoming final PEIS and LCA Study Report.*

Under provisions of the NEPA, ESA, and the Fish and Wildlife Coordination Act, and because they are integral components of the administrative record, the District has included (see appendix B) the three previous draft FWCAR (Paille and Roy 2003a, and 2003b, and Grouchy and Paille 2004); the letter listing threatened and endangered species within coastal parishes (Appendix A of the FWCAR); the draft Programmatic Biological Assessment for the Comprehensive Plan effects on threatened and endangered species; the May 11, 2004, letter affirming the USFWS continued participation as a Cooperating Agency; the August 23, 2004, Department of the Interior letter of concurrence with the District's programmatic "not likely to adversely affect" threatened and endangered species determinations; and the October 6, 2004 FWCAR in Appendix B6 of the FPEIS as integral components of the administrative record for the forthcoming final PEIS and LCA Study Report.

> **6.** *For purposes of maximizing synergistic wetland restoration benefits within the eastern Terrebonne Basin critical needs area, the post-authorization studies for the proposed Small Bayou Lafourche Diversion Project should, to the maximum extent possible, incorporate key Grand Bayou-area features of the Convey Atchafalaya River Water to Northern Terrebonne Basin Project.*

The District working with other federal and non-federal agencies will evaluate the synergistic effects of other features at the LCA Plan or projects and actions of others during the specific feasibility level evaluation and make adjustments to project implementation accordingly.

6.1.1.5 Threatened and Endangered Species Act – Compliance and Coordination

As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program compliance with the Threatened and Endangered Species Act would be fully coordinated with the USFWS and NMFS for threatened and endangered species under their respective jurisdictions. Should any threatened or endangered species be sighted within any work area, the USFWS Lafayette, Louisiana Field Office and/or the NMFS Baton Rouge, Louisiana and St. Petersburg, Florida Field Offices would be contacted immediately. The use of recommended primary activity exclusion zones and timing restrictions would be utilized, to the maximum extent practicable, to avoid project construction impacts to any threatened or endangered species or their critical habitat within the study area. The District will continue to closely coordinate and consult with the USFWS and the NMFS regarding threatened and endangered species under their jurisdiction that may be potentially impacted by the proposed action. See also sections 3.13, Threatened and Endangered Species and 4.12 Threatened and Endangered Species.

6.1.1.5.1 *Louisiana State Threatened and Endangered Species and Rare and Unique Habitats Coordination*

As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program would also be fully coordinated with the Louisiana Department of Wildlife and Fisheries for threatened and endangered species and rare and unique habitats under their jurisdiction. See also section 3.13, Threatened and Endangered Species.

6.1.1.6 Essential Fish Habitat

NMFS has been a cooperating agency and collaborative partner in the LCA Study process with experts on various marine organisms, as well as Essential Fish Habitat (EFH), contributing to the documentation and analysis of potential impacts. These efforts would continue after an LCA Plan is selected. As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program compliance with the Magnuson-Stevens Fishery Conservation and Management Act of 1996 would be fully coordinated with NMFS. See also section 3.12, Essential Fish Habitat.

6.1.1.7 Clean Air Act – Air Quality Determination

As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program compliance with the Clean Air Act would be fully coordinated with the Air Quality Section of the LDEQ. See also section 3.20, Air Quality.

6.1.1.8 Historic and Cultural Resources

As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program compliance with the National Historic Preservation Act and all other pertinent statutes would also be fully coordinated with the State Historic Preservation Officer (SHPO). See also section 3.17, Historic and Cultural Resources.

6.1.1.9 Prime and Unique Farmlands

The NRCS has been a cooperating agency and collaborative partner in the LCA Study process with experts on various soils, vegetation, and agriculture aspects contributing to the documentation and analysis of potential impacts. These contributions would continue after an LCA Plan has been selected. As individual projects selected to implement the LCA Plan are further conceived and designed, that phase of the program compliance with the Farmland Protection Policy Act and the Prime and Unique Farmlands, 1980 CEQ Memorandum would be fully coordinated with the NRCS. See also section 3.2, Soils.

6.1.1.10 Executive Order 13186 – Migratory Bird Habitat Protection

EO 13186 proclaims the intent to support the conservation of previous migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions. Migratory birds are of great ecological and economic value to the United States and to other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of Americans who study, watch, feed, or hunt these birds throughout the United States and other countries.

This order requires that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern. In addition, each Federal agency shall restore and enhance the habitat of migratory birds, as practicable.

6.1.1.11 Executive Order 12898 – Environmental Justice

Environmental justice (EJ) can be traced to Title VI of the Civil Rights Act of 1964:

> *No person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance.*

On February 11, 1994, the President issued EO 12898 regarding Federal actions to address EJ in minority populations and low-income populations:

> *Each Federal agency shall analyze the environmental effects, including human health, economic, and social effects, of Federal Actions, including effects on minority communities and low-income communities, when such analysis is required by the National Environmental Policy Act of 1969 (NEPA), 42 U.S.C. section 4321 et seq.*

EO 12898 is designed to focus Federal attention on the environmental and human health conditions in minority communities and low-income communities. The order is also intended to promote non-discrimination in Federal programs substantially affecting human health and the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for public participation in, matters relating to human health or environmental planning, regulations, and enforcement.

Any restoration plan for Louisiana has the potential to affect people living along the coast. Moreover, there is always the possibility that some environmental changes resulting from a restoration effort would be more relevant to particular groups or communities than to others. For example, potential changes in fisheries would more likely be of immediate and direct interest to people who rely on those resources for income and/or subsistence. It is possible, therefore, that the design and implementation of a coast wide restoration program could potentially affect minority or low-income populations.

Potential EJ issues would be considered throughout the entire LCA Study process, from study initiation through project implementation and monitoring. However, identifying potential EJ issues requires a level of detail that is not available at the programmatic level at which the LCA Plan is currently being developed. Although restoration features and their general locations are discussed as part of the LCA Study report, the exact location, design, and operation of such features are subject to considerable change, depending on the outcome of future feasibility study and environmental review. Thus, at the programmatic level, there is only a general discussion of potential project impacts. Without further detail and specificity, it is neither possible nor appropriate at this point to try to identify particular populations or communities that might be disproportionately affected by a particular restoration feature.

Given that the LCA Study planning effort is currently at the programmatic stage, it was determined that the best course of action relative to EJ was to (1) sensitize the PDT to EJ issues in Louisiana, (2) look and listen for potential EJ concerns during the NEPA process (particularly during the public hearings and comment period), (3) discuss the issue in general as part of the DPEIS, (4) solicit input on potential EJ issues, and (5) commit to fully reviewing any potential EJ issues during the NEPA assessment of specific LCA Plan restoration features.

On January 24, 2003, the PDT met with Dr. Beverly Wright, founder and director of the Deep South Center for Environmental Justice at Xavier University. During this meeting, the PDT also teleconferenced with EJ experts from the USEPA's Region 6 office in Dallas, Texas. The objective of this meeting was to inform and sensitize PDT members to EJ issues.

As part of the NEPA process, the PDT held numerous public and scoping meetings, during which attention was given to any potential EJ issues. During these meetings, information was made available to the public to help assist in the identification of potential concerns, including potential EJ issues. Members of the PDT have also continued to look for potential EJ issues during development of the programmatic plan and the assessment of its potential effects.

Reviewing potential EJ issues at the project-specific level is arguably the most important step the PDT can take towards addressing potential EJ concerns. While the LCA Study process is not yet at the project-specific level, it is not too early to begin identifying potential EJ issues that should be more closely reviewed in the future. The District is committed to ensuring that any potential

EJ issues are addressed as implementation of the LCA Plan proceeds. As part of this process, we encourage any interested parties to participate by informing us of potential concerns and by participating in the LCA Plan process in general.

6.1.1.12 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646)

All real estate interests acquired for construction of the LCA Project will be in accordance with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act), as amended in 42 USC 4601-4655, and the Uniform Regulations contained in 49 C.F.R. Part 24. The Uniform Act sets forth procedures for the acquisition of private property for public use and specifically requires that the acquiring agency appraise the real property interests it wishes to acquire and provide the owner a written summary of the basis for the amount established as just compensation. The Real Estate section of the Main Report outlines a proposed acquisition plan for this project.

6.1.1.13 Executive Order 13112 – Invasive Species

On February 3, 1999, EO 13112 was signed to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause by establishing the National Invasive Species Council. The EO requires that a Council of Departments dealing with invasive species be created. Currently there are 10 departments and agencies on the Council of Departments.

The LCA Program shall pursue the duties set forth in EO 13112 in consultation with the Invasive Species Council, consistent with the Invasive Species Management Plan, and in cooperation with stakeholders, as appropriate, and, as approved by the Department of State, when Federal agencies are working with international organizations and foreign nations. The LCA Plan would be consistent with EO 13112 and shall, to the extent practicable and permitted by law:

1. *identify such actions;*
2. *subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and*
3. *not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.*

6.2 CONSISTENCY OF THE LCA PLAN WITH OTHER EFFORTS

This section outlines key challenges with respect to ensuring consistency between development and coastal restoration. It then describes proposed action items for reducing conflict between the two. Some of the proposed action items represent new initiatives, while others describe or build upon ongoing efforts to improve consistency. For example, the proposals to enhance internal and external coordination would build upon the significant progress already made as a result of the formation of an interagency collocated restoration team housed within the District. These proposed action items are intended to be a starting point for developing the processes and mechanisms needed to move towards greater consistency.

6.2.1 Finding the Balance

In coastal Louisiana we are trying to find the balance between economic development and coastal restoration and protection. We must address both our economic and environmental needs, which are inextricably linked and yet often in conflict. This is a challenge facing restoration efforts across the country, from California to the Chesapeake Bay and the Everglades. However, this challenge is perhaps greatest in coastal Louisiana for the simple fact that we live and work in and among the same wetlands we rely on and need to protect. How we confront this challenge will not only be critical for our future, but it may also serve as an example for other restoration efforts around the country. The LCA Plan has set the following goals for consistency with other programs:

- Instill confidence in the taxpayers and decision-makers that we have the solutions for ensuring both a healthy economy and a sustainable coast.
- Set the standard for balancing coastal restoration and development.

6.2.2 Ensuring Consistency Between Development, Coastal Protection, and Restoration

Perhaps, nowhere are the economy and the environment more inextricably linked than in coastal Louisiana. Louisiana's coastal wetlands support the Nation's second largest fishery and provide critical habitat for a vast array of wildlife, while at the same time helping to protect navigation and energy infrastructure critical to the Nation's economy. The loss of Louisiana's coastal wetlands threatens these important economic assets, as well as the millions of people who live and work in coastal Louisiana. Thus, protecting Louisiana's coastal wetlands is essential for ensuring a vital state economy, while also protecting important sectors of the Nation's economy.

Development activities - from navigation improvements and hurricane protection to residential and commercial construction - can harm the coastal environment. Yet, such activities are critical for a vital economy in coastal Louisiana and beyond. The challenge is to ensure that economic development does not undermine the wetlands and coastal ecosystems that are also intrinsic to long-term economic vitality. A moratorium on growth in the coastal zone is not the solution, nor is "business as usual."

We must be able to address critical societal needs such as hurricane protection, navigation, and economic development in a way that is, at a minimum, consistent with coastal restoration and protection efforts. Indeed, Section 303(d) of the CWPPRA mandates consistency for some important activities:

> *Consistency.---(1) In implementing, maintaining, modifying, or rehabilitating navigation, flood control or irrigation projects, other than emergency actions, under other authorities, the Secretary, in consultation with the Director and the Administrator, shall ensure that such actions are consistent with the purposes of the restoration plan submitted pursuant to this section.*

Despite efforts to address this important provision, it is acknowledged by many stakeholders that a more thorough, comprehensive, and balanced effort is needed to ensure consistency across the coast. It is further recognized that once an LCA Plan is selected and approved, it would be the appropriate vehicle for beginning such an effort.

While growth will continue to occur, it must be done in a way that avoids and minimizes wetland impacts as much as possible. Federal and state actions affecting the coastal environment need to reflect the fundamental premise that it is less expensive and more effective to prevent wetland loss, than it is to repair the damage. The challenge is to find balance between economic growth and wetland protection. While consistency between economic development and coastal restoration should be sought in every instance, it may be possible in some cases to go even further by devising ways to make such activities complement each other.

6.2.3 Need for Consistency

The following subsections describe the need for consistency between the LCA Plan and the CWPPRA, regulatory programs, hurricane protection, and navigation.

6.2.3.1 Consistency with CWPPRA

The LCA Plan is consistent with, and complementary to, the CWPPRA, which was passed in 1990 and established a Federal/State Task Force responsible for the development of a plan to protect and restore Louisiana's disappearing coastal ecosystem. The CWPPRA Plan was completed in 1993, was improved in the Coast 2050 Plan, and served as part of the basis for development of the LCA Plan.

CWPPRA provides about $50 million per year to construct coastal wetlands projects. With limited funding and loss coast wide, CWPPRA has concentrated on small-scale projects distributed across the coast. In contrast, the LCA Plan focuses on larger projects that would generally work at an ecosystem scale. From its inception until 2001, the CWPPRA program has built projects that are estimated to restore or preserve over 156,500 acres by 2050.

There is a need for both small and large projects to restore the coast and CWPPRA's contribution is significant. Thus, CWPPRA has a continuing contribution to make to coastal restoration.

6.2.3.2 Regulatory Programs

The Federal Government and the State of Louisiana share regulatory responsibility for a broad range of public and private development activities that take place in and around coastal wetlands. These activities include residential and commercial development, oil and gas extraction, highway construction, and others. All of these activities can, to varying degrees, harm wetlands. At the largest scale, it is possible for individual development projects to directly undermine coastal restoration efforts. In addition, some of the smallest scale development activities can add incrementally to the cumulative loss of coastal wetlands.

Future development activities will continue to adversely impact Louisiana's coastal wetlands. However, it is both unreasonable and undesirable to place a moratorium on future human development. Although existing regulatory programs have reduced wetland losses from development, Louisiana's unique coastal wetland loss problems necessitate further efforts to ensure effective protection of these resources. Consistent with the long-standing Federal regulatory policy of no net loss of wetlands, the District, partnering with Federal and state regulatory agencies, would implement the actions presented below to further avoid and minimize adverse impacts to Louisiana's coastal wetlands.

Special attention will be paid to identifying ways to avoid and minimize potential impacts through the use of environmentally appropriate development approaches. For example, the construction of new highways can have significant direct, indirect, and cumulative wetland impacts. However, the use of environmentally appropriate design and construction techniques can greatly reduce potential adverse impacts. Specifically, the use of so-called “end-on” highway construction has been used to greatly reduce the environmental impacts of highways in coastal Louisiana. End-on is a construction technique devised to work from the decks of the structures, building each section of the bridge from the top of the last completed section and using heavy cranes to push each section forward one bay at a time. The cranes can also be used to position steel platforms, drive in support pilings, and lay deck slabs, alternating this procedure between each bay (USEPA 2004). Identifying and employing such environmentally sensitive techniques will be critical for protecting Louisiana’s valuable coastal wetlands, while also meeting important economic and safety needs.

6.2.3.3 Hurricane Protection

As a result of ongoing wetland loss, communities across coastal Louisiana are increasingly at risk from tropical storms and hurricanes. Currently, there are a number of large-scale hurricane protection projects in the planning stages. While in many cases such further protection is needed, levee projects can result in significant wetland losses if not sited, designed, and operated correctly. These losses can include direct impacts from the placement of the levee and borrow areas; and indirect and secondary effects from modified hydrology and induced development. Such impacts can further reduce the natural storm protection that wetlands provide.

Many communities in coastal Louisiana are very much in need of increased hurricane protection. Fortunately, techniques and approaches do exist for avoiding and minimizing wetland impacts when developing hurricane protection projects. In some cases, it may even be possible for hurricane protection levees to complement wetland protection efforts. The challenge, therefore, is to increase structural protection where needed while, at a minimum, not decreasing the natural protection and other important functions and value provided by wetlands. The District is studying the following new or expanded hurricane protection and flood protection projects: "West Bank," "Morganza to the Gulf of Mexico," "Donaldsonville to the Gulf of Mexico," "Mississippi River Levees and Berms," "Vermilion River Bridges and Culverts," "Alexandria to the Gulf of Mexico," and "The Lower Atchafalaya Basin Reevaluation Study."

6.2.3.4 Navigation

Efficient and effective navigation in and through coastal Louisiana is critical to the local, state, and National economies. However, the creation, expansion, and ongoing maintenance of navigation channels can and has had significant impacts on wetlands. Such impacts include the direct loss of wetlands from channel excavation, enlargement, and maintenance, and indirect losses from hydrologic modification, salinity intrusion, and increased wake-induced erosion. The continued loss of coastal wetlands can threaten the integrity, safety, and efficiency of existing navigation routes and the communities and industries they serve. The District is currently studying the deepening of the following existing navigation channels: "Mississippi River Ship Channel;" "Houma Navigation Canal;" "Acadiana-Gulf of Mexico Access Channel;" "Chene, Boeuf, and Black Navigation Channel;" and "Calcasieu Ship Channel."

The District uses hopper dredges to maintain only the near-shore channel reaches of Southwest Pass, MRGO, and the Calcasieu River Navigation Channel. In the last two channels, the dredge removes material and places it adjacent to the removal site so it is still in the littoral drift. In the first channel, the dredge removes sediments from the coastal system and disposes it in deeper water offshore sites. This removal of material from the coastal littoral system reduces the sustainability of nearby barrier headlands and adjacent marshes. Navigation projects can, however, offer opportunities to use dredged material beneficially for restoration purposes (e.g., marsh creation).

Upgrading our navigation system is necessary to ensure the vitality of this critical economic asset. We need to develop ways to ensure that future navigation projects avoid and minimize wetland losses as much as possible, while simultaneously maximizing the beneficial use of dredged material for restoration activities.

6.2.4 Proposed Action Items

The following subsections describe proposed action items for consistency of the LCA Program with regulatory programs, hurricane protection projects, navigation projects, and other USACE Mississippi Valley Division, New Orleans District projects.

6.2.4.1 Regulatory Programs

It is important to ensure that regulated activities within the coast do not undermine or run counter to Louisiana coastal restoration efforts. To that end, once an LCA Plan has been selected, the District, working with the state, proposes to:

- Continue reviewing permit applications to avoid and minimize potential conflicts with the LCA Plan.
- Use best available science tools to assess the environmental effects of the regulatory program.
- Consider the effects of restoration projects during the review of permit applications.
- Further enhance the effectiveness of compensatory mitigation.
- Encourage private mitigation banks that support LCA Plan objectives.
- Enhance internal coordination.
- Encourage and support wetland-planning efforts.
- Expedite the regulatory review of public and private activities that are fully consistent with the LCA Plan.
- Review options for increasing protection of vulnerable areas.

6.2.4.1.1 *Continue Reviewing Permit Applications to Avoid and Minimize Potential Conflicts with the LCA Plan*

During the review of permit applications for projects affecting areas within the LCA Plan boundary, the District, working with the state, would work to avoid and minimize any potential conflict with coastal restoration efforts. Specifically, permit applications would be reviewed to ensure that regulated activities: (1) do not undo or substantially reduce the beneficial effects of any existing restoration project(s), and (2) do not prevent or unduly restrict future coastal restoration projects. These determinations would be made through enhanced internal and external coordination (see section 6.2.4.1.6, Enhance Internal Coordination). In addition, comments from landowners, commenting agencies, and the general public regarding the potential effects of proposed projects on restoration activities would be fully considered during the permit review process. Where necessary and appropriate, permits would contain conditions for minimizing potential conflict with the LCA Plan, once a plan is selected.

6.2.4.1.2 *Use Best Available Science Tools to Assess the Environmental Effects of the Regulatory Program*

Understanding the direct, indirect, and cumulative effects of wetland permit decisions is critical for determining whether the regulatory program is achieving the CWA Section 404 goal of no net loss of wetland functions. However, it continues to be technically challenging to assess the landscape-level effects of multiple wetland impacts. The science tools being developed as part of the LCA Plan could potentially help examine the effects of permit decisions, particularly with respect to cumulative impacts. Specifically, the modeling, monitoring, and other technical evaluations that would be an important part of the LCA Plan implementation process could enable better assessment of how wetland permit decisions might impact wetland functions within a given basin and coast wide.

Accordingly, the District proposes to use, where appropriate and available, LCA Program science tools to assess the potential cumulative effects of the Federal regulatory permit program within the boundary of the LCA Study area. Individual permit proposals that would result in potentially significant direct, indirect, and/or cumulative impacts to waters of the U.S. would be evaluated on a project-by-project basis. However, the review of specific permit applications would not be delayed while science tools are being developed. Rather, such tools would be used in the regulatory program only when they become available and their use would not unduly delay project review.

6.2.4.1.3 *Consider the Effects of Restoration Projects During Permit Review Process*

The review of permit applications would take into account the effects that existing restoration projects may have on the wetlands and other aquatic resources at issue. All things being equal, wetland areas that benefit from coastal restoration efforts would be healthier, more productive, more sustainable, and provide greater functions than comparable areas where no such restoration has occurred. This increased functional capacity would be acknowledged and considered as part of the CWA Section 404 permit review process, particularly with respect to the analysis of alternatives and the determination of compensatory mitigation. Additionally, Federal, state, and local support for protection and restoration of coastal Louisiana would be fully considered during the public interest review for all permit applications within coastal Louisiana.

The LDNR Office of Coastal Restoration and Management's existing procedures to identify potential regulatory and restoration conflicts would continue to be utilized to support the goals of the LCA Program (personal communication August 15, 2003, with Honora Buras, LDNR). The following describes the existing procedures:

If a proposed project is within ¼ mile from either an active restoration project or a proposed restoration project, Coastal Management Division (CMD) submits a request to Coastal Restoration Division (CRD) to review the proposed activity with regard to its potential effect on the restoration project. If CRD's review determines that the proposed project would interfere or have adverse effects on a restoration project, then CMD informs the applicant and requires that the applicant communicate and coordinate with CRD. A CMD authorization is not issued until CRD has indicated that it has no objections to the proposed project.

6.2.4.1.4 *Further Enhance the Effectiveness of Compensatory Mitigation*

Effective mitigation of unavoidable wetland impacts is critical to the overall success of the CWA Section 404 program. If done properly, compensatory mitigation can offset lost wetland functions, and greatly reduce the chances that specific activities authorized under CWA Section 404 could be counter to or inconsistent with the coastal restoration efforts. Despite progress, however, it is recognized that compensatory mitigation does not always guarantee full replacement of wetland functions. To enhance the effectiveness of compensatory mitigation, on December 24, 2002, the USACE and USEPA, in conjunction with other Federal agencies, issued the "National Wetlands Mitigation Action Plan," which contains 17 actions designed to improve mitigation performance in a number of areas.

The "National Wetlands Mitigation Action Plan," along with associated policy guidance, emphasizes the importance of effective tracking and monitoring of compensatory mitigation projects. This is particularly true in Louisiana, where there are over 90 active, closed, or proposed mitigation areas in the District alone. Unfortunately, high permit review workloads limit the District's ability to effectively monitor and track ongoing and completed compensatory mitigation areas.

Given the importance of effective compensatory mitigation in ensuring that regulated activities do not run counter to restoration efforts, the District would review opportunities to help support mitigation projects within the boundary of the LCA Study area. Such support could, for example, include the incorporation of compensatory mitigation projects within the monitoring framework used for whatever plan is selected, along with other efforts to share technical expertise and scientific tools.

6.2.4.1.5 *Encourage Private Mitigation Banks that Support LCA Plan Objectives*

Mitigation banking has the potential to benefit both the environment and the regulated community. Mitigation banks can provide larger, more ecologically valuable, and more manageable wetland areas than piecemeal, permit-by-permit compensatory mitigation efforts. Mitigation banks can also be sited and designed to take into account the special needs of a particular watershed or hydrologic basin. For the developer, mitigation banking offers a quicker, simpler, and more predictable way to address compensatory mitigation requirements. If sited, designed, and operated properly, specific mitigation banks could complement coastal restoration efforts. For example, a marsh creation bank might be sited in the influence area of a river re-introduction project such that the bank becomes more sustainable, while also resulting in increased nutrient and sediment retention within the given basin. The District would support the establishment of private, entrepreneurial mitigation banks that complement the LCA Plan by helping to identify mitigation bank sites that are consistent with the selected plan, and assisting in the conceptual design of such banks. Consistent with longstanding CWA Section 404 policy, compensatory mitigation will be used only after potential adverse impacts to wetlands have been avoided to the maximum extent practicable.

6.2.4.1.6 *Enhance Internal Coordination*

Effective coordination is critical for ensuring that activities authorized under CWA Section 404 do not conflict with coastal restoration efforts. The LCA PDT would work closely with District personnel responsible for reviewing CWA Section 404 permit applications to help identify cases where proposed development projects might affect existing restoration projects or could have the potential to interfere with future restoration efforts. This coordination has begun; however, further dedication of staff resources is needed for full and effective coordination. Additionally, staff and managers from the regulatory and coastal restoration offices would meet periodically to review on-going and future projects, identify potential conflicts, and further develop strategies for ensuring consistency.

6.2.4.1.7 *Encourage and Support Wetland-Planning Efforts*

Wetland planning can increase certainty for the regulated community, enhance wetland protection, reduce conflict, and expedite permit processing for environmentally acceptable projects. In the context of CWA Section 404, such planning often entails the identification and functional assessment of wetland resources in a given geographic area. This information is then used to identify areas that are generally suitable for development, along with areas that are generally not suitable for development. Local officials and private parties can then use the results to help identify appropriate future development locations. The information can even be used to develop specific regulatory tools, such as general permits for certain activities in appropriate locations, mitigation banks, and additional protection measures for valuable sites.

Wetland planning efforts are resource intensive in the short-term. Therefore, wetland planning is often most appropriate in areas where high growth rates threaten particularly valuable wetland resources. To be successful, such planning efforts must have strong local involvement and support. In recognition of the potential benefits of wetland planning, the District would support wetland planning efforts in areas that are critical to coastal restoration and where there is strong local support for such planning. The ultimate success of such planning depends upon the extent to which the outcome is embraced and supported by the local community, along with local, state, and Federal sponsors.

6.2.4.1.8 *Expedite the Regulatory Review of Public and Private Activities that are Fully Consistent with the LCA Plan*

It is also important to ensure the regulatory program expedites the permitting of public and/or private restoration activities that are fully consistent with the LCA Plan. There is currently a nationwide permit Number 27 that authorizes restoration, enhancement, and creation of tidal, nontidal, and riparian wetlands. Also, the District on May 1, 1998, announced a Programmatic General Permit that provides expedited authorization of certain wetland restoration activities (excluding CWPPRA Projects) within the Louisiana coastal zone specifically designed to have a beneficial effect on wetlands and/or aquatic resources such as backfilling of artificial channels, terracing in open water areas, and planting of appropriate wetland species to restore degraded wetland habitats. Wetland restoration activities not authorized by nationwide or general permits may nevertheless be fully consistent with the LCA Plan, and should, therefore, be expedited as much as possible. Coordination between regulatory officials and members of the LCA PDT would help determine when restoration proposals are fully consistent with the LCA Plan. For restoration proposals that are consistent with the LCA Plan, efforts would be made to expedite permit processing by making available information developed for the LCA Plan to help address environmental assessment needs for the particular project. It may even be possible to develop a general permit designed for a specific class of activities that are fully consistent with the LCA Plan. Such a regulatory tool would help encourage and expedite environmentally beneficial projects.

6.2.4.1.9 *Review Options for Increasing Protection of Vulnerable Areas*

In some cases, it may be possible for activities allowed under the existing regulatory program to undermine the beneficial effects of restoration projects. For example, there is much concern that certain logging activities that fall under the CWA Section 404(f) silvicultural exemption could in some cases undermine efforts to restore coastal swamp. Using public monies to restore vulnerable areas could be questionable, unless there is some way to increase the protection of the area so that activities that would undermine restoration efforts are precluded.

Tools for increasing the protection of vulnerable areas include acquisition and conservation easements/servitudes. Such approaches rely first and foremost on the willingness of the landowner to sell his property or restrict future activities at the given site. Obviously, such measures would also increase the cost of restoration efforts, and should only be used where existing laws may not adequately protect potential restoration areas. In such cases, it would be hoped that in return for public funding of restoration of a landowner's property, the landowner would in turn be willing to consider some restrictions on future activities.

As the development of the LCA Program planning process continues, the PDT would work closely with interested stakeholders to review tools for increasing protection of vulnerable areas.

6.2.4.2 Hurricane Protection Projects

The District recognizes the importance of ensuring that hurricane protection efforts are consistent with coastal restoration efforts. To that end, the PDT proposes to:

- Develop guiding principles for ensuring consistency between hurricane protection and coastal restoration.
- Assess whether ongoing and future hurricane protection projects are consistent with the LCA Plan during the NEPA review of such projects.
- Use best available science tools to assess environmental effects of hurricane protection projects.
- Enhance internal and external coordination.
- Seek opportunities to develop hurricane protection projects that complement coastal restoration.

6.2.4.2.1 *Develop Guiding Principles for Ensuring Consistency Between Hurricane Protection and Coastal Restoration*

To help ensure consistency between hurricane protection and coastal restoration efforts, the PDT would collaborate with interested parties (including environmental interests, landowners, state, and local government, other Federal agencies, and business interests) to develop guiding principles regarding the ecologically appropriate design, siting, implementation, and operation of hurricane protection projects in coastal Louisiana. Building upon the USACE's environmental operating principles, the hurricane protection guiding principles would emphasize the need to avoid and minimize wetland impacts to the maximum extent practicable, and to ensure that such projects do not interfere with or preclude restoration projects. The guiding principles would also emphasize the benefits of building upon the upland/wetland interface and/or existing levees. In addition to the issue of avoiding direct wetland impacts, the guiding principles would address the need to avoid hydrologic modifications that could result in indirect and secondary wetland losses. The guiding principles would then be applied, as appropriate, to ongoing and future hurricane protection projects. The guiding principles have the potential to both enhance consistency and expedite project reviews by addressing, in advance, key project design and citing issues.

6.2.4.2.2 *Assess Whether Ongoing and Future Hurricane Protection Projects are Consistent with the LCA Plan During the NEPA Review of Such Projects*

The NEPA review of ongoing and future hurricane protection projects is the appropriate venue for assessing whether such projects are consistent with coastal restoration in general, and the LCA Plan in particular. Accordingly, it is recommended to have a section in all relevant NEPA documents, that evaluates whether, and the extent to which, the particular project is consistent with coastal restoration. As necessary, such NEPA documentation would also examine alternatives for making the project more consistent, and if possible, complementary with coastal restoration. Among other benefits, this would provide the public and decision makers with a better opportunity to participate in efforts to ensure consistency between hurricane protection and coastal restoration on a project-by-project basis.

6.2.4.2.3 *Use Best Available Science Tools to Assess Environmental Effects of Hurricane Protection Projects*

As with the wetland regulatory program, fully understanding direct, indirect, and cumulative environmental effects of proposed hurricane protection projects is essential for avoiding, minimizing, and offsetting any potential adverse effects. Yet, assessing the landscape-level effects of large-scale hurricane protection projects continues to be technically challenging. The science tools being developed for the LCA Plan could potentially help examine the effects of such projects, particularly with respect to cumulative impacts. These tools might also assist in designing hurricane protection projects in a way that complements coastal restoration efforts. However, the review of specific projects should not be held while the LCA Plan science tools are under development. Rather, such tools would be used only when they are available and their use would not unduly delay project review.

6.2.4.2.4 *Enhance Internal and External Coordination*

Hurricane protection projects often involve challenging technical and social issues. The siting and design of hurricane protection levees affects the safety and viability of coastal communities into the future, and can have broad, landscape-level impacts on the coastal environment. Developing effective hurricane protection, while also protecting and restoring the coastal environment, requires a wide range of expertise and extensive teamwork. Better internal and external coordination is needed to more effectively meet these goals. Internally, representatives of the PDT would participate in all hurricane protection projects, to ensure consistency with existing and future restoration projects. In seeking public comments on proposed hurricane protection projects, the PDT would help provide the public with information regarding ongoing and future restoration efforts in the project area. The PDT would fully consider all input regarding how such restoration efforts might be affected by the proposed hurricane protection project.

6.2.4.2.5 ***Seek Opportunities to Develop Hurricane Protection Projects that Complement Coastal Restoration***

In some case, it may be possible to design hurricane protection projects so that they facilitate or enhance restoration efforts. For example, the USACE is currently conducting a feasibility study regarding the Donaldsonville to the Gulf Hurricane Protection Project. As part of this study, the USACE has the ability to review opportunities to facilitate future restoration projects by restoring the natural hydrologic regime in the Barataria Basin. To the extent that such complementary solutions can be identified, the public stands to benefit from both improved structural hurricane protection, and the natural protection provided by coastal wetlands (along with other important wetland functions). The enhanced coordination and guiding principles discussed above could be used to help identify such solutions.

6.2.4.3 Navigation Projects

As with regulatory and hurricane protection activities, there is a need to ensure consistency between navigation projects and coastal restoration. To that end, the District proposes to:

- Develop guiding principles for ensuring consistency between navigation and coastal restoration.
- Use best available science tools to assess cumulative effects of navigation projects (see above).
- Increase beneficial use of dredged material.
- Enhance internal and external coordination.

6.2.4.3.1 ***Develop Guiding Principles for Ensuring Consistency Between Navigation and Coastal Restoration***

To help improve coordination between navigation projects and coastal restoration efforts, the District would collaborate with interested parties (including navigation interests, landowners, state and local government, other Federal agencies, businesses, and environmental organizations) to develop guiding principles regarding ecologically appropriate approaches for navigation improvement projects in coastal Louisiana. The guiding principles would emphasize the need to avoid and minimize wetland impacts, and to ensure that such projects do not interfere with or preclude restoration projects. In addition to the issue of avoiding direct wetland impacts, the guiding principles would address the need to avoid salinity increases and hydrologic modifications that could result in indirect and secondary wetland losses. The guiding principles would then be applied, as appropriate, to ongoing and future navigation improvement projects.

6.2.4.3.2 ***Increase Beneficial Use of Dredged Material***

The District fully recognizes the value of using dredged material for beneficial projects such as marsh creation. Given that many areas in coastal Louisiana are sediment deprived, we should take advantage of every opportunity to use dredged material from navigation projects to help bring new sediments into the coastal environment in the form of created marsh and other environmental features. However, there are many instances when budgetary and related policy constraints limit the extent to which dredged material can be used beneficially for coastal restoration purposes. In such cases, additional funds from another source could cover the incremental cost of using more of the dredged material for marsh creation or other environmental projects. The LCA Plan proposes a program similar to the Continuing Authorities Section 204 of the Water Resources Development Act 1992 to further the beneficial use of dredged material above and beyond that which is currently being done under the District's dredging maintenance program. Funding could be provided by the LCA Program funds and be cost-shared with the non-Federal sponsor. Execution of this program could be coordinated between the PDT and the District's Operations Manager.

6.2.4.3.3 *Enhance Internal and External Coordination*

Further internal and external coordination is needed to ensure consistency between navigation projects and coastal restoration efforts. Internally, a representative of the PDT would participate fully in all navigation improvement projects to ensure consistency with existing and future restoration projects. In seeking public comments on proposed navigation improvement projects, the PDT would help provide the public with information regarding ongoing and future restoration efforts in the project area, and would fully consider all input regarding how such restoration efforts might be affected by the proposed navigation project.

6.2.4.4 Other Mississippi Valley Division, New Orleans District Projects

The proposed consistency action items discussed above focus on regulatory activities and future and ongoing hurricane protection and navigation projects. In some instances it would also be appropriate to review the extent to which the maintenance and operation of existing projects are consistent with coastal restoration activities, and recommend changes to such projects, where necessary and practicable, to ensure consistency with restoration efforts. As part of the proposed LCA Study, the USACE would review the management of the Old River Control Structure (as part of a long-term study), address wetland loss associated with the Mississippi River to the Gulf Outlet, reevaluate the existing Davis Pond and Caernarvon Diversions, and increase the beneficial use of material dredged as part of the maintenance of existing navigation projects. It is also recognized that there may be other USACE activities (beyond those mentioned previously) that could have implications with respect to coastal restoration efforts (e.g., Continuing Authorities Projects). These other activities would also be reviewed and modified, where necessary and practicable to ensure consistency with coastal restoration. The District would support the review of any and all existing, ongoing, and future USACE projects, where such review is necessary to minimize a potential conflict with coastal restoration or where there is an opportunity to have such projects complement coastal restoration efforts. Based on such a review, recommendations for any and all modifications that are necessary and practicable to improve consistency with coastal restoration efforts would be made.

6.2.5 Rare and Unique Designations of Habitats

The District would fully coordinate with the LDWF for threatened and endangered species and rare and unique habitats under the state's jurisdiction.

6.2.6 Coastal Zone Management Act

The CZMA was enacted in 1972 to develop a national program to manage competing uses of and impacts to coastal resources, through the approved management programs of individual participating states. The CZMA Federal consistency requirement mandates that Federal agency activities be consistent to the maximum extent practicable with the enforceable policies of the approved state management program. The Louisiana Coastal Resources Program (LCRP) was approved by the NMFS in September 1980 and began implementation on October 1, 1980, and is administered by the LDNR, CMD.

The relevant citations and specific language are reproduced below. In summary, a Federal agency must review any activity it proposes for consistency with the approved state program, and then present that conclusion and supporting information to the state for review and concurrence or nonconcurrence. The Federal review must include all reasonably foreseeable direct and indirect, secondary, and cumulative impacts to coastal resources.

Coordination between state and Federal agencies, particularly for large, complex projects or programs, should occur at an early stage. Usually this would be during the preparation of the DPEIS, before the Federal agency reaches a significant point in its decision making and while there is still time to modify the activity. 'Coordination' does not necessarily refer to the formal Consistency Determination, rather, the Federal and state agencies should communicate as to the proposed project plans and how they can best meet the requirements of the coastal management program.

In cases where the proposed Federal activity is complex or dependent upon future developments, the need for early coordination can be met through the use of a 'phased consistency.' In brief, a phased consistency is prepared in stages over the planning life of the project. Initially, a Consistency Determination is submitted once the broad scope of the project has been established. As specific elements of the project are refined or additional information is developed, supplemental Consistency Determinations are prepared at a level of detail appropriate for those components.

As an example, a major freshwater diversion project may undergo initial design that lasts several years. The proposed location, size, operating parameters, and many other details may be identified in a general way relatively early in the planning, but as planning proceeds and specific problems and opportunities are encountered, the plan is modified. Consistency coordination at the earliest stages ensures that the overall concept would meet with state agency approval. Continued coordination as the plan evolves would assure that the specific elements are consistent with the state program prior to their construction.

It is anticipated that the LCA Plan, being a large and complex program with a great many component projects, still in the conceptual stage, would best be served by the phased consistency approach (personal communication with Mr. Jeff Harris, LDNR). The overall goals and methods outlined in the LCA Main Report and this FPEIS would be coordinated with LDNR during the planning stage, and submitted for consistency review once the preferred alternative has been identified. As each of the individual projects selected to implement the LCA Plan are conceived and designed, that phase of the program would be fully coordinated with the state management program pursuant to state and Federal consistency provisions.

CHAPTER 7 CONCLUSIONS AND RECOMMENDATIONS

This chapter first presents areas of controversy and unresolved issues, followed by the conclusions and recommendations for the **Recommended Plan – the LCA Plan**.

7.1 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

1. Conflict concerning the operation of the Mississippi River Gulf Outlet (MRGO).

The Mississippi River Gulf Outlet (MRGO), a channel connecting the Gulf of Mexico to the City of New Orleans, was completed in 1965 to provide a shorter, safer, and more efficient passage to New Orleans that would simultaneously boost the economy of St. Bernard Parish. Since the construction and operation of the MRGO land loss, soil erosion, habitat modification, and wildlife and fisheries losses have occurred in the surrounding area. Concerned citizens propose to "close" the MRGO, which would prohibit oceanic vessels with a draft of more than 12 feet from utilizing the canal. Along with eliminating deep draft vessels, the initial proposals call for water control structures including floodgates, locks, weirs and sills to be strategically built along the MRGO. The goal of these structures is to reduce water influx into the marshes and bayous from the MRGO channel, thus reducing the potential for storm surges and saltwater intrusion. Navigation stakeholders do not necessarily oppose the closure of the MRGO; however, they believe closure should be synchronized with construction of a new lock at the Inner Harbor Navigation Canal (IHNC) so commerce will not be disrupted. To resolve this conflict, the USACE/MVN is currently performing an economic analysis of the channel's efficiency. Residents are very concerned that this study will not lead to closure or significant modification of the MRGO.

2. Public concern that litigation from parties negatively impacted by restoration projects will make restoration prohibitively expensive.

Elements of the public expressed concern that restoration efforts, particularly projects that would involve freshwater diversions, would affect existing oyster beds via lowering salinity levels, thereby creating a situation where excessive compensation for potentially affected oyster leases would be necessary. As noted in Chapter 4 of the LCA main report, if oyster leases will be adversely impacted by a project, then such leases will be acquired and just compensation will be made. It is anticipated that this will reduce the potential liabilities in the future.

3. Concern about the priority of certain restoration projects.

- *Demand by Terrebonne and Barataria Basin residents for the immediate restoration of the Barataria-Terrebonne Estuary before other regions of the coastal ecosystem.*

Many residents of Terrebonne and Barataria Basins have expressed scoping concerns that this area has suffered the greatest land lost and ecological degradation and therefore should have immediate restoration efforts directed to address these problems. The Terrebonne and Barataria Basins are losing coastal wetlands more rapidly than anywhere else in Louisiana. Since these basins are in such dire need, there is strong public sentiment that these areas should be addressed first. Projects with considerable public support include the Bayou Lafourche reintroduction and the Third Delta Conveyance channel.

- *Public support for the construction of restoration projects in areas that will maximize the benefits to society, culture, and the regional economy.*

Nearly 2 million Louisiana residents live in the coastal zone, and the culture and socioeconomic structure of the population has evolved to depend on the presence and productivity of the wetlands. In general, the public is supportive of coastal restoration, but request project construction in areas that will maximize the benefit to Louisiana citizens. Restoration projects that will prevent flooding, storm surge, infrastructure damage, property damage, and damage to commercial and recreational fisheries are most desirable. In addition, the public wants restoration projects to coordinate with flood control projects, navigation activities, and other activities that preserve the local economy. Projects in isolated areas, with limited direct benefit for Louisiana residents are generally not supported by the public.

- *Public concern for additional salinity controls in the Chenier Plain and inclusion of additional restoration features for this subprovince in the implemented LCA Plan.*

Because of its distance from a major river, restoration opportunities in the Chenier Plain are hampered by the limited availability of "excess" freshwater and sediment. Thus, restoration projects constructed in this subprovince have attempted to capitalize on this limited excess freshwater through salinity control and hydrologic restoration measures. There is a great deal of public support for continued construction of such projects, as the belief is that they are effective means of combating saltwater intrusion and land loss in this region. However, members of the National Technical Review Committee (NTRC) as well as many other researchers and managers are concerned that such measures do not fully address the problem, and will not provide long-term sustainability in this region. Data indicate that the excess freshwater is very limited and is not available at times of the year when salinities are highest. Additionally, subsidence is not sufficiently offset using these measures, as they provide for very limited sediment redistribution. Fisheries access within and through this region is also hampered by the construction of these structures, creating another stress on valuable natural resources. To resolve this issue, the LCA Plan includes the Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study, in order to provide managers with the information needed to formulate the best restoration plan for Subprovince 4.

4. Concern with inaction and perceived lack of urgency with respect to restoration.

- *Public support for comprehensive, long-term restoration efforts beyond near-term restoration efforts.*

Members of the public expressed concern that the restoration of the Louisiana coastal ecosystem must include a long-term, comprehensive approach and commitment to significantly reverse the current trend of land loss and ecosystem degradation. While many members of the public acknowledged the need for a "near-term" effort, as embodied by the proposed LCA Plan, the majority viewed such an effort only as the initial step of the overall Louisiana coastal ecosystem restoration effort. Although the model results indicate that the LCA Plan would offset roughly 70 percent of the projected land loss in the future significant need still exists to offset the past loss of approximately 1.2 million acres and subsequent reduction in overall ecosystem quality.

Through meetings, the public has been informed of Federal guidance to focus on near-term restoration measures. The public was involved in the formulation of a comprehensive long-term restoration program and is certain a comprehensive program is the key to successful restoration. Many projects with considerable public support, including the restoration of the Bayou Chevreuil reef and additional salinity controls and other features in the Chenier Plain cannot be implemented in the near-term. However, the public feels these projects are essential to the restoration of coastal Louisiana; and consequently, they request a substantial long-term commitment from the Federal Government.

- *Public demand for the immediate construction of restoration actions versus requirements for conducting additional study of restoration problems.*

Members of the public expressed concern that the LCA Program's restoration effort will focus on the need for more studies rather than construction, operation and maintenance of restoration projects. In addition, it was expressed that immediate action should be taken to address Louisiana coastal ecosystem degradation issues, and that there are enough existing studies of the problem to warrant and justify that immediate action.

5. Concern about the necessity for sediment and water quality testing for each restoration feature.

Restoration measures call for riverine water and sediment to be redistributed into the surrounding coastal ecosystem. However, there is concern that these resources are sufficiently contaminated with nutrients and toxins such as mercury that restoration actions may intensify problems associated with eutrophication within the receiving areas, or compromise human health through consumption of contaminated fish and shellfish. Therefore, environmental groups have requested that sediment and water quality testing become a routine part of the project planning, engineering, and design phase. The Federal planning process requires that sediment and water quality be evaluated prior to implementation. If an issue arises during the evaluation, it will be addressed in a manner that is consistent with policy set by such acts as National Environmental Policy Act and Clean Water Act.

6. Conflicts may result when balancing economic interests with coastal restoration, especially when multiple stakeholders share common coastal resources.

- *Public concern that diversions will over-freshen receiving basins and concern that diversions could create widespread algae blooms in interior bays and lakes.*

Although there are many proponents of freshwater and sediment diversions, some members of the public are concerned about possible unintended consequences of implementing this type of restoration feature. Commercial and recreational fishermen are concerned that the change in the salinity regime often associated with a freshwater diversion, would cause loss or displacement of current recreational and commercially valuable fishery species. In addition to altering salinity, diversions may increase the amount of nutrients supplied to lakes and bays. Increased nutrients create the possibility of algal blooms, which are potentially detrimental to many aquatic organisms including fish, shellfish, and invertebrates, and may contribute to formation of hypoxic zones.

- *Concern with changing the existing operational scheme of the Old River Control Structure in regulating river flows in the Mississippi and Atchafalaya Rivers.*

Alterations in the operation of the Old River Control structure could increase sediment and freshwater in certain areas. The same concerns exist as with diversions. Change in the salinity regime often associated with a freshwater diversion, would cause loss of current recreational and commercially valuable fishery species. In addition to altering salinity, the features may increase the amount of nutrients supplied to a wetland. Increased nutrients create the possibility of algal blooms, which are potentially detrimental to many aquatic organisms including fish, shellfish, and invertebrates.

- *Concern that LCA Plan restoration features in Subprovince 3 would excessive amounts of water and sediment into the area.*

Overall, residents in Subprovince 3 are supportive of the proposed restoration features, however some citizens are concerned that an overabundance of water and sediment would result if the features are implemented. Concern is based on the thought that an excess of water and sediment could potentially displace many aquatic organisms, including fish, shellfish, and invertebrates. Additional concerns were raised that these sediments would accelerate infilling of the Atchafalaya Basin.

- *Real property rights issues including public access, mineral rights, and the perception that Federal monies would be spent to restore private properties.*

There are differing opinions regarding public access to restored areas and the extent to which mineral rights should be restricted within project areas. Also, some elements of the public are concerned that public monies will be used to benefit private land. Additional concerns were raised by private landowners that new rights for public access should not be created if private lands benefit from expenditures of public funds.

- *Concern with impediments to navigation and proposed re-routing of the Mississippi River and the Atchafalaya River Navigation channels.*

Members of the public, including Navigation interests, expressed concern that proposals to re-route portions of the Mississippi River and the Atchafalaya River Navigation channels could result in delays and restricted access, which could interrupt the transport of goods and commodities into and out of various ports in the Louisiana coastal area.

- *The effect of coastal restoration on flood control projects*.

Some members of the public are concerned that funding coastal restoration projects will reduce available funding for vital flood protection projects. Although the LCA program intends to be a complement, not a substitute, for flood protection projects, Federal funding shortages are a concern with any large-scale project.

7.2 CONCLUSIONS AND RECOMMENDATIONS

As the District Engineer, I have considered the environmental, social, and economic effects, the engineering feasibility, and the comments received from other resource agencies and the public during this LCA Study effort and plan formulation. Based upon the sum of this information, I am recommending for implementation the LCA Ecosystem Restoration Plan (LCA Plan) that includes the highest priority actions from among those considered during plan formulation. I am convinced that the LCA Plan would begin to reverse the current trend of degradation of Louisiana's coastal ecosystem, support Nationally significant living resources, provide a sustainable and diverse array of fish and wildlife habitats, reduce nitrogen delivery to offshore gulf waters, provide infrastructure protection, and make progress towards a more sustainable ecosystem.

The LCA Plan I am recommending has seven components, with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable.

A comparison of the cost effectiveness of the LCA Plan versus the final array of coastwide frameworks from which the LCA Plan was derived shows that the LCA Plan produces a lesser magnitude of output. However the efficiency of the LCA Plan is comparable to that of the larger frameworks in the final array. The comparison of the LCA Plan and the final array of coastwide frameworks is presented in **table 7-1**.

Table 7-1
LCA Plan and Final Array of Coastwide Frameworks

Plan	Subprovince Framework Codes	Average Annual Benefits ^	Average Annual Costs
LCA Plan		**2865**	**$ 55,921,000**
5610	S1M2, S2M3, S3R1	3094	171,479,754
5110	S1M2, S2R1, S3R1	3098	159,643,014
5410	S1M2, S2M1, S3R1	3110	185,416,495
10130	S1-3 N3*	3134	179,073,919
7610	S1E1, S2M3, S3R1	3166	193,662,284
7410	S1E1, S2M1, S3R1	3182	207,599,025
7002	S1E1, S2E3, S3M1	3202	542,511,742

*Plan developed by modification of plan 5110.
^Based on a composite of land building, habitat suitability, and nitrogen removal.

The ecologic model output for land building estimates that the LCA Plan would offset approximately 62.5 percent of the 462,000 acres projected to be lost within the Louisiana coastal area under the Future Without-Project condition. The estimated land building for Subprovince 1 exceeds projected Future Without-Project condition. In Subprovinces 2 and 3, the models estimated that the LCA Plan prevented almost 50 percent of the expected losses in each basin. These estimates do not include any projects in Subprovince 4.

The LCA Plan presents significant capacity for the prevention of future wetland loss with a smaller component of wetland building capacity. Although the LCA Plan acts significantly to reduce future loss of ecosystem structure and function, overall levels of environmental outputs will remain significantly reduced compared to historical conditions. This is especially true in Subprovince 4 where limited actions are recommended in the LCA Plan.

The cost of the five Near-Term Critical Restoration Features recommended for specific Congressional authorization, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents, (referred to as "Conditionally authorized" elsewhere in the report) is estimated at $864,065,000. The total cost of the Science and Technology Program, the Demonstration Projects, the Program for the Beneficial Use of Dredged Material, and Investigations of Modifications of Existing Structures is estimated at $310,000,000. The combined total cost of the previously stated components of the LCA Plan is estimated at $1,174,065,000. The total costs of Other Near-Term Critical Restoration Features Requiring Future Congressional Construction Authorization and Large-Scale and Long-Term Concepts Requiring Detailed Study is estimated to be $821,916,000. The total cost of the LCA Plan is estimated to be $1,995,981,000. Currently, the annual operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs are estimated at $7,883,000. OMRR&R costs are the responsibility of the non-Federal sponsor. These costs can be found in **table 7-3** through **table 7-5**.

7.2.1 The Seven Components of the LCA Plan

7.2.1.1 Near-Term Critical Restoration Features for Conditional Authorization

The LCA Plan includes 15 near-term critical restoration features (listed in **table 7-2a** and **7-2b**), five of which are recommended for specific Congressional authorization, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents. Implementation of these five restoration features would be subject to subsequent NEPA compliance, and appropriate decision documents. These decision documents would be constructed utilizing current policy and guidelines to provided a sound basis for decision makers at all levels. I recommend that Congress authorize implementation of the five near-term critical restoration features detailed below, with implementation subject to review and approval of the decision documents by the Secretary of the Army.

Studies or design of the five near-term features have been advanced to a state of readiness that suggest the feasibility-level decision documents can be completed prior to the next WRDA. In addition, initial analysis indicates that these five features address the most critical ecological needs of the coastal area in locations where delaying action would result in a "loss of opportunity" to achieve restoration and/or much greater restoration costs. These five critical near-term features present a range of effects essential for success in restoring the Louisiana coast. The benefits provided by these features include: sustainable reintroduction of riverine resources; rebuilding of wetlands in areas at high risk for future loss, the preservation and maintenance of critical coastal geomorphic structures; preservation of critical areas within the coastal ecosystem; and, the opportunity to begin to identify and evaluate potential long-term solutions. Based on a body of work both preceding and including this study effort, the PDT produced an estimate of average annual costs and benefits for these five features. This information shows that average annual environmental output for these five authorized features would be on the order of 22,000 habitat units at an average annualized cost of $2,700 per unit provided.

The five near-term critical restoration features recommended for specific Congressional authorization, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents are:

- MRGO Environmental Restoration Features
- Small Diversion at Hope Canal [1]
- Barataria Basin Barrier Shoreline Restoration
- Small Bayou Lafourche Reintroduction [1]
- Medium Diversion with Dedicated Dredging at Myrtle Grove [1]

7.2.1.2 Science & Technology (S&T) Program

The District recommends that the LCA S&T Program be programmatically authorized and funded at an amount not to exceed $100 million over the initial 10 years of the LCA Program. This S&T Program would support all facets of program implementation by providing for acquisition of data, developing analytic tools, and providing recommendations to the LCA Program Manager within the adaptive management framework. Major benefits of the S&T Program would be reduced scientific and technological uncertainties and optimized attainment of LCA Program restoration objectives.

7.2.1.3 Science and Technology Program Demonstration Projects

The District recommends that demonstration projects recommended by the S&T Program be programmatically authorized, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents, and funded as a construction item at an amount not to exceed $100 million over 10 years, including a maximum cost of $25 million per project. Demonstration projects would serve to reduce critical uncertainties and provide valuable lessons learned to improve overall program performance. The District recommends that Congress authorize implementation of the $100 million demonstration program subject to review and

[1] Diversion / reintroduction sizes: Small diversion: 1000 cfs - 5000 cfs; Medium diversion: 5001 cfs - 15000 cfs; Large diversion - > 15000 cfs

approval of individual project feasibility-level decision documents by the Secretary of the Army. In addition to standard decision document information, the demonstration project documents would address:

- Major scientific or technological uncertainties to be resolved; and
- A monitoring and assessment plan to ensure that the demonstration projects would provide results that contribute to overall LCA Program effectiveness.

The purpose of the recommended LCA S&T Program demonstration projects is to resolve critical areas of scientific, technical, or engineering uncertainty while providing meaningful restoration benefits whenever possible. The types of uncertainty that are best resolved through implementation of appropriately scaled demonstration projects are the "Type 2" uncertainties introduced in section 3.1.1. After design, construction, monitoring, and assessment of individual demonstration projects, the LCA program will leverage the lessons learned to improve the planning, design, and implementation of other LCA restoration projects. Beyond serving to resolve the list of "Type 2" uncertainties detailed in this report, demonstration projects may be necessary to address uncertainties discovered in the course of individual project implementation or during the study of large-scale and long-term restoration concepts.

7.2.1.4 Programmatic Authorization for the Beneficial Use of Dredged Material

The District recommends that Congress authorize $100 million over the initial 10 years of the LCA Program for execution of additional beneficial use of dredged material projects within the Louisiana coastal area. Based on the requested funds and a 10-year period of implementation, it is expected that this beneficial use program could contribute to the attainment of approximately 21,000 acres of newly created wetlands. I recommend that this program follow guidelines similar to the Section 204 Continuing Authorities beneficial use program that provides authority for the USACE to restore, protect, and create aquatic and wetland habitats in connection with construction or maintenance dredging of an authorized project.

7.2.1.5 Programmatic Authorization for Investigations of Modifications of Existing Structures

The District recommends that Congress authorize $10 million over the initial 10 years of the program for use in studies of potential modification or rehabilitation of existing water resources structures and/or their operation management plans for the purpose of contributing to the attainment of LCA Plan restoration objectives. This authority would improve environmental performance within a project purpose by authorizing the use of LCA funds.

7.2.1.6 Near-Term Critical Restoration Features Recommended for Study and Future Congressional Authorization

In addition to the five critical near-term restoration features previously recommended and listed for Congressional authorization, with implementation subject to Secretary of the Army review and approval of feasibility-level decision documents, the District recommends approval of funding for full development of feasibility reports for the other 10 LCA Plan features, for which the total study cost is $47,529,000. These features would be Congressionally authorized via future WRDA. The 10 features are:

- Multi-purpose operation of the Houma Navigation Canal Lock
- Terrebonne Basin barrier Shoreline Restoration
- Maintain land bridge between Caillou Lake and Gulf of Mexico
- Small diversion at Convent/Blind River
- Increase Amite River Diversion Canal influence by Gapping Banks
- Medium Diversion at White's Ditch
- Stabilize Gulf Shoreline at Point Au Fer Island
- Convey Atchafalaya River water to northern Terrebonne marshes
- Modification of Caernarvon Diversion
- Modification of Davis Pond Diversion

7.2.1.7 Large-Scale and Long-Term Concepts Requiring Detailed Study

The District recommends development of studies that evaluate large-scale, long-term coastal restoration concepts. Investigations of the following six large-scale, long-term concepts will fully determine their potential for achieving restoration objectives beyond the critical needs, near-term focus of other LCA Plan components. Upon completion of the studies, recommendations may be forwarded to Congress for consideration of authorization. The estimated cost of these studies is $60 million

- Mississippi River Hydrodynamic Study
- Mississippi River Delta Management Study
- Third Delta Study
- Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study
- Acadiana Bays Estuarine Restoration Study
- Upper Atchafalaya Basin Study

These studies and their resultant projects, if authorized and constructed, could significantly restore environmental conditions that existed prior to large-scale alteration of the natural system.

COST SHARING AND AGENCY RESPONSIBILITIES

The District further recommends Federal and Non-Federal Sponsor responsibilities and cost sharing requirements as set forth in Section 4.6 DIVISION OF RESPONSIBILITIES of the Main Report

The recommendations contained herein reflect the information available at this time and current Department of the Army policies governing 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 review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the state, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity for further comment.

Table 7-2a. Components of the LCA Plan.

Recommended for Conditional or Programmatic Authorization

1. Near-term Critical Restoration Features
    - MRGO Environmental Restoration Features
    - Small Diversion at Hope Canal
    - Barataria Basin Barrier Shoreline Restoration, Caminada Headland, Shell Island
    - Small Bayou Lafourche Reintroduction
    - Medium Diversion with Dedicated Dredging at Myrtle Grove
2. S&T Program
3. Initial S&T Program Demonstration Projects
    - Marsh Restoration and/or Creation Using Non-Native Sediment
    - Marsh Restoration Using Long-Distance Conveyance of Sediment
    - Canal Restoration Using Different Methods
    - Shoreline Erosion Prevention Using Different Methods
    - Barrier Island Restoration Using Offshore and Riverine Sources of Sediment
4. Programmatic Authorization for the Beneficial Use of Dredged Material
5. Programmatic Authorization to Initiate Studies of Modifications to Existing Water Control Structures

Table 7-2b. Components of the LCA Plan.

Recommended for Approval With Future Authorization

(Implemented with Congressional Approval Authority)

6. Other Near-term Critical Restoration Features
    - Multi-purpose Operation of Houma Navigation Canal Lock
    - Terrebonne Basin Barrier Shoreline Restoration
    - Maintain Land Bridge between Caillou Lake and Gulf of Mexico
    - Small Diversion at Convent / Blind River
    - Increase Amite River Diversion Canal Influence by Gapping Banks
    - Medium Diversion at White's Ditch
    - Stabilize Gulf Shoreline at Point Au Fer Island
    - Convey Atchafalaya River water to Northern Terrebonne Marshes
    - Modification of Caernarvon Diversion
    - Modification of Davis Pond Diversion
7. Large-scale and Long-term Concepts Requiring Detailed Study
    - Mississippi River Hydrodynamic Study
    - Mississippi River Delta Management Study
    - Third Delta Study
    - Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study
    - Acadiana Bays Estuarine Restoration Feasibility Study
    - Upper Atchafalaya Basin Study

Table 7-3
LCA Plan Component Cost Estimates
(June 2004 Price Levels)

Item		Cost ($)
MRGO environmental restoration features		$ 80,000,000
Small diversion at Hope Canal		$ 10,645,000
Barataria Basin Barrier shoreline restoration		$ 181,000,000
Small Bayou Lafourche reintroduction		$ 75,280,000
Medium diversion with dedicated dredging at Myrtle Grove		$ 142,920,000
	SUBTOTAL	$ 489,845,000
LERRD		$ 178,619,000
First Cost	SUBTOTAL	$ 668,464,000
Feasibility-Level Decision Documents		$ 54,673,000
Preconstruction, Engineering, and Design (PED)		$ 36,252,000
Engineering and Design (E&D)		$ 29,018,000
Supervision and Administration (S&A)		$ 68,973,000
Project Monitoring		$ 6,685,000
Conditionally Authorized Cost	SUBTOTAL	**$ 864,065,000**
Science & Technology Program Cost (10 year Program)		**$ 100,000,000**
Demonstration Program Cost (10 year Program)*		**$ 100,000,000**
Beneficial Use of Dredged Material Program*		**$ 100,000,000**
Investigations of Modifications of Existing Structures		**$ 10,000,000**
Total Authorized LCA Plan Cost		**$ 1,174,065,000**
Multi-purpose operation of Houma Navigation Canal (HNC) Lock [#]		$ -
Terrebonne Basin Barrier shoreline restoration		$ 84,850,000
Maintain Land Bridge between Caillou Lake and Gulf of Mexico		$ 41,000,000
Small diversion at Convent / Blind River.		$ 28,564,000
Increase Amite River Diversion Canal influence by gapping banks		$ 2,855,000
Medium diversion at White's Ditch		$ 35,200,000
Stabilize Gulf shoreline at Point Au Fer Island		$ 32,000,000
Convey Atchafalaya River Water to Northern Terrebonne marshes		$ 132,200,000
Modification of Caernarvon diversion		$ 1,800,000
Modification of Davis Pond diversion		$ 1,800,000
	SUBTOTAL	$ 360,269,000
LERRD		$ 208,100,000
First Cost	SUBTOTAL	$ 568,369,000
Feasibility Level Decision Documents		$ 47,529,000
Preconstruction, Engineering, and Design (PED)		$ 36,027,000
Engineering & Design (E&D)		$ 45,635,000
Supervision & Administration (S&A)		$ 58,673,000
Project Monitoring		$ 5,683,000
Approved Projects Requiring Future Congressional Authorization for Construction		**$ 761,916,000**
Mississippi River Hydrodynamic Study		$ 10,250,000
Mississippi River Delta Management Study		$ 15,350,000
Third Delta Study		$ 15,290,000
Chenier Plain Freshwater and Sediment Management and Allocation Reassessment Study		$ 12,000,000
Acadiana Bays Estuarine Restoration Feasibility Study		$ 7,110,000
Upper Atchafalaya Basin Study^		$ -
Large-scale and Long Term Studies Cost	SUBTOTAL	**$ 60,000,000**
Total LCA Restoration Plan Cost		**$ 1,995,981,000**

*Program total costs include any estimated Real Estate costs for these activities
[#] Feature of the Mississippi River and Tributaries, Morganza Louisiana to the Gulf of Mexico Hurricane Protection project
^ Study to be funded under the Mississippi River and Tributaries authority

Table 7-4. Summary of LCA Plan Federal and Non-Federal Cost Share Responsibilities (June 2004 Price Levels)

Conditionally Authorized Features:		
Feasibility-level Decision and NEPA Documentation Cost:		
Federal (50%)	$	27,336,500
Non-Federal (50%)	$	27,336,500
Subtotal	$	54,673,000
Construction Cost (Including PED, E&D, S&A, Monitoring):		
Federal (65%)	$	500,768,550
Non-Federal (35%):		
LERRD*	$	178,619,000
Cash	$	130,004,450
Subtotal	$	809,392,000
Total	**$**	**864,065,000**
*For the conditionally authorized feature, Small Diversion at Hope Canal, LERRD exceeded 35% of the total project cost by $25,336,250, which is reimbursed to the non-federal sponsor.		
Programmatically Authorized Features:		
Science & Technology Program (10 year program)		
Federal (65%)	$	65,000,000
Non-Federal (35%)	$	35,000,000
Demonstration Program (10 year program)		
Federal (65%)	$	65,000,000
Non-Federal (35%)	$	35,000,000
Beneficial Use of Dredge Material Program		
Federal (75%)	$	75,000,000
Non-Federal (25%)	$	25,000,000
Investigations of Modifications of Existing Structures		
Federal (50%)	$	5,000,000
Non-Federal (50%)	$	5,000,000
Total	**$**	**310,000,000**
Conventionally Authorized Features:		
Feasibility-level Decision and NEPA Documentation Cost:		
Federal (65%)	$	23,764,500
Non-Federal (35%)	$	23,764,500
Subtotal	$	47,529,000
Construction Cost (Including PED, E&D, S&A, Monitoring):		
Federal (65%)	$	464,351,550
Non-Federal (35%)		
LERRD	$	208,100,000
Cash	$	41,935,450
Subtotal	$	714,387,000
Total	**$**	**761,916,000**
Large-scale, Long-term Studies for Future Congressional Authorization:		
Federal (50%)	$	30,000,000
Non-Federal (50%)	$	30,000,000
Total	**$**	**60,000,000**

Table 7-5
Average Annual O&M Cost Estimates for the LCA Plan Features
(June 2004 Price Levels)

Item	O&M Cost ($/yr)
MRGO Environmental Restoration Features	$ 711,000
Small Diversion at Hope Canal	$ 120,000
Barataria Basin Barrier Shoreline Restoration	$ 500,000
Small Bayou Lafourche Reintroduction	$ 1,400,000
Medium Diversion with Dedicated Dredging at Myrtle Grove	$ 120,000
Total Conditionally Authorized Cost	$ 2,851,000
Multi-purpose Operation of Houma Navigation Canal Lock	$ -
Terrebonne Basin Barrier Shoreline Restoration E. Timbalier, Isle Dernieres	$ 2,760,000
Maintain Land Bridge between Caillou Lake and Gulf of Mexico	$ 745,000
Small diversion at Convent / Blind River.	$ 120,000
Increase Amite River Diversion Canal Influence by Gapping Banks	$ -
Medium Diversion at White's Ditch	$ 120,000
Stabilize Gulf Shoreline at Point Au Fer Island	$ 644,000
Convey Atchafalaya River Water to Northern Terrebonne Marshes	$ 643,000
Total Future Congressionally Authorized Cost	$ 5,032,000
Total Cost	**$ 7,883,000**

CHAPTER 8 DISTRIBUTION LIST AND OTHER

This chapter presents the distribution list for the FPEIS, list of preparers, list of study participants, literature cited, glossary, abbreviations, index, and measurements.

8.1 DISTRIBUTION LIST

The FPEIS 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 provided in **appendix A2**.

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8.5 GLOSSARY

Acceptability – Adequate to satisfy a need, requirement, or standard. One of the Army Corps of Engineers requirements for a project.

Adaptive management - An interdisciplinary approach acknowledging our insufficient information base for decision-making; that uncertainty and change in managed resources are inevitable; and that new uncertainties will emerge. An iterative approach that includes monitoring and involves scientists, engineers and others who provide information and recommendations that are incorporated into management actions; results are then followed with further research, recommendations and management actions, and so on.

Aggradational Process of Plant Growth – Plant root material building elevation, usually in fresh marsh.

Air Quality Determination – The Louisiana Department of Environmental Quality ensures that projects do not adversely affect air quality through this determination as a requirement of the Clean Air Act.

Alternative Plan – A set of one of more management measures within a subprovince functioning together to address one or more objectives.

Amplitude – The maximum absolute value of a periodically varying quantity.

Anoxia – Absence of oxygen.

Anthropogenic – Caused by human activity.

Aquaculture – The science and business of farming marine or freshwater food fish or shellfish, such as oysters, crawfish, shrimp and trout, under controlled conditions.

Astronomical Tides – Daily tides controlled by the moon, as opposed to wind-generated tides.

Average Annual Habitat Units (AAHUs): represent a numerical combination of habitat quality and quantity (acres) existing at any given point in time. The habitat unites resulting from the future without- and future with-project scenarios are annualized, averaged over the project life, to determine Average Annual Habitat Units (AAHUs).

Barbary Soils – Soils in swamps (with logs and stumps) that are level, very poorly drained, with a thin mucky surface layer and clayey underlying material.

Benefits – Valuation of positive performance measures.

Benthic – Living on or in sea, lake, or stream bottoms.

Best Management Practice – or BMP, is a design, technique, or landscape addition that reduces pollution in storm water runoff. BMPs can be structural or non-structural.

Biomass – The total mass of living matter (plant and animal) within a given unit of environmental area.

Bottomland Hardwood Forest – Low-lying forested wetlands found along streams and rivers.

Brackish Marsh (BRM) – Intertidal plant community typically found in the area of the estuary where salinity ranges between 4-15 ppt.

Chenier Plain – Western part of coastal Louisiana with little influence from Mississippi and Atchafalaya rivers.

Clean Water Act Section 404 (b) (1) – There are several sections of this Act that pertain to regulating discharges into wetlands. The discharge of dredged or fill material into waters of the United States is subject to permitting specified under Title IV (Permits and Licenses) of this Act and specifically under Section 404 (Discharges of Dredge or Fill Material) of the Act.

Coastal Zone Consistency Determination – The U.S. Environmental Protection Agency reviews plans for activities in the coastal zone to ensure they are consistent with Federally approved State Coastal Management Programs under Section 307(c)(3)(B) of the Coastal Zone Management Act.

Coast-wide Plan – Combination of alternative plans assembled to address an objective of set of objectives across the entire Louisiana Coast.

Collocated Team – A collection of scientists and professionals from the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, NOAA Fisheries, Natural Resources Conservation Service, U.S. Geological Survey, U.S. Environmental Protection Agency, Louisiana Department of Natural Resources, and Louisiana Department of Wildlife and Fisheries that are located at the USACE, New Orleans District, office and work together on the LCA Plan.

Compaction of Holocene Deposits – Deltaic mud that packs down under its own weight.

Completeness – The ability of a plan to address all of the objectives. One of the USACE four requirements for a project.

Comprehensive Plan – Same as Coast-wide Plan.

Connectivity – Property of ecosystems that allows for exchange of resources and organisms throughout the broader ecosystem.

Continental Shelf – The edge of the continent under gulf waters; the shallow Gulf of Mexico fringing the coast.

Control Structure – A gate, lock, or weir that controls the flow of water.

Crevasse – A breach or gap in the levee or embankment of a river (natural or manmade), through which floodwaters flow.

Cumulative Impacts – The combined effect of all direct and indirect impacts to a resource over time.

Datum – A point, line, or surface used as a reference, as in surveying, mapping, or geology.

Deciduous Forest – Forest composed mostly of trees that lose their leaves in the winter.

Decomposition – Breakdown or decay of organic materials.

Degradation Phase – The phase of the deltaic cycle when sediments are no longer delivered to a delta, and it experiences erosion, dieback, or breakup of marshes.

Deltaic Cycle – Capture of the Mississippi River by a distributary that offered a shorter route to the Gulf of Mexico. After abandonment of an older delta lobe, which would cut off the primary supply of fresh water and sediment, an area would undergo compaction, subsidence, and erosion. The old delta lobe would begin to retreat as the gulf advanced, forming lakes, bays, and sounds. Concurrently, a new delta lobe would begin its advance gulfward.

Deltaic Deposits – Mud and sand deposited at the mouth of a river.

Deltaic Plain – The land formed and reworked as the Mississippi River switched channels in the eastern part of the Louisiana coastal area.

Demersal – Dwelling at or near the bottom of a body of water (e.g., a *demersal fish*).

Detritus – The remains of plant material that has been destroyed or broken up.

Dewatering – The process of dredged sediments compacting while losing water after being deposited.

Discharge – The volume of fluid passing a point per unit of time, commonly expressed in cubic feet per second, millions of gallons per day, or gallons per minute.

Dissolved Oxygen – Oxygen dissolved in water, available for respiration by aquatic organisms. One of the most important indicators of the condition of a water body.

Direct Impacts – Those effects that result from the initial construction of a measure (e.g., marsh destroyed during the dredging of a canal). Contrast with "Indirect Effects."

Diurnal – Relating to or occurring in a 24-hour period; daily.

Diversion – A turning aside or alteration of the natural course or flow of water. In coastal restoration this usually consists of such actions as channeling water through a canal, pipe, or conduit to introduce water and water-borne resources into a receiving area.

Dynamic – Characterized by continuous change and activity.

Ecological – Refers to the relationship between living things and their environment.

Economic – Of or relating to the production, development, and management of material wealth, as of a country, household, or business enterprise.

Ecosystem – An organic community of plants and animals viewed within its physical environment (habitat); the ecosystem results from the interaction between soil, climate, vegetation and animal life.

Ecosystem Restoration – activities that seek to return a organic community of plants and animals and their habitat to a previously existing or improved natural condition or function.

Effectiveness – Having an intended or expected effect. One of the USACE four requirements for a project.

Efficiency – The quality of exhibiting a high ratio of output to input. One of the USACE four requirements for a project.

Egress – A path or opening for going out; an exit.

Electrical Conductivity – The ability of a medium to conduct electricity. Salt water has a higher electrical conductivity than fresh water, and this property allows the measurement of salinity through a simple meter.

Embankment – A linear mound of earth or stone existing or built to hold back water or to support a roadway.

Encroachment –Entering gradually into an area not previously occupied, such as a plant species distribution changing in response to environmental factors such as salinity.

Endangered Species – Animals and plants that are threatened with extinction.

End-on Construction – End-on is a construction technique devised to work from the decks of the structures, building each section of the bridge from the top of the last completed section and using heavy cranes to push each section forward one bay at a time. The cranes can also be used to position steel platforms, drive in support pilings, and lay deck slabs, alternating this procedure between each bay.

Endpoints – see Objectives

Engineering News Record (ENR) – A magazine that provides news needed by anyone in or from the construction industry.

Enhance – To augment or increase/heighten the existing state of an area.

Entrenchment – Being firmly embedded.

Environmental Impact Statement (EIS) – A document that describes the positive and negative environmental effects of a proposed action and the possible alternatives to that action. The EIS is used by the federal government and addresses social issues as well as environmental ones.

Estuary – A semi-enclosed body of water with freshwater input and a connection to the sea where fresh water and salt water mix.

Estuarine – Related to an estuary.

Evaporation – The process by which any substance is converted from a liquid state into, and carried off in, vapor; as, the evaporation of water.

Exotic Species – Animal and plant species not native to the area; usually undesirable (e.g., hyacinth, nutria, tallow tree, giant salvinia).

Faulting – A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture.

Feasibility Report – A description of a proposed action, previously outlined in a general fashion in a Reconnaissance Report, that will satisfy the Federal interest and address the problems and needs identified for an area. It must include an assessment of impacts to the environment (either in an Environmental Assessment, or the more robust Environmental Impact Statement), an analysis of alternative methods of completion, and the selection of a Recommended Plan through the use of a cost-effectiveness analysis.

Federal Principals Group (FPG) –A collaboration among Federal agencies at the Washington level to facilitate the flow of information, to provide guidance and recommendations to the USACE and LDNR throughout the study process, and to facilitate resolution of any interagency issues that may be identified in the conduct of the study.

Final Array – The final grouping of the most effective coast-wide plans from which a final recommendation can be made.

Foreshore Dikes – An embankment of earth and rock built to prevent floods or erosion that is built in the area of a shore that lies between the average high tide mark and the average low tide mark.

Framework Development Team (FDT) – A group of professionals from various Federal and state agencies, academia and the public formed to provide a forum for individual members to discuss LCA Comprehensive Study activities and technical issues and to provide comments to the Senior Management Committee.

Fresh Marsh (FAM) – Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 0-3 ppt.

Furbearer – An animal whose skin is covered with fur, especially fur that is commercially valuable, such as muskrat, nutria, and mink.

Geomorphic – Related to the geological surface configuration.

Geosynclinal Down-warping – The downward bend or subsidence of the earth's crust, which allows of the gradual accumulation of sediment

Geotropically – Downward growth in response to gravity, as in plant roots.

Glycophytes – A plant that cannot live in high salinity environments, most plants.

Goals – Statements on what to accomplish and/or what is needed to address a problem without specific detail.

Gradient – A slope; a series of progressively increasing or decreasing differences in a system or organism.

Habitat – The place where an organism lives; part of physical environment in which a plant or animal lives.

Habitat Loss – The disappearance of places where target groups of organisms live. In coastal restoration, usually refers to the conversion of marsh or swamp to open water.

Habitat Units – (HU) represent a numerical combination of quality (Habitat Suitability Index; HSI) and quantity (acres) existing at any given point in time. The HUs resulting from the future without- and future with-project scenarios are annualized, averaged over the project life, to determine Average Annual Habitat Units (AAHUs). The "benefit" of a project can be quantified by comparing AAHUs between the future without- and future with-project scenarios. The difference between the two scenarios represents the net benefits attributable to the project in terms of habitat quantity and quality.

Hazardous, Toxic, and Radioactive Wastes (HTRW) – Projects features must be examined to ensure that their implementation will not result in excessive exposure to pollutants possibly located in the study area.

Headland – A point of land projecting into the sea or other expanse of water, still connected with the mainland.

Herbaceous – A plant with no persistent woody stem above ground.

Hydrodynamic – The continuous change or movement of water

Hydrology – The pattern of water movement on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hypoxia – The condition of low dissolved oxygen concentrations.

Indemnification – Insurance against or compensation for loss or damage.

Indirect Impacts – Those effects that are not as a direct result of project construction, but occur as secondary impacts due to changes in the environment brought about by the construction. Contrast with “Direct Impacts.”

Infrastructure – The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.

Ingress – An entrance or the act of entering.

Inorganic – Not derived from living organisms; mineral; matter other than plant or animal.

Interdistributary Deposits – Sand and mud deposited between the river channels or between bayous.

Intermediate Marsh (INM) – Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 2-5 ppt.

Intertidal – Alternately flooded and exposed by tides.

Invertebrates – Animals without backbones, including shrimp, crabs, oysters, and worms.

Keystone Strategy – A strategy that other strategies rely upon for successful implementation.

Land-water Ratio – The relative proportion or wetlands and uplands to water in an area.

Larvae – The stage in some animal’s life cycles between egg and adult (most invertebrates).

Leeward – Sheltered from the wind; away from the wind.

Levee – A linear mound of earth or stone built to prevent a river from overflowing; a long, broad, low ridge built by a stream on its flood plain along one or both banks of its channel in time of flood.

Loamy – Soil composed of a mixture of sand, clay, silt, and organic matter.

Locally Preferred Plan (LPP) – Alternative plan preferred by local sponsor if other than the Recommended Plan.

Maintain – To keep in existing state.

Marine forcing – tidal action or exchange.

Measure – A programmatic restoration feature that can be assembled with other measures to produce alternative plans. See also “Project.”

Methodology – A set of practices, procedures, and rules.

Mineral Substrate – Soil composed predominately of mineral rather than organic materials; less than 20 percent organic material.

Mudflats – Flat, unvegetated wetlands subject to periodic flooding and minor wave action.

Myatt Series – Gray terrace soil, with whitish, pebbly subsoil.

National Ecosystem Restoration (NER) – USACE standard for cost-effectiveness based on ecosystem, not economic, benefits.

Near-shore Currents – Movement of water parallel to the shoreline. Usually generated by waves breaking on the shore at an angle other than perpendicular.

National Environmental Policy Act (NEPA) – Ensures that Federal agencies consider the environmental impacts of their actions and decisions. NEPA requires all Federal agencies to consider the values of environmental preservation for all significant actions and prescribes procedural measures to ensure that those values are fully respected.

Net Gain – The amount of cumulative land gain less land loss, when gain is greater than loss.

Net Loss – The amount of cumulative land gain less land loss, when gain is less than loss.

No Action Alternative – The alternative in the LCA Plan which describes the ecosystem of the coastal area if no restoration efforts/projects were done.

Nursery – A place for larval or juvenile animals to live, eat, and grow.

Objectives – More specific statements than "Goals," describing how to achieve the desired targets.

Oceanic-dumping – The discharge of wastes or pollutants into offshore waters.

Organic – Composed of or derived from living things.

Oscillations – Fluctuations back and forth, or up and down.

Oxidation of Organic Matter – The decomposition (rotting, breaking down) of plant material through exposure to oxygen.

Oxygen-depleted – Situation of low oxygen concentrations where living organisms are stressed.

Petrochemical – Any compound derived from petroleum or natural gas.

Point-Bar Deposit – The shallow depositional area on the inside bank of a river bend.

Post-larval – Stage in an animal's lifecycle after metamorphosis from the larval stage, but not yet full grown.

Potable Water – Water that is fit to drink.

ppt – parts per thousand. The salinity of ocean water is approximately 35 ppt.

Primary Consolidation/Secondary Compression – Two processes acting on a substrate that has a load applied to it to cause the sediment to increase in density, and decrease in volume.

Prime Farmland - Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. One of the categories of concern in the EIS.

Principles – Framing statements that can be used to evaluate alternatives while considering issues that affect them. Used along with targets and assessments of ecosystem needs to provide guidance in formulation of alternative plans.

Productivity – Growth of plants and animals.

Progradation – The phase during the deltaic cycle where land is being actively accreted through deposition of river sediments near the mouth.

Programmatic Environmental Impact Statement (PEIS) – an Environmental Impact Statement that supports a broad authorization for action, contingent on more specific detailing of impacts from specific measures.

Project – A constructible increment of an alternative plan.

Project Implementation Report (PIR) – A project-specific follow-up report that expands on the information contained in a Programmatic Feasibility Report to ensure NEPA compliance, such as conducting public meetings, preparing the appropriate environmental documentation, and preparing the engineering designs as specifications necessary to build the project.

Province – A major division of the coastal zone of Louisiana. (e.g., Deltaic Plain and Chenier Plain).

Pulsing – Letting a diversion flow periodically at a high rate for a short time, rather than continuously.

Quantitative – Able to assign a specific number; susceptible to measurement.

Radiocarbon Age Determination –The use of the ratio of carbon isotopes to determine age.

Rebuild – To some extent build back a structure/landform that had once existed.

Reconnaissance Report – A document prepared as part of a major authorization that examines a problem or need and determines if sufficient methods and Federal interest exists to address the problem/need . If so, then a "Feasibility Report" is prepared, which details the solution and its impacts further.

Reduce – To diminish the rate or speed of a process.

Regional Working Group (RWG) – An inter-agency team formed to support the Washington-level Federal Principal's Group and to facilitate regional level collaboration and coordination on the LCA study.

Rehabilitate – To focus on historical or pre-existing ecosystems as models or references while emphasizing the reparation of ecosystem processes, productivity and service.

Relative Sea Level Rise – The sum of the sinking of the land (subsidence) and eustatic sea level change; the change in average water level with respect to the surface.

Restore – Return a wetland to a close approximation of its condition or function prior to disturbance by modifying conditions responsible for the loss or change; re-establish the function and structure of that ecosystem.

Sangamonian Interglacial Period – the last interglacial period before the Holocene period (the current geological period).

Saline Marsh (SAW) – Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 12-32 ppt.

Salinity – The concentration of dissolved salts in a body of water, commonly expressed as parts per thousand.

Salt Marshes – See "Saline Marsh."

Scoping – Soliciting and receiving public input to determine issues, resources, impacts, and alternatives to be addressed in the draft EIS.

Sea-Level – Long-term average position of the sea surface.

Sediment Plume – Caused by sediment rich rainwater runoff entering the ocean. The runoff creates a visible pattern of brown water that is rich in nutrients and suspended sediments that forms a kind of cloud in the water spreading out from the coastline. Commonly forms at river and stream mouths, near sloughs, and along coasts where a large amount of rain runoff flows directly into the ocean.

Sheet Flow – Flow of water, sediment, and nutrients across a flooded wetland surface, as opposed to through channels.

Shoaling – The shallowing of an open-water area through deposition of sediments.

Slikensides – The smooth or partially polished surface of rock caused by one rock mass sliding over another in a fault plane.

Social – Relating to human society and its modes of organization.

Socioeconomic – Involving both social and economic factors.

Spoil Banks – Dredged material removed from canals and piled in a linear mound along the edge of canals.

Stabilize – To fix the level or fluctuation of; to make stable.

State Historic Preservation Office (SHPO) – The part of the Louisiana Department of Culture, Recreation, and Tourism that deals with Indian sites and other archaeological remains.

Stillstand – A period of time when sea level did not change.

Storm Overwash – The process by which sand is transposed landward over the dunes during a storm event by waves.

Storm Surge – An abnormal and sudden rise of the sea along a shore as a result of the winds of a storm.

Stough soils – Yellowish brown coarse-loamy soil.

Strategy – Ecosystem restoration concept from the Coast 2050 Plan.

Stream Gaging Data – Records of water levels in streams and rivers.

Submergence – Going under water.

Subprovince – The divisions of the two Provinces (see "Province") into smaller groupings: 1) east of the Mississippi River; 2) west of the Mississippi River to Bayou Lafourche; 3) Bayou Lafourche to Freshwater Bayou; 4) Freshwater Bayou to Sabine River.

Subsidence – The gradual downward settling or sinking of the Earth's surface with little or no horizontal motion.

Sustain – To support and provide with nourishment to keep in existence; maintain.

Tarbert Flow – Stream gage data recorded at Tarbert's Landing on the Mississippi River.

Target – A desired ecosystem state that meets and objective or set of objectives.

Terrestrial Habitat – The land area or environment where an organism lives; as distinct from water or air habitats.

Third Delta – A proposed project that would divert up to 120,000 cubic feet of water per second from the Mississippi River near Donaldsonville, Louisiana down a conveyance channel to the marshes in southern Barataria and Terrebonne Basins.

Toxicity – The measure of how poisonous something is.

Transpiration – The process by which water passes through living plants into the atmosphere.

Turbidity – The level of suspended sediments in water; opposite of clarity or clearness.

Unique Farmland – Land other than Prime Farmland (see "Prime Farmland") that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, fruits, and vegetables.

Upconing – The tendency of underground salt water to move closer to the surface in the vicinity of a well by drawing fresh ground water out.

Upland (UPL) – A general term for non-wetland elevated land above low areas along streams or between hills.

Water Resource Units (WRU) Stage-damage data developed as part of the Flood Damage Estimation System (FDES) in 1980 for the Mississippi River and Tributaries (MR&T) project were used to estimate the flood damages that are expected to occur in Subprovinces 1, 2, and 3. The data collected for the FDES were delineated into geographic areas with homogenous physical and hydraulic characteristics. These geographic areas were numerically coded and designated as Water Resource Units (WRUs). Within each WRU, land-use elements (structures, cropland, roads, bridges, railroads, etc.) were categorized by location, value, and corresponding depth-damage relationship. The structural damage categories included: residential, commercial, industrial, public, and farm buildings.

Water Resources Development Act (WRDA) – A bill passed by Congress that provides authorization and/or appropriation for projects related to the conservation and development of water and related resources.

Wetland Value Assessment (WVA) – The WVA methodology is the primary means of measuring the wetland benefits of candidate projects proposed for funding by the CWPPRA and allows for a comparison of benefits between those projects. The WVA methodology includes seven community habitat assessment models used to project the benefits of restoration projects: 1) fresh/intermediate marsh, 2) brackish marsh, 3) saline marsh, 4) barrier island, 5) barrier headland, 6) swamp, and 7) coastal chenier/ridge.

Weir – A dam placed across a canal or river to raise, divert, regulate or measure the flow of water.

8.6 ABBREVIATIONS AND ACRONYMS

AAHU- Average Annual Habitat Units

AEAM- Adaptive Environmental Assessment And Management

BMP- Best Management Practices

BTNEP- Barataria-Terrebonne National Estuary Program

BUMP - Beneficial Use Monitoring Program

CAP - Continuing Authorities Program

CE/ICA – Cost Effectiveness and Incremental Cost Analysis

CEQ – Council on Environmental Quality

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CFR – Code of Federal Regulations

cfs – Cubic Foot Per Second

CIAF - Coastal Impact Assistance Fund

cms – cubic meter per second

CO – carbon monoxide

COFCL - Governor's Committee on the Future of Coastal Louisiana

CRMS – Coastwide Reference Monitoring System

CSC - Calcasieu Ship Channel

CSVR – contents-to-structure value ratio

CWA – Clean Water Act

CWS - Canadian Wildlife Service

CWPPRA – Coastal Wetlands Planning, Protection, and Restoration Act

CWPPRA PPL– Coastal Wetlands Planning, Protection, and Restoration Act Priority Project List

CY – cubic yards

CZMA – Coastal Zone Management Act

DD – Decision Document

DEQ – Department of Environmental Quality

DPEIS – Draft Programmatic Environmental Impact Statement

DSS – Decision Support System

E&D – Engineering and Design

EFH – Essential Fish Habitat

EIS – Environmental Impact Statement

EJ – Environmental Justice

EO – Executive Order

EOPs - Environmental Operating Principles

ERDC – Engineering Research and Development Center

FDES - Flood Damage Estimation System

FDT – Framework Development Team

FEMA – Department of Homeland Defense Federal Emergency Management Agency

FHWAR – National Survey of Fishing, Hunting and Wildlife Associated Recreation

FPEIS – Final Programmatic Environmental Impact Statement

FPG - Federal Principals Group

FTL – Functional Team Leader

FWCA – Fish and Wildlife Coordination Act

FWCAR – Fish and Wildlife Coordination Act Report

FWP - Future with Project

FWOP or FWO - Future -Without Project

GIS – Geographic Information System

GIS/RS – Geographic information system/Remote Sensing

GIWW – Gulf Intracoastal Waterway

GMFMC – Gulf of Mexico Fisheries Management Council

GPRA - Government Performance and Results Act

GSMFC – Gulf States Marine Fisheries Council

HEP – Habitat Evaluation Procedures

H&H – Hydrology and Hydraulics

HILCP - Hydrologic Investigation of the Louisiana Chenier Plain

HNC – Houma Navigation Canal

HQUSACE – Headquarters, United States Army Corps of Engineers

HSI – Habitat Suitability Index

HTRW – Hazardous, Toxic, or Radioactive Waste

IHNC – Inner Harbor Navigation Canal

ISA – Initial Site Assessment

ITM - Inland Testing Manual

IWR – Institute of Water Resources

LAC – Louisiana Administrative Code

LADNR – Louisiana Department of Natural Resources

LADNR-CMD – Louisiana Department of Natural Resources-Coastal Management Division

LADNR-CRD – Louisiana Department of Natural Resources-Coastal Restoration Division

LCA – Louisiana Coastal Area

LCRP – Louisiana Coastal Resources Program

LCWCRTF – Louisiana Coastal Wetlands Conservation and Restoration Task Force

LDEQ – Louisiana Department of Environmental Quality

LDWF – Louisiana Department of Wildlife and Fisheries

LNHP – Louisiana Natural Heritage Program

LPBF - Lake Pontchartrain Basin Foundation

LPDES – Louisiana Pollution Discharge Elimination System

LOOP – Louisiana Offshore Oil Port

LSU – Louisiana State University

MCS – Management Classification System

mg/L – milligrams per liter

Mgal/d – Million gallons per day

mi2 – square miles

MMS – Minerals Management Service

MR – Main Report

MR&T – Mississippi River and Tributaries

MRC – Mississippi River Commission

MRGO – Mississippi River Gulf Outlet

MRL – Mississippi River Levee

MRSNFR - Mississippi River, Sediment, Nutrient, and Freshwater Redistribution

MVD – Mississippi Valley Division

MVN – Mississippi Valley New Orleans District

NAAQS – National Ambient Air Quality Standards

NASQAN – National Stream Quality Accounting Network

NAWCA – North American Wetlands Conservation Act

NAWMP - North American Waterfowl Management Plan

NED – National Economic Development

NEPA – National Environmental Policy Act

NER – National Ecosystem Restoration

NGOs – Non-Government Organizations

NGVD – National Geodetic Vertical Datum

NMFS – Department of Commerce National Marine Fisheries Service

NTRC – National Technical Review Committee

NOAA – National Oceanic and Atmospheric Administration

NPDES – National Pollutant Discharge Elimination System

NO2 – nitrogen dioxide

NOMSA – New Orleans metropolitan statistical area

NRCS – Department of Agriculture Natural Resources Conservation Service

NWR – National Wildlife Refuge

NWRC – National Wetlands Research Center

O&M – Operations and Maintenance

OCS – Outer Continental Shelf

OPEC – Organization of Petroleum Exporting Countries

ORCS – Old River Control System

P&G – Principles and Guidelines

pB – lead

PBMO – Plan that best meets objectives

PCWRP – [Louisiana] Parish Coastal Wetland Restoration Program

PDT – Project Delivery Team

PED – Preconstruction, Engineering, and Design

PEIS – Programmatic Environmental Impact Statement

PM-10 – Particulate matter less than ten microns

ppt – Parts Per Thousand

PVC – polyvinyl chloride

RA – Overfill Factor

RCRA – Resource Conservation Recovery Act

RO1 – Restoration Opportunity 1

ROD – Record of Decision

ROR – Restore or Retreat

RWG – Regional Working Group

RSLR – Relative Sea Level Rise

SA – Study Area

S&A – Supervision and Administration

S&T – Science and Technology

SAM– Saline Marsh

SAV – Submerged Aquatic Vegetation

S.C. – Sorting Criteria

SCORP – Louisiana Statewide Comprehensive Outdoor Recreation Plan

SETAC - Society of Environmental Toxicology and Chemistry

SHPO – State Historic Preservation Officer

SIP - State Implementation Plan

SP1 – Subprovince 1

SP2 – Subprovince 2

SP3 – Subprovince 3

SP4 – Subprovince 4

SO2 – sulfur dioxide

SQGs - sediment quality guidelines

SWCC – Soil and Water Conservation Committee

TMDL – Total Maximum Daily Limit

TSP – Tentatively Selected Plan

UDV – Unit Day Value

UNO – University of New Orleans

ULL – University of Louisiana at Lafayette

USACE – United States Army Corps of Engineers

USACE-MVN – United States Army Corps of Engineers – Mississippi Valley New Orleans District

USACE-OVEST - USACE Office of the Chief of Engineers Value Engineering Study Team

USEPA – United States Environmental Protection Agency

USFWS – U.S. Fish and Wildlife Service

USGS – United States Geological Survey

VE/ITR - Value Engineering/Independent Technical Review

VOC – Volatile Organic Compounds

VT – Vertical Team

WCRA – Wetlands Conservation and Restoration Authority

WCRF - Wetlands Conservation and Restoration Fund

WCSC - Waterborne Commerce Statistics Center

WMA – Wildlife Management Area

WRDA – Water Resource Development Act

WVA – Wetland Value Assessment

8.7 INDEX

SUMMARY

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8.8 MEASURMENTS

MEASUREMENTS			
METRIC SYSTEM[1]			
LENGTH			
Unit	*Abbreviation*	*Number of Meters*	*Approximate U.S. Equivalent*
kilometer	km	1,000	0.62 mile
hectometer	hm	100	328.08 feet
dekameter	dam	10	32.81 feet
meter	m	1	39.37 inches
decimeter	dm	0.1	3.94 inches
centimeter	cm	0.01	0.39 inch
millimeter	mm	0.001	0.039 inch
micrometer	µm	0.000001	0.000039 inch
AREA			
Unit	*Abbreviation*	*Number of Square Meters*	*Approximate U.S. Equivalent*
square kilometer	sq km *or* km^2	1,000,000	0.3861 square miles
hectare	ha	10,000	2.47 acres
are	a	100	119.60 square yards
square centimeter	sq cm *or* cm^2	0.0001	0.155 square inch
VOLUME			
Unit	*Abbreviation*	*Number of Cubic Meters*	*Approximate U.S. Equivalent*
cubic meter	m^3	1	1.307 cubic yards
cubic decimeter	dm^3	0.001	61.023 cubic inches
cubic centimeter	cu cm *or* cm^3 *also* cc	0.000001	0.061 cubic inch

CAPACITY					
Unit	*Abbreviation*	*Number of Liters*	*Approximate U.S. Equivalent*		
			cubic	*dry*	*liquid*
kiloliter	kl	1,000	1.31 cubic yards		
hectoliter	hl	100	3.53 cubic feet	2.84 bushels	
dekaliter	dal	10	0.35 cubic foot	1.14 pecks	2.64 gallons
liter	l	1	61.02 cubic inches	0.908 quart	1.057 quarts
cubic decimeter	dm^3	1	61.02 cubic inches	0.908 quart	1.057 quarts
deciliter	dl	0.10	6.1 cubic inches	0.18 pint	0.21 pint
centiliter	cl	0.01	0.61 cubic inch		0.338 fluid ounce
milliliter	ml	0.001	0.061 cubic inch		0.27 fluid dram
microliter	µl	0.000001	0.000061 cubic inch		0.00027 fluid dram

MASS AND WEIGHT			
Unit	*Abbreviation*	*Number of Grams*	*Approximate U.S. Equivalent*
metric ton	t	1,000,000	1.102 short tons
kilogram	kg	1,000	2.2046 pounds
hectogram	hg	100	3.527 ounces
dekagram	dag	10	0.353 ounce
gram	g	1	0.035 ounce
decigram	dg	0.10	1.543 grains
centigram	cg	0.01	0.154 grain
milligram	mg	0.001	0.015 grain
microgram	µg	0.000001	0.000015 grain

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APPENDIX A1

U.S. FISH AND WILDLIFE SERVICE
PLANNING AID INPUT
for
LCA COMPREHENSIVE STUDY

Completed by U.S. Fish and Wildlife Service, Lafayette, Louisiana

August 13, 2003

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Louisiana Coastal Area Comprehensive Study
Fish and Wildlife Benefits Evaluation

Completed by U.S. Fish and Wildlife Service, Lafayette, Louisiana

August 13, 2003

A team of scientists led by Dr. Robert Twilley of the University of Louisiana at Lafayette (LCA Modeling Team) is assisting the development and evaluation of restoration alternatives for the Louisiana Coastal Area Comprehensive Study (LCA). That team has developed a comprehensive modeling approach which utilizes numerical modeling and coarser-scale "desktop" modeling to forecast wetland conditions under future without-project (FWOP) and future with-project (FWP) scenarios. The numerical modeling includes the use of hydrodynamic, ecological, and water quality simulation models to predict hydroperiod, salinity, and sediment distribution. The desktop modeling has involved the development of a set of modules to convert numerical modeling results into landscape and ecological responses (e.g., acres of wetlands created). Outputs from the numerical models are utilized in the desktop models at different time intervals and space scales to predict habitat change, habitat loss, salinity, and a host of other pertinent variables. Desktop modules developed for this study include 1) Land-Building, 2) Habitat Switching, 3) Water Quality and 4) Habitat Use.

The Habitat Use module provides a methodology for estimating the impacts of restoration alternatives on fish and wildlife resources in the study area. That methodology is very similar to the Habitat Evaluation Procedures (HEP) developed by the U.S. Fish and Wildlife Service (Service). Twelve representative species/species groups of fish, shellfish, and wildlife were selected for evaluation, and include white shrimp, brown shrimp, American oyster, Gulf menhaden, spotted seatrout, Atlantic croaker, largemouth bass, American alligator, muskrat, mink, river otter, and dabbling ducks. The Service's published Habitat Suitability Index (HSI) models for the fish and shellfish species were modified to only include those variables for which output would be available from numerical or other desktop models. Important variables for those species included salinity, temperature, water depth, and percent wetland area. Models for the wildlife species were developed with methods similar to those used for the fish and shellfish models. All of the wildlife models utilized three variables, i.e., habitat type, percent wetland area, and water depth.

Originally, the Service intended to use the Habitat Use module outputs to determine impacts to fish and wildlife resources in the study area. Several inconsistencies and problems were noted, however, when comparing outputs among restoration alternatives and across the four coastal Subprovinces. Of particular concern is the projected increase in habitat values for most of the evaluation species under the No Action alternative and the inverse relationship between wetland dependent wildlife benefits and increases in their preferred habitats under some scenarios. Therefore, the Service decided to use an interim method to determine impacts to fish and wildlife until the LCA numerical and desktop models are further refined to more accurately project impacts to fish and wildlife resources. The Service fully intends to continue assisting the LCA

Modeling Team and the other involved agencies as part of an ongoing effort to refine model outputs. The Service fully recognizes that the plan selection process is ongoing, and that the estimates presented here reflect a set of wetland restoration measures that continues to be refined. Therefore, the benefit estimates presented in this evaluation should be viewed as interim values.

Evaluation Methodology

To determine impacts of the Preferred Plan on fish and wildlife resources, the Service used a modification of the HEP. Biologists with the USACE, Louisiana Department of Wildlife and Fisheries, and the Service selected 10 of the 12 evaluation species from the Habitat Use module. The species selected represent fish and wildlife resources which utilize the full range of coastal wetland habitats, from swamp to saline marsh. Estuarine-dependent species selected for evaluation include Atlantic croaker, spotted seatrout, Gulf menhaden, brown shrimp, and white shrimp. Wildlife species selected for evaluation include mink, river otter, muskrat, American alligator, and dabbling ducks. The largemouth bass was not selected as an evaluation species because its HSI model is primarily used for lacustrine and riverine habitats, not estuarine habitats. Therefore, it was difficult to draw inferences from the published HSI model and apply them to estuarine habitats, as was done for the other evaluation species. In addition, largemouth bass prefer low-salinity habitats such as fresh and intermediate marsh; thus, benefits to that species could be inferred from benefits to other low-salinity species (e.g., dabbling ducks and American alligator). In addition, the American oyster was not selected as an evaluation species because it is not impacted by the quality of emergent wetland habitat. Habitat suitability for each of the selected species is dependent on emergent wetland habitat conditions.

To determine impacts on each evaluation species, the Service incorporated habitat change and wetland acres projected by the LCA numerical and desktop models and an HSI for each species for each wetland type into the HEP methodology to determine impacts in terms of net Average Annual Habitat Units (AAHUs). To derive AAHUs, a species' HSI for a specific habitat type is multiplied by the acreage of that habitat type to obtain Habitat Units, which are annualized over the evaluation period (i.e., 50 years). Net AAHUs represents the difference in AAHUs between the Preferred Plan, and No Action conditions.

Because the models used to project future habitat types assigned a single average salinity value to a very large area or "salinity box", salinities are essentially averaged across those areas. In some cases, this has eliminated actual salinity gradients and caused unexpected shifts in projected salinities (those shifts appear at target year 10, the first future projection). Not having a better method for projecting future habitat type changes, the Service has used the existing habitat type data until the methodology can be improved.

HSI values for each wetland type were derived for the wildlife species using the wetland type-habitat suitability relationships found in the LCA Habitat Use module. For the estuarine-dependent species, HSI values were provided by the National Marine Fisheries Service utilizing the published salinity-habitat suitability relationships found in each species' HSI model. The HSI values for each evaluation species, by wetland type, are displayed in Table 1.

Table 1. HSI Values for each Evaluation Species by Wetland Type

Evaluation Species	Swamp	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Saline Marsh
Atlantic Croaker	0	0.4	0.8	1.0	0.6
Spotted Seatrout	0	0.1	0.2	0.5	0.9
Gulf Menhaden	0	0.2	0.4	0.6	0.9
Brown Shrimp	0	0.1	0.3	0.8	1.0
White Shrimp	0	0.2	1.0	1.0	0.7
Mink	0.68	0.40	0.29	0.24	0
River Otter	0.68	0.39	0.67	1.0	0
Muskrat	0.04	0.21	0.11	1.0	0.43
American Alligator	0.26	0.55	1.0	0.55	0
Dabbling Ducks	0.66	1.0	0.69	0.66	0.08

Evaluation of the Preferred Plan

Subprovince 1

In this Subprovince, restoration features of the Preferred Plan are as follows: 1) a 5,000 cubic feet per second (cfs) diversion into the Maurepas Swamp at Convent/Blind River; 2) a 1,000 cfs diversion into the Maurepas Swamp at Hope Canal; 3) a 10,000 cfs diversion into the Breton Sound Basin at White's Ditch; 4) a 110,000 cfs diversion into the Breton Sound Basin at American/California Bay with sediment enrichment; 5) a 12,000 cfs diversion at Bayou Lamoque; 6) Seabrook salinity control structure; 7) optimize Caernarvon Freshwater Diversion Project to optimize marsh creation; 8) opportunistic use of the Bonnet Carre Spillway; 9) gap Amite River Diversion Canal spoil banks; 9) restore Labranche wetlands through sediment delivery; 10) rehabilitate and operate the Violet Siphon; 11) study the diversion of freshwater from the Mississippi River through the IHNC; and 12) nourish land bridge marshes.

Under the No Action Alternative, wetland loss continues with over 47,000 acres lost by year 50. Under the Preferred Plan, wetland acreage would increase through deltaic land-building resulting in a gain of over 118,000 acres by year 50. Compared to the No Action Alternative, the Preferred Plan would result in a gain of over 166,700 wetland acres (Table 2) at year 50. Freshwater diversion associated with the Preferred Plan would also increase fresh and intermediate marsh acreages, compared to the No Action Alternative under which the acreage of all habitat types would decrease between years 10 and 50. The proposed diversions into brackish and/or saline marsh areas (White's Ditch, American/California Bay, and Bayou Lamoque) would result in greater amounts of fresh and intermediate marsh, at the expense of brackish and saline marsh, compared to No Action.

Table 2. Subprovince 1 wetland type distribution (acres) for the No Action and Preferred Plan Alternatives

Subprovince 1 - No Action Alternative

Wetland type	acres00	acres10	acres20	acres30	acres40	acres50
Fresh marsh	71,279	218,350	215,393	211,989	210,104	207,760
Intermediate marsh	160,752	101,797	101,113	99,948	99,045	98,156
Brackish marsh	180,441	151,820	150,303	148,071	146,116	142,972
Saline marsh	113,149	61,278	58,879	58,241	55,652	54,802
Swamp	353,904	336,154	333,897	331,680	329,497	327,350
Total wetlands	879,525	869,399	859,586	849,929	840,414	831,040

Subprovince 1 - Preferred Plan Alternative

Wetland type	acres00	acres10	acres20	acres30	acres40	acres50
Fresh marsh	71,279	231,822	245,951	263,623	282,554	300,482
Intermediate marsh	160,752	225,491	242,345	252,678	261,799	269,920
Brackish marsh	180,441	63,800	62,750	62,099	61,086	60,190
Saline marsh	113,149	56,738	55,297	54,485	52,360	51,558
Swamp	353,904	329,470	325,290	321,915	319,112	315,646
Total wetlands	879,525	907,320	931,632	954,801	976,912	997,796

Of the five wildlife species evaluated, four would benefit from the proposed restoration features associated with the Preferred Plan. Mink, which prefer swamp and fresh and intermediate marsh, would benefit from the projected increase in those wetland types. Overall, mink habitat value, in terms of AAHUs, would increase by 5.7 percent. The American alligator and dabbling ducks also prefer fresher environments and, thus, would benefit from the projected increase in fresh and intermediate marshes. Habitat value for the American alligator and dabbling ducks would increase by 22.2 percent and 11.7 percent, respectively. The river otter prefers brackish marsh, but swamp, fresh marsh, and intermediate marsh also provide desirable habitat for that species. Although brackish marsh would decline with the Preferred Plan, the projected increase in swamp and fresh and intermediate marshes would offset the predicted loss of the otter's preferred habitat, brackish marsh. Therefore, the HEP analysis indicates that the Preferred Plan would result in a 5.5 percent increase in AAHUs for the river otter. The muskrat is the only evaluation species, which would be negatively impacted by the Preferred Plan. Brackish marsh is considered its preferred habitat and has a much higher value for that species than fresh and intermediate marshes. Due to the anticipated decline in brackish marsh acreage, a net decrease in muskrat AAHUs of 19.7 percent is projected under FWP conditions. Table 3 displays AAHUs by wetland type for each of the evaluation species.

Table 3. Impacts (AAHUs) of the Preferred Plan Alternative on coastal wildlife in Subprovince 1

Wetland Type	Mink		Otter		Muskrat		Alligator		Dabbling Ducks	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	55,262	73,435	53,880	71,600	29,012	38,554	75,985	100,974	138,155	183,589
Intermediate	37,723	62,131	87,154	143,544	14,309	23,567	130,080	214,245	89,755	147,829
Brackish	38,899	29,164	162,081	121,518	162,081	121,518	89,145	66,835	106,974	80,202
Saline	0	0	0	0	59,407	26,495	0	0	11,052	4,929
Swamp	340,892	335,157	231,807	227,907	13,636	13,406	88,632	87,141	224,989	221,204
Total	**472,777**	**499,888**	**534,922**	**564,568**	**278,445**	**223,539**	**383,842**	**469,194**	**570,925**	**637,752**

Four of the five fish species evaluated would be adversely affected by the Preferred Plan Alternative (Table 4). Atlantic croaker, Gulf menhaden, and white shrimp typically utilize low-salinity habitats as juveniles and more brackish habitats as subadults and adults. Of those species, white shrimp would receive a minute positive effect under the Preferred Plan and Atlantic croaker would experience a minute negative impact. Gulf menhaden would experience a moderate decrease of 16.8 percent in AAHUs. In response to the loss of their preferred brackish habitats, spotted seatrout and brown shrimp would experience greater decreases in AAHUs of 27.6 percent and 24.7 percent, respectively.

Table 4. Impacts (AAHUs) of Preferred Plan Alternative on coastal fisheries in Subprovince 1

Wetland Type	Croaker		Menhaden		Spotted Seatrout		White Shrimp		Brown Shrimp	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	55,262	73,435	27,631	36,718	13,815	18,359	55,262	73,435	13,815	18,359
Intermediate	104,064	171,396	52,032	85,698	26,016	42,849	130,080	214,245	39,024	64,273
Brackish	162,081	121,518	97,249	72,911	81,041	60,759	162,081	121,518	129,665	97,214
Saline	82,893	36,969	124,339	55,454	124,339	55,454	110,524	49,293	138,155	61,616
Swamp	0	0	0	0	0	0	0	0	0	0
Total	**404,300**	**403,318**	**301,251**	**250,780**	**245,211**	**177,421**	**457,947**	**458,490**	**320,659**	**241,462**

Subprovince 2

Restoration features of the Preferred Plan include: 1) a 5,000 cfs diversions at Edgard with sediment enrichment; 2) a 5,000 cfs pulsed diversion at Myrtle Grove; 3) a 60,000 cfs diversion at Fort Jackson with sediment enrichment; 4) wetland creation; 5) barrier island restoration; 6) reauthorization of the Davis Pond Diversion at 5,000 cfs; 7) initiate the Mississippi River Delta Management Study; and 8) the Third Delta freshwater and sediment diversion.

Under the No Action Plan an additional 163,000 acres of wetlands would be lost over 50 years. Implementation of the Preferred Plan would reduce that loss to less than 58,000 acres. Over 50 years, the net effect of the Preferred Plan would be to save almost 106,000 wetland acres. The No Action alternative used for this analysis does not include the Davis Pond Freshwater Diversion Project. The Service believes that the current LCA modeling analysis for No Action, which included the Davis Pond Diversion, does not accurately project the likely distribution of wetland types in the Barataria Basin.

The Preferred Plan would cause a shift toward fresher conditions in Subprovince 2 compared to the No Action Alternative. The diversions at Myrtle Grove and Fort Jackson would result in greater amounts of fresh and intermediate marsh, at the expense of brackish marsh, compared to the No Action scenario. Those diversions, with the associated sediment enrichment, would also result in the restoration/creation of several thousand acres of wetlands. Habitat distribution with this alternative compared to the No Action alternative is shown in Table 5. However, the Service believes that the current LCA modeling analysis for the Preferred Plan, which indicates that no brackish and saline marsh would exist at year 10, is inaccurate. Refinement of model output is planned in the future.

Table 5. Subprovince 2 wetland type distribution (acres) for the No Action and Preferred Plan Alternatives

Subprovince 2 - No Action Alternative

Wetland type	acres00	acres10	acres20	acres30	acres40	acres50
Fresh marsh	180,876	306,490	290,379	275,368	260,297	244,994
Intermediate marsh	85,267	996	750	747	494	488
Brackish marsh	65,338	107,558	87,039	70,958	59,271	52,168
Saline marsh	117,809	0	0	0	0	0
Swamp	294,397	289,559	290,879	289,560	286,968	282,291
Total wetlands	743,687	704,602	669,046	636,633	607,030	579,940

Subprovince 2 - Preferred Plan Alternative

Wetland type	acres00	acres10	acres20	acres30	acres40	acres50
Fresh marsh	180,876	321,531	317,750	308,436	299,097	289,385
Intermediate marsh	85,267	152,727	150,297	141,436	131,829	122,469
Brackish marsh	65,338	0	0	0	0	0
Saline marsh	117,809	0	0	0	0	0
Swamp	294,397	283,288	281,021	277,855	274,526	274,018
Total wetlands	743,687	757,547	749,068	727,726	705,452	685,872

Except for muskrat, each of the wildlife species evaluated would benefit from the proposed restoration features associated with the Preferred Plan. The American alligator and dabbling ducks would benefit the most with 21.1 percent and 9.1 percent increases in AAHUs, respectively. Mink, which prefers swamp and fresh marsh, would also benefit from the projected increase in those wetland types. Overall, mink AAHUs would increase by 4.0 percent. The river otter prefers brackish marsh, but swamp, fresh marsh, and intermediate marsh also provide desirable habitat for that species. Although brackish marsh would decline with this alternative, the projected increase in swamp and fresh and intermediate marshes would offset the loss of the otter's preferred habitat. Our analysis indicates that the Preferred Plan would result in a 5.5 percent increase in AAHUs for the river otter. Brackish marsh is considered preferred muskrat habitat and has a much higher value for that species than fresh and intermediate marshes. The projected reduction in brackish marsh, compared to the No Action Alternative, results in a 10.0 percent decrease in AAHUs for the muskrat. Table 6 displays AAHUs by wetland type for each of the evaluation species.

Table 6. Impacts (AAHUs) of the Preferred Plan on coastal wildlife in Subprovince 2

Wetland Type	Mink		Otter		Muskrat		Alligator		Dabbling Ducks	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	84,918	93,618	82,795	91,278	44,582	49,150	116,762	128,725	212,294	234,046
Intermediate	12,680	30,014	29,296	69,342	4,810	11,385	43,725	103,496	30,170	71,412
Brackish	14,132	7,997	58,884	33,322	58,884	33,322	32,386	18,327	38,864	21,993
Saline	0	0	0	0	25,836	25,836	0	0	4,807	4,807
Swamp	288,465	284,411	196,156	193,400	11,539	11,376	75,001	73,947	190,387	187,711
Total	**400,195**	**416,041**	**367,131**	**387,342**	**145,650**	**131,068**	**267,874**	**324,495**	**476,521**	**519,969**

Of the five fish species evaluated, all but brown shrimp would benefit under the Preferred Plan (Table 7). Brown shrimp, which prefer brackish marshes, would experience a very slight decrease in AAHUs. Atlantic croaker, Gulf menhaden, and white shrimp, which typically utilize low-salinity habitats as juveniles and more-brackish habitats as subadults and adults, would receive the greatest benefits (AAHU increases of 14.4 percent, 8.7 percent, and 18.2 percent, respectively). Those benefits, derived largely from a substantial increase in marsh acreage through deltaic landbuilding, would more than offset the adverse affects of the conversion of brackish habitats to fresher habitats. For spotted seatrout, the negative effects of losing the brackish marsh under the Preferred Plan would be compensated for by the beneficial effects of substantial deltaic land building and increases in low-salinity habitat acreages.

Table 7. Impacts (AAHUs) of the Preferred Plan on coastal fisheries in Subprovince 2

Wetland Type	Croaker		Menhaden		Spotted Seatrout		White Shrimp		Brown Shrimp	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	84,918	93,618	42,459	46,809	21,229	23,405	84,918	93,618	21,229	23,405
Intermediate	34,980	82,797	17,490	41,398	8,745	20,699	43,725	103,496	13,117	31,049
Brackish	58,884	33,322	35,331	19,993	29,442	16,661	58,884	33,322	47,107	26,658
Saline	36,050	36,050	54,074	54,074	36,050	36,050	48,066	48,066	60,083	60,083
Swamp	0	0	0	0	0	0	0	0	0	0
Total	**214,831**	**245,787**	**149,354**	**162,275**	**95,466**	**96,814**	**235,593**	**278,502**	**141,537**	**141,194**

Subprovince 3

Features of the Preferred Plan are as follows: 1) a 1,000 cfs pump at Bayou Lafourche; 2) features to convey Atchafalaya River water to the eastern Terrebonne marshes; 3) freshwater introduction via Blue Hammock Bayou and south of Lake DeCade; 4) the Penchant Basin Restoration Plan; 5) relocation of the Atchafalaya River navigation channel to Shell Island Pass; 6) increased sediment transport down the Wax Lake Outlet; 7) modification of operation of the Old River Control structure; 8) multi-purpose operation of the Houma Navigation Canal Lock; 9) maintain north Cote Blanche Bay shore; 10) rebuild the Pointe Chevreuil reef; 11) restore the Isle Dernieres and Timbalier Islands; 12) restore and maintain the landbridge between Sister Lake and the Gulf; and 13) armor the Pointe au Fer Gulf shoreline.

At year 50, wetland loss under the No Action Plan (over 203,000 acres) would be greater in Subprovince 3 than in any other Subprovince. The Preferred Plan would reduce that loss to less than 84,000 acres. That loss would be the greatest Preferred Plan loss of any Subprovince. However, over 50 years, the Preferred Plan would save over 119,000 wetland acres in Subprovince 3, compared to the No Action Alternative.

According to model projections at year 50, the Preferred Plan would save substantially more fresh marsh than would the No Action alternative. Marsh-building processes on the Atchafalaya and Wax Lake Deltas would be made more efficient with relocation of the navigation channel and sediment enrichment of the Wax Lake Outlet. The Penchant Basin Restoration Plan would improve the health and productivity of flotant marsh in western Terrebonne and greater volumes of fresh water, sediments, and nutrients would be delivered to marshes south of the Penchant Basin. Conveyance of Atchafalaya River water to marshes in eastern Terrebonne would improve productivity and reduce marsh loss in areas where marine processes are advancing inland. Under the Preferred Plan, brackish marsh would decrease nearly 20 percent over 50 years, saline marsh would increase by over 200 percent, and swamp would decrease by nearly 4 percent. Habitat distribution for this alternative, compared to the No Action alternative, is shown in Table 8.

Table 8. Wetland type distribution (acres) at year 50 for Subprovince 3 for the No Action and the Preferred Plan Alternatives

Subprovince 3 - No Action Alternative

Wetland type	acres00	acres10	acres20	acres30	acres40	acres50
Fresh marsh	341,733	39,008	38,143	37,981	36,677	33,294
Intermediate marsh	193,569	647,998	645,519	639,828	627,832	619,079
Brackish marsh	201,216	100,504	86,608	69,219	55,812	40,046
Saline marsh	113,513	61,496	41,509	25,620	12,985	5,355
Swamp	388,811	339,603	331,847	331,263	334,418	337,828
Total wetlands	1,238,841	1,188,609	1,143,626	1,103,911	1,067,724	1,035,601

Subprovince 3 - Preferred Plan Alternative

Wetland type	acres00	acres10	acres20	acres30	acres40	acres50
Fresh marsh	341,733	221,320	214,225	203,142	188,130	175,592
Intermediate marsh	193,569	553,530	565,762	578,639	594,813	605,659
Brackish marsh	201,216	35,430	33,706	33,033	32,436	32,088
Saline marsh	113,513	74,540	54,970	37,977	23,936	16,490
Swamp	388,811	340,952	335,023	331,678	329,060	325,335
Total wetlands	1,238,841	1,225,772	1,203,685	1,184,469	1,168,376	1,155,164

Each of the five wildlife species evaluated would benefit from the proposed restoration features associated with the Preferred Plan Alternative. Muskrat, American alligator, and dabbling ducks would benefit the most, with 4.9 percent, 4.9 percent and 7.4 percent increases in AAHUs, respectively. Except for the muskrat, each of those species prefer fresher marshes, which would occur in substantially greater acreages with this alternative. Although the river otter and muskrat prefer brackish marsh, the projected increase in fresh and saline marshes would offset the relatively minor decrease in their preferred habitat. Table 9 displays AAHUs by wetland type for each of the evaluation species.

Table 9. Impacts (AAHUs) of the Preferred Plan Alternative on coastal wildlife in Subprovince 3

Wetland Type	Mink		Otter		Muskrat		Alligator		Dabbling Ducks	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	76,239	104,130	74,333	101,526	40,026	54,668	104,829	143,178	190,598	260,324
Intermediate	116,600	114,693	269,386	264,980	44,228	43,504	402,069	395,493	277,428	272,890
Brackish	29,338	28,402	122,243	118,343	122,243	118,343	67,233	65,089	80,680	78,107
Saline	0	0	0	0	26,022	28,368	0	0	4,841	5,278
Swamp	363,829	357,708	247,404	243,241	14,553	14,308	94,596	93,004	240,127	236,087
Total	**586,006**	**604,933**	**713,366**	**728,091**	**247,071**	**259,192**	**668,727**	**696,764**	**793,674**	**852,685**

The Preferred Plan would benefit all five fish species evaluated (Table 10). For species such as Atlantic croaker, Gulf menhaden, and white shrimp, which typically utilize low-salinity habitats as juveniles and more-brackish habitats as subadults and adults, those benefits are likely due to the substantial increase in fresh marsh acreage. Brackish marsh species such as brown shrimp and spotted seatrout would also benefit by increased acreage of fresh marsh habitat. Those increases, together with the increased acreage of saline marsh, would more than compensate for the small loss of preferred brackish marsh habitat, and would result in a small positive benefit for spotted seatrout (4.0 percent) and a slight increase for brown shrimp (2.5 percent) under the Preferred Plan.

Table 10. Impacts (AAHUs) of the Preferred Plan Alternative on Coastal Fisheries in Subprovince 3

Wetland Type	Croaker		Menhaden		Spotted Seatrout		White Shrimp		Brown Shrimp	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	76,239	104,130	38,120	52,065	19,060	26,032	76,239	104,130	19,060	26,032
Intermediate	321,655	316,394	160,828	158,197	80,414	79,099	402,069	395,493	120,621	118,648
Brackish	122,243	118,343	73,346	71,006	61,121	59,172	122,243	118,343	97,794	94,675
Saline	36,309	39,583	54,464	59,374	54,464	59,374	48,412	52,777	60,515	65,971
Swamp	0	0	0	0	0	0	0	0	0	0
Total	**556,446**	**578,450**	**326,757**	**340,642**	**215,059**	**223,677**	**648,963**	**670,743**	**297,990**	**305,326**

Subprovince 4

Preferred Plan restoration features are as follows: 1) salinity control at Oyster Bayou, Long Point Bayou, Black Lake Bayou, Alkali Ditch, Black Bayou, and the Highway 82 Causeway; 2) modification of the existing Cameron-Creole Watershed structures; 3) the East Sabine Hydrologic Restoration Project; 4) freshwater introduction at Pecan Island, Rollover Bayou, Highway 82, Little Pecan Bayou, and South Grand Chenier; 5) shoreline stabilization along the Gulf of Mexico; 6) beneficial use of dredged material along the Calcasieu Ship Channel; and 7) introduction of fresh water via the Sabine Irrigation Canal.

Under the Preferred Plan, wetland loss over 50 years would be limited to slightly more than 8,000 acres. However, under the No Action Alternative, the 50 year wetland loss would exceed 47,000 acres. Over the 50 year project life, the Preferred Plan Alternative would save over 39,000 wetland acres compared to the No Action Alternative.
The Preferred Plan Alternative, which utilizes perimeter structural salinity control and small freshwater diversions, would reduce the encroachment of marine processes and protect fresh and intermediate mashes throughout Subprovince 4. Consequently, under the Preferred Plan, the acreage of fresh and intermediate marshes would increase and brackish marsh acreage would

decrease, compared to the No Action Alternative. Habitat distribution for those alternatives is shown in Table 11.

Table 11. Wetland type distribution (acres) at year 50 for Subprovince 4 for the No Action and Preferred Plan Alternatives

Subprovince 4 - No Action Alternative

Wetland type	acres00	Acres10	acres20	acres30	acres40	acres50
Fresh marsh	346,923	327,770	329,149	322,709	317,432	312,800
Intermediate marsh	284,702	252,741	252,199	247,418	242,973	238,517
Brackish marsh	137,529	203,099	210,131	207,889	205,021	202,292
Saline marsh	30,307	0	0	0	0	0
Swamp	3,674	2,493	2,325	2,301	2,269	2,239
Total wetlands	803,134	786,103	793,804	780,317	767,695	755,848

Subprovince 4 - Preferred Plan Alternative

Wetland type	acres00	Acres10	acres20	acres30	acres40	acres50
Fresh marsh	346,923	329,535	335,420	331,951	328,759	326,685
Intermediate marsh	284,702	319,515	321,051	317,444	314,143	310,088
Brackish marsh	137,529	144,385	153,770	156,162	153,788	155,884
Saline marsh	30,307	0	0	0	0	0
Swamp	3,674	2,505	2,359	2,347	2,330	2,311
Total wetlands	803,134	795,940	812,599	807,903	799,020	794,968

Of the five wildlife species evaluated, all but muskrat would benefit from the proposed restoration features associated with the Preferred Plan Alternative. Mink, river otter, American alligator, and dabbling ducks would benefit with 3.0 percent, 0.7 percent, 4.9 percent, and 2.6 percent increases in AAHUs, respectively. Each of those species, except the river otter, prefers the fresher wetland types such as fresh and intermediate marsh, which would occur in substantially greater acreages with this alternative. Although the river otter prefers brackish marsh, the projected increase in fresh and intermediate marsh would offset the loss of its preferred habitat. The muskrat, however, would experience a 6.4 percent reduction in habitat value due to brackish marsh decreases under the Preferred Plan. Table 12 displays AAHUs by wetland type for each evaluation species.

Table 12. Impacts (AAHUs) of the Preferred Plan Alternative on coastal wildlife in Subprovince 4

Wetland Type	Mink		Otter		Muskrat		Alligator		Dabbling Ducks	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	132,081	134,802	128,779	131,432	69,343	70,771	181,611	185,353	330,202	337,006
Intermediate	76,001	86,171	175,588	199,084	28,828	32,685	262,071	297,141	180,829	205,027
Brackish	40,623	35,166	169,263	146,523	169,263	146,523	93,095	80,588	111,714	96,705
Saline	0	0	0	0	6,646	6,646	0	0	1,237	1,237
Swamp	2,970	3,006	2,020	2,044	119	120	772	782	1,961	1,984
Total	**251,675**	**259,145**	**475,650**	**479,084**	**274,199**	**256,747**	**537,550**	**563,864**	**625,942**	**641,959**

Compared to the No Action Alternative, Atlantic croaker, Gulf menhaden, and white shrimp, which utilize low salinity marshes as nursery habitat, would be benefited under the Preferred Plan Alternative. Those benefits are likely due to increases in fresh and intermediate marsh acreages under this alternative. Species such as spotted seatrout and brown shrimp would also benefit from gains in fresh and intermediate marsh. However, those benefits would not compensate for the substantial loss of preferred brackish marsh habitat. As a result, spotted seatrout and brown shrimp would experience small decreases in AAHUs of 2.0 percent and 2.7 percent, respectively.

Table 13. Impacts (AAHUs) of the Preferred Plan Alternative on coastal fisheries in Subprovince 4

Wetland Type	Croaker		Menhaden		Spotted Seatrout		White Shrimp		Brown Shrimp	
	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan	No Action	Preferred Plan
Fresh	132,081	134,802	66,040	67,401	33,020	33,701	132,081	134,802	33,020	33,701
Intermediate	209,657	237,713	104,829	118,856	52,414	59,428	262,071	297,141	78,621	89,142
Brackish	169,263	146,523	101,558	87,914	84,632	73,262	169,263	146,523	135,410	117,219
Saline	9,274	9,274	13,911	13,911	13,911	13,911	12,365	12,365	15,457	15,457
Swamp	0	0	0	0	0	0	0	0	0	0
Total	**520,275**	**528,312**	**286,338**	**288,082**	**183,977**	**180,301**	**575,781**	**590,832**	**262,509**	**255,518**

Coastwide Benefits Summary

The coastwide effects of the Preferred Plan Alternative for each Subprovince would include a substantial increase in fresh marsh, a moderate increase in intermediate marsh, a substantial reduction in brackish marsh, a small gain in saline marsh, and a slight decrease in swamp (Table 14). Thus, the Preferred Plan Alternative would result in a combined net increase of over 431,000 wetland acres at year 50, compared to the No Action scenario.

Table 14. Coastwide wetland type distribution (acres) at year 50 for the No Action and the Preferred Plan Alternatives

Coastwide wetland acreage - No Action Alternative

Wetland type	acres00	Acres10	acres20	acres30	acres40	acres50
Fresh marsh	940,811	891,618	873,064	848,047	824,509	798,847
Intermediate marsh	724,289	1,003,532	999,582	987,941	970,344	956,240
Brackish marsh	584,524	562,981	534,080	496,138	466,220	437,477
Saline marsh	374,778	122,774	100,388	83,861	68,637	60,157
Swamp	1,040,785	967,809	958,948	954,803	953,153	949,707
Total wetlands	3,665,188	3,548,713	3,466,062	3,370,791	3,282,862	3,202,429

Coastwide wetland acreage - Preferred Plan Alternative

Wetland type	acres00	Acres10	acres20	acres30	acres40	acres50
Fresh marsh	940,811	1,104,208	1,113,345	1,107,151	1,098,540	1,092,144
Intermediate marsh	724,289	1,251,263	1,279,454	1,290,197	1,302,585	1,308,136
Brackish marsh	584,524	243,615	250,226	251,294	247,311	248,162
Saline marsh	374,778	131,278	110,267	92,462	76,296	68,047
Swamp	1,040,785	956,215	943,694	933,795	925,028	917,310
Total wetlands	3,665,188	3,686,579	3,696,985	3,674,899	3,649,759	3,633,799

By year 50 under the No Action Alternative, loss of coastal wetlands would continue with nearly 463,000 acres being lost. However, under the Preferred Plan Alternative, those losses would be nearly eliminated with only 31,389 acres being lost under the Preferred Plan Alternative. Under the No Action Alternative, the acreage of all habitat types would decrease, except for intermediate marsh, which might increase. Saline marsh would experience the greatest decrease (60 percent) over 50 years. Because the drastic shifts in saline and intermediate marsh acreage are projected to occur by year 10, they may be unrealistic artifacts of the salinity projection methodology. Future refinement of the methodology may yield estimates depicting a more gradual change in habitat type acreages.

Coastwide effects on evaluated fish and wildlife species reflect the acreage changes of the various wetland types. Due to the large increase in their preferred fresh and intermediate habitats, dabbling ducks and the American alligator would be most benefited, with a 10.6 and 7.5 percent increases in AAHUs, respectively (Table 15). Other fish and wildlife that utilize low-salinity habitats, such as mink, Atlantic croaker, and white shrimp, would also benefit, but to a lesser degree. However, Gulf menhaden, which utilize low-salinity habitats as juveniles, would experience a coastwide 2.1 percent decrease in AAHUs (due to the substantial impacts of the Preferred Plan in Subprovince 1). Consistent with the decrease in brackish marsh acreage, species which prefer brackish habitats (such as muskrat, spotted seatrout, and brown shrimp), would experience decreases in AAHUs of 7.9 percent, 8.3 percent, and 7.7 percent, respectively.

Table 15. Coastwide impacts (AAHUs) on fish and wildlife at year 50 for the No Action and the Preferred Plan Alternatives

Species	No Action Alternative	Preferred Plan Alternative	Difference	Percent Change
Mink	1,710,654	1,780,006	69,353	4.1
Otter	2,091,068	2,159,085	68,017	3.3
Muskrat	945,364	870,546	-74,818	-7.9
Alligator	1,857,992	2,054,316	196,324	10.6
Dabbling Ducks	2,467,062	2,652,365	185,303	7.5
Atlantic Croaker	1,695,852	1,755,867	60,015	3.5
Gulf Menhaden	1,063,699	1,041,780	-21,919	-2.1
Spotted Seatrout	739,713	678,213	-61,500	-8.3
White Shrimp	1,918,283	1,998,567	80,284	4.2
Brown Shrimp	1,022,695	943,500	-79,195	-7.7

APPENDIX A2

PEIS MAIL LIST

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APPENDIX A2

PEIS MAIL LIST

Business (Dredging Construction Oil and Gas Companies)

Count: 55

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Apache Louisiana Minerals, Inc. Scott Rosteet / Cameron
Avoca Inc. Mr. Paul Hogan / President / New Orleans
Bernard Mcmenamy Cont Inc Dredging Mar & Gen Contractors / Florissant
Berry Brothers Gen Contractors Inc. Attn: Weldon Miller / Berwick
Bud Brodtmann Environmental Professional Ltd / Metairie
Carr Oil Company Inc / Franklin
Castex Laterre, Inc / Houma
CF Bean Corporation Mr. William J. Ashy / Lafayette
Circle, Inc. / Belle Chasse
Cl Jack Stelly & Associates Inc / Lafayette
CNG Producing Company / New Orleans
Cockrell Oil Corporation / Houston
Conrad Industries Mr. J. Parker Conrad / President / Morgan City
David, Saunders & Miller / Metairie
Diamond Services Corporation / Morgan City
Engineering Development Group Inc / Metairie
Ford Construction Company Co / Dyerburg
Geological Consultant Robert P Waldron Inc / Metairie
George Strain Continental Land and Fur Co. Suite 500 / Metairie
Glynn Haines CO-MAR Offshore Corporation / Morgan City
Grand Isle Material Co Inc / Grand Isle
Grand Isle Shipyard Inc Robert Pregeant / Raceland
Grasso Services Division / Galveston
Gulf Coast Pre-stress Co Inc / Pass Christian
Hank Smart Roy O Martin Lumber Co Inc / Alexandria
Hydro Consultants Inc Mr. Ernest Gammon / Baton Rouge
J H Menge & Co. Attn: Buren Jones / New Orleans
Je Jumonville Contractor Inc / Plaquemine
John Connolly Shinteaux Env Ser / Baton Rouge
Kaiser Aluminum & Chemical Corp. Chairman Env. Department / Arabi
Larry Doiron Inc General Contracting / Morgan City
Luhr Bros Inc / Columbia
Massaman Construction Company / St. Louis
Matzinger Petroleum Company / Houston
Mike Plaisance Plaisance Dragline & Dredging Co Inc / Golden Meadow
Mr. Jim Porter Mid-Continent Oil & Gas / Baton Rouge
P Hutchinson Construction / New Orleans
Pontchartrain Materials Corp / New Orleans
Port Aggregates, Inc. Timothy J. Guinn / Lake Charles
Potashnick-Harrison Construction Company / Cape Girardeau
Rebstock Drilling Co / Kenner
Richard B. Koen Martin Marietta Aggregates / St. Rose
St. Mary Land & Exploration Co. Ms. Linda Ditsworth Suite 1100 / Denver
Stanley Stockstill Inc / St. Martinville
Swiftships Inc Mr. Robert Ness / President / Morgan City
T Baker Smith & Son Inc. / Houma
Tennessee Gas Pipeline Sugar Mill Point / Houma
Texaco Inc. / New Orleans
Thompson Marine Transport Mr. Bob Thompson / Morgan City
Trigon Exploration Inc / Lafayette
Walk Haydel's Assoc Mr. Frank H. Walk Chairman / New Orleans
WHC Inc / Lafayette
Williams Inc Mr. Hugh C Brown, Jr. / Patterson
Williams-McWilliams Co Inc / Metairie

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Count: 28

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Atchafalaya Basin Levee District Director William Tyson / Port Allen
Board of Commissioners Lake Charles Harbor And Terminal District / Lake Charles
Board of Commissioners Southeast Arkansas Levee District / Rohwer
Bossier Levee District / Benton
Caddo Levee District Administrator : Sam Windham / Shreveport
Campti-Clarence Levee District / Natchitoches
Cane River Levee and Drainage District / Natchitoches
City Parish Department of Public Works Fred Raiford, Director / Baton Rouge
Fifth Louisiana Levee District Madison Parish Courthouse / Tallulah
Grand Isle Independent Levee District David Camardelle / Grand Isle
Lafourche Basin Levee District Administrative Manager: Randy Trosclair / Vacherie
Lake Borgne Basin Levee District Robert Turner / Violet
Mr. Ed Preau C / Water Res Design & Dev Div LA-DOTD / Baton Rouge
Natchitoches Levee And Drainage District / Natchitoches
Nineteenth Louisiana Levee District / Colfax
North Bossier Levee District / Benton
Orleans Levee District Executive Director: Max Hearn / New Orleans
Pontchartrain Levee District Executive Director: Stephen Cupit / Lutcher
Red River, Atchafalaya, & Bayou Boeuf Levee District Vice President: Jessie Lachney / Alexandria
Red River-Bayou Pierre Levee and Drainage District / Coushatta

South Lafourche Levee District Executive Director: Windell Curole / Galliano
South Louisiana Tidal Water Control Levee District / Galliano
Teche-Vermillion Fresh Water District Executive Director: Jason Dupuis / Lafayette
Tensas Basin Levee District Executive Director : John Stringer / Monroe
Terrebonne Levee & Conservation Dist. Executive Director: Jerome Zeringue / Chauvin
West Cal Port Harbor and Terminal District John Dixon - Director / Sulphur
West Jefferson Levee District Exe. Director: Gerald Spohrer / Marrero

Business (Local and Other)

Count: 20

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C & M Contractors, Inc. Attn: Kenny Daigle / Lafitte
Camp, Carmouche, Barsh, Hunter, Gray & Hoffman 9th Floor - La Saving Bldg / Lake Charles
Entergy / Gretna
Entergy Land & R/W Manager / New Orleans
Gravity Drainage Dist No 4 of Calcasieu Parish Louisiana Ken Boudreaux / Lake Charles
JC Seafood / Arabi
John Price SSA Gulf Terminals / New Orleans
Kansas City Southern Railway Company / Kansas City
Kathy Pitre Lafourche Telephone Co Inc / La Rose
Marilyn Smith Digital Engineering and Imaging Inc / Kenner
New Orleans International Airport / New Orleans
O'Neil Malbrough Shaw Coastal, Inc. / Houma
South Central Planning and Development Mr. Craig Roussel / Gray
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St Charles Grain Elevator Attn: Darryl G. Peltier / Ama
Vinson & Elkins-Attys Mr. Larry W Nettles / Houston
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William L Yeates Jr. Director of Public Works / Covington

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Count: 25

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Board of Commissioners Morgan City Harbor And Terminal District / Morgan City
Board of Commissioners Vinton Harbor District / Vinton
Caddo-Bossier Parishes Port Comm / Shreveport
Crescent River Port Pilots Assoc. Mike Buccola / Belle Chasse
Dept of Planning, Zoning and Codes Executive Director Mr. John Raines / Lafayette
Executive Director Mr. John Lebourgeois-RPC Amoco Building / New Orleans
Grayling Hadnott Acadiana Regional Dev. Distr. / Lafayette
Greater Krotz Springs Port Commission / Krotz Springs
Greater Ouachita Port Commission / Monroe
Lafayette Area Planning Commission Mr. Roger Hedrick, Director / Lafayette
Mr. Channing F. Hayden, Jr. Steamship Association of Louisiana World Trade Center - Suite 2217 / New Orleans
N Delta Reg Plng & Dev District Federal Programs Review Coord. Ms. Judy Milton / Monroe
Nw Regional Clearinghouse Federal Programs Review Coord. Ms. Helen Esparaza / Shreveport
Ouachita Council of Governments Mr. David Creed / Monroe
Ouachita Port Commission Mr. Saul A. Mintz / President F. Strauss & Son Inc. / Monroe
Plaquemines Parish Government Plaq Port Harbor & Term Dist Andrew MacInnis-CAM / Belle Chasse
Port Manchac South Tangipahoa Port Commission / Ponchatoula
Port of Greater Baton Rouge David Beck Director of Engineering / Port Allen
Port of New Orleans Board of Commissioners Chief Engineer / New Orleans
Regional Planning Commission Federal Programs Review Coord. Karen Kirkland / Baton Rouge
South Central Planning & Development Ms. Marie Fertitta / Gray
South LA Port Commission Suite. 100 - Drawer K / LaPlace
Ted M. Falgout Greater Lafourche Port Commission / Galliano
Terrebonne Parish Council Waterways & Permit Committee Paul Labat / Houma

Coastal Restoration Branch Master List

Count: 1566

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A.J. Gibbs Crescent River Port Pilots' Association / Belle Chasse
Aaron Viles Gulf States Field Director U.S. Public Interest Research Group / New Orleans
Acadiana Regional Clearinghouse Grayling Hadnot Dir of Planning / Lafayette
Adam Babich Associate Professor Tulane Law School / New Orleans
Addison Ellis Private Citizen / Covington
Albert Prater Calcasieu Parish Police Jury Gov. Access Channel / Lake Charles
Albert S. Enos / Belle Chasse
Albin Champagne, Jr. / LaRose
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Alex Plaisance Louisiana Landowners Assoc. & Restore / Golden Meadow
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Alfred Lippman Lippman, Mahjouz and Martin / Morgan City
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Allied Towing Service Inc. Attn: Mr Gary Sercovitch / Venice
Alton Farbe / Ponchatoula
Amanda Phillips LA. DNR CRD / Baton Rouge
American Commercial Barge Line Co. Attn: Bryan Christy / New Orleans
American Commercial Barge Line Co. Attn: Port Captain / Jeffersonville
American Commercial Barge Line Co. Mr. Dennis M. Hill/dir-fleet O / Jeffersonville
American Press Brenda Merchant / Lake Charles
Ancil Taylor Bean Stuyvesant / New Orleans
Andrew Adams Citizen / Cut Off
Andrew and Manitca Hyde Small Business Owner / New Orleans
Andrew J. Lewis Publisher-The Woodville Republican /

Woodville
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Ann Ballard Johnson Controls / Baton Rouge
Anne Perry LED / Patterson
Ansythe Exploration Co. Inc. 1030 Oil & Gas Building / New Orleans
Ante Lepetie / Harvey
Anthony Cross The Environmental Management Society / Baton Rouge
Apex Oil Co Attn: Capt Terry Philips / Port Allen
Archie Chaisson / Thibodeaux
Army Times & Federal Times / Springfield
Art & Mary Courville / Carencro
Arthur Lemann IV Lemann and Associates / New Orleans
Assoc Federal Coast Pilots / Metairie
Associated Branch Pilots / Metairie
Att: Peter Spotts Christian Science Monitor / Boston
Attorney J. Tomas Anderson / Hammond
Audubon Society-Natl Chrmn Field Research Director / Taverier
AUX, LLC / Thibodaux
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Calcasieu Parish Police Jury Deparment of Planning & Development / Lake Charles
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Cameron Parish Police Jury / Hackberry
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Central Gulf Lines Attn: Mr. William B. Rudolf Suite 103 / Metairie
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Chad Courville Ducks Unlimited Suite 180 / Lafayette
Charles Fryling Baton Rouge Audubon / Baton Rouge
Charles Harris WEEKS MARINE / Covington
Charles Kaplan VPCAC / Kaplan
Charles Ledet / Mongtegut
Charles Reppel / Chalmette
Charles Roche' Acadiana Bay Association / Broussard
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Cheryl Wells QRIUC Suite 106 / Baton Rouge
Chester C. Watson / Fort Collins
Chris Cretini Johnson Controls / USGS / Lafayette
Chris Doley NOAA Restoration Center / Silver Spring
Chris Knotts LA. DNR CRD / Baton Rouge
Chris Williams LA. DNR CRD / Baton Rouge
Christian Spies / Pequabuck
Christopher J. Areas / Lafitte
Christopher M. Swarzenski US Geological Survey LA Dist Office - Suite 120 / Baton Rouge
Cindy Brown The Nature Conservancy / Baton Rouge
CJ Kiff West Cameron Port Comm / Cameron
C-K Associates ATTN: Cheryl Booth / Baton Rouge
C-K Associates Dan Strecker / Baton Rouge
C-K Associates, Inc. Ioannis Georgiou / Baton Rouge
Clark Allen LA. DNR CRD / Baton Rouge
Clay T. Midkiff USDA/NRCS / Lake Charles
Cleve Thibodeaux / Erath
Cliff Seiber, Environmental Reporter Southwest Daily News / Sulphur
Cliff Smith T. Baker Smith and Son / Houma
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Clint Padgett USGS / New Orleans
Clyde J. Orgeron / Lockport
Coastal Zone Advisory Committee Mr. Henry Rodriguez, Jr. / St. Bernard
Colle Towing Co Inc Attn: Mr Charles Mcvea Jr / Pascagoula
Concerned Citizen Johnny Benoit / Gueydan
Councilman J. B. Breaux Suite 600 / Houma
Craig Vega Chamber / Galliano
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Cullen Curole Barataria Terrebonne Estuary Foundation / Thibodaux
Curtis Trahan Cameron Parish Police Jury / Cameron
Cynthia Duet Office of The Governor / Baton Rouge
Cyrus Theriot, Jr. President Harry Bourg Corp. / Dulac
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Dan Collins / Baton Rouge
Dan Llewellyn LA. DNR / Baton Rouge
Dan Saucier CCA Lake Charles Chapter / Lake Charles
Dan W. Marrish / Jennings
Daniel Coluda Lake Borgne Levee Dist. / Vilolet
Daniel Jewell Jefferson Rod & Gun Club / Harahan
Daniel R Fontenot Sys / Lake Charles
Darrell Judice Iberia SWCD / New Iberia
Darryl Clark USFWS / Lafayette
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David Bourgeois LA. Cooperative Extension Service / Cut Off
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David Creed / Monroe
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David Walther US Fish & Wildlife Service Ecological Services - Suite 400 / Lafayette
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Dean McInnis Shaw Environmental, Inc. / Baton Rouge
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Denise Reed Department of Geology UNO - Lakefront Campus / New Orleans
Dennis Jones LA. Archaeological Society / Baton Rouge
Dennis Lambert Moffatt & Nichol / New Orleans
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Dr. Charles Wilson Dept. of Geography and Coastal Science School of the Coast and Environment / Baton Rouge
Dr. Chip Groat U.S. Geological Survey MS100 / Reston

Dr. Dick Walther LA. Cattlemans Assoc. / Houma
Dr. Dimy Cossich / Belle Chasse
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Dr. Donald Davis LA Applied and Ed. Oil Spill R&D LSU-Energy Programs / Baton Rouge
Dr. Duane Blumberg University of Southwestern La. VP Research and Graduate Studies / Lafayette
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Dr. Ed Campbell / Metairie
Dr. Enrique Reyes Dept. of Geology and Geophysics UNO - Lakefront Campus / New Orleans
Dr. Gary Shaffer Dept. of Biological Sciences Southeastern La University / Hammond
Dr. Greg Stone LSU Dept of Geography / Baton Rouge
Dr. Harry Roberts Coastal Studies Institute Howe-r\Russel Geoscience Complex / Baton Rouge
Dr. James Liberatos Asso. Dean for Undergrad. College of Applied and Nat. Sci. / Ruston
Dr. Jenneke Visser Coastal Ecology Institute Louisiana State University / Baton Rouge
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Dr. Jim Coleman Coastal Studies Institute Howe-Russel Geoscience Complex / Baton Rouge
Dr. Johanes Van Beek Coastal Environmental, Inc. / Baton Rouge
Dr. John Day Dept. of Oceanography and Coastal Sciences and Coastal Ecology Inst. / Baton Rouge
Dr. Joseph Suhayda LA. Water Resources Research Inst. Dept. of Civil and Env. Engineering / Baton Rouge
Dr. Keith Ouchley Nature Conservancy / Baton Rouge
Dr. Larry Rouse Coastal Studies Institute Louisiana State University / Baton Rouge
Dr. Len Bahr Office of The Governor- Capital Annex / Baton Rouge
Dr. Len Bahr-Exec Ast Cstl Act State Lands Nat Resources Bd / Baton Rouge
Dr. Lloyd Breslau-President Environmental Solutions Inc / Slidell
Dr. Mark Dortch USACE- ERDC CEERD-EP-W / Vicksburg
Dr. Mark Hester Dept. of Bological Sciences UNO - Lakefront Campus / New Orleans
Dr. Michael Robichaux, Md Alliance of Concerned Citizens of Louisiana / Mathews
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Ray Fremin / Belle Chasse
Ray J. Cheramie R.C. Cattle Co. / Lockport
Raymond W. Bianchini Comm. Fisherman / Gretna
Rebecca Howard USGS-NWRC / Lafayette
Rebecca Shirley Abbeville-Vermillion Chamber of Commerce / Abbeville
Reginald and Betty Oubre / New Orleans
Remy Amedee / Garyville
Republication / Woodville
Retif Oil & Fuel Attn: J F Thompson / New Orleans
Rex Moore, Assignments Editor KLFY-TV
Rhebb Rybiski / Raceland
Ricardo Johnson John Chance Land, Inc. / Lafayette
Rich Major Providence Engineering Suite 100 / Baton Rouge
Richard Armstrong / Diamondhead
Richard Aycock USDA/NRCS / Alexandria
Richard Campanella Center For Bio-Env. Research-Tulane U. / New Orleans
Richard Demay BTNEP Nicholls State University / Thibodaux
Richard Grillot Grillot Construction INC / Belle Chasse
Richard McCulloh LA. Geological Survey LSU Coast and Environment Bldg / Baton Rouge
Richard W. Fox Terrma, Co. / Covington
Rick Bryan Central LA Audubon Society / Pineville
Rick Smith Weeks Marine / Covington
River City Towing Service / Denham Springs
Riverbarge Excursion Lines Attn: Jeff Kindl / New Orleans
Robert Arceneaux / Meraux
Robert Becnel Farmer / Belle Chasse
Robert C. Esenwein C.E.P Vice President Turner Collie & Braden Inc. / Houston
Robert C. Mccad / Lake Charles
Robert Cashner Pontchartrain Inst. of Envir. Studies UNO - Lakefront Campus / New Orleans
Robert Day Indian River Lagoon National Estuary Program / Palm Bay
Robert Dolese-Director Parish Planning Commission / Baton Rouge
Robert Ensminger / DeRidder
Robert Hastings Southeastern Louisiana University / Hammond
Robert Heath Professional Eng. and Env. Consultants / Marerro
Robert Kelly Parsons Corp. Suite 100 / Norcross
Robert L. Allen Assistant Director, LSU CCEER 1002-T Energy, Coast and Env Bldg / Baton Rouge
Robert Lazor, CEWESEP-W US Army Engineer, Res & Dev Center / Vicksburg
Robert W. Sabate Subsurface Geologist / Metairie
Robin Knox Weston Solutions Suite 229 / New Orleans
Rogerest Romero Cameron Parish Police Jury / Cameron
Roland J. Chiasson 4-C's Land Corp. / Lockport
Ron Boustang USGS-NWRC / Lafayette
Ronald M. Madden Pine Bluff Sand & Gravel / Baton Rouge
Ronald Paille USFWS Suite 400 / Lafayette
Ronald Sanders Oases Offshore / Covington
Ronnie Barcak Coe/ Galveston / Galveston
Roy Keller Director, LA Technology Transfer Off. South Stadium Dr. LSU / Baton Rouge
Roy Walter USFWS -Sabine Refuge / Hackberry
RT Cerniglia / Kenner
Russ Wise News One / LaPlace
Russel Walters CH Fenstermaker and Assoc. / Lafayette
Russell G. Olivier Manager Safety, Security and Env. IMC Phosphates MP Inc. / Uncle Sam
Rusty Belsome Associated Federal Pilots / Metairie
Rusty Gaude' LSU Agcenter / Belle Chasse
Rusty Vincent Management Committee CCA / Sulphur
Sam Hamilton U.S. Fish and Wildlife Service / Atlanta

Sam Holder / River Ridge
Sammy Acordo Jr. / Garyville
Samuel P. Miano / Garyville
Sandra Thompson LA. DNR / Baton Rouge
Sauare Defelice Defelice Land Co. / Belle Chasse
Scott Privat Office of US Senator John Breaux Suite 1300 / Lafayette
Scott Romero USDA/NRCS / Jennings
Sean McMahon, Asst. Dir. Gov. Relation Ntl. Audubon Society Washington DC Policy Office / Washington
Senator Ken Hollis 9th Senatorial Dist / Metairie
Senator Lynn Dean / Braithwaite
Shea Penland Department of Geology / New Orleans
Shelly Beville LA. DNR / Baton Rouge
Shirley Laska Center For Hazards UNO Dept. of Sociology / New Orleans
Shreveport Area Office U.S. Army Corps of Engineers / Bossier City
Sidney Coffee Gov's Office of Coastal Activities / Baton Rouge
Sidney Coffee LA. DNR CRD / Baton Rouge
Sierra Club Delta Chapter / New Orleans
Skip Harris Valentine Paper Inc. / Lockport
South Lafourche Levee District Board Of Commissioners / Galliano
Southeastern La University Lab School Ms. Paulette Walkwitz
Southern Herald / Liberty
Southern University Lab School Mr. James Machen / Baton Rouge
Springhill Journal / Springhill
St Mary Parish Council Mr. Derhyl Hebert-dir Of
St. James Parish Government Mr. Dale Hymel / Convent
St. John the Baptist Parish Attn: Chris Guidry Chief Administrative Officer / LaPlace
St. Tammany News-Banner Scott Harrington, Mng. Ed. / Covington
Stapp Towing Company Inc. / Dickinson
State Rep. Ben Nevers Dist 75 / Bogalusa
Stefanie Regal, Reporter WWL-TV, Channel 4 / New Orleans
Stephen Stefanski Jr. Executive Assistant Representative Chris John / Lafayette
Steve Cochran Edf-116 Th Floor / New York
Steve Gauthreaux HESCO / Hammond
Steve Mathies CH2M / New Orleans
Steve Mire / Garyville
Steven A. Denham / Atlanta
Stu Scheer / Chauvin
Students Environmental Action Coalition / Baton Rouge
Sullivan Vullo / Port Sulphur
Susan King Legislative Analyst / Baton Rouge
Sweet Lake Land & Oil Co., Inc. Attn: Thomas G. Wright / Lake Charles
T Baker Smith & Son Inc Lou Schoher / Houma
T Baker Smith & Son Inc. Attn: Steven Smith / Houma
Tad Loupe LA DEQ / Raceland
Tangipahoa Parish Engineer Attn: Maurice Jordan / Amite
Tari Bradford US Courthouse Suite 2240 / Shreveport
Taylor Towing Co Inc Attn: Mr. Daniel S Taylor / Bayou La Batre
Ted Beaullieu Acadiana Bay Association / Broussard
Ted Kahn Port of Iberia / Jeanerette
Ted Mcmanus Daily Review / Morgan City
Teddy Babin DOTD / Lafayette
Teddy Leleux / New Iberia
Teri Goodmann Development Director National Rivers Hall of Fame / Debuque
Terrebonne Parish Attn: James Miller / Houma
Terrebonne Port Commission Attn: Ed Watson - Director / Houma
Terry Lejeune Big River Industries / Baton Rouge
Texaco Exploration & Production Attn: Daniel Ledet / Morgan City
Texas Gas Transmission, LLC / Lafayette
Theresa M.Jones / New Orleans
Theriot, Alex & Assoc Livingston Parish / Denham Springs
Tideland Barge Co Attn: Mr. Gene Drake / Metairie
Tiffany Crane UNO / New Orleans
Tim Allen / Houma
Tim Vincent National Audubon Society / Perry
Times / Shreveport
Times-Picayune Amy Ragsdale
Tina Sanchez Mobile Project Impact & Mobil NEP / Mobile
Tmr Exploration Inc Attn: Jack Lagrove / Bossier City
Tod Davison Director Mitigation Division FEMA Region IV / Atlanta
Todd Truax / Lake Charles
Tom Denes URS / Bethesda
Tom Gallagher Hydroqual Inc. / Mahwah
Tom Hess LA. Dept. Wildlife & Fisheries / Grand Chenier
Tom Holtzclaw Hatch Mott MacDonald Infrastructure and Environment / Monroe
Tom Wells WS Nelson / New Orleans
Tommy Milioto / La Place
Tommy Wright Sweet Lake Land & Oil Co. / Sulphur
Toni DeBosier Dept of Forestry and Ag. Suite F / Lafayette
Troy Pleblier / Lake Charles
Troy Rice Indian River Lagoon National Estuary Program / Palm Bay
Troy Voisin Seafood / Dulac
Tulane Environmental Law Clinic Karla Raettig / New Orleans
U. S. Coast Guard Marine Safety Office Attn: Port Operations Dept. / New Orleans
U.S. Army Corps of Engineers Area Engineer Lafayette Area Office / Lafayette
U.S. Coast Guard Commander (m) 8th District / New Orleans
U.S. Department of Housing & Urban Development Environmental Officer / New Orleans
U.S. Dept of Agriculture Nat'l Resource Conserv Ser / Alexandria
U.S. Dept of Agriculture NRCS Natl Env Coord/ecol Sci Div / Washington
U.S. Dept of Housing And Urban Development Hale Boggs Federal Bldg. / New Orleans
U.S. EPA Ofc of Fed Act (A-104) Rm
U.S. Fish and Wildlife Service Cameron Prairie National Wildlife Refuge / Bell City
U.S. Geological Survey Dr. Jeff Williams / Woods Hole
United Commercial Fisherman's / Chalmette
United Gas Pipe Line Company Marine Transportation Dept / Houma
University Lab School Dr. Glen Bowman Louisiana State University / Baton Rouge
US Department of Housing and Urban Development Attn: Terrance B. Course / New Orleans
USACE Inst. For Water Resources Attn: CEIWR-MD Ken Orth / Alexandria
USCG Marine Sfty Dtcmt Lake Charles Attn: Waterways Management / Lake Charles
USGS Attn: Charles Demas / Baton Rouge
Vann Fortier / Abbeville
Vernon Behrhorst National Rivers Hall of Fame / Lafayette
Vibhas Aravamuthan PhD Research Assocaite Oceanographer Louisiana State University / Baton Rouge
Viciki Ludden Gulf Restoration Network / New Orleans
Vicki Murillo Gulf Restoration Network / New Orleans

Vince Wilson LSU Environmental Graduate Org. Energy Coast and Environmental Bldg. / Baton Rouge
Virginia Burkett / Many
W. Dale Martin Blind River Properties / Maurepas
W.P. Edwards III Vermilion Corporation / Abbeville
Wade Matherne / Lockport
Wall Street Journal Renaissance Tower Attn:newsroom / Dallas
Walter R. Dunn / Des Allemands
WDSU-TV Jeff Hamburger / New Orleans
Webster Pierce, Jr. / Cut Off
Weeks Marine Inc / Covington
Western Gas Resources Inc Attn: Ttyrone C Ben / St. Bernard
WGNO-TV 26 (ABC) Kath Quinn (PD) / New Orleans
WGNO-TV 26 Ralph Mipro News Director / New Orleans
Whitney Baccigahopi / Grand Chenier
WILK - Amite Record / Gloster
Will Norman LA. DNR / Baton Rouge
William "Bud" Watson, III New Orleans - Baton Rouge Pilot Association / Jefferson
William Mitsch / Columbus
William Straw FEMA Region IV / Atlanta
Willie Cooper Stae Executive Director Consolidated farm Services Agency / Alexandria
Winn Parish Enterprise News Amer / Winnfield
WLPB-TV, Channel 27 (PBS) Beth George Courtney / Baton Rouge
WMIS / Natchez
WNAT / WQNZ / Natchez
WQBC / Vicksburg
WWL / New Orleans
WWL/WAJY / New Orleans
WYES-TV, Channel 12 (PBS) Beth Arroyo, Program Director / New Orleans
Yazoo River Towing / Vicksburg

Conservation Groups (GCCA, BASS, etc.)

Count: 6

Bonnet Carre' Rod & Gun Club Chairman Environmental Committee / Norco
CLIO Sportsman League / Metairie
Ducks Unlimited Director Ken Babcock / Ridgeland
Gulf Coast Conservation Assn. / Baton Rouge
Gulf States Marine Fisheries Commission Jeff Rester / Ocean Springs
President Mr. Wayne Allemond Association of Louisiana Bass Clubs / Marrero

Environmental Organizations (Audubon Society, Sierra Club, LWF, etc.)

Count: 16

Audubon Society- Baton Rouge Chapter Ms. Dorothy Prowell / Baton Rouge
Audubon Society, New Orleans Jennifer Coulson President / Metairie
Coalition of Coastal Parishes / Thibodaux
Coalition To Restore Coastal Louisiana Mr. Mark Davis / Exec Director / Baton Rouge
Donald Landry South La Environmental Council / Houma
Doug Daigle, Hypoxia Proj Mgr Mississippi River Basin Alliance / New Orleans
Environmental Defense Fund Mr. James T. B. Tripp / New York
La Nature Conservancy Mr. Keith Ouchley Director BBCC / Baton Rouge
Lake Pontchartrain Basin Foundation / Metairie
Louisiana Audubon Council Dr. Barry Kohl-Conserv Chr / New Orleans
Mr Carlton Dufrechou Lake Pontchartrain Basin Foundation / Metairie
National Audubon Society / New York
National Wildlife Federation / Washington
Natural Resources Defense Council Inc / New York
Randy Lanctot Louisiana Wildlife Federation / Baton Rouge
Sierra Club Russel Butz EPEC Organizer / Covington

Federal Agencies

Count: 17

Carl J. Brevelle USDA Forest Service / Pineville
CEMVD-PM-R US Army Corps of Engineers Attn: Chief / Vicksburg
Division Administrator Federal Highway Administration / Baton Rouge
Mark Schexnayder LSU Ag Center / Metairie
Mr Ron Brinkman US Minerals Management Service / New Orleans
Policy Review Branch US Army Corps of Engineers-HQ Cecw-ar / Washington
U.S. Advisory Council on Historic Preservation / Lakewood
U.S. Advisory Council on Historic Preservation-Executive Director Suite 809 / Washington
U.S. Army Corps of Engineers Mr. Ron Ventola CELMN-OD-S / New Orleans
U.S. Coast Guard 8th District Guy Tetreau Hale Boggs Federal Building / New Orleans
U.S. Dept of Agriculture Marine Advisory Agent LA Cooperative Extension Svc / Baton Rouge
U.S. Dept of Commerce - NOAA Ofc of Ecology & Conservation Rm 6117: Mr. William Archambault / Washington
U.S. Dept of Energy Office of Env Compliance Room 3g-092 Eh22 / Washington
U.S. Dept of The Interior Fish & Wildlife Service / Lacombe
U.S. Dept of The Interior Office of Env Policy & Compliance / Washington
U.S. EPA-Office Fed. Activities EIS Section Mail Code 2252-A / Washington
USEPA Region 6 Marine and Wetlands Section 6WQ-EM Attn: Troy Hill / Dallas

Individuals (Mr., Mrs., Boat Captains, etc.)

Count: 31

Armand Brinkhaus / Sunset
AUX LLC / Thibodaux
Barbara B. Kyle / Houston
Capt. K.C. Siverd / St. Bernard
Capt. O. T. Melvin Jr. / La Rose
Cecil Picard Suite 200 / Abbeville
Daniel Oakley / Sulphur
Dr. John C Moser / Pineville
Federal Aviation Administration/DOTD Joyce M. Porter / Fort Worth
Lafourche Parish Council James P. Ledet / Thibodaux
Linda Mathies U.S. Army Corps of Engineers OD-T / New Orleans
Montgomery Watson / Metairie
Mr. George Pivach Jr. / Belle Chasse
Mr. H. J. Broussard Jr. / New Iberia

Mr. Jay Vincent / Harvey
Mr. John E. Hine / Houston
Mr. John Edwin Kyle, Jr. / Houston
Mr. John Taliancich / Empire
Mr. Joseph V Frank III / Natchez
Mr. Jules A Toups Sr / Empire
Mr. Marvin J Buras / Empire
Mr. R W Collins, III Southdown Animal Hospital / Houma
Mr. Ray Gibbens / Venice
Mr. Robert D. Gorman / Thibodaux
Nolan Robicheaux Mike Hooks Inc / Lake Charles
Roy Kiesel & Tucker Mr. Victor L. Roy III / Baton Rouge
Tim Stine / Sulphur
Virginia H. Barber / Houston
Virginia Kyle Hine / Houston
W.a. Monteleone / New Orleans
Wildlife Photographer Mr. C. C. Lockwood Cactus Clyde Productions / Baton Rouge

Libraries and Museums (Public University, Parish, etc.)

Count: 65

Acadia Parish Library / Crowley
Allen Parish Library / Oberlin
Ascension Parish Library / Donaldsonville
Assumption Parish Library / Napoleonville
Avoyelles Parish Library / Marksville
Beauregard Parish Library / DeRidder
Bienville Parish Library / Arcadia
Bossier Parish Library / Bossier City
Calcasieu Public Library / Lake Charles
Cameron Parish Library / Cameron
Catahoula Parish Library Bushley Street / Harrisonburg
Claiborne Parish Library / Homer
Concordia Parish Library / Ferriday
Desoto Parish / Mansfield
Earl K. Long Library LA Collection, Sybil A. Boudreaux
UNO - Lakefront Campus / New Orleans
East Baton Rouge Parish Library / Baton Rouge
East Carroll Parish Library / Lake Providence
Evangeline Parish Library / Ville Platte
Franklin Parish Library / Winnsboro
Grant Parish Library / Colfax
Iberville Parish Library / Plaquemine
Jackson Parish Library / Jonesboro
Jefferson Davis Parish Library / Jennings
Jefferson Parish Library / Metairie
Lafayette Natural History Museum & Planetarium / Lafayette
Lafayette Public Library / Lafayette
Lafourche Parish Library / Thibodaux
Lasalle Parish Library / Jena
Leslie Blanchard Iberia Parish Library / New Iberia
Library Louisiana State University Mrs. Roberta A. Scull / Baton Rouge
Lincoln Parish Library / Ruston
Livingston Parish Library / Livingston
Louisiana Collection Special Collections Tulane University Libraries / New Orleans
Madison Parish Library / Tallulah
Morehouse Parish Library / Bastrop
Natchitoches Parish Library / Natchitoches
New Orleans Public Library Mr. Colin Hamer / Louisiana
Opelousas-Eunice Public Library / Opelousas
Ouachita Parish / Monroe
Plaquemines Parish Library / Buras
Pointe Coupee Parish Library / New Roads
Rapides Parish Library / Alexandria
Red River Parish Library / Coushatta
Richland Parish Library / Rayville
Sabine Parish Library / Many
Shreve Memorial Library / Shreveport
St. Bernard Parish Library / Chalmette
St. Charles Parish Library / Luling
St. James Parish Library / Lutcher
St. John The Baptist Parish Library / LaPlace
St. Martin Parish Library / St. Martinville
St. Mary Parish Library / Franklin
St. Tammany Parish Library / Covington
State Library of Louisiana Louisiana Section / Baton Rouge
Tangipahoa Parish Library / Amite
Tensas Parish Library / St. Joseph
Terrebonne Parish Library / Houma
Union Parish Library / Farmerville
Vermilion Parish Library Jackie Choate / Abbeville
Vernon Parish Library / Leesville
Washington Parish Library / Franklinton
Webster Parish Library / Minden
West Baton Rouge Parish Library / Port Allen
West Carroll Library Highway 17 & Amp Marietta Street / Oak Grove
Winn Parish Library / Winnfield

Local Ports

Count: 7

Port of Iberia Executive Director: Roy Pontiff / New Iberia
Port of New Orleans Joseph G. Cochiara Jr. Sr. Manager For Mgt. Services / New Orleans
Port of New Orleans Sr. Manager For Operations Deborah Keller / New Orleans
Port of South Louisiana Globalplex Intermodal Terminal / LaPlace
Port of South Louisiana James Nelson Assistant Port Director / LaPlace
Port of South Louisiana Kay Jackson Director of Business Development / LaPlace
Port of South Louisiana Mitch Smith Operations Director / LaPlace

Locally Elected Officials (Mayors, Police Jurors, etc.)

Count: 567

"Barry" Verret District 8 - Iberia Councilman / New Iberia
"Bill" Wild District 12 - Jefferson Davis Police Juror / Welsh
"Bob" Manuel District 5 - Evangeline Police Juror / Ville Platte
"Buck" Richardson District 3 - East Feliciana Police Juror / Clinton
"Chris" Roberts District 1 - Jefferson Councilmember / Terrytown
"Chuck" Nassauer District 3 - Washington Council Member / Bogalusa
"Don" Davis District 10 - Jefferson Davis Police Juror / Iowa
"Donald" Woods District 1 - Jefferson Davis Police Juror / Lake Arthur
"Jay" Friedman District 7 - Plaquemines Member of Parish Council / Buras
"Jeff Big Daddy" Naquin District 2 - Assumption Police Juror / Labadieville
"Jeff Petit" Kershaw District 2 - West Baton Rouge Council Member / Port Allen
"Jerry" Binder District 12 - St. Tammany Council Member / Slidell
"Joe" Clark District 9 - Plaquemines Member of Parish Council / Venice
"Joe" Fuller District F - Rapides Police Juror / Alexandria
"Joe" Impastato District 7 - St. Tammany Council Member / Lacombe
"Johnny" Guinn District 5 - Jefferson Davis Police Juror / Jennings
"Ken" Burkhalter District 14 - St. Tammany Council Member / Slidell
"Ken" Wheat District 1 - Washington Council Member / Bogalusa
"Kenny" Alfred District 4 - St. Mary Councilman / Morgan City
"Kim" Elfert District 3 - Terrebonne Council Member / Houma
"Marty" Dean District 1 - St. Tammany Council Member / Covington
"Marty" Gould, Jr. District 5 - St. Tammany Council Member / Mandeville
"Mike" Mudge District 4 - Plaquemines Member of Parish Council / Belle Chasse
"Mike" Nothnagel District 4B - Beauregard Police Juror / Longville
"Pat" Miller District 3 - St. Landry Council Member / Opelousas
"Pete" Lambert District 9 - Terrebonne Council Member / Montegut
"Ram" Ramchandran District 3 - St. Charles Councilman / Destrehan
"Randy" Menard District 9 - Lafayette Member / Lafayette
"Ray" Fremin, Jr. District 3 - Iberia Councilman / New Iberia
"Ray" Pynes District 12 - Vernon Police Juror / Leesville
"Rick" Fremin District 2 - Plaquemines Member of Parish Council / Belle Chasse
"Rob" Stevenson District 8 - Lafayette Member / Lafayette
"Steve" Bordelon District B - Rapides Police Juror / Pineville
"Steve" Eastman District 7 - Jefferson Davis Police Juror / Jennings
"Steve" Lee District 7 - St. John the Baptist Councilman / LaPlace
"Steve" Stefancik District 11 - St. Tammany Council Member / Slidell
"Steve" Vaughn District 5 - Plaquemines Member of Parish Council / Belle Chasse
"Tommy" Lasseigne District 4 - Lafourche Council Member / Thibodaux
"Wayne" Ardoin District 9 - St. Landry Council Member / Opelousas
"Zeb" Simon District 12 - Iberia Councilman / Jeanerette
A. "Buddy" Mincey District 5 - Livingston Councilman / Denham Springs
A. J. "Fatty" Broussard District 2 - Acadia Police Juror / Crowley
A. J. "Jay" Credeur District 6 - Acadia Police Juror / Church Point
Adrian Thompson District 3 - Ascension Council Member / Gonzales
Albert "Dewey" Dukes District 7 - Pointe Coupee Police Juror / New Roads
Albert Foulcard District 2 - St. Mary Councilman / Franklin
Albert Hollier District 7 - St. Landry Council Member / Arnaudville
Allen J. St. Pierre District 2 - St. John the Baptist Councilman / Reserve
Allen Parish Police Jury / Oberlin
Alton Stevenson District 1 - Acadia Police Juror / Crowley
Alvin Tillman District 1 - Terrebonne Council Member / Houma
Alvin W. "Coach" Thomas, Jr. District 1 - Ascension Council Member / Donaldsonville
Amos Cormier, Jr. District 6 - Plaquemines Member of Parish Council / Port Sulphur
Andrew Hayes District 1 - Allen Police Juror / Oakdale
Anthony "Twine" Desselle District 5 - Avoyelles Police Juror / Marksville
April Black District 5 - St. Charles Councilman / St. Rose
Ascension Parish Police Jury / Donaldsonville
Barbara Gibson Village of Sun / Sun
Barbara J. Jacob St. Charles Parish Council Secretary / Destrehan
Barry Bagert District 9 - St. Tammany Council Member / Pearl River
Barry Minnich District 7 - St. Charles Councilman / Luling
Beauregard Parish Police Jury / DeRidder
Bernard E. Broussard District 6 - Iberia Councilman / New Iberia
Bert F. Babers, III District 6 - West Feliciana Police Juror / St. Francisville
Betty Nelson District 9 - West Baton Rouge Council Member / Port Allen
Billy D. Shoemake District 4 - West Feliciana Police Juror / Tunica
Bobby Badeaux District 1 - Lafayette Member / Scott
Bradley Eastman District 4 - Jefferson Davis Police Juror / Jennings
Brent Callais District 8 - Lafourche Council Member / Cut Off
Brian A. Fabre District 2 - St. Charles Councilman / Luling
Bruce Boudreaux District 1 - St. Landry Council Member / Opelousas
Bruce Conque District 6 - Lafayette Member / Lafayette
Buddy Farris District 2 - Allen Police Juror / Oakdale
Byrel H. Book District 4A - Beauregard Police Juror / Longville
Byron Lee District 3 - Jefferson Councilmember / Marrero
Byron Sharper Metro District 7 - East Baton Rouge Councilman / Baton Rouge
C. Ray Naquin City of New Orleans Mayor / New Orleans
Caesar Comeaux District 5 - Iberia Councilman / New

Iberia
Carl "Stan" Cain District 7 - Livingston Councilman / Walker
Carlo S. Bruno District 4 - Tangipahoa Councilman / Independence
Carlos Archield District 3A - Beauregard Police Juror / DeRidder
Carlos D. Notariano District 8 - Tangipahoa Councilman / Hammond
Cecelia S. Broussard District 4 - Acadia Police Juror / Crowley
Charles "I Spy" Ketchens District 5 - St. James Councilman / Vacherie
Charles A. "Chuck" Walters District 8 - St. Mary Councilman / Amelia
Charles Davis District 5 - St. Helena Police Juror / Amite
Charles Frank Haynes, Jr. District 5 - East Feliciana Police Juror / Clinton
Charles H. Reppel Special Asst. to the Parish President St. Bernard Parish Government / Chalmette
Charles Precht, III District 3 - Cameron Police Juror / Bell City
Charles R. Kelly Metro District 5 - East Baton Rouge Councilman / Baton Rouge
Cheryl K. Fontenot District 4 - Ascension Council Member / Gonzales
Christa M. Duplantis District 5 - Terrebonne Council Member / Houma
Christopher "Chris" Canulette District 8 - St. Tammany Council Member / Slidell
Christopher "Chris" Williams District 3 - Lafayette Member / Lafayette
City / Parish President Mr. Walter Comeaux / Lafayette
City of Abbeville Mark F. Piazza Mayor / Abbeville
City of Baker Leroy Davis Mayor / Baker
City of Bogalusa James "Mack" McGehee Mayor / Bogalusa
City of Breaux Bridge Jack Dale Delhomme Mayor / Breaux Bridge
City of Bunkie Gerard Moreau, Jr. Mayor / Bunkie
City of Carencro Glenn L. Brasseaux Mayor / Carencro
City of Convington Candace Watkins Mayor / Covington
City of Crowley Isabella L. Delahoussaye Mayor / Crowley
City of Denham Springs James E. Durbin Mayor / Denham Springs
City of Deridder Gerald Johnson Mayor / De Ridder
City of Donaldsonville Raymond "Ray" Jacobs Mayor / Donaldsonville
City of Eunice E. Lynn Lejeune Mayor / Eunice
City of Franklin Vincent J. St. Blanc, III Mayor / Franklin
City of Gonzales John A. "Johnny" Berthelot Mayor / Gonzales
City of Hammond Mayson H. Foster Mayor / Hammond
City of Harahan Paul D. Johnston Mayor / Harahan
City of Jennings Terry W. Duhon Mayor / Jennings
City of Kaplan Levi J. Schexnider Mayor / Kaplan
City of Kenner Philip L. "Phil" Capitano Mayor / Kenner
City of Lake Charles "Randy" Roach Mayor / Lake Charles
City of Leesville Jim Shapkoff Mayor / Leesville
City of Mandeville "Eddie" Price Mayor / Mandeville
City of Marksville Richard Michel Mayor / Marksville
City of Morgan City Tim Tregle Mayor / Morgan City
City of New Iberia Ruth Fontenot Mayor / New Iberia
City of New Roads Sylvester Muckelroy Mayor / New Roads
City of Oakdale Bobby Abrusley Mayor / Oakdale
City of Patterson J. L. "Jimmy" Bernauer Mayor / Patterson
City of Pineville Clarence Ray Fields Mayor / Pineville
City of Plaquemine Mark A. "Tony" Gulotta Mayor / Plaquemine
City of Ponchatoula Julian E. Dufreche Mayor / Ponchatoula
City of Port Allen Lynn B. Robertson Mayor / Port Allen
City of Rayne James J. "Jimbo" Petitjean Mayor / Rayne
City of Scott Hazel D. Myers Mayor / Scott
City of St. Gabriel George L. Grace Mayor / Sunshine
City of St. Martinville Eric Martin Mayor / St. Martinville
City of Sulphur Ron LeLeux Mayor / Sulphur
City of Thibodaux Charles Caillouet Mayor / Thibodaux
City of Ville Platte "Phil" Lemoine Mayor / Ville Platte
City of Westlake Dudley R. Dixon Mayor / Westlake
City of Westwego Robert E. Billiot Mayor / Westwego
City of Zachary Charlene M. Smith Mayor / Zachary
Clayton "Snookie" Faucheux St. Charles Parish Council Council Member At Large, Division B / Luling
Clayton J. Voisin District 7- Terrebonne Council Member / Dulac
Clement Guidroz District 4 - Pointe Coupee Police Juror / Jarreau
Clerk of Council Polly Boudreaux / Chalmette
Clifford "Ted" Nelson District 12 - Pointe Coupee Police Juror / Ventress
Clinton A. Miley, Sr. District 2 - Washington Council Member / Bogalusa
Council Member At Large Eastern Division Lynn B. Dean / Braithwaite
Council Member At Large Mr. Eddie L. Sapir Orleans Parish / New Orleans
Council Member At Large Oliver M. Thomas Orleans Parish / New Orleans
Council Member At Large Western Division "Joey" DiFatta / Chalmette
Council Member at Large, Division A John F. Young Jefferson Parish / Metairie
Council Member At Large, Division A Mr. Cleveland Farlough St. John the Baptist / Reserve
Council Member at Large, Division A Thomas J. "Tom" Capella Jefferson Parish / Metairie
Council Member At Large, Division B Joel S. McTopy St. John the Baptist / LaPlace
Craig Taffaro, Jr. District D - St. Bernard Councilman / Meraux
Curtis Anderson District 5 - West Baton Rouge Council Member / Port Allen
Curtis Clay District 10 - Vernon Police Juror / Leesville
Curtis J. Boudoin District 2 - Iberia Councilman / New Iberia
Cynthia Willard-Lewis District E - Orleans Councilmember / New Orleans
Dale Bourgeois District 2 - Lafayette Member / Carencro
Dale Laborde District 4 - Avoyelles Police Juror / Mansura
Daniel Lorraine District 9 - Lafourche Council Member / Golden Meadow
Danny Harrell District 3 - Livingston Councilman / Denham Springs
Dantin V. "Danny" LeBlanc District 4 - West Baton Rouge Council Member / Port Allen
Darrell P. Ourso Council Member, Metro District 9 / Baton Rouge
Darrell P. Ourso Metro District 9 - East Baton Rouge Councilman / Baton Rouge
Darryl Farque District 7 Police Juror / Lake Charles
Darwin Sharp District 7 - Washington Council Member / Franklinton
David Boneno Metro District 11 - East Baton Rouge Councilman / Baton Rouge
Davis Manuel District 1 - Evangeline Police Juror / Ville Platte
Debbie D. Edwards District 9 - Tangipahoa Councilman / Ponchatoula

Dempsey Lambert District 5 - Ascension Council Member / Prairieville
Derryl Wayne Walls District 4 - St. Charles Councilman / Des Allemands
Desmond J. Hilaire District 1 - St. Charles Councilman / Hahnville
Dewey A. Harrell District 6 - Livingston Councilman / Livingston
Dexter Q. Brown District 10 - St. Landry Council Member / Opelousas
Donald H. Wilmore District E - Rapides Police Juror / Boyce
Donald Ray Willson District 6 - St. Helena Police Juror / Kentwood
Douaine Conner District 4 - Cameron Police Juror / Creole
Douglas A. "Doug" Hillensbeck District 7 - Ascension Council Member / Prairieville
Douglas Ohmer District 3 - Assumption Police Juror / Labadieville
Douglas Wayne Sonnier District 5 - Allen Police Juror / Oberlin
Dudley "Dut" Jarreau District 10 - Pointe Coupee Police Juror / Livonia
Dwight Hill District 4B - East Feliciana Police Juror / Jackson
E. R. "Butch" Jones District 1 - West Feliciana Police Juror / St. Francisville
East Feliciana Parish Police Jury / Clinton
Eddie Wagner District 9 - Livingston Councilman / Albany
Edval Simon, Jr. District 8 - Vermilion Police Juror / Delcambre
Edwin M. Reeves, Jr. District 5- Iberville Council Member / Plaquemine
Elton Lagasse District 2 - Jefferson Councilmember / River Ridge
Elton M. Aubert District 6 - St. James Councilman / Vacherie
Elwyn Bocz District 1 - St. James Councilman / Gramercy
Elzie R. Bryant District 1 - Avoyelles Police Juror / Centerpoint
Ernal J. Broussard District 7 - Vermilion Police Juror / Abbeville
Eugene P. Stevens, Jr. District 8- Iberville Council Member / Plaquemine
Evangeline Parish Police Jury Courthouse Building / Ville Platte
Ezra Reed District C - Rapides Police Juror / Deville
Felton Moreau District 8 - Acadia Police Juror / Eunice
Floyd Younger West Feliciana Parish Police Jury / St. Francisville
Frank E. Johnson District 4 - St. Helena Police Juror / Pine Grove
Franklin Parish Police Jury Jenny Curtis, Parish Secretary / Winnsboro
Fred Mills, Jr. District 6 - St. Martin Council Member / St. Martinville
Gary D. Courville District 13 - St. Landry Council Member / Eunice
Gary Duhon District 11 - St. Mary Councilman / Morgan City
Gary T. Singletary District 6 - St. Tammany Council Member / Pearl River
Gaulman Gaspard District 10 - Vermilion Police Juror / Kaplan
George T. Gros District 7 - Iberia Councilman / New Iberia
George Valentine District 8 - Ascension Council Member / Geismar
Gerald M. "Mike" McLeod District 1 - Beauregard Police Juror / Singer
Geraldine "Gerry" Battley District 8 - Pointe Coupee Police Juror / New Roads
Glenn P. Romero District 9 - Iberia Councilman / New Iberia
Greg Nothnagel District 5 - Beauregard Police Juror / DeRidder
Guy Buckley District 1 - Tangipahoa Councilman / Kentwood
Guy Cormier District 1 - St. Martin Council Member / St. Martinville
H. G. "Buddy" Ridgel District 5 - Tangipahoa Councilman / Tickaw
H. G. "Buddy" Ridgel District 5 - Tangipahoa Councilman / Tickfaw
Harlan James Cashiola District 7 - West Baton Rouge Council Member / Port Allen
Harold F. Lapeyre District 6 - Terrebonne Council Member / Houma
Harry B. Levy District 6 - Jefferson Davis Police Juror / Jennings
Henry Billiot District 10 - St. Tammany Council Member / Mandeville
Henry Dupre District 7 - Assumption Police Juror / Belle Rose
Henry Hines District 8 - Avoyelles Police Juror / Bunkie
Hill Johnson District 4 - Evangeline Police Juror / Ville Platte
Houston Burns District 6 - Vernon Police Juror / Leesville
Howard "Pete" Dowden District 2 - Vernon Police Juror / Anacoco
Howard Oubre, Jr. District 7- Iberville Council Member / Plaquemine
Hubert Faulk District 2 - Vermilion Police Juror / Abbeville
Huet "Picheau" Dupre District 4 - St. Landry Council Member / Opelousas
Huey P. Brown District 6 - West Baton Rouge Council Member / Port Allen
Hurlin Dupre District 6 - St. Landry Council Member / Port Barre
Irma L. Cry St. Tammany Parish Council / Slidell
J. Michael Walker, Sr. Metro District 8 - East Baton Rouge Councilman / Baton Rouge
Jackie L. Grimes District 4 - Vernon Police Juror / Leesville
Jaclyn S. Hotard District 4 - St. John the Baptist Councilman / LaPlace
Jacquelyn Brechtel Clarkson District C - Orleans Councilmember / New Orleans
James "Jimmy" Brazan District 7 - St. James Councilman / Vacherie
James A. "Red" Thompson, II District 3 - St. Tammany Council Member / Folsom
James B. Tuck District 1 - Vernon Police Juror / Leesville
James Boswell District 3C - Beauregard Police Juror / Longville
James C. Eaglin District 2 - St. Landry Council Member / Opelousas
James Doxey District 6 - Cameron Police Juror / Cameron
James Francis Hunt, Sr. District 1A - East Feliciana Police Juror / Clinton
James Hebert District 8 - St. Martin Council Member / Breaux Bridge
James T. "Jim" Benham Metro District 12 - East Baton Rouge Councilman / Baton Rouge
Jared "Burger" Beiriger District 11 - Ascension Council Member / Gonzales
Jefferson Davis Parish Police Jury Courthouse / Jennings
Jefferson Parish Dr. Mary G. Curry / Harahan
Jefferson Parish Mrs. Marnie Winter Director Envir & Dev

Control Dept. / Jefferson
Jefferson Parish Police Jury Parish Council / Gretna
Jennifer Sneed District 5 - Jefferson Councilmember / Metairie
Jerome W. Fitch District 11 - Iberia Councilman / Jeanerette
Jerry Hodnett District 3 - Plaquemines Member of Parish Council / Belle Chasse
Jerry M. Kern District 3B - Beauregard Police Juror / DeRidder
Jerry McDonald Parish President Sabine Parish / Many
Jerry P. Savoy District 6 - Ascension Council Member / St. Amant
Jerry P. Wood District G - Rapides Police Juror / Alexandria
Jerry Shirley District 3E - Beauregard Police Juror / DeRidder
Jimmie McCoy District 2 - Livingston Councilman / Watson
Jimmie Pellerin District 5 - Acadia Police Juror / Rayne
Jimmy Bello District 5 - Pointe Coupee Police Juror / Ventress
Jimmy L. James District 5 - Vernon Police Juror / Pitkin
Joe "Coach" Thomas District 13 - St. Tammany Council Member / Slidell
John "Jay" Batt District A - Orleans Councilmember / New Orleans
John "Sassy" Pourciau District 2 - Pointe Coupee Police Juror / Batchelor
John Calvin James District 6 - Assumption Police Juror / Napoleonville
John Carroll Duhon District 1 - Vermilion Police Juror / Maurice
John Cobb District 3 - West Feliciana Police Juror / St. Francisville
John Hamilton District 11 - Vernon Police Juror / New Llano
John K. Roach District 5 - West Feliciana Police Juror / St. Francisville
John L. Barthelemy, Jr. District 1 - Plaquemines Member of Parish Council / Pointe-a-la-Hache
John M. Barnett District 1B - East Feliciana Police Juror / Ethel
John P. Marceaux District 2 - Jefferson Davis Police Juror / Lake Arthur
John R. Sexton District 11- Iberville Council Member / Rosedale
John W. Humble, Sr. District 3 - Acadia Police Juror / Morse
John W. Strother District 3 - Allen Police Juror / Oakdale
Joseph "Bozo" Bergeron District 11 - Pointe Coupee Police Juror / Fordoche
Joseph "Joe" Greco Metro District 4 - East Baton Rouge Councilman / Greenwell Springs
Joseph M. "Tooney" Davis, Jr. District 1 - St. Mary Councilman / Jeanerette
Judy Darby Hoffmeister District B - St. Bernard Councilman / Chalmette
Jule Charles Wascom District 1 - St. Helena Police Juror / Greensburg
Juliet Williams District 1 - Pointe Coupee Police Juror / Lettsworth
Julio C. Mayorga St. Bernard Parish Government Community Development / Chalmette
Karl "Bubba" Chaney District 6 - East Feliciana Police Juror / Clinton
Keith J. Leonard District 6 - St. Mary Councilman / Berwick
Keith K. Washington, Sr. District 3 - West Baton Rouge Council Member / Brusly
Keith O. Miller District 11 - St. Landry Council Member / Lawtell
Keith W. Lacombe District 9 - Avoyelles Police Juror / Simmesport
Keith Wade District 4 - Assumption Police Juror / Napoleonville
Kenneth W. "Kenny" Henderson District C - St. Bernard Councilman / Chalmette
Kent Fontenot District 7 - Allen Police Juror / Reeves
Kent Schexnaydre District 2 - Ascension Council Member / Gonzales
Kevin J. Voisin District 7 - St. Mary Councilman / Morgan City
Kirby Roy, III District 2 - Avoyelles Police Juror / Hessmer
L. Phillip Gouaux District 7 - Lafourche Council Member / Lockport
Lafayette Parish Police Jury Courthouse Building / Lafayette
Lance Marino St. Charles Parish Council Council Member At Large, Division A / Norco
Larry James Fontenot District 9 - Jefferson Davis Police Juror / Jennings
Larry L. Johnson District 8 - West Baton Rouge Council Member / Port Allen
Lenwood Broussard District 5 - Lafayette Member / Lafayette
Leonard "Buck" Jackson District 4- Iberville Council Member / Carville
Leroy A. Faul District 11 - Jefferson Davis Police Juror / Welsh
Lester Rainey, Jr. District 1 - St. John the Baptist Councilman / Edgard
Linda Calvert Mayor's Office of Env. Affairs NO City Hall / New Orleans
Lindel Toups District 6 - Lafourche Council Member / Gheens
Lionell Wells District 7 - Tangipahoa Councilman / Hammond
Lloyd "Red" Higginbotham District 5 - St. Martin Council Member / St. Martinville
Lloyd Brown District 4 - Iberia Councilman / New Iberia
Lorri Burgess Metro District 10 - East Baton Rouge Councilman / Baton Rouge
Louis "Pete" Kelley, Jr. District 10- Iberville Council Member / Plaquemine
Louis C. Benjamin, Jr. District 4 - Lafayette Member / Lafayette
Louis J. Congemi District 4 - Jefferson Councilmember / Kenner
Louis Kent District 7 - East Feliciana Police Juror / Clinton
Luther "Buster" Hardee, III District 14 - Vermilion Police Juror / Kaplan
Lynda Banta District 8 - Plaquemines Member of Parish Council / Buras
M. Larry Richard District 13 - Iberia Councilman / New Iberia
Maggie F. Daniels District 1 - Iberia Councilman / New Iberia
Magnus "Sonny" McGee District 1 - Cameron Police Juror / Cameron
Marc E. Guillory District 6 - Evangeline Police Juror / Ville Platte
Marc Mouton District 7 - Lafayette Member / Lafayette
Mark A. Borrel District 3 - Avoyelles Police Juror / Marksville
Mark Atzenhoffer District 5 - Lafourche Council Member / Bayou Blue
Mark Madary District A - St. Bernard Councilman / Arabi
Mark Poche District 6 - Vermilion Police Juror / Erath

Marlin N. Gusman District D - Orleans Councilmember / New Orleans
Marshall H. Harris District 4 - Livingston Councilman / Denham Springs
Martha Jane Tassin Metro District 6 - East Baton Rouge Councilman / Baton Rouge
Martin M. McConnell District 10 - Ascension Council Member / Gonzales
Martin S. Triche District 5 - Assumption Police Juror / Napoleonville
Marvin Thomas District 6 - Washington Council Member / Franklinton
Matthew H. Jewell District 12- Iberville Council Member / Maringouin
Matthew R. Hollins District 4 - Allen Police Juror / Mittie
Maxwell Chreene District 9 - Vermilion Police Juror / Abbeville
Mayor's Office of Env. Affairs Yarrow Etheredge City of New Orleans / New Orleans
McKinley "Pop" Keller District 6 - Avoyelles Police Juror / Bunkie
Melanie "Miss Mel" Bueche District 6 - Pointe Coupee Police Juror / Lakeland
Melton Alfred District 3 - Jefferson Davis Police Juror / Jennings
Melvin Haymon District 8 - Vernon Police Juror / New Llano
Merlin Price St. Mary Parish Council / Morgan City
Michael "Mike" Matherne District 3 - Lafourche Council Member / Thibodaux
Michael A. Petitto District 3 - Tangipahoa Councilman / Amite
Michael E. "Mike" Harper District 3D - Beauregard Police Juror / DeRidder
Michael F. Delatte District 2 - Lafourche Council Member / Thibodaux
Michael W. Domingue District 3 - St. Mary Councilman / Franklin
Mike Huval District 4 - St. Martin Council Member / Parks
Milton "Rocky" Ourso, Jr. District 2- Iberville Council Member / White Castle
Minos Broussard District 3 - Vermilion Police Juror / Erath
Mitchell "Mitch" Ardoin District 3 - Evangeline Police Juror / Mamou
Mix F. Vosburg District 9 - Pointe Coupee Police Juror / New Roads
Mr. Jess Curole Lafourche Parish CZM Administrator / Cut Off
Myron Matherne District 9 - Assumption Police Juror / Pierre Part
N. R. "Rusty" Williamson District 2 - Beauregard Police Juror / Merryville
Naray Hulin District 14 - Iberia Councilman / New Iberia
Nicholas P. Migliacio District 9- Iberville Council Member / Plaquemine
Odell Trahan District 3 - St. Martin Council Member / St. Martinville
Otis L. Wilson District 7 - West Feliciana Police Juror / St. Francisville
Parish President "Joey" Durel Layfayette Parish / Lafayette
Parish President Aaron F. Broussard Jefferson Parish / Kenner
Parish President Benny Rousselle Plaquemines Parish Government / Belle Chasse
Parish President Charlotte Angelette Randolph Lafourche Parish / Larose
Parish President Donald "Don" Menard St. Landry Parish / Cankton
Parish President Donald "Don" Schwab Terrebonne Parish / Houma
Parish President Henry "Junior" Rodriguez St. Bernard Parish / St. Bernard
Parish President M. E. "Toye" Taylor Washington Parish / Bogalusa
Parish President Michael "Mike" Grimmer Livingston Parish / Walker
Parish President Mr. Albert D. Laque St. Charles Parish / Boutte
Parish President Mr. Dale Hymel, Jr. St. James Parish / Lutcher
Parish President Mr. Gordon A. Burgess Tangipahoa Parish / Loranger
Parish President Mr. J. Mitchell Ourso, Jr. Iberville Parish / Plaquemine
Parish President Mr. Kevin C. Davis St. Tammany Parish / Slidell
Parish President Mr. Wilfred Langlinais Iberia Parish / New Iberia
Parish President Mr. William A. Cefalu St. Mary Parish / Morgan City
Parish President Nickie Monica St. John the Baptist Parish / LaPlace
Parish President Riley "Pee Wee" Berthelot West Baton Rouge Parish / Addis
Parish President Ronnie Hughes Ascension Parish / Gonzales
Parish President Suzanne D. Blanchard St. Martin Parish Parish / Martinville
Pat Cluse District 7 - St. Martin Council Member / Breaux Bridge
Pat Culbertson Metro District 3 - East Baton Rouge Councilman / Baton Rouge
Patricia "Pat" Brister District 4 - St. Tammany Council Member / Mandeville
Patrick Lawless District 1 - Assumption Police Juror / Belle Rose
Paul P. Naquin, Jr. District 9 - St. Mary Councilman / Baldwin
Peter Rhodes District 8 - Terrebonne Council Member / Houma
Peter Soprano District 10 - St. Mary Councilman / Garden City
Pierre J. Galley District 13 - Jefferson Davis Police Juror / Lacassine
Planning Department City of Kenner / Kenner
Plaquemine Parish Government / Port Sulphur
Plaquemines Parish Police Jury / Pointe-a-la-Hache
Pointe Coupee Parish Police Jury / New Roads
Police Jury St. Martin Parish / St. Martinville
President Metro Council, City of Baton Rouge Mr. Bobby R. Simpson / Baton Rouge
Public Works Superintedant Allen J. Benoit / Berwick
Purvis Abshire District 12 - Vermilion Police Juror / Kaplan
R. E. "Sonny" Weatherford District 6 - Allen Police Juror / Kinder
Ralph A. Patin, Jr. District 4 - St. James Councilman / Convent
Randal J. Mouch District 1 - West Baton Rouge Council Member / Addis
Randall L. Rushing District 1 - Livingston Councilman / Walker
Randy Stevens District 2 - West Feliciana Police Juror / Jackson
Ravis Menard District 11 - Vermilion Police Juror / Kaplan
Reid Weeks District 7 - Vernon Police Juror / Rosepine
Relton Sumrall District 5 - Washington Council Member / Franklinton
Renee Gill Pratt District B - Orleans Councilmember / New

Orleans
Richard "Blood" Thomas District 9 - Evangeline Police Juror / Ville Platte
Richard "Butch" Lindsay District A - Rapides Police Juror / Pineville
Richard "Dickie" Duhe District 6 - St. Charles Councilman / Norco
Richard Champagne Town of Lockport / Lockport
Richard Dale Wolfe District 3 - St. John the Baptist Councilman / Reserve
Richard Dudley District 4A - East Feliciana Police Juror / Jackson
Richard W. Billings District H - Rapides Police Juror / Forest Hill
Robert "Bob" Ray District 9 - St. Martin Council Member / Breaux Bridge
Robert J. Broussard District 8 - Jefferson Davis Police Juror / Jennings
Robert Johnson District 2 - East Feliciana Police Juror / Ethel
Rodney Brown District 4 - Washington Council Member / Bogalusa
Rodney Littleton, Acting Director City of New Orleans Env. Affairs Off. Orleans Parish / New Orleans
Roger D. Faust District 2 - Tangipahoa Councilman / Loranger
Roger Duncan District 10 - Iberia Councilman / New Iberia
Ronald "T" Doucet District 8 - Evangeline Police Juror / Ville Platte
Ronald Dugas District 8 - St. Landry Council Member / Sunset
Ronald E. Buschel District 5 - St. Landry Council Member / Washington
Ronald J. Darby District 4 - Vermilion Police Juror / Abbeville
Ronald L. Sharp District 8 - Livingston Councilman / Springfield
Ronnie Bankston District 6 - Tangipahoa Councilman / Hammond
Ronnie S. Smith District 6 - St. John the Baptist Councilman / LaPlace
Russell Fitzmorris District 2 - St. Tammany Council Member / Covington
Russell Young District 3 - Pointe Coupee Police Juror / New Roads
Salaris G. Butler District 6- Iberville Council Member / Plaquemine
Sam B. Fulton, Jr. District 9 - Vernon Police Juror / Leesville
Scott Perry, Jr. District I - Rapides Police Juror / Alexandria
Scott Trahan District 5 - Cameron Police Juror / Creole
Sean P. Roussel District 5 - St. John the Baptist Councilman / LaPlace
Sidney Fontenot District 2 - Evangeline Police Juror / Basile
St. Bernard Parish Police Jury Courthouse Annex St. Bernard / Chalmette
St. Charles Parish Police Jury St. Charles Parish Council / Hahnville
St. Helena Parish Police Jury St. Helena / Greensburg
St. James Parish Police Jury Convent Courthouse St. James / Convent
St. John The Baptist Parish Police Jury St. John the Baptist / Edgard
St. Landry Parish Police Jury St. Landry / Opelousas
St. Mary Parish Police Jury Courthouse St. Mary / Franklin
St. Tammany Parish Council St. Tammany / Covington
Steve F. Bierhorst District 5 - St. Mary Councilman / Patterson
Steve Trahan District 2 - Cameron Police Juror / Hackberry
T. J. Prejean, Jr. District 13 - Vermilion Police Juror / Abbeville
T.J. Smith, Jr. St. Tammany Parish Council St. Tammany / Covington
Tangipahoa Parish Police Jury Tangipahoa / Amite
Teri Chatagnier Cavalier District 4 - Terrebonne Council Member / Gray
Terrebonne Parish Police Jury Al Levron Terrebonne / Houma
Theodore Fountaine, Jr. District D - Rapides Police Juror / Alexandria
Thomas "Cade" Benoit District 7 - Acadia Police Juror / Church Point
Thomas E. Dominique, Sr. District 3- Iberville Council Member / White Castle
Thomas J. Wicker District 2 - St. Helena Police Juror / Greensburg
Thomas Nelson District 2 - St. Martin Council Member / St. Martinville
Timothy P. "Timmy" Roussel District 2 - St. James Councilman / Lutcher
Todd Foles District 8 - Assumption Police Juror / Pierre Part
Todd Lambert District 9 - Ascension Council Member / Gonzales
Tommy L. McMahon District 3 - Vernon Police Juror / Evans
Tony "Ricky" Melerine District E - St. Bernard Councilman / Violet
Town of Abita Springs Louis Fitzmorris Mayor / Abita Springs
Town of Addis Carroll P. Bourgeois Mayor / Addis
Town of Amite City Reggie Goldsby Mayor / Amite
Town of Arcadia Eugene Smith Mayor / Arcadia
Town of Arnaudville "Kathy" M. Richard Mayor / Arnaudville
Town of Baldwin Wayne J. Breaux Mayor / Baldwin
Town of Ball Roy Hebron Mayor / Pineville
Town of Basile Berline Boone Mayor / Basile
Town of Boyce Julius Patrick, Jr. Mayor / Boyce
Town of Brusly Joey Normand Mayor / Brusly
Town of Cheneyville Coral A. Johnson Mayor / Cheneyville
Town of Church Point Roger Boudreaux Mayor / Church Point
Town of Clinton H. Toler Hatcher Mayor / Clinton
Town of Cottonport Cleveland Carmouche Mayor / Cottonport
Town of Delcambre Carol Broussard Mayor / Delcambre
Town of Duson John E. Lagneaux Mayor / Duson
Town of Elizabeth Robert "Bob" Crafton Mayor / Elizabeth
Town of Elton "Cathy" Hollingsworth Mayor / Elton
Town of Evergreen Drew Robert Mayor / Evergreen
Town of Fordoche Justin K. Cox Mayor / Fordoche
Town of Franklinton Earle R. Brown, Sr. Mayor / Franklinton
Town of Glenmora Tyrone Doyle Mayor / Glenmora
Town of Golden Meadow Joey Bouziga Mayor / Golden Meadow
Town of Gramercy Terry Borne Mayor / Gramercy
Town of Grand Coteau Jean J. Coco Mayor / Grand Coteau
Town of Grand Isle David J. Camardelle Mayor / Grand Isle
Town of Greensburg "Ken" L. Carter Mayor / Greensburg
Town of Gueydan Chris Theriot Mayor / Gueydan
Town of Henderson Earl "To Bit" Patin Mayor / Henderson
Town of Hornbeck Clarence Beebe Mayor / Hornbeck
Town of Independence Phillip F. Domiano Mayor /

Independence
Town of Iota John D. Sittig Mayor / Iota
Town of Kentwood Harold J. Smith Mayor / Kentwood
Town of Killian Gillis Windham Mayor / Killian
Town of Kinder Fred A. Ashy Mayor / Kinder
Town of Krotz Springs Gary G. Soileau Mayor / Krotz Springs
Town of Lake Arthur E. R. "Red" Giles Mayor / Lake Arthur
Town of Lecompte Rosa S. Jones Mayor / Lecompte
Town of Leonville Joel Lanclos, Jr. Mayor / Leonville
Town of Livingston D. Derral Jones Mayor / Livingston
Town of Livonia Ronald "TB" Scallan Mayor / Livonia
Town of Lockport Richard Champagne Mayor / Lockport
Town of Lutcher Troas A. Poche Mayor / Lutcher
Town of Madisonville Peter Gitz, Jr. Mayor / Madisonville
Town of Mamou James S. Fontenot Mayor / Mamou
Town of Mansura Harold Quebedeaux Mayor / Mansura
Town of Maringouin John Fitzgerald Overton, Sr. Mayor / Maringouin
Town of Melville Willie "Butch" Haynes, III Mayor / Melville
Town of Merryville Foy W. Rhodes Mayor / Merryville
Town of New Llano Freddie Boswell Mayor / New Llano
Town of Oberlin "Phil" Beard Mayor / Oberlin
Town of Pearl River James Lavigne Mayor / Pearl River
Town of Port Barre John B. Fontenot Mayor / Port Barre
Town of Roseland Charles Bracey Mayor / Roseland
Town of Rosepine Keith Foshee Mayor / Rosepine
Town of Simmesport James "Boo" Fontenot Mayor / Simmesport
Town of Slaughter Bobbie Bourgeois Mayor / Slaughter
Town of Sorrento Camile J. Trabeau Mayor / Sorrento
Town of Springfield Charles E. "Charlie" Martin Mayor / Springfield
Town of St. Francisville William "Billy" D'Aquilla Mayor / St. Francisville
Town of Sunset Danny J. Louviere Mayor / Sunset
Town of Vinton David T. Riggins Mayor / Vinton
Town of Walker Travis Clark Mayor / Walker
Town of Washington Joseph "Joe" Pitre Mayor / Washington
Town of Welsh Jimmy Cormier Mayor / Welsh
Town of White Castle Maurice A. Brown Mayor / White Castle
Town of Woodworth David C. Butler, II Mayor / Woodworth
Town of Youngsville Wilson B. Viator, Jr. Mayor / Youngsville
Tyrone Brown Williams District 1 - Lafourche Council Member / Thibodaux
Tyrone Dufour District 7 - Avoyelles Police Juror / Plaucheville
Ulysses Z. Addison, Jr. Metro District 2 - East Baton Rouge Councilman / Baton Rouge
Vermilion Parish Police Jury / Abbeville
Vernon Parish Police Jury / Leesville
Village of Albany Thomas Allen Stewart Mayor / Albany
Village of Anacoco Leroy Cooley Mayor / Anacoco
Village of Angie John Dawsey Mayor / Angie
Village of Cankton Susan Menard Mayor / Cankton
Village of Chataignier Herman Malveaux Mayor / Ville Platte
Village of Estherwood Jeanelle F. Schexnider Mayor / Estherwood
Village of Fenton Frank D. Broxton Mayor / Fenton
Village of Folsom Marshell Brumfield Mayor / Folsom
Village of Forest Hill Marcia F. Young Mayor / Forest Hill
Village of French Settlement Clyde L. Wheat Mayor / French Settlement
Village of Grosse Tete Philip "Tunnie" Sarullo Mayor / Grosse Tete
Village of Hessmer Lynn Bordelon Mayor / Hessmer
Village of Loreauville Forbus J. Mestayer, Sr. Mayor / Loreauville
Village of Maurice Barbara L. Picard Mayor / Maurice
Village of Mcnary Don Parker, II Mayor / Glenmora
Village of Mermentau Myrtis A. Gautreaux Mayor / Mermentau
Village of Moreauville Lionel J. Bordelon Mayor / Moreauville
Village of Morganza Charles "Chuck" Landry Mayor / Morganza
Village of Morse Leon Clement Mayor / Morse
Village of Napoleonville Darrell Jupiter, Sr. Mayor / Napoleonville
Village of Norwood David C. Jett Mayor / Norwood
Village of Palmetto Earline H. Bihm Mayor / Palmetto
Village of Parks John Dugas Mayor / Parks
Village of Pine Prairie Terry L. Savant Mayor / Pine Prairie
Village of Plaucheville Terryl St. Romain Mayor / Plaucheville
Village of Port Vincent Mary T. Gourdon Mayor / Port Vincent
Village of Reeves Shelley Tyler Mayor / Reeves
Village of Rosedale Lawrence J. "Football" Badeaux Mayor / Rosedale
Village of Simpson Donnis Brinkley Mayor / Simpson
Village of Tangipahoa James Fultz Mayor / Tangipahoa
Village of Tickfaw Anthony "Tony" Lamonte Mayor / Tickfaw
Village of Turkey Creek Blaine Janet Mayor / Turkey Creek
Village of Wilson Bennie C. Jones, Jr. Mayor / Wilson
Warren Taylor District 1- Iberville Council Member / White Castle
Wayne "Spider" Carter Metro District 1 - East Baton Rouge Councilman / Zachary
Wayne J. Thibodeaux District 2 - Terrebonne Council Member / Gray
Wayne M. Roy District 13- Iberville Council Member / St. Gabriel
Wayne Touchet District 5 - Vermilion Police Juror / Abbeville
West Baton Rouge Parish Police Jury / Port Allen
William "Billy" Gil District 12 - St. Landry Council Member / Eunice
William A. "Bill" Guidry District 7 - Evangeline Police Juror / Ville Platte
Willie J. Morgan District 3 - St. Helena Police Juror / Greensburg
Wilson F. Malbrough, Jr. District 3 - St. James Councilman / Paulina

Louisiana District Conservationist

Count: 38

District Conservationist Acadia Parish Crowley Service Center / Crowley
District Conservationist Allen Parish Oberlin Service Center / Oberlin
District Conservationist Ascension Parish Donaldsonville Service Center / Donaldsonville
District Conservationist Assumption Parish Donaldsonville Service Center / Donaldsonville
District Conservationist Avoyelles Parish Marksville Service Center / Marksville
District Conservationist Beauregard Parish Deridder Service Center / DeRidder

District Conservationist Calcasieu Parish Lake Charles Service Center / Lake Charles
District Conservationist Cameron Parish Lake Charles Service Center / Lake Charles
District Conservationist East Baton Rouge Parish Denham Springs Service Center / Denham Springs
District Conservationist East Feliciana Parish Clinton Service Center / Clinton
District Conservationist Evangeline Parish Ville Platte Service Center / Ville Platte
District Conservationist Iberia Parish New Iberia Service Center / New Iberia
District Conservationist Iberville Parish Donaldsonville Service Center / Donaldsonville
District Conservationist Jefferson Davis Parish Jennings Service Center / Jennings
District Conservationist Jefferson Parish Boutte Service Center / Boutte
District Conservationist Lafayette Parish Lafayette Service Center / Lafayette
District Conservationist Lafourche Parish Thibodaux Service Center / Thibodaux
District Conservationist Livingston Parish Denham Springs Service Center / Denham Springs
District Conservationist Orleans Parish Boutte Service Center / Boutte
District Conservationist Plaquemines Parish Council Boutte Service Center / Boutte
District Conservationist Pointe Coupee Parish New Roads Service Center / New Roads
District Conservationist Rapides Parish Alexandria Service Center / Alexandria
District Conservationist St. Bernard Parish Boutte Service Center / Boutte
District Conservationist St. Charles Parish Boutte Service Center / Boutte
District Conservationist St. Helena Parish Amite Service Center / Amite
District Conservationist St. James Parish Donaldsonville Service Center / Donaldsonville
District Conservationist St. John The Baptist Parish Boutte Service Center / Boutte
District Conservationist St. Landry Parish Opelousas Service Center / Opelousas
District Conservationist St. Martin Parish Breaux Bridge Service Center / Breaux Bridge
District Conservationist St. Mary Parish Franklin Service Center / Franklin
District Conservationist St. Tammany Parish Franklinton Service Center / Franklinton
District Conservationist Tangipahoa Parish Amite Service Center / Amite
District Conservationist Terrebonne Parish Thibodaux Service Center / Thibodaux
District Conservationist Vermillion Parish Abbeville Service Center / Abbeville
District Conservationist Vernon Parish Leesville Service Center / Leesville
District Conservationist Washington Parish Franklinton Service Center / Franklinton
District Conservationist West Baton Rouge Parish Addis Service Center / Addis
District Conservationist West Feliciana Parish Clinton Service Center / Clinton

Louisiana Flood Plain Administrators

Count: **286**

Permit Administrator Killian, Village of / Killian
Adrienne Labat Planning Coordinator St. John the Baptist Parish / LaPlace
Al Courouleau Building Inspector Ponchatoula, City of / Ponchatoula
Alan Dwyer Special Services Director West Feliciana Parish / St. Francisville
Ali Mustapha Assistant City Engineer Shreveport, City of / Shreveport
Alice Galland Town Clerk Plaucheville, Town of / Plaucheville
Amanda Castello Chief Bldg. Official Zachary, City of / Zachary
Amber Higginbotham Town Clerk Church Point, Town of / Church Point
Andre Bass Building Inspector Winnfield, City of / Winnfield
Angela Canady Permit Official Baker, City of / Baker
Arthur Israel Building Inspector Walker, Town of / Walker
Barbara E. Dupree*** Clerk Martin, Village of / Coushatta
Barry Brewer Administrator Port Allen, City of / Port Allen
Bea Guidry Permit Officer Kaplan, City of / Kaplan
Becky Blanchard City Clerk Breaux Bridge, City of / Breaux Bridge
Becky Culpepper FPA Westlake, City of / Westlake
Becky Garner Town Clerk Goldonna, Village of / Goldonna
Ben Adams Building Inspector Jonesville, Town of / Jonesville
Bernard Frances Code Enforcement Officer Donaldsonville, City of / Donaldsonville
Betsy Jordan Clerk Robeline, Village of / Robeline
Betty Jo Moberly Clerk Campti, Town of / Campti
Beverly Perry Clerk Merryville, Village of / Merryville
Bill Smith Parish Administrator DeSoto Parish / Mansfield
Bob Carpenter Mayor Calvin, Village of / Calvin
Bonnie Dugas Clerk Mermentau, Village of / Mermentau
Bonnie G. Price Clerk Carencro, City of / Carencro
Bonnie Sonnier Permit Official St. Martin Parish / St. Martinville
Brad Duhon Permit Official Scott, City of / Scott
Brandon Mellieon Building Inspector Plaquemine, City of / Plaquemine
Brenda Hilton Town Clerk Hornbeck, Town of / Hornbeck
Brenda Jones Secretary Red River Parish / Coushatta
Brent Cooley Building Inspector Minden, City of / Minden
Bruce Fleming Director of Planning West Monroe, City of / West Monroe
Bryan Harmon Dept. of Public Works East Baton Rouge Parish / Baton Rouge
Buddy Redmon City Superintendent Bunkie, Town of / Bunkie
Candance Thomas Municipal Clerk Tickfaw, Town of / Tickfaw
Carl Robichaux Parish Engineer Ascension Parish / Gonzales
Carla Richard Clerk Erath, Town of / Erath
Carmen Judice Permit Official Iberia Parish / New Iberia
Carol Martin Clerk Rodessa, Village of / Rodessa
Carolyn Davis-Goff Clerk Boyce, Town of / Boyce
Cathy Fitch Clerk Oak Ridge, Village of / Oak Ridge
Charlene E. Hill Clerk Parks, Village of / Parks
Charlene Picard/OfficeMgr Acadian Metrocode Lafayette Parish / Lafayette
Charlene Picard/OfficeMgr Acadian Metrocode Lafayette, City of / Lafayette
Charlene Smith Clerk Haughton, Town of / Haughton
Charles Dixon Clerk Greensburg, Town of / Greensburg
Charles Germany Clerk Rayville, Town of / Rayville
Charlie Driver Building Inspector New Llano, Town of / New Llano

Cheryl Thomas Clerk Glenmora, Town of / Glenmora
Christi Morgan Clerk Gonzales, City of / Gonzales
Christine Logarbo Clerk Morse, Village of / Morse
Chuck Vincent Building Inspector Denham Springs, City of / Denham Springs
Cinderella Miller Clerk Cankton, Village of / Cankton
Cindy Mallett Clerk Lake Arthur, Town of / Lake Arthur
Cindy Murry Planning & Zoning Clerk Abita Springs, Town of / Abita Springs
Clegg Chaumont Superintendent Oberlin, Town of / Oberlin
Collins Bonicard Building Inspector Tangipahoa Parish / Hammond
Connie McKeel Clerk Waterproof, Town of / Waterproof
Connie Treadway Permit Officer Plaquemines Parish / Port Sulphur
Corrine Jones Admin Asst for Parish Planning Natchitoches Parish / Natchitoches
Cynthia Taylor Clerk Arnaudville, Town of / Arnaudville
D. Michael Metcalf Gretna, City of / Gretna
Dale Kelly Building Inspector Leesville, City of / Leesville
Danette Cloud Clerk Pine Prairie, Village of / Pine Prairie
Danny Hebert Bldg. Inspector Crowley, City of / Crowley
Darla Duet Permit Officer Lafourche Parish / Thibodaux
Dave Lowery City Manager Patterson, City of / Patterson
David C. Butler, II Mayor Woodworth, Village of / Woodworth
David Dupont Building Inspector Iberville Parish / Plaquemine
David Sellers Building Inspector Kentwood, Town of / Kentwood
Dawn B. Stott Town Clerk Olla, Town of / Olla
Deborah Strickland Sec./Treasurer St. Helena Parish / Greensburg
Debra Blackledge Clerk Cottonport, Town of / Cottonport
DeeDee Wagner Permits & Address Admin. Livingston Parish / Livingston
Denise Frank Town Clerk Epps, Village of / Epps
Denise Moore Town Clerk Grand Coteau, Town of / Grand Coteau
Denise Mose Clerk Kinder, Town of / Kinder
Derhyl Hebert Dir. of Planning & Zoning Morgan City, City of / Morgan City
Diane Mataya Town Clerk Lockport, Town of / Lockport
Dolores Melancon Clerk Leonville, Town of / Leonville
Dolores Pousson Clerk Iota, Town of / Iota
Donald Simmons Building Inspector St. Francisville, Town of / St. Francisville
Donna Baudoin Permits Director Abbeville / Abbeville
Donna Bergeron Town Clerk Livonia, Town of / Livonia
Donna Tyler Clerk Colfax, Town of / Colfax
Donna Veillon City Treasurer Ville Platte, City of / Ville Platte
Donnie Ousse Bldg. Inspector Rayne, City of / Rayne
Doris McGee Clerk Palmetto, Village of / Palmetto
Doris Narron Town Clerk Benton, Town of / Benton
Dorothy Kropog Assistant Village Clerk Albany, Village of / Albany
Doug Burguieres FPA Lake Charles, City of / Lake Charles
E. A. Greer Secretary/Morehouse Par PJury Morehouse Parish / Bastrop
Earl Matherne Permit Officer St. Charles Parish / Hahnville
Elisha Matthews Secretary/Treasurer East Carroll Parish / Lake Providence
Elizabeth Allen Clerk Pearl River, Town of / Pearl River
Eloise Means Town Clerk Bonita, Village of / Bonita
Elton Pickering Director of Public Works Beauregard Parish / DeRidder
Emily Bentley Clerk Clinton, Town of / Clinton
Eva Taylor Asst. Secretary/Treasurer Madison Parish / Tallulah
Evelyn Sandidge Clerk Pioneer, Village of / Pioneer
Faye Boyd Permit Official Franklinton, Town of / Franklinton
Floodplain Administrator Bossier Parish / Benton
Floodplain Administrator Clerk Clarence, Village of / Clarence
Flora Hicks Clerk Collinston, Village of / Collinston
Frankie Crooks Code Enforcement Officer Pineville, City of / Pineville
Gary Beadle Director of Planning & Zoning Berwick, Town of / Berwick
Genevieve Ellis Permit Official Richmond, Village of / Tallulah
Genie Drouin Clerk Hessmer, Village of / Hessmer
Gerald Odom Clerk Tallulah, City of / Tallulah
Gilbert Pitre City Inspector Jennings, City of / Jennings
Glen Couvillion Floodplain Administrator Alexandria, City of / Alexandria
Glenda Thomas Clerk South Mansfield, Village of / South Mansfield
Gloria Dean King Clerk Delhi, Town of / Delhi
Grady Stephens Business Manager Vernon Parish / Leesville
Greg Prejean (Bubba) Floodplain Administrator Sulphur, City of / Sulphur
Guy Pucheu(pro. pea-shoe) Clerk Mamou, Town of / Mamou
Heuetta Benoit Clerk Gueydan, Town of / Gueydan
Holly Gilmore Clerk Jackson, Town of / Jackson
Irvin Richoux, Sr. Building Inspector Grand Isle, Town of / Grand Isle
James Boyd Fire Protection Chief Bastrop, City of / Bastrop
James Demouchet Permit Official Caddo Parish / Shreveport
James Hall Building Inspector Bogalusa, City of / Bogalusa
Jamie Liner Clerk Golden Meadow, Town of / Golden Meadow
Jana Klock Clerk Cheneyville, Town of / Cheneyville
Jason Benoit Senior Planner Houma, City of / Houma
Jason Benoit Senior Planner Terrebonne Parish / Houma
Jean Blackard Clerk Mer Rouge, Village of / Mer Rouge
Jeff L. James Mayor Rosepine, Town of / Rosepine
Jennifer Perkins Clerk Natchez, Village of / Natchez
Jenny Curtis Parish Secretary Franklin Parish / Winnsboro
Jerry DeWitt Code Enforcement Officer DeRidder, City of / DeRidder
JoAnn Basinger Town Clerk Ringgold, Town of / Ringgold
Jody Chenier Director of Operations St. James Parish / Convent
Joe Graves Clerk Wisner, Town of / Wisner
Joe Sontoyo Fire Chief Ferriday, Town of / Ferriday
John Boudreaux Floodplain Administrator Assumption Parish / Napoleonville
John Boudreaux Floodplain Administrator Napoleonville, Village of / Napoleonville
John Pinsonat Building Inspector New Roads, City of / New Roads
John Quebodeaux Permit Officer Acadia Parish / Crowley
Joy Fontenot Clerk DeQuincy, City of / DeQuincy
Joy S. Rhodes Clerk Plain Dealing, Town of / Plain Dealing
Joyce Core Clerk Folsom, Village of / Folsom
Juanita Fowler Director of Planning & Zoning Natchitoches, City of / Natchitoches
Judy Massey Clerk Ridgecrest, Town of / Ridgecrest
Judy Shelton Town Clerk Pollock, Town of / Pollock
Jules Lefeaux Town Clerk Brusly, Town of / Brusly
June Farmer Permit Administrator Port Vincent, Village of

/ Port Vincent
Karen Carlton Secretary/Treasurer Winn Parish / Winnfield
Karen Davis Clerk Springfield, Town of / Springfield
Kathy Dickens Clerk Vidalia, Town of / Vidalia
Kay Kleinpeter Clerk Grosse Tete, Village of / Grosse Tete
Kay Smith Secretary-Treasurer LaSalle Parish / Jena
Keith Chiro Permit Officer Kenner, City of / Kenner
Ken Amedee Clerk Rosedale, Village of / Rosedale
Laura Adams Floodplain Manager Catahoula Parish / Harrisonburg
Lee Butler Utilities Supervisor Maringouin, Village of / Maringouin
LeeAnn Clement Town Clerk Lake Providence, Town of / Lake Providence
Leslie Thibodeaux Clerk Fordoche, Village of / Fordoche
Linda Duhon Floodplain Administrator Vermilion Parish / Abbeville
Linda Gaspard Clerk Washington, Town of / Washington
Linda Lowery E-911 Admin/Floodplain Manager Caldwell Parish / Columbia
Linda S. LeBlanc Town Clerk Welsh, Town of / Welsh
Linda Sikes Sec./Treasurer Tensas Parish / St. Joseph
Lisa Richardson Building Permit Officer Ouachita Parish / Monroe
Lorraine M. Brummett Clerk Grand Cane, Village of / Grand Cane
Lorraine Thibodaux Clerk Baldwin, Town of / Baldwin
Louria* Jefferson Permit Official Arcadia, Town of / Arcadia
Lydia A. Boxie Clerk Sunset, Town of / Sunset
Lydia Z. Louque Permit Official Gramercy,Town of / Gramercy
Mack Thompson Parish Engineer Allen Parish / Oberlin
Margaret Doucet Code Enforcement Officer Opelousas, City of / Opelousas
Margie Holden Clerk McNary, Village of / McNary
Marie Beeson Clerk Elizabeth, Town of / Elizabeth
Marilyn Dilmore Clerk Sterlington, Town of / Sterlington
Marilyn Juneau Clerk Moreauville, Village of / Moreauville
Mark Hudson Civil Engineer Bossier City, City of / Bossier City
Mark Ramagos City Manager Morganza, Town of / Morganza
Mary Hebert Clerk Maurice, Town of / Maurice
Mary Hebert Tax Collector Jeanerette, City of / Jeanerette
Mary Lou Lacassin Clerk Krotz Springs, Town of / Krotz Springs
Mary Lou Lee Clerk Amite City, Town of / Amite City
Mary Pringle Clerk Forest Hill, Village of / Forest Hill
Mary Vice Clerk Vinton, Town of / Vinton
Maurice T. Bourgeois, Jr. City Clerk Westwego, City of / Westwego
Maxine Ard Assistant Clerk Montpelier, Village of / Montpelier
Maxine Buller Clerk Lecompte, Town of / Lecompte
Melissa Becker Rapides Parish / Alexandria
Melissa Blanco Permit Clerk St. Landry Parish / Opelousas
Mercedes Williams Clerk St. Joseph, Town of / St. Joseph
Merilyn Morris Tax Collector St. Gabriel, Town of / St. Gabriel
Michael Andrus Building Inspector Monroe, City of / Monroe
Michael Hunnicut Dir. of Comm. Development St. Bernard Parish / Chalmette
Michelle Jones Clerk Oakdale, City of / Oakdale
Mike Allen Supervisor of Public Works Farmerville, Town of / Farmerville
Mike Centineo Building Official Orleans Parish (New Orleans) / New Orleans
Mildred Johns Clerk Mangham, Town of / Mangham
Mindy Ezernick Town Clerk Zwolle, Town of / Zwolle
Minnie Hutchinson Clerk Tangipahoa, Village of / Tangipahoa
Mr. Carol J. Vinning Planning Director St. Mary Parish / Franklin
Mr. Chris Young Fire Chief Jonesboro, Town of / Jonesboro
Ms. Donny Duffy Clerk Livingston, Town of / Livingston
Ms. Eylene Bolling Secretary Claiborne Parish / Homer
Ms. Louise Jeansonne Asst. Administrator Marksville, Town of / Marksville
Ms. Lynn Hicks Clerk Cotton Valley, Town of / Cotton Valley
Ms. Paris Sumrall Mayor Varnado, Village of / Varnado
Ms. Willie Bishop Clerk Ball, Town of / Ball
Nancy Burney Clerk Cullen, Town of / Cullen
Nancy Robbins Town Clerk Gilbert, Village of / Gilbert
Neil Minor Planning & Zoning Director Franklin, City of / Franklin
Nell Tassin Town Clerk Mansura, Town of / Mansura
Pam Guidry Building Inspector Henderson, Town of / Breaux Bridge
Pam Mattingly Assistant Director of Planning Calcasieu Parish / Lake Charles
Pam Stokes Clerk Delta, Village of / Delta
Patricia Griffith Permit Clerk Evangeline Parish / Ville Platte
Patricia Lemoine Clerk Lutcher, Town of / Lutcher
Patti Vincent City Clerk Delcambre, Town of / Delcambre
Paulette St. Romain Permit Official Pointe Coupee Parish / New Roads
Peggy Robinson Permit Official West Carroll Parish / Oak Grove
Penny Fields Town Clerk Haynesville, Town of / Haynesville
Pete Panepinto Building Official Hammond, City of / Hammond
Phyllis Barnhill Clerk Many, Town of / Many
Phyllis Savoy Loreauville, Village of / Loreauville
Rachel Denison Town Clerk Columbia, Town of / Columbia
Ray Rozas (Shorty) Bldg. Inspector Eunice, City of / Eunice
Rebecca Langlinais Clerk Youngsville, Town of / Youngsville
Reggie Edmiston Building Inspector Ruston, City of / Ruston
Renee Dixon Clerk Melville, Town of / Melville
Rhonda King Clerk Newellton, Town of / Newellton
Richard Durrett Parish Engineer Lincoln Parish / Ruston
Robert Meeker Building Inspector Grant Parish / Colfax
Rodney Warren Permit Official Bienville Parish / Arcadia
Ron Keller Planning Director St. Tammany Parish / Mandeville
Rose Johnson Town Clerk Basile, Town of / Basile
Roxy Fletcher City Clerk Winnsboro, City of / Winnsboro
Ruby Maggio Building Permit Office Thibodaux, City of / Thibodaux
Russell Wagoner Secretary/Treasurer Concordia Parish / Vidalia
Sadie G. Jones Clerk Clayton, Town of / Clayton
Sallie Broadway Clerk Provencal, Village of / Provencal
Sandra Miller Town Clerk Oak Grove, Town of / Oak Grove
Sandra Turley Clerk Iowa, Town of / Iowa
Sandy S. Sarver Clerk Estherwood, Village of / Estherwood
Sarah Hebert Asst. Clerk Broussard, Town of / Broussard
Shannon Burke Covington, City of / Covington
Shannon Reeves Town Clerk Roseland, Town of /

Roseland
Sharon Eiland Clerk Doyline, Village of / Doyline
Sharon Johnson Permit Officer Union Parish / Farmerville
Sharon Keel Clerk Jena, Town of / Jena
Sharon Stewart Clerk Logansport, Town of / Logansport
Shedrick Berard Safety Director St. Martinville, City of / St. Martinville
Sheila McManus Clerk Montgomery, Town of / Montgomery
Sherry Boyd Town Clerk Sibley, Town of / Sibley
Sherwin LeFranc FPA Jefferson Davis Parish / Jennings
Shirley Byrd Sec./Treasurer Webster Parish / Minden
Sonia Marquette Floodplain Administrator West Baton Rouge Parish / Port Allen
Stacey Adler Clerk White Castle, Town of / White Castle
Stacey Swindle Clerk Florien, Village of / Florien
Stanley Polivick City Engineer Slidell, City of / Slidell
Steve Benton Floodplain Administrator Madisonville, Town of / Madisonville
Sue White Town Clerk/Permit Admin French Settlement, Village of / French Settlement
Susan E. Robinson Clerk Grayson, Village of / Grayson
Sybil Josey Clerk Mound, Village of / Mound
Sylvia Forbes Flood Administrator Washington Parish / Franklinton
Talona Hathcock Clerk Harrisonburg, Village of / Harrisonburg
Tara Albares Town Clerk Sorrento, Town of / Sorrento
Tekisha Guidry Town Clerk Duson, Town of / Duson
Terrence Green Permit Administrator Greenwood, Town of / Greenwood
Therese Wilcox Clerk Harahan, City of / Harahan
Tina Forrest Independence, Town of / Independence
Tina Horn Parish Administrator Cameron Parish / Cameron
Tina Lemoine OEP Assistant Avoyelles Parish / Marksville
Tom Rodrigue Jefferson Parish / Marrero
Tommy Burgess Floodplain Administrator Richland Parish / Rayville
Toria Comeaux Clerk Port Barre, Town of / Port Barre
Travis Beebee Building Inspector Homer, Town of / Homer
Trudy Boudreaux Clerk/Floodplain Administrator Baskin, Village of / Baskin
Vacant - Talk to Mayor Town Clerk Richwood, Town of / Richwood
Vera Lucas Clerk Addis, Town of / Addis
Verian Guillory Clerk Elton, Town of / Elton
Vernell S. Franklin Clerk Simmesport, Town of / Simmesport
Vicki Adkins Permit Officer Springhill, City of / Springhill
Wayne Berggren Bldg. Inspector Mandeville, City of / Mandeville
Wesley Dunn Clerk Mansfield, City of / Mansfield
Wilbur J. Rozas Clerk Chataignier, Village of / Chataignier
Willie B. Robinson Clerk Coushatta, Town of / Coushatta
Winston Copell Building Inspector New Iberia, City of / New Iberia
Yvette Crain Clerk Jean Lafitte, Town of / Lafitte

Media (Newspaper , TV, Radio)

Count: 197

Abbeville Meridional / Abbeville
Acadian Press / Mamou
Acadian Tribune / Rayne
American Press Attn: Hector San Miguel / Lake Charles
American Press Attn: Linda Young / Lake Charles
American Waterways Operators / Mandeville
Amite Tangi-Digest / Amite
Ascension Citizen / Gonzales
Avoyelles Journal / Marksville
Baton Rouge Business Report / Baton Rouge
Bill Capo WWL-TV, Channel 4 / New Orleans
Bob Breck Fox 8 Live WVUE-TV / New Orleans
Bobby Brennan Fox 8 Live WVUE-TV / New Orleans
Bunkie Record / Bunkie
Callais Cablevision Channel 5 / La Rose
Cameron Parish Pilot / Cameron
Carissa Mire The Daily Iberian / New Iberia
Carl Arredondo WWL-TV, Channel 4 / New Orleans
Catherine Carlock Simpson News Mgr LA Dept of Wildlife & Fisheries / Baton Rouge
Chief / Donaldsonville
Church Point News / Church Point
Citizen / Coushatta
Citizen / Welsh
City Business Deon Roberts / Metairie
City Business Editor: Terry O'Connor / Metairie
Courier / Daily Comet / Houma
Daily Comet Editor Jeffrey Zeringue / Thibodaux
Daily Comet Todd Siegrist / Thibodaux
Daily Shipping Guide Garry Naquin / New Orleans
Daily Star Lillian Mirando / Hammond
Daily World Exec Editor Harland Kirgan / Opelousas
David Bernard WWL-TV, Channel 4 / New Orleans
David Krapf Workboat Magazine / Mandeville
Denham Springs-Livingston News / Denham Springs
Dennis Woltering WWL-TV, Channel 4 / New Orleans
Dir - Advertising & Promotion LA Dept of Commerce & Industry / Baton Rouge
Don Hoffman Where Magazine / New Orleans
Eunice News / Eunice
Franklin Banner Tribune / Franklin
Galen H Rogers Gentilly Freak Productions / New Orleans
Gambit Weekly Michael Tisserand / New Orleans
Gazette / Ville Platte
Gonzales Weekly / Gonzales
Herald / Kaplan
Huey Stein - Editor The Enterprise / Vacherie
Jeanerette Enterprise / Jeanerette
Jeff Duhe-News Director Louisiana Public Broadcasting / Baton Rouge
John Gumm WWL-TV, Channel 4 / New Orleans
John Snell-Anchor Person WVUE-TV / New Orleans
KADN / Lafayette
KALB-TV / Alexandria
Kane - News Director / New Iberia
KAPB / KWLB / Marksville
KATC-TV / Lafayette
Katheline Gilbert The Courier Weekend Editor / Houma
KDBS / KRRV / Alexandria
Keith Magill The Courier Executive Editor / Houma
Ken Hocke Workboat Magazine / Mandeville
Kenner Star Candy Lovitt-Managing Editor / Kenner
Kent Prince, News Editor Associated Press / New Orleans
KEUN-AM / KJJB-AM / Eunice
KFNV-AM-FM / Ferriday
KGLA / Marrero
Kim Holden Fox 8 Live WVUE-TV / New Orleans
Kimberly Krupa The Courier / Houma
KJIN / KCIL / Houma
KLCL / KHLA / Lake Charles
KLFY-TV / Lafayette
KLLA / Leesville
KMRC-KFXY / Morgan City
KPEL AM FM / Lafayette
KPLC - TV Ch 7 Assignment Editor Sheletta Smith / Lake Charles
KPLC - TV Ch 7 Environmental Ed Teresa Schmidt / Lake Charles

KPLC - TV Ch 7 News Director Cynthia Victorian / Lake Charles
KPLC-TV / Lake Charles
KQKI / KDLP Ernst Polk / Morgan City
KSIG / Crowley
KSLO / KOGM / Opelousas
KSMB / Lafayette
KSYL / Alexandria
KTIB / Thibodaux
KVIP-AM-FM / Ville Platte
KVVP / Leesville
KWBJ Channel 39 / Morgan City
KWCL-AM-FM / Oak Grove
La Prensa Attn: Gina Cortez / Metairie
Lafayette Advertiser Attn: Charles Lenox / Lafayette
Lafayette Advertiser Attn: Ann Wakefield / Lafayette
Lafayette Advertiser Attn: Bill Decker / Lafayette
Lafourche Gazette Vicki Chaisson, ED / La Rose
Leader / Leesville
Ledger / Kentwood
Livingston Parish News / Denham Springs
L'Observateur Leonard Gray / LaPlace
Louisiana Network Inc Attn: Jeff Palermo / Baton Rouge
Louisiana Shipbuilding & Repairs Association / New Orleans
Marty Authement The Courier Features Editor / Houma
Matt Gresham The Courier / Houma
Mikel Schaefer WWL-TV, Channel 4 / New Orleans
Morgan City Daily Review / Morgan City
Ms Fran Marcus New York Times / New Orleans
Ms Janet Plume Journal of Commerce / New Orleans
New Orleans Port Record / New Orleans
News / Denham Springs
News / De Quincey
News Director KVPO Radio / Morgan City
News Examiner / Lutcher
News One State Capitol Station / Baton Rouge
Plaquemines Newspaper Publishing Inc / Belle Chasse
Pointe Coupee Banner / New Roads
Port of Lake Charles Harbor and Terminal District / Lake Charles
Port of New Orleans Gary Lagrange / New Orleans
Post Signal / Crowley
Rajun Cajun Radio Station / La Rose
Randy Decuir Avoyelles Journal / Marksville
River Parishes Guide / Boutte
Roger Hooper, Ed & Publisher Go Gulf Magazine / Baton Rouge
Scott Turick The Daily Iberian / New Iberia
Slidell Sentry News / Slidell
St Bernard News / Metairie
St Charles Herald Guide Daniel Moore / Boutte
St Helena Echo / Greensburg
St Mary Journal / Morgan City
St Tammany News Banner / Covington
Stanley R Dufrene - Public Affairs Union Carbide / Dow Chemical / Hahnville
Supervisor US Coast Guard (MSO) / Morgan City
Tangi-Talk / Amite
Teche News / St. Martinville
Terrebonne Press / Houma
Terry Westerfield WGNO TV Ch 26 / New Orleans
The Advocate Amy Wold / Baton Rouge
The Advocate Angela Simoneaux / Lafayette
The Advocate Ben Reed Asst. State Editor / Baton Rouge
The Advocate Bill Bankston / Baton Rouge
The Advocate Bobby Lamb Business Editor / Baton Rouge
The Advocate Carl Redman Managing Editor / Baton Rouge
The Advocate Chris Baughman City Desk / Baton Rouge
The Advocate Curt Eysink City Editor / Baton Rouge
The Advocate Emily Kern Westside Bureau / Port Allen
The Advocate Fred Kalmbach City Desk / Baton Rouge
The Advocate Joe Macaluso Outdoor Writer / Baton Rouge
The Advocate John LaPlante Capitol Bureau Chief / Baton Rouge
The Advocate John Mcmillan / Gonzales
The Advocate Johnny Brooks News / Baton Rouge
The Advocate Linda Lightfoot Executive Editor / Baton Rouge
The Advocate Madeleine Lamb People Editor / Baton Rouge
The Advocate Mike Dunne News / Baton Rouge
The Advocate Milford Fryer Surburban Editor / Baton Rouge
The Advocate Randy McLain News / Baton Rouge
The Advocate Roy Miller State Editor / Baton Rouge
The Advocate Tim Belehrad Newsfeatures Ed. / Baton Rouge
The Chamber Chris Laborde / New Orleans
The Currents Naval Support Activity, PAO / New Orleans
The Observer / Baker
The Rayne Independent / Rayne
The Times Picayune Attn: Sandra Barbier / Gretna
The Waterways Journal 666 Security Building / St. Louis
Times of Acadiana / Lafayette
Times Picayune / Metairie
Times Picayune Andrea Shaw / Gretna
Times Picayune Bob Marshall-Venture Editor / New Orleans
Times Picayune Charlie Crumpley - Money Section / New Orleans
Times Picayune Coleman Warner / New Orleans
Times Picayune Jed Horne, City Editor / New Orleans
Times Picayune Jefferson Bureau Drew E Broach / Metairie
Times Picayune Leslie Williams / New Orleans
Times Picayune St. Bernard Bureau Karen Turni / Chalmette
Times Picayune St. Tammany Bureau Ron Thibodeaux / Slidell
Times Picayune Terri Troncale / New Orleans
Times Picayune
Times-Picayune Mr. Mark Schleifstein / New Orleans
Town Talk / Alexandria
WABL / Amite
WBOK / New Orleans
WBRZ / Baton Rouge
WBYU / WSHO / New Orleans
WCKW-AM / Metairie
WDSU-TV / New Orleans
West Side Journal / Port Allen
WFCG / Franklinton
WFPR / WHMD / Hammond
WGGZ-FM / Baton Rouge
WGNO-TV 26 Paula Pendarvis News Director / New Orleans
WGSO Attn: Charles Travis / Metairie
White Castle Times / Plaquemine
WIBR / Baton Rouge
William A Evans Waterways Journal / Mandeville
WJBO / WFMF / Baton Rouge
WLPB-TV / Baton Rouge
WNOE-AM-FM / New Orleans
WQUE-FM / New Orleans
WSMB / New Orleans
WVUE-TV / New Orleans
WWL / WAJY / New Orleans
WWOZ / New Orleans
WYES-TV / New Orleans

WYNK Radio / Baton Rouge

Other Membership Organizations

Count: 8

American Rivers / Signal Mountain
Barbara Dodds League of Women Voters / Covington
Bicycle Awareness Committee of New Orleans Mr. Robin P. Robert / New Orleans
Concerned Citizens For Informed Choices / Slidell
LA League of Women Voters / Baton Rouge
La State Governors Advisory Committee On Bicycling Mr. Bill Keller - Chairman / New Orleans
Lake Pontchartrain Sanitary District / Baton Rouge
Ms. Jean Armstrong LA League of Women Voters / Baton Rouge

Standard Personal-Coordination Names for EA & EIS

Count: 11

David Bernhart NMFS - Protected Species Division / St. Petersburg
Donald Gohmert State Conservationist - NRCS / Alexandria
Field Supervisor U.S. Fish and Wildlife Service / Lafayette
Gary Zimmerer FEMA - Region VI, Federal Center / Denton
Gregory P. Ducote Interagency Affairs - LADNR CMD / Baton Rouge
Larry Wiesepape, Ph.D LA DEQ Permits Division / PER-REGC / Baton Rouge
Miles Croom NMFS - Habitat Conservation Division / St. Petersburg
Pam Breaux SHPO, Dept. of Culture Recreation and Tourism / Baton Rouge
Richard D. Hartman NMFS - Habitat Conservation Division Louisiana State University / Baton Rouge
Rob Lawrence EPA, Region VI - Off. of Planning and Coord. / Mail Code 6EN-XP / Metairie
Russell C. Watson Field Supervisor U.S. Fish and Wildlife Service / Lafayette

State Agencies

Count: 28

Cultural & Historical/ Research & Development Research Coord Melanie Marcotte / Charenton
Darin M. Lee Coastal Resources Scientist Supervisor LA DNR - CRD / Thibodaux
David Frugé, Administrator LA Dept. of Natural Resources Coastal Management Division / Baton Rouge
East Baton Rouge City-Parish Council / Baton Rouge
Edgar S. Bordes City of New Orleans Mosquito & Termite Control Board / New Orleans
Governors Office for Coastal Activities State Land & Nat Resources Bldg. / Baton Rouge
Katherine Vaughn Deputy Secretary of Louisiana DNR / Baton Rouge
LA Dept of Natural Resources Coastal Resources Program Consistency Coordinator / Baton Rouge
LA Dept of Natural Resources Office of Conservation Surface Mining Division / Baton Rouge
LA Dept of Natural Resources Title & Records Section Division of State Lands / Baton Rouge
LA Dept of Public Works / Baton Rouge
LA Dept of Transportation & Dev Asst Chief Engr Water Resources Office of Public Works / Baton Rouge
LA Dept of Wildlife & Fisheries Mr. Tim Morrison / Baton Rouge
LA Dept Wildlife & Fisheries Mr. Gary Lester-Nat Heritage Pgm / Baton Rouge
LA Dept Wildlife & Fisheries Mr. Maurice B. Watson / Baton Rouge
LA Dept Wildlife & Fisheries Secretary / Baton Rouge
LA Dept. of Agriculture & Forestry Mr. Matthew Keppinger Office of Ag & Environmntal Science / Baton Rouge
LA Dept. of Agriculture & Forestry Office of Forestry / Baton Rouge
LA Dept. of Culture Recreation & Tourism/office of State Parks Div. of Outdoor Recreation / Baton Rouge
LA Dept. of Environmental Quality Environmental Planning Division Ep-sip / Baton Rouge
LA Dept. of Health & Hospitals Office of Public Health Attn: Engineering/sewerage Unit / Baton Rouge
LA Dept. of Natural Resources Louisiana Geological Survey / Baton Rouge
LA Dept. of Transportation & Dev. Federal Projects Section Rm 207 - PO 94245 / Baton Rouge
LA Division of Administration State Land Office / Baton Rouge
LA Division of Administration State Planning Office / Baton Rouge
LA State Attorney Gen's Office Mr. William W. Goodell Jr/asst. A G State Lands & Natl. Res. Div. / Baton Rouge
LA State Board of Commerce & Industry Research Division / Baton Rouge
Lisa Miller LA DEQ MF-CG / Baton Rouge

State Elected Officials (Gov Lt.,Gov Sec.State, etc.)

Count: 4

Bob Odom LA Dept of Ag & Forestry / Baton Rouge
Governor of Louisiana Hon. Kathleen Babineaux Blanco State Capitol / Baton Rouge
Lieutenant Governor "Mitch" Landrieu / Baton Rouge
Secretary of State Honorable W. Fox Mckeithen / Baton Rouge

State Representatives

Count: 102

State Representative 45th Representative District / Lafayette
A. G. Crowe State Representative 76th Representative District / Pearl River
Alexander "Alex" Heaton State Representative 95th Representative District / New Orleans
Arthur A. Morrell State Representative 97th Representative District / New Orleans
Austin J. Badon, Jr. State Representative 100th Representative District / New Orleans
Avon R. Honey State Representative 63rd Representative District / Baton Rouge
Beverly Bruce State Representative 7th Representative District / Mansfield
Billy Montgomery State Representative 9th Representative District / Haughton
Brett Geymann State Representative 35th Representative District / Lake Charles
Bryant O. Hammett, Jr. State Representative 21st Representative District / Ferriday
Carl Crane State Representative 70th Representative District / Baton Rouge
Carla Blanchard Dartez State Representative 51st

Representative District / Morgan City
Cedric Bradford Glover State Representative 4th Representative District / Shreveport
Cedric Richmond State Representative 101st Representative District / New Orleans
Charles D. Lancaster, Jr. State Representative 80th Representative District / Metairie
Charles I. "Chuck" Hudson State Representative 40th Representative District / Opelousas
Charles McDonald State Representative 14th Representative District / Fairbanks
Charles W. "Charlie" Dewitt State Representative 25th Representative District / Alexandria
Charmaine Marchand State Representative 99th Representative District / New Orleans
Cheryl Gray State Representative 98th Representative District / New Orleans
Clara Guilbeau Baudoin State Representative 39th Representative District / Carencro
Dale Erdey State Representative 71st Representative District / Livingston
Damon J. Baldone State Representative 53rd Representative District / Houma
Dan "Blade" Morrish State Representative 37th Representative District / Jennings
Dan Flavin State Representative 36th Representative District / Lake Charles
Daniel R. "Danny" Martiny State Representative 79th Representative District / Kenner
Derrick Shepherd State Representative 87th Representative District / Marrero
Diane Winston State Representative 77th Representative District / Covington
Don Trahan State Representative 31st Representative District / Lafayette
Donald "Don" Cazayoux, Jr. State Representative 18th Representative District / New Roads
Donald Ray Kennard State Representative 65th Representative District / Baton Rouge
Edwin R. "Ed" Murray State Representative 96th Representative District / New Orleans
Elcie Joseph Guillory State Representative 34th Representative District / Lake Charles
Emile "Peppi" Bruneau State Representative 94th Representative District / New Orleans
Eric Lafleur State Representative 38th Representative District / Ville Platte
Ernest Baylor, Jr. State Representative 3rd Representative District / Shreveport
Ernest D. Wooton State Representative 105th Representative District / Belle Chasse
Ernie Alexander State Representative 43rd Representative District / Lafayette
Errol "Romo" Romero State Representative 48th Representative District / New Iberia
Francis Thompson State Representative 19th Representative District / Delhi
Gary Beard State Representative 69th Representative District / Baton Rouge
Gary L. Smith, Jr. State Representative 56th Representative District / Norco
Gil Pinac State Representative 42nd Representative District / Crowley
Glenn Ansardi State Representative 92nd Representative District / Kenner
Gordon Dove State Representative 52nd Representative District / Houma
Harold L. Ritchie State Representative 75th Representative District / Franklinton
Herman Ray Hill State Representative 32nd Representative District / Dry Creek
Hollis Downs State Representative 12th Representative District / Ruston
Israel "Bo" Curtis State Representative 26th Representative District / Alexandria
Jack D. Smith State Representative 50th Representative District / Stephensville
Jalila Jefferson State Representative 91st Representative District / New Orleans
James R. "Jim" Fannin State Representative 13th Representative District / Jonesboro
James W. "Jim" Tucker State Representative 86th Representative District / New Orleans
Jane H. Smith State Representative 8th Representative District / Bossier City
Jean M. Doerge State Representative 10th Representative District / Minden
Jeffery "Jeff" Arnold State Representative 102nd Representative District / New Orleans
Joe R. Salter State Representative 24th Representative District / Florien
John A. Alario, Jr. State Representative 83rd Representative District / Westwego
John La Bruzzo State Representative 81st Representative District / Metairie
John Smith State Representative 30th Representative District / Leesville
Joseph F. Toomy State Representative 85th Representative District / Gretna
Karen Carter State Representative 93rd Representative District / New Orleans
Karen Gaudet St. Germain State Representative 60th Representative District / Pierre Part
Kay Kellogg Katz State Representative 16th Representative District / Monroe
Kenneth L. Odinet, Sr. State Representative 103rd Representative District / Arabi
Lelon Kenney State Representative 20th Representative District / Columbia
Loulan Pitre, Jr. State Representative 54th Representative District / Cut Off
M. J. "Mert" Smiley, Jr. State Representative 88th Representative District / St. Amant
Mack "Bodi" White State Representative 64th Representative District / Baker
Michael A. "Mike" Walsworth State Representative 15th Representative District / West Monroe
Michael G. "Mike" Strain State Representative 74th Representative District / Covington
Michael Jackson State Representative 61st Representative District / Baton Rouge
Mickey Frith State Representative 47th Representative District / Kaplan
Mickey J. Guillory State Representative 41st Representative District / Eunice
Mike Futrell State Representative 66th Representative District / Baton Rouge
Mike Powell State Representative 6th Representative District / Shreveport
Monica Walker State Representative 28th Representative District / Bunkie
N. J. Damico State Representative 84th Representative District / Marrero
Nita Rusich Hutter State Representative 104th Representative District / Chalmette
Pete Schneider State Representative 90th Representative District / Slidell.
Rick Gallot State Representative 11th Representative District / Ruston
Rick L. Farrar State Representative 27th Representative

District / Pineville
Robby Carter State Representative 72nd Representative District / Greensburg
Robert R. "Bobby" Faucheux, Jr. State Representative 57th Representative District / Gramercy
Ronnie Johns State Representative 33rd Representative District / Sulphur
Roy "Hoppy" Hopkins State Representative 1st Representative District / Oil City
Roy Burrell State Representative 2nd Representative District / Shreveport
Roy Quezaire State Representative 58th Representative District / Donaldsonville
Sharon Weston Broome State Representative 29th Representative District / Baton Rouge
Shirley Bowler State Representative 78th Representative District / River Ridge
Stephen J. "Steve" Scalise State Representative 82nd Representative District / Jefferson
Sydnie Mae Maraist Durand State Representative 46th Representative District / St. Martinville
T. Taylor Townsend State Representative 23rd Representative District / Natchitoches
Thomas H. "Tom" McVea State Representative 62nd Representative District / St. Francisville
Tim Burns State Representative 89th Representative District / Mandeville
Tommy Wright State Representative 22nd Representative District / Jena
Troy Hebert State Representative 49th Representative District / Jeanerette
Warren Triche, Jr. State Representative 55th Representative District / Thibodaux
Wayne Waddell State Representative 5th Representative District / Shreveport
Wilfred Pierre State Representative 44th Representative District / Lafayette
William Daniel State Representative 68th Representative District / Baton Rouge
Willie Hunter, Jr. State Representative 17th Representative District / Monroe
Yvonne Dorsey Welch State Representative 67th Representative District / Baton Rouge

State Senators

Count: **39**

"Butch" Gautreaux State Senator 21st Senatorial District / Morgan City
"Don" Hines State Senator 28th Senatorial District / Bunkie
"Joe" McPherson State Senator 29th Senatorial District / Woodworth
"Ken" Hollis State Senator 9th Senatorial District / Metairie
"Mike" Michot State Senator 23rd Senatorial District / Lafayette
"Nick" Gautreaux State Senator 26th Senatorial District / Abbeville
"Tom" Schedler State Senator 11th Senatorial District / Slidell
Ann Duplessis State Senator 2nd Senatorial District / New Orleans
Arthur "Art" Lentini State Senator 10th Senatorial District / Kenner
Ben Nevers State Senator 12th Senatorial District / Bogalusa
Charles D. Jones State Senator 34th Senatorial District / Monroe
Cleo Fields State Senator 14th Senatorial District / Baton Rouge
Craig Romero State Senator 22nd Senatorial District / New Iberia
Diana E. Bajoie State Senator 5th Senatorial District / New Orleans
Donald "Don" Cravins State Senator 24th Senatorial District / Arnaudville
Francis C. Heitmeier State Senator 7th Senatorial District / New Orleans
Gerald "Jerry" Theunissen State Senator 25th Senatorial District / Jennings
Heulette "Clo" Fontenot State Senator 13th Senatorial District / Livingston
J. Chris Ullo State Senator 8th Senatorial District / Marrero
James David Cain State Senator 30th Senatorial District / Dry Creek
Jay Dardenne State Senator 16th Senatorial District / Baton Rouge
Joel T. Chaisson, II State Senator 19th Senatorial District / Destrehan
John J. Hainkel, Jr. State Senator 6th Senatorial District / New Orleans
Kenneth M. "Mike" Smith State Senator 31st Senatorial District / Winnfield
Lambert C. Boissiere, Jr. State Senator 3rd Senatorial District / New Orleans
Lydia Patrice Jackson State Senator 39th Senatorial District / Shreveport
Max T. Malone State Senator 37th Senatorial District / Shreveport
Melvin L. "Kip" Holden State Senator 15th Senatorial District / Baton Rouge
Noble Ellington State Senator 32nd Senatorial District / Winnsboro
Paulette R. Irons State Senator 4th Senatorial District / New Orleans
Reggie P. Dupre, Jr. State Senator 20th Senatorial District / Bourg
Robert "Rob" Marionneaux, Jr. State Senator 17th Senatorial District / Grosse Tete
Robert Adley State Senator 36th Senatorial District / Benton
Robert J. Barham State Senator 33rd Senatorial District / Oak Ridge
Robert W. "Bob" Kostelka State Senator 35th Senatorial District / Monroe
Senator"Jody" Amedee State Senator 18th Senatorial District / Gonzales
Sherri Smith Cheek State Senator 38th Senatorial District / Shreveport
Walter J. Boasso State Senator 1st Senatorial District / Arabi
Willie Landry Mount State Senator 27th Senatorial District / Lake Charles

Tribes

Count: **5**

Chitimacha Tribe Director of Cultural Affairs Kim Walden / Charenton
Chitimacha Tribe Mr. Alton D. Leblanc Jr. Chairman / Charenton
Coushatta Tribe Mr. Lovelin Poncho Chairman / Elton
Cultural & Historic Preservation Tunica-Biloxi Indians of La Chairman Earl Barbry Sr. / Marksville
Jena Band Choctaw Beverly C. Smith, Chairperson / Jena

United States District Conservationist

Count: **2**

Allen Bolotte Dist. Cons. U.S. - NRCS / Boutte
Michael Jordon Avoyelles Parish-Dist. Conservationist / Marksville

Universities, University Affiliated Persons (Professors)

Count: 7

Craig A. Johnson - Director Louisiana Geographic Information Cent. Louisiana State University / Baton Rouge
Dr. Jack Van Lopik Executive Director Office of Sea Grant Development-LSU / Baton Rouge
Louisiana State University Curator of Anthropology Department of Geography / Baton Rouge
Louisiana State University Sea Grant Legal Program / Baton Rouge
Melanie Reed Tulane Environmental Law Clinic / New Orleans
Tulane University Army ROTC / New Orleans
Tulane University Dr. Oliver Houck Tulane Law School / New Orleans

US Representatives

Count: 7

Hon. "Chris" John U. S. Representative 7th Congressional District / Crowley
Hon. Billy Tauzin U. S. Representative 3rd Congressional District / Washington
Hon. David Vitter U. S. Representative 1st Congressional District / Metairie
Hon. Jim Mccrery U. S. Representative 4th Congressional District / Shreveport
Hon. Richard Baker U. S. Representative 6th Congressional District / Baton Rouge
Hon. Rodney Alexander U. S. Representative 5th Congressional District / Quitman
Hon. William Jefferson U. S. Representative 2nd Congressional District / New Orleans

US Senators

Count: 2

Honorable John B. Breaux U.S. Senate Hale Boggs Federal Bldg / New Orleans
Honorable Mary Landrieu U.S. Senate / New Orleans

Scoping Meeting - April 2004
Count: 94

Mr. Chris Liner
Mr. Darryl Chauvin, Atchafalaya River Coalition
Mr. Dustin Walker
Mr. E.J. Blaize
Mr. Forrest Forbes, OMI, Inc.
Mr. Jeff Evans
Mr. Jeff Stanford, DMJM & Harris, Inc.
Mr. Ken Savastano
Mr. Mike Landers
Mr. Terry O'Connor, The People
Mr. Tony Fazzio
Mr. Troy Clautier, MidSouth Bank
Ms. Charmaine Cacciopi
Ms. Jane Arnette, SCIA
Ms. Jeanne Fritsche, GSE Associates
Ms. Lynn Hadhy, Cajun Cultural Coalition
Ms. Sandy Kain, Congressman Billy Tauzin's Office
Ms. Shirley Laska, CHART, UNO
CF Bean LLC
Mr. Alex Kaplun
Mr. Ralph Lugvihuff, LA Hydroelectric
Mr. Rob Hamilton, Rob Hamilton Construction, Inc.
Mr. Robert C. Esenwein, TurnerCollie @ Braden, Inc.
Mr. Robert Graveolet, Plaquemines Parish Assessor
Mr. Andrew MacInnes, Plaquemines Parish
Mr. Daniel J. Babin, Gulf Fish Inc.
Mr. Jenneke Visser
Mr. Aaron Meredith, Outdoor Action with Aaron
Mr. Al Levron, Terrebonne Parish Government
Mr. Allen Dupont, SHAW Environmental, Inc.
Mr. Andy Jurkowski, Madison Dearborn Partners
Mr. Barry Blackwell, Terrebonne Parish Consolidated
Mr. Ben Bienvenu, LCPA-West
Mr. Bill New , New Offshore, Inc.
Mr. Bruce L. Badon, Burk-Kleinpeter, Inc.
Mr. Burt Marmande
Mr. Charles J. Starkovich, USDA-NRCS
Mr. Charles R. Caillouet, Jr., Vision Unlimited
Mr. Dan Arceneaux, CZM - St. Bernard
Mr. Daniel Bolinger, DMJM & Harris, Inc.
Mr. Daniel C. McCool, Political Science Department
Mr. Danny McKearan, Bean/Stuveysant Dredging
Mr. Cullen Curole, Lafourche Parish
Mr. David S. Williams, CTE Engineers
Mr. Denis de la Houssaye, Iberia Parish Coastal
Mr. Dennis Lambert, Moffatt Nichol
Mr. Don Samples
Mr. Doug Daigle, Mississippi River Basin Alliance
Mr. Ed Landgraf, Shell/Terrebonne CZM
Mr. Ed Nugent, Coalition to Close the MRGO
Mr. Freddie Castello III
Mr. Gene Simon, Bertucci Contracting
Mr. George Rey
Mr. Harold Schoeffler, Sierra Club
Mr. Hugh Babylon
Mr. Jay Lobrano, Lobrano & Lobrano
Mr. Jerry Bostic, Port of Morgan City
Mr. Jerry Lee Mayeaux
Mr. Jim Rausch, Dredging Contractors of America
Mr. Jim Hufft
Mr. John Higgins , Business Publishers Inc.
Mr. John Arms
Mr. John P. Laguens
Mr. John Woodard
Mr. Kenny Smith, Terrebonne Chamber of Commerce
Mr. Louis Walker
Mr. Mart Black , TPCG Cultural Res. & Eco. Dev.
Mr. Michael Scurto, Terrebonne Levee
Mr. Paul Medus
Mr. Paul Yakupzach, Terrebonne Coastal Mgt.
Mr. Percy J. Rodriguez
Mr. R. George Rey, Pres., COTS Technology,
Mr. Ryan Richard, Richard's Restaurant Supply
Mr. Sal Maiorana
Mr. Sam Hotard, Guarantz Broadcasting
Mr. Scott Rogers, American Press
Mr. Shane Bagala, Acadiana Bay Association
Mr. Sid Sundbery, Houma-Terrebonne Chamber of
Mr. Steve Peyronnin, Coalition to Restore Coastal
Mr. Stu Scheer, LA Charter Boat Association
Mr. Tom Hess, LDWF Rockefeller Refuge
Mr. W. Alex Ostheimer
Ms. Andi Stohler, TEC Icon
Ms. Barbara Coman
Ms. Carolyn Woosley, CRCL, SWLA Team Green
Ms. Christian Walker

Ms. Cindy Brown, The Nature Conservancy
Ms. Jennifer Armand, Restore or Retreat
Ms. Kelly Krenz
Ms. Kim M. Sylve, Grand Bayou Families United
Ms. Linda M Walker, League of Women Voters of
Ms. Margaret Sullivan, Coastal Environments, Inc.
Ms. Ruth Laney , Time Magazine
Ms. Sharon Alford, Houma Area CVB

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APPENDIX B1

PROGRAMMATIC BIOLOGICAL ASSESSMENT

LOUISIANA COASTAL AREA (LCA)
ECOSYSTEM RESTORATION STUDY

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APPENDIX B1

PROGRAMMATIC BIOLOGICAL ASSESSMENT

LOUISIANA COASTAL AREA ECOSYSTEM RESTORATION STUDY

1.0 PURPOSE

The purpose of this programmatic biological assessment (PBA) is to determine the potential impacts of the Louisiana Coastal Area (LCA) Ecosystem Restoration Plan (LCA Plan), which is described in the final Programmatic Environmental Impact Statement (FPEIS) of the LCA Ecosystem Restoration Study, on Federally-listed threatened and endangered species, and their critical habitat, that occur within the proposed action area. This review evaluates the LCA Plan and provides information on potential impacts of this programmatic plan to Federally-listed threatened and endangered species and their critical habitat to decision makers to make determinations on whether to proceed with the plan.

2.0 PROPOSED ACTION

The proposed action is implementation of the final LCA Plan, which is to develop, evaluate, and apply subprovince and coast -wide ecosystem restoration opportunities. Restoration would be achieved by combining a series of measures that would be expected to achieve one or more of the following objectives: minimize and/or control salinity changes, provide continuous reintroduction of fresh water, mimic historic hydrology, maximize Atchafalaya River inflow, build land through delta development, and maximize geomorphic features. Conceptual restoration measures include constructing river and/or sediment-delivery diversions, maintaining land bridges, restoring barrier islands, installing water control structures, creating marsh, and achieving beneficial use of dredged material.

Detailed descriptions of the LCA Plan can be found in chapter 2 of the FPEIS; historic, existing, and future without conditions are discussed in chapter 3 of the FPEIS, and direct, indirect, and cumulative impacts of the LCA Plan are discussed in chapter 4 of the FPEIS. Because the outputs of the LCA Plan are conceptual and at a program-level, the site-specific locations of each recommended measure have not been identified.

3.0 LOCATION AND GENERAL DESCRIPTION OF THE PROPOSED ACTION AREA

For the purposes of coast wide ecosystem planning, the Louisiana coastal study area is divided into four subprovinces. Subprovince 1 encompasses the coastal portion of the Pontchartrain Basin, Breton Sound basin, and the eastern half of the Mississippi River Delta. Subprovince 2 encompasses the deltaic plain between the Mississippi River and Bayou Lafourche, including the Barataria Basin and the western half of the Mississippi River Delta. Subprovince 3 encompasses the deltaic complex between Bayou Lafourche and Freshwater Bayou Canal, including the Terrebonne, Atchafalaya, and Teche-Vermilion basins. Subprovince 4 encompasses the Chenier Plain between Freshwater Bayou Canal and the Louisiana-Texas border, including the Mermentau and Calcasieu-Sabine basins. Detailed descriptions of the subprovinces can be found in chapter 1 of the FPEIS.

4.0 SPECIES DESCRIPTIONS

Seventeen endangered or threatened species have been identified which may occur within the boundaries of the proposed action area. However, the proposed activities would not be located within suitable habitat for five of those species: the gopher tortoise (*Gopherus polyphemus*), inflated heelsplitter mussel (*Potamilus inflatus*), Louisiana quillwort (*Isoetes louisianensis*), red-cockaded woodpecker (RCW, *Picoides borealis*), and ringed sawback turtle (*Graptemys oculifera*). Any suitable habitats for those species would be located outside the region of influence for the proposed action. Therefore, detailed species descriptions for those species are not included in this PBA. Descriptions of the remaining 12 species follow.

A total of 28 cetaceans have been reported in the Gulf of Mexico waters (Davis et al. 2002 see http://www.fws.gov). Of these, five Mysticeti [i.e., baleen whales including the blue whale (*Balaneoptera musculus*), finback whale (*Balaenoptera physalus*) and sei (*Balaenoptera borealis*); and Odontoceiti (i.e., toothed whales including the humpback (*Megaptera novaeangliae*) and sperm whale (*Physeter macrocephalus*)] have been reported in the Gulf of Mexico and all are listed as endangered species. Generally, infrequent historical sightings and strandings in the study area of these endangered cetaceans suggest that most of these species are rare, accidental, or uncommon. All whales are principally marine deepwater species and would not likely be impacted by the proposed action. Strandings of whales have occurred throughout the gulf coast.

4.1 BIRDS

4.1.1 Bald Eagle (*Haliaeetus leucocephalus*)

Status

The bald eagle was initially considered to have two distinct subspecies when the southern bald eagle was listed as an endangered species on March 11, 1967. Following the enactment of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), the entire species was listed as endangered in 43 of the conterminous 48 states and threatened in the remaining five states (Michigan, Minnesota, Oregon, Washington, and Wisconsin) on February 14, 1978. On August 11, 1995, the bald eagle was officially down-listed from endangered to threatened in the lower 48 states. There is no critical habitat currently designated for the bald eagle.

Species and Habitat Description

The bald eagle is a large bird of prey with white head and tail feathers, dark body feathers, yellow beak and black talons. The bald eagle is one of eight sea and fish eagles in the genus *Haliaeetus*, and is the only species of sea eagle native to North America. Male bald eagles generally measure almost 3 feet from head to tail, weigh 8 to 10 pounds, and have a wingspan of about 6.5 feet. Females are larger, reaching 42 inches in length, weigh up to 14 pounds, and have a wingspan as wide as 8 feet. Juvenile bald eagles are a mixture of brown and white with a black bill, and do not develop the characteristic white head and tail feathers until they are sexually mature. Bald eagles are believed to live as long as 30 years in the wild. Bald eagles are predominantly piscivorous, but they are also opportunistic and will supplement their diets with birds, small mammals, reptiles, amphibians, and carrion. Humans are thought to be the adult eagle's only significant predator (USFWS 1989c).

Bald eagles may range for long distances, but will return to within 100 miles of where they were raised to build a large nest. Each pair of birds can have several nests, reusing them several times.

Nesting rarely occurs farther than 2 miles from water. Most eagles select nest sites that include a dominant tree or stand of trees and prefer tall mature trees in an open stand with a clear flight path to water, usually associated with riparian habitat along coasts, rivers, and lakes. Most nests are located in the upper 30 feet of the tree with canopy cover above and a clear view of open water. The cone-shaped nest may be 6 feet in diameter and 6 to 8 feet in height, and may be lined with Spanish moss, cornhusks, or grasses. In the southeastern United States, nesting activities generally begin in early September with egg laying beginning as early as late October and peaking in the latter part of December (USFWS 1989c). In southeastern Louisiana, nests are often built in large bald cypress trees that are located near fresh to intermediate marshes or open water, and infrequently in large pine trees near large lakes in central and northern Louisiana.

Bald eagles reach sexual maturity between 4 and 5 years of age. Bald eagles pair with the same mate until one dies, at which time the survivor will accept a new mate. Once each year bald eagles lay one to three eggs, which hatch after 33 to 35 days of incubation. Although both males and females participate in incubating the eggs, the female does most of the incubating. Fledglings will take their first flights in about 3 months, but may not leave the nest for several more months. Final fledging occurs between 12 to16 weeks after hatching. Both parents participate in parental care, which may extend 4 to 6 weeks after fledging. As is typical for raptors, young eagles are fully developed at the time of fledging. Fledging generally occurs from March to April. It is estimated that only about 50 percent of fledglings survive to adulthood.

Range and Population Dynamics

Historically, the bald eagle ranged throughout North America, except extreme northern Alaska and Canada and central and southern Mexico. Nesting occurred along major lakes and rivers on both coasts of the United States, coastal plains of the Southeast, as well as the East Coast from the Chesapeake Bay to the Florida Keys, and north along the west coast of Florida to the Panhandle. The nesting range also appears to have been continuous along the entire Mississippi and other major rivers, through Louisiana and into eastern Texas, with a low density along the Gulf coast. The bald eagle currently ranges throughout much of North America, nesting on both coasts from Florida to Baja California, Mexico in the south, and from Labrador to the western Aleutian Islands, Alaska, in the north (USFWS 1999a).

An estimated quarter to a half million bald eagles lived on the North American continent prior to the arrival of the first Europeans (Gerrard and Bortolotti 1988). The first major decline in the bald eagle population probably began in the mid- to late 1800s. Widespread shooting for feathers and trophies led to extirpation of eagles in some areas. Shooting also reduced part of the bald eagle's prey base. Big game animals like bison, which were essentially important to eagles as carrion, were decimated. Waterfowl, shorebirds, and small mammals were also reduced in numbers. Carrion treated with poisons was used as bait to kill livestock predators and ultimately killed many eagles as well. These were the major factors, in addition to the loss of habitat from forest clearing and development, which contributed to a reduction in bald eagles numbers through the 1940s.

Following World War II in the late 1940s, organochlorine pesticides such as dichloro-diphenyl-trichloroethane (DDT) were initially used to control mosquitoes but also became popular as general crop pesticides. In the late 1960s and early 1970s, bald eagle numbers had decreased due to the use of such pesticides, which were linked to the thinning of eggshells and resulted in reproductive failure (USFWS 1999a). In response to that decline, the bald eagle was listed as endangered south of the 40th parallel on March 11, 1967, under the Endangered Species Preservation Act of 1966. Nationwide bald eagle surveys conducted in 1973 and 1974 revealed that the eagle population throughout the lower 48 states was declining. At the species' lowest numbers in the Southeast, the breeding range had been reduced to remnant populations in South Carolina, Louisiana, and east Texas, with apparently secure nesting only in Florida.

In 1963, the National Audubon Society surveyed the lower 48 states and located 417 active bald eagle nests. By 1994, 4,452 occupied bald eagle territories were identified (an occupied territory is an area occupied by a pair of adult bald eagles, and the pair may or may not be engaging in nesting or breeding behavior). In Louisiana there were 36 occupied breeding areas during the 1987-1988 nesting season, and 226 occupied breeding areas during the 2002-2003 nesting season. Several factors have contributed to the resurgence of the bald eagle, including the ratification of the Bald Eagle Protection Act in 1940, the species' listing as endangered under the Endangered Species Preservation Act of 1966 and the ESA of 1973, the Migratory Bird Treaty Act, the Lacy Act, and the prohibition of DDT in 1972.

Management and Protection

The bald eagle adapts poorly to radical changes in its environment, and has a relatively low reproductive rate with deferred maturity and a small clutch size (i.e., 1 to 3 eggs). Consequently, the bald eagle may always require monitoring and management. Protective measures for the species consist mainly of legal and regulatory procedures, and habitat protection and improvement. The bald eagle is currently protected by Federal and state laws, which are enforced by the U.S. Fish and Wildlife Service (USFWS) and the Louisiana Department of

Wildlife and Fisheries (LDWF), respectively. Nest sites are also protected under management programs on Federal lands (i.e., National Wildlife Refuges [NWR] and National Forests).

To facilitate recovery of the bald eagle and ecosystems upon which it depends, the lower 48 states were divided into five recovery regions, and recovery within those regions has been successful (USFWS 1999a). An expanding population requires the successful production of young, and reproduction has generally met or exceeded target levels established by recovery teams across the nation since 1990. Certain geographically restricted areas still have contamination threats, but with a national average of more than one fledgling per occupied breeding area since 1990, the eagle population continues to increase in overall size and maintains a healthy reproductive rate.

The USFWS proposal to delist the bald eagle was published in the Federal Register on July 6, 1999. Should the USFWS remove the bald eagle from the threatened and endangered species list, protection for the bird would continue under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests except when specifically authorized by the Department of the Interior. The BGEPA, the successor to the Bald Eagle Protection Act, prohibits, except under certain specified conditions, the taking, possession, transportation, export or import, barter, or offer to sell, purchase or barter a bald or golden eagle, alive or dead, or any part, nest, or eagle egg. If the bald eagle would be delisted, the USFWS would also work with state wildlife agencies to monitor the status of the species for a minimum of five years, as required by the ESA. If at any time it becomes evident that the bald eagle again needs protection under the ESA, the USFWS would relist the species (USFWS 1999a).

4.1.2 Brown Pelican (*Pelecanus occidentalis*)

Status

The brown pelican was originally listed as endangered throughout its range on October 13, 1970. The species was delisted in Alabama, Florida, Georgia, North Carolina, South Carolina, and points northward along the Atlantic coast on February 4, 1985. The brown pelican remains endangered throughout the remainder of its range, which includes Louisiana, Mississippi, Texas, California, Mexico, Central and South America, and the West Indies. No critical habitat is designated for the brown pelican within Louisiana.

Species and Habitat Description

The brown pelican is a large water bird that can be found year around along the Gulf of Mexico coastal waters from Texas to Florida and is one of two species of pelican in North America, the other being the white pelican (*Pelecanus erythrorhynchos*). Adult brown pelicans are dark gray-brown with white about the head and neck. Immature brown pelicans are gray-brown on their head and neck with white underparts. The brown pelican weighs up to 8 pounds and larger individuals have wingspans of more than 7 feet. They spend their entire life cycle in or near marine and estuarine waters, seldom venturing more than 20 miles out to sea. Brown pelicans feed mainly on fish, including menhaden, mullet, sardines, and pinfish, which they capture by plunge diving (USFWS 1989a).

Preferred nesting sites are small coastal islands, which provide protection from mammalian predators (mainly raccoons), and have sufficient elevation to prevent widespread flooding of nests. The nests are usually built in available vegetation (e.g., black mangrove trees), but ground nesting may also occur. Ground nests vary from practically nothing to well built nests of sticks, reeds, straw, palmetto leaves, and grasses. Tree nests are made of similar materials, only they are more firmly constructed. Sand spits and offshore sandbars are used extensively as daily loafing and nocturnal roost areas.

Brown pelican breeding activity in Louisiana can vary from as early as February to as late as September. They nest in colonies on small coastal islands in salt and brackish waters. Nesting islands are often chosen near channels where shipping and shrimping operations make fish easily available to nesting pairs. Normal clutch size is three eggs, and both parents share incubation and rearing of the young. The species is considered to be long-lived; one pelican captured in Edgewater, Florida, in November 1964 was banded in September 1933.

Range and Population Dynamics

In the United States, the brown pelican is found along the California coast, and from North Carolina to Texas. It is also found in Mexico, the West Indies and many Caribbean Islands, and as far south as Guyana and Venezuela in South America (USFWS 1995a). Brown pelicans were extirpated from the Louisiana coast during the 1960s, but were reintroduced from Florida in 1968. Extensive use of pesticides, which were ultimately ingested by brown pelicans, has been noted as the primary cause of decline of the species (USFWS 1989a). This threat has been essentially eliminated, resulting in delisting of the species in Alabama and Florida, and stable populations in Louisiana, Mississippi, and Texas coastal regions.

Historically, brown pelicans used the Shell Keys NWR in south-central Louisiana (Emmons 1990). Refuge Staff at the Delta NWR, located in Plaquemines Parish, Louisiana, have noted that brown pelicans tend to use the refuge more during the winter months and the coastal barrier islands during the spring. They suspect that the majority of the pelicans that use that refuge are immature and non-breeding birds (Wigginton 1990). Brown pelicans use the area around Breton NWR in St. Bernard and Plaquemines Parishes, Louisiana, as loafing, feeding, and nesting areas. Flocks typically containing 50 to 100 birds are routinely observed by refuge staff on or near all islands in the Breton and Chandeleur Sounds (Wigginton 1990, Guidry 1994).

The Louisiana population numbered as many as 50,000 birds in the 1930s. By 1963, brown pelicans had completely disappeared from Louisiana. The LDWF and Florida Game and Fresh Water Fish Commission jointly implemented a restoration project from 1968 to 1980, and a total of 1,276 pelicans were reintroduced at three release sites in southeastern Louisiana. Restored nesting populations were established at North Island in the Chandeleur Island chain and at Queen Bess/Camp Island in Barataria Bay. North Island production was 909 fledglings between 1974 and 1979, and first nested successfully when the birds were 2 years of age. Reintroduced birds at the Queen Bess/Camp Island site first nested successfully at 3 years of age (McNease and Joanen

1984). The 13-year reintroduction project suffered a setback in 1975 when approximately 40 percent of the population was killed by a pesticide incident, but the subsequent trend in numbers of nesting pairs continued a generally upward trend. In 1983, the estimated number of nesting pairs in Louisiana was 602. In 1997, the LDWF estimated that there were approximately 10,000 pelican nests with 25,000 adults nesting in Louisiana, primarily on the Chandeleur Islands (Larry McNeese, LDWF personal communication 1997; Elizabeth Souheaver, USFWS, Southeast Louisiana Refuges, personal communication 1997). During the 2000 nesting season, a substantial portion of the Chandeleur Island nesting population relocated to an island created by dredge material at the mouth of Baptiste Collette Pass, but the birds returned to the Chandeleur Islands for the 2001 nesting season (Tom Hess, LDWF, Rockefeller Refuge, personal communication 2002). The LDWF estimates that there were approximately 16,400 pelican nests in Louisiana during the 2001 breeding season (Hess 2001). Other nesting areas in Louisiana are Raccoon and Wine Islands in the Isles Dernieres barrier island system, Queen Bess Island in Barataria Bay, West Breton Island in Breton Sound, and most recently, Rabbit Island in Calcasieu Lake. Current population estimates for Louisiana are estimated to be near 50,000 birds.

Management and Protection

The brown pelican is extremely susceptible to disturbance and habitat alteration in key nesting areas. It is, therefore, important to prevent disturbance to nesting colonies (e.g., by low-flying aircraft, noise disturbance from project-related activities, etc.) that could cause nest desertion and egg losses, as well as the control of pesticide use and other types of environmental pollution. Consequently, regular surveying occurs in Louisiana. Protective measures for the species consist mainly of legal and regulatory procedures, and habitat protection and improvement. The brown pelican is currently protected by Federal and state laws, which are enforced by the USFWS and the LDWF, respectively. Nest sites are also protected under management programs on Federal lands (i.e., NWRs).

4.1.3 Piping Plover (*Charadrius melodus*)

Status

On January 10, 1986, the piping plover was Federally listed as endangered in the Great Lakes watershed, and as threatened elsewhere in its range. Critical habitat for the wintering population was designated in 2001; that designation included 142 areas along the coast of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas, to provide sufficient wintering habitat to support the piping plover at the population level and geographic distribution necessary for recovery of the species. Critical habitat for breeding populations in the Great Lakes and Great Plains was designated in 2001 and 2002, respectively.

Species and Habitat Description

The piping plover, named for its melodious mating call, is a small North American shorebird approximately 8 inches long with a wingspread of about 15 inches (Palmer 1967). Its light sand-colored plumage blends in well with beaches and sand flats, part of its primary habitat. During the breeding season, the legs are bright orange, and the short bill is orange with a black tip. There are two single dark bands, one around the neck and one across the forehead between the eyes. The black breast band and brow bar are generally more pronounced in breeding males than females (Wilcox 1959). Breeding birds have white underparts, a light beige back and crown, a white rump, and a black upper tail with a white edge. In flight, each wing shows a single, white wing stripe with black highlights at the wrist joints and along the trailing edges. In winter, the bill turns black, the legs remain orange but pale, and the black plumage bands are lost on the head and neck. Chicks have speckled gray, buff, and brown down, a black beak, orange legs, and a white collar around the neck. Juveniles resemble wintering adults and obtain their adult plumage the spring after they fledge (Prater et al. 1977).

The primary constituent elements for piping plover critical habitat (wintering) are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), associated dune systems, and flats above annual high tide. Primary constituent elements of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important for roosting plovers (USFWS 2002).

Northward migration to the breeding grounds occurs during late February, March and early April (Patterson 1988, MacIvor 1990). Plovers will breed at 1 year of age (MacIvor 1990, Strauss 1990, Haig 1992) and are monogamous, but usually shift mates between years (Wilcox 1959, Haig and Oring 1988, MacIvor 1990).

Southward migration to the wintering grounds along the southern Atlantic coast and Gulf of Mexico shoreline extends from late July through September. Individuals can be found on their wintering grounds throughout the year but sightings are rare in May, June, and early July (USFWS 2001b). In general, wintering piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependant on a mosaic of sites distributed through the landscape, as the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change.

The following units are designated critical habitat in Louisiana: (1) Texas/Louisiana border to Cheniere au Tigre in Cameron and Vermilion Parishes; (2) Atchafalaya River Delta in St. Mary Parish; (3) Point Au Fer Island in Terrebonne Parish; (4) Isles Dernieres in Terrebonne Parish; (5) Timbalier Island to East Grand Terre Island in Terrebonne, Lafourche, Jefferson, and Plaquemines Parishes; (6) Mississippi River Delta in Plaquemines Parish, and (7) Breton Islands and Chandeleur Island Chain in Plaquemines and St. Bernard Parishes (see 50 CFR Part 17, pages 36127 to 36131, or http://plover.fws.gov/#maps, for detailed descriptions and/or maps).

Range and Population Dynamics

Piping plovers breed only in North America within three geographic regions encompassing three distinct breeding populations: the Northern Great Plains, the Great Lakes, and the Atlantic Coast. The piping plover's primary winter range is along the Atlantic and Gulf coasts from North Carolina to Mexico and into the Bahamas and West Indies (USFWS 1988, 1989a, 1989b, 1996, 2002).

Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the species' decline. Recreational activity, coastal development, and dune stabilization have resulted in loss of suitable sandy beaches and other littoral habitats. Breeding success continues to be affected by human disturbance (foot and vehicular traffic), which destroys nests and young (USFWS 1989b, 1996). Since piping plovers spend 55 to 80 percent of their annual cycle associated with wintering areas, factors that affect their well being on the wintering grounds can substantially affect their survival and recovery (USFWS 1996).

Between 1986 and 1987, there were an estimated 1,258 to 1,326 breeding pairs of piping plovers in the Northern Great Plains breeding population. The 1991 International Piping Plover Census estimated that there were 1,486 breeding pairs in the Northern Great Plains. The 1996 census for that population indicated that it numbered about 3,284 adults, which would be the largest of the three breeding populations (i.e., Northern Great Plains, Great Lakes, and Atlantic Coast).

Russell (1983) reviewed historic records and estimated pre-settlement Great Lakes piping plover populations at 492 to 682 breeding pairs; those totals may be high, but there are no other estimates of pre-settlement population. Coinciding with major industrial development, piping plovers were extirpated from most of the Great Lakes beaches in the late 1970s and early 1980s. In 1977, the Great Lakes population was estimated at 31 nesting pairs (Lambert and Ratcliff 1979), but declined to 17 pairs by 1985 (USFWS 1985). Since 1986, nests have been recorded at 30 breeding sites with populations ranging from 12 to 25 breeding pairs.

Historical trends for the Atlantic Coast piping plover population have been gathered from largely qualitative records. In the nineteenth century, piping plovers were a common summer resident along the Atlantic Coast; by the twentieth century, uncontrolled hunting and egg collecting greatly reduced their populations. Following the passage of the Migratory Bird Treaty Act in 1918, piping plover numbers recovered to some extent. Raithel (1984) showed that Rhode Island piping plover numbers reached a twentieth century peak following a 1938 hurricane, which flattened sand dunes and shoreline developments. After World War II, populations declined due to dune stabilization efforts and construction of summer homes. The population partially recovered following another severe hurricane in 1954, but then began a decline that continued through the early 1980s. Recent population estimates indicate that, since the late 1980s, piping plover populations have increased steadily along the Atlantic Coast from 790 adults in 1986 to 1,349 adults in 1995 (USFWS 1996) and 2,581 adults in 1996 (USFWS 1999b).

Management and Protection

Habitat alterations such as marina construction, erosion control measures, and residential development affect the dynamic nature of the beach ecosystem by altering sediment patterns and hydrology, and inhibiting dune formation. Those actions may degrade or destroy habitat for a variety of marine plants and animals (USFWS 1996, 1997; Cuthbert et al. 1998). Off-road vehicles and high levels of foot traffic may erode sand dunes and result in direct mortality by trampling (Bowles et al. 1990, USFWS 1997).

The piping plover is currently protected by Federal and state laws, which are enforced by the USFWS and the LDWF, respectively. Critical habitat is also protected under management programs on Federal lands (i.e., NWRs).

4.2 FISH

4.2.1 Gulf Sturgeon (*Acipenser oxyrhynchus desotoi*)

Status

On September 30, 1991, the Gulf sturgeon was listed as a threatened species under the ESA, and the USFWS designated critical habitat for this species throughout its range on February 28, 2003. In Louisiana, Gulf sturgeon critical habitat includes the Pearl River System in Washington and St. Tammany Parishes, the Bogue Chitto River, as well as Lake Pontchartrain, Lake Borgne, Lake Catherine, and the Rigolets.

Species and Habitat Description

The Gulf sturgeon, also known as the Gulf of Mexico sturgeon, is an anadromous fish (breeds in freshwater after migrating up rivers from marine and estuarine environments). The Gulf sturgeon inhabits coastal rivers from Louisiana to Florida during spring and summer, and the estuaries, bays, and marine environments of the Gulf of Mexico during fall and winter. It is a nearly cylindrical, primitive fish embedded with bony plates or scutes. The head ends in a hard, extended snout; the mouth is inferior and protrusible and is preceded by four conspicuous barbels. The tail (caudal fin) is distinctly asymmetrical; the upper lobe is longer than the lower lobe (heterocercal). Adults range from 4 to 8 feet [(1.2 to 2.4 meters) in length, with adult females larger than adult males.

Gulf sturgeon are long-lived, with some individuals reaching at least 42 years of age (Huff 1975). Age at sexual maturity for females ranges from 8 to 17 years, and for males from 7 to 21 years (Huff 1975). In the spring (from late February to mid-April) when the river surface temperatures are 63 to 70 degrees Fahrenheit (^{o}F) [17 to 21 degrees Celsius (^{o} C)], sexually mature, ripe males and females migrate into the rivers (Carr, Tatman, and Chapman 1996) to spawn. It is believed that Gulf sturgeon exhibit a spawning periodicity similar to Atlantic sturgeon, which have a long inter-spawning period, with females spawning at intervals ranging from every 3 to 5 years, and males every 1 to 5 years (Smith 1985 see http://www.fws.gov).

Gulf sturgeon eggs are demersal (they sink to the bottom), adhesive, and vary in color from gray to brown to black (Vladykov and Greeley 1963, Huff 1975, Parauka et al., 1991). During their early life history stages, sturgeon require hard substrates for eggs to adhere to, and for shelter for developing larvae (Sulak and Clugston 1998 see http://www.fws.gov). Egg collection sites have consisted of limestone bluffs and outcroppings, cobble, limestone bedrock covered with gravel, and small cobble, gravel, and sand (Marchant and Shutters 1996 see http://www.fws.gov, Sulak and Clugston 1999 see http://www.fws.gov, Heise et al. 1999a see http://www.fws.gov, Fox et al. 2000 see http://www.fws.gov, Craft et al. 2001 see http://www.fws.gov). Water depths at egg collection sites have ranged from 4.6 to 26 ft (1.4 to 7.9 m), with temperatures ranging from 64.8 to 75.0°F (18.2 to 23.9°C) (Fox et al. 2000, Ross et al. 2000, Craft et al. 2001). Laboratory experiments indicate that optimal water temperature for survival of Gulf sturgeon larvae is between 59 and 68°F (15 and 20°C), with low tolerance to temperatures above 77°F (25°C) (Chapman and Carr 1995 see http://www.fws.gov). Young-of-the-year Gulf sturgeon appear to disperse widely, using extensive portions of the river as nursery habitat. They are typically found on sandbars and sand shoals over rippled bottom and in shallow, relatively open, unstructured areas.

Gulf sturgeon feeding habits in freshwater vary depending on the fish's life history stage. Young-of-the-year Gulf sturgeon remain in freshwater feeding on aquatic invertebrates and detritus approximately 10 to 12 months after spawning occurs (Mason and Clugston 1993, Sulak and Clugston 1999 see http://www.fws.gov). Juveniles less than 11 lbs (5 kg) are believed to forage extensively and exploit scarce food resources throughout the river, including aquatic insects (e.g., mayflies and caddis flies), worms (oligochaetes), and bivalve mollusks (Huff 1975, Mason and Clugston 1993). Subadults (age 6 to sexual maturity) and adults (sexually mature) only feed in marine and estuarine habitats and are thought to forage opportunistically (Huff 1975) on primarily benthic (bottom dwelling) invertebrates. Gut content analyses have indicated that the Gulf sturgeon's diet is predominantly amphipods, lancelets, polychaetes, gastropods, shrimp, isopods, mollusks, and crustaceans (Huff 1975, Mason and Clugston 1993, Carr et al. 1996b see http://www.fws.gov, Fox et al. 2000 see http://www.fws.gov, Fox et al. 2002 see http://www.fws.gov).

When river temperatures drop in the fall to about 63 to 72°F (17 to 22°C), Gulf sturgeon return to the coastal shelf areas of the Gulf of Mexico (Carr, Tatman, and Chapman 1996 see http://www.fws.gov). Most subadult and adult Gulf sturgeon spend the cooler months (October or November through March or April) in estuarine areas, bays, or the Gulf of Mexico (Odenkirk 1989, Foster 1993, Clugston et al. 1995, Fox et al. 2002 see http://www.fws.gov) feeding. Winter habitats used by Gulf sturgeon coincide with the habitats of their prey. Along the Mississippi Sound barrier islands, Gulf sturgeon habitat typically consists of sandy substrates with an average depth of 6.2 to 19.4 ft (1.9 to 5.9 m). Gulf of Mexico near shore (less than 1 mi [1.6 km]) unconsolidated, fine-medium grain sand habitats, including natural inlets and passes from the Gulf to estuaries, support crustaceans such as mole crabs, sand fleas, various amphipod species, and lancelets (Menzel 1971 see http://www.fws.gov, Abele and Kim 1986 see http://www.fws.gov, American Fisheries Society 1989 see http://www.fws.gov, Brim personal communication 2002) where Gulf sturgeon are found. Estuary and bay unvegetated habitats have a preponderance of sandy substrates that support burrowing crustaceans, such as ghost shrimp, small crabs, various polychaete worms, and small bivalve mollusks (Menzel 1971 see http://www.fws.gov, Abele and Kim 1986 see http://www.fws.gov, American Fisheries Society 1989 see http://www.fws.gov, Brim personal communication 2002) which are prey for Gulf sturgeon.

Range and Population Dynamics

Historically, the Gulf sturgeon occurred from the Mississippi River east to Tampa Bay. Its present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi, east to the Suwannee River in Florida, with infrequent sightings occurring west of the Mississippi River. In the late 19th century and early 20th century, the Gulf sturgeon supported an important commercial fishery, providing eggs for caviar, flesh for smoked fish, and swim bladders for isinglass, a gelatin used in food products and glues (Huff 1975, Carr 1983). Gulf sturgeon numbers declined due to over fishing throughout most of the 20th century. The decline was exacerbated by habitat loss associated with the construction of water control structures, such as dams and sills (submerged ridges or vertical walls of relatively shallow depth separating two bodies of water), mostly after 1950. In several rivers throughout the species' range, dams have severely restricted sturgeon access to historic migration routes and spawning areas (Boschung 1976, Wooley and Crateau 1985, McDowall 1988).

The majority of recent Gulf sturgeon sightings in the Pearl River drainage have occurred downstream of the Pools Bluff Sill on the Pearl River, near Bogalusa, Louisiana, and downstream of the Bogue Chitto Sill on the Bogue Chitto River in St. Tammany Parish, Louisiana. Between 1992 and 1996, 257 Gulf sturgeon were captured from the Pearl River system (West Middle River, Bogue Chitto River, East Pearl River, and West Pearl River). The subpopulation in that system was estimated at 292 fish, of which only 2 to 3 percent were adults (Morrow et al. 1998b see http://www.fws.gov). The annual mortality rate was calculated to be 25 percent.

Preliminary results from captures between 1992 and 2001 suggest a stable subpopulation of 430 fish, with approximately 300 adults (Rogillio et al. 2002 see http://www.fws.gov). Morrow et al. (1999 see http://www.fws.gov) suggested that the Pearl River Gulf sturgeon population would be self-sustaining if the number of adults was at least 100, recruitment was satisfactory, and annual mortality was less than about 15 percent. Based on those criteria and from data gathered during 2000 and 2001, it appears that the population is at least self-sustaining and may even be recovering. There may be as many as 300 adults. While mortality estimates may be somewhat biased, the rate is probably about half of the 15 percent deemed to be a minimum acceptable benchmark.

Management and Protection

Life history characteristics of Gulf sturgeon may complicate and protract recovery efforts. Gulf sturgeon cannot establish a breeding population rapidly because of the amount of time it takes them to reach sexual maturity. Further, Gulf sturgeon appear to be river-specific spawners, although immature Gulf sturgeon occasionally exhibit plasticity in movement from one river to another. Therefore, natural repopulation by Gulf sturgeon migrating from other rivers may be non-existent or very low.

The take of Gulf sturgeon is prohibited in the state waters of Louisiana, Mississippi, Alabama, and Florida. Section 6(a) of the ESA provides for extended cooperation with states for the purpose of conserving threatened and endangered species. Under that provision, the Departments of the Interior and Commerce may enter into cooperative agreements with a state, provided that state has an established program for the conservation of a listed species. The agreements authorize the states to implement the authorities and actions of the ESA relative to the listed species recovery. Specifically, the states are authorized: 1) to conduct investigations to determine the status and requirements for survival of resident species of fish and wildlife (this may include candidate species for listing), and 2) to establish programs, including acquisition of land or aquatic habitat or interests for the conservation of fish and wildlife. Federal funding is also provided to states under those agreements to implement the approved programs. All four of the above mentioned states have entered into Section 6 agreements with the USFWS.

4.2.2 Pallid Sturgeon (*Scaphirhynchus albus*)

Status

The pallid sturgeon was listed as endangered on October 9, 1990. The reasons for listing were habitat modification, apparent lack of natural reproduction, commercial harvest, and hybridization in parts of its range. Critical habitat has not been proposed or designated for the pallid sturgeon.

Species and Habitat Description

Pallid sturgeon evolved from an ancient group of bony fishes, the subclass Paleopterygii. Most species in this subclass became extinct sometime in the Mesozoic Era. The living descendants of this group in North America include paddlefish and eight species of sturgeon.

The pallid sturgeon grows to lengths of over 6 feet, can weigh in excess of 80 pounds, and has a flattened, shovel-shaped snout, a long, slender, and completely armored caudal peduncle, and lacking a spiracle (Smith 1979). As with other sturgeon, the mouth is toothless, protrusible, and ventrally positioned under the snout. The skeletal structure is primarily cartilaginous (Gilbraith et al. 1988).

Forbes and Richardson (1905), Schmulbach et al. (1975), Kallemeyn (1983), and Gilbraith et al. (1988) describe the pallid sturgeon as being well adapted to life on the bottom in swift water of large, turbid, free-flowing rivers. Pallid sturgeon evolved in the diverse environments of the Missouri and Mississippi Rivers. Floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters formed the large-river ecosystem that provided macrohabitat requirements for pallid sturgeon and other native large-river fish, such as paddlefish and other sturgeon. Those habitats were historically in a constant state of change. Mayden and Kuhajda (1997) describe the natural habitat conditions to which pallid sturgeon are adapted as braided channels, irregular flow patterns, flooding of terrestrial habitats, extensive microhabitat diversity, and turbid waters. Those habitat conditions and much of the once naturally functioning ecosystem have been changed by human activities.

Bramblett (1996) noted important aspects of pallid sturgeon habitat use and movements. He also noted that the pallid sturgeon is specific and restrictive in use of macrohabitat selection. According to Bramblett's (1996) study, pallid sturgeon were found most often in sinuous channels with islands or alluvial bars present. Straight channels, and channels with irregular patterns or irregular meanders were only rarely used by pallid sturgeon. The seral stage of islands or bars near pallid sturgeon occurrences was most often subclimax (Bramblett 1996). Bramblett (1996) found macrohabitats used by pallid sturgeon were diverse and dynamic. For example, pallid sturgeon used river reaches with sinuous channel patterns and islands and alluvial bars; those river reaches generally have more diverse depths, current velocities, and substrates than do relatively straight channels without islands or alluvial bars, as well as a high diversity of channel features such as backwaters and side channels. The subclimax riparian vegetational seres in those areas are indicative of a dynamic river channel and riparian zone (Johnson 1993).

In telemetry studies of pallid sturgeon on the middle Mississippi River, Sheehan et al. (1998) found a positive selection for main channel border and downstream islands tips, depositional areas between wing dams, and deep holes off wing dam tips. Sheehan et al. (1998) speculated that areas between wing dams and downstream island tips may be used as velocity refugia and/or feeding stations. Sturgeon were found most often in main channel habitat; however, they exhibited selection against that habitat type. Their occurrence in such habitat was not surprising, considering main channel habitat comprised approximately 65 percent of the available habitat in the study reach (Sheehan et al. 1998).

Constant et al. (1997) reported on radio-tracked sturgeon, and stated that sturgeon were most frequently found in low-slope areas and that such areas were used in proportion to their availability. No sturgeon were observed on extremely steep slopes. Constant et al. (1997) found that sand made up over 80 percent of the substrate in low-slope areas where over 90 percent of pallid sturgeon were located. Those authors stated that the preference for sand substrates in low-slope areas suggests that pallid sturgeon use such areas as current refugia. Sand substrates were found to have lower invertebrate densities than substrates of silt-clay, which were generally located on steep-slope areas that were exposed by swift currents. As such, it would have been energetically costly for pallid sturgeon to remain near those steep-slope areas for extended periods of time. Telemetry observations, however, showed that 55 percent of sturgeon locations occurred within 33 feet of steep slopes, suggesting that pallid sturgeon remained near areas of high food abundance (Constant et al. 1997). Reed and Ewing (1993) found sturgeon occurring in the man-made riprap lined outfall channels of the Old River Control Structure Complex (ORCSC) in Louisiana. Bramblett (1996) found that pallid sturgeon preferred sandy substrates, particularly sand dunes, and avoided substrates of gravel and cobble. Pallid sturgeon have adhesive eggs. Thus, spawning is thought to occur over hard substrates of gravel or cobble with moderate flow (USFWS 2000).

Caution must be used in interpreting the results of habitat preference studies conducted in today's highly altered river environments. The results of studies conducted by Bramblett (1996) under fairly unaltered riverine conditions, however, provide additional information on habitat conditions preferred by this species. Characteristics of microhabitat used by pallid sturgeon have recently been described. Much of the microhabitat research to date has been conducted in significantly altered environments. That research does not necessarily indicate preferred or required habitats; instead it may only indicate which habitats of those presently available the pallid sturgeon uses. Also, capture locations may have conditions representing seasonal habitat preferences. Hurley (1996) found that pallid sturgeon were selecting downstream island tips although the island tips were not abundant within the study area. Constant et al. (1997) found pallid sturgeon in the Atchafalaya and Mississippi Rivers at mean depths of 49.9 feet and observed pallid sturgeon at depths of 23.0 and 68.9 feet with greater frequency than such areas were available. The range of depth used by pallid sturgeon is likely related to the available habitat within the river segment (USFWS 2000).

Pallid sturgeon spawning occurs from March through July depending on location (Forbes and Richardson 1905, Gilbraith et al. 1988). Keenlyne and Jenkins (1993) estimate that spawning probably begins in March in the lower Mississippi and Atchafalaya Rivers; in late April or early

May in the lower Missouri and middle Mississippi Rivers; and in late May or early June in the upper Missouri River.

All sturgeon species spawn in the spring or early summer, are multiple spawners, and release their eggs at intervals. In the wild, the adhesive eggs are released in deep channels or rapids and are left unattended (Gilbraith et al. 1988). The larvae of Acipenserids are generally pelagic, becoming buoyant or active immediately after hatching (Moyle and Cech 1982). Although the behavior of young pallid sturgeon is poorly understood, work by Kynard et al. (1998) indicates that a downstream migration period for larval pallid sturgeon begins at hatching and continues up to day 13. With this information it has been possible to use water velocities to roughly estimate that larval pallid sturgeon may drift in the water column for a distance of 40 to over 400 miles (USFWS 2000).

Although benthic macroinvertebrates, characteristic of river habitats, are important pallid sturgeon dietary components (Modde and Schmulbach 1977, Carlson et al. 1985), the occurrence of lake and terrestrial invertebrates in sturgeon stomachs suggest that drifting invertebrates may also be important forage organisms (Modde and Schmulbach 1977, Constant et al. 1997). Aquatic invertebrates (principally the immature stages of insects) compose most of the diet of shovelnose sturgeon, while adult pallid sturgeon and hybrids consume a greater proportion of fish (mostly cyprinids). Other researchers also reported a higher incidence of fish in the diet of adult pallid sturgeon than in the diet of shovelnose sturgeon (Cross 1967, Held 1969).

Range and Population Dynamics

The pallid sturgeon is endemic to the Yellowstone, Missouri, Middle and Lower Mississippi Rivers, and the lower reaches of their major tributaries. Within Louisiana, the pallid sturgeon is found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the ORCSC); it is possibly found in the Red River as well. The historic range of pallid sturgeon, as described by Bailey and Cross (1954), encompassed the middle and lower Mississippi River, the Missouri River, and the lower reaches of the Platte, Kansas, and Yellowstone Rivers. Duffy et al. (1996) stated that the historic range of pallid sturgeon once included the Mississippi River upstream to Keokuk, Iowa, before the river was converted into a series of locks and dams for commercial navigation (Coker 1930).

The pallid sturgeon appears nearly extirpated from large segments of its former range. In 1991, pallid sturgeon were discovered in the Atchafalaya River in Louisiana (Constant et al. 1997). Today, they are only occasionally found in a few selected areas. Since 1980, reports of most frequent occurrence are from the Missouri River, the Mississippi River, and the Atchafalaya River at the ORCSC (USFWS 1993). Of 872 pallid sturgeon records prior to 1998, 70 percent were reported from the Missouri River. Nine percent of the total records came from the Yellowstone River, 5 percent from the Mississippi River, 14 percent from the Atchafalaya River, and less than 2 percent from the St. Francis, Platte, Ohio, Kansas, and Big Sunflower Rivers (USFWS 2000). Keenlyne (1989) updated previously published and unpublished information on distribution and abundance of pallid sturgeon.

The Missouri River has been modified significantly, with approximately 36 percent of the riverine habitat inundated by reservoirs, 40 percent channelized, and the remaining 24 percent altered due to dam operations (USFWS 1993). Most of the major tributaries of the Missouri and Mississippi Rivers have also been altered to various degrees by dams, water depletions, channelization, and riparian corridor modifications.

Levee construction on the lower Mississippi River from the Ohio River to near the Gulf of Mexico has eliminated the river's major natural floodway and reduced the area of the floodplain connected to the river by more than 90 percent (Fremling et al. 1989). Fremling et al. (1989) also reported that levee construction isolated many floodplain lakes and raised riverbanks. Destruction and alteration of big-river ecologic functions and habitat once provided by the Missouri and Mississippi Rivers is believed to be the primary cause of declines in reproduction, growth, and survival of pallid sturgeon (USFWS 1993). In spite of efforts to constrict and control the Missouri and Mississippi Rivers with reservoirs, stabilized banks, jetties, dikes, levees, and revetments, remnant reaches of the Missouri River and Mississippi River from the Missouri River confluence to the Gulf of Mexico still provide habitat usable by pallid sturgeon for certain life stages.

Since 1988, pallid sturgeon researchers have collaborated on studies to gather information about the species (Keenlyne 1995). Tag and recapture data indicate that 50 to 100 pallid sturgeon remain in the Missouri River above Fort Peck Dam in Montana, and between 200 and 300 pallid sturgeon remain between the Garrison Dam in North Dakota and Fort Peck Dam, including the lower Yellowstone River (USFWS 2000). One to five pallid sturgeon sightings per year have been recorded between the headwaters of Oahe Reservoir in South Dakota to the Garrison Dam and from the riverine reach in the Missouri River above Gavins Dam to Fort Randall Dam, suggesting that perhaps as many as 25 to 50 pallid sturgeon may remain in each of these areas. A small population also exists between Oahe Dam and Big Bend Dam on the Missouri River in South Dakota with perhaps 50 to 100 individuals remaining in that riverine section. There is no evidence that the upper Missouri River system populations are successfully reproducing (Keenlyne 1989, Duffy et al. 1996).

Glen Constant, while conducting research at Louisiana State University, estimated the pallid sturgeon population in the Atchafalaya River to range from 2,750 to 4,100 fish. A high rate of hybridization is occurring in the Atchafalaya and Mississippi Rivers (Keenlyne et al. 1994); that makes estimation of the number of pure pallid sturgeon in those river systems difficult (Duffy et al. 1996).

In recent years, pallid sturgeon populations have been augmented by release of hatchery-reared fish. In 1994, the Missouri Department of Conservation (MDC) released approximately 7,000 fingerlings in the Missouri and Mississippi Rivers, and an additional 3,000 fingerlings were stocked in 1997 (Graham 1997, 1999). Since stocking in 1994, approximately 86 pallid sturgeon returns have been reported, mostly in the Mississippi River downstream of St. Louis (Graham 1999). Thirty-five 12- to 14-inch pallid sturgeon raised at Natchitoches NFH were stocked in the lower Mississippi River in 1998 (Kilpatrick 1999). Also in 1998, 745 hatchery-reared yearling pallid sturgeon were released at three sites in the Missouri River above Fort Peck Reservoir

(Gardner 1999) and another 750 yearling sturgeon were released near the confluence of the Yellowstone and Missouri Rivers (USFWS 2000).

Evidence of successful pallid sturgeon reproduction is rare throughout the range of the species. Recent work in the Atchafalaya River has revealed pallid sturgeon of several age groups, suggesting that some reproduction and recruitment may also occur in the Atchafalaya River. The only physical evidence of reproduction, however, were three gravid females reported by Constant et al. (1997). According to their data, pallid sturgeon collected in the Atchafalaya River and other areas of the Mississippi River have averaged less than 6.6 pounds and length-at-age estimates calculated according to Fogle (1963) indicated that even the smallest fish were over age 6, with the oldest perhaps over age 14. The age of fish in their study indicates the most recent recruitment of pallid sturgeon to be from the 1988-year class (Constant et al. 1997).

Management and Protection

Habitat destruction and alteration is believed to be the primary cause of declines in pallid sturgeon reproduction, growth, and survival. It is unlikely that successfully reproducing pallid sturgeon populations can be recovered without restoring the habitat elements (morphology, hydrology, temperature regime, cover, and sediment/organic matter transport) of the Missouri and Mississippi Rivers necessary for the species' continued survival (USFWS 1993). In spite of efforts to control the Missouri and Mississippi Rivers with reservoirs, stabilized banks, jetties, dikes, levees, and revetments, remnant reaches of the Missouri and Mississippi Rivers still provide habitat believed to be usable by the pallid sturgeon. Those habitat remnants are priority areas for implementation of recovery actions (USFWS 1993).

Mortality of pallid sturgeon occurs from both sport and commercial fishing activities. The states of North Dakota, South Dakota, and Louisiana require the release of all sturgeon whether taken commercially or for sport. Neither Montana nor Kansas allow commercial harvest of sturgeon. Sturgeon continued to be harvested as a bycatch of commercial fishing operations in Nebraska, Iowa, Missouri, Illinois, Kentucky, Tennessee, Arkansas, and Mississippi (USFWS 1993).

Pollution is also a likely threat to the pallid sturgeon over much of its range. Further investigations are needed to identify sources of contaminants in the Missouri and Mississippi Rivers, and to assess the role of contaminants in the decline of pallid sturgeon populations (USFWS 1993).

The pallid sturgeon is known to hybridize with the shovelnose sturgeon (Carlson et al. 1985). Keenlyne et al. (1992) concluded that hybridization might be occurring in half of the river reaches within the pallid sturgeon's range. Hybridization may be related to environmental degradation. Presumably, the loss of habitat diversity caused by human-induced environmental changes inhibits the reproductive isolating mechanisms that naturally occur among fish species. Also, the loss of available spawning habitat forces sharing of suitable habitat areas by similar species, with resultant increased hybridization (USFWS 1993).

4.3 MAMMALS

4.3.1 Louisiana Black Bear (*Ursus americanus luteolus*)

Status

The Louisiana black bear was listed as threatened on January 7, 1992, due to the population decline resulting from extensive habitat loss (USFWS 1995b). Simultaneously, other free-living black bears within the historic range of the Louisiana black bear were listed as threatened due to their similarity of appearance to the Louisiana black bear. The USFWS proposed to designate critical habitat for the Louisiana black bear in December 2, 1993, but no final rule has been issued. Proposed critical habitat included forested habitat within the Tensas River Basin, the Atchafalaya River Basin, and the Lower Iberia-St. Mary Parish area.

Species and Habitat Description

The Louisiana black bear is one of 16 subspecies of the American black bear. The black bear is a large, bulky mammal with long black hair and a short, well-haired tail. The facial profile is blunt, the eyes are small and the nose pad is broad with large nostrils. The muzzle is yellowish brown with a white patch sometimes present on the lower throat and chest. Although weight varies considerably throughout their range, adult males weigh more than 600 pounds; adult females generally weigh less than 300 pounds.

Though classified as a carnivore by taxonomists, black bears are not active predators and only prey on vertebrates when the opportunity arises. Most meat eaten by black bears is carrion. Bears are best described as opportunistic feeders, as they eat almost anything that is available; thus, they are typically omnivorous. Their diet varies seasonally, and includes primarily succulent vegetation during spring, fruits and grains in summer, and hard mast such as acorns and pecans during fall. Bears utilize all levels of forest for feeding; they can gather foods from treetops and vines, but also grub in fallen logs for insects. The growth rate, maximum size, breeding age, litter size, and cub survival of black bears are all correlated with nutrition.

Bear activity revolves mainly around the search for food, water, cover, and mates during the breeding season. Home ranges of bears, particularly females, appear to be closely linked to forest cover (Marchinton 1995). Beausoleil (1999) estimated maximum home range for Deltic bears in the Tensas River Basin to be 1,729 and 1,038 acres for males and females, respectively. Maximum home range estimates for Tensas River NWR bears were 81,396 and 13,072 acres for males and females, respectively (Weaver 1999). Home range estimates for male bears in the inland Atchafalaya River Basin subpopulation may be as high as 80,000 acres, while female home ranges are approximately 8,000 acres (Wagner 1995). Home range estimates for female and male bears in the coastal subpopulation are estimated to be 3,706 and 10,378 acres, respectively (Wagner 1995). Wagner (1995) speculated that the smaller home ranges of coastal bears as compared to inland bears were due to superior habitat quality in the coastal area.

Female black bears become sexually mature at 3 to 5 years of age. Breeding occurs in summer and the gestation period for black bears is 7 to 8 months. Cubs are born in winter dens at the end of January or the beginning of February. Estimated litter sizes for the three Louisiana subpopulations ranges from 1.73 to 2.43. The normal litter size is two, although litter sizes of three to four cubs do occur. Cubs stay with the sow through summer and fall and den with them the second winter. The young disperse in spring or summer, prior to the female's period of estrus (Pelton 1982).

Louisiana black bears use a variety of den types, including ground nests, hollow trees, and brush piles. Generally, adult males and sub-adults use ground dens with greater frequencies than adult females. Black bears do not truly hibernate, but go through a dormancy period termed "carnivorian lethargy", a period of torpor, which helps them survive food shortages and severe weather during the winter. In warmer climates, such as in Louisiana, bears can remain active all winter (Taylor 1971). Bears may enter dens between October and early January depending on latitude, available food, sex and age, and local weather conditions (Pelton 1982). Adult females generally enter the den first, followed by sub-adults and adult males. Females with cubs generally are the last to leave the den.

The key habitat requirements of black bears are food, water, cover, and denning sites, which are spatially arranged across sufficiently large, relatively remote blocks of land. The remaining populations of Louisiana black bears typically inhabit bottomland hardwood communities; other habitat types may be utilized, including marsh, upland forested areas, forested spoil areas, and agricultural fields. Throughout its range, prime black bear habitat is characterized by relatively inaccessible terrain, thick understory vegetation, and abundant sources of food (Pelton 1982). Other important features of prime black bear habitat include dispersal corridors, protection from human-related disturbances, water, and denning sites. Corridors providing cover may facilitate the movement of bears through agricultural lands, particularly when bears reside in fragmented tracts of forest as observed by Weaver et al. (1992) in the Tensas Basin. According to Marchinton (1995), telemetry locations and visual observations indicated that wooded drainages were important travel corridors for movements among forested tracts.

Bear mortality has been attributed to natural and human causes. Natural causes include disease, cannibalism, drowning, poor maternal care, and climbing accidents. Human-induced mortality includes hunting, trapping, poaching, vehicle collisions, electrocution, depredation/nuisance kills, disturbance (causing den abandonment), and accidents associated with research activity. Road access can increase the chances of people or dogs disturbing maternal dens in winter (Rogers and Allen 1987). Cubs are dependent on the sow for warmth and food; human disturbance of denning females has resulted in cub mortality from abandonment (Elowe and Dodge 1989).

Pace et al. (2000) evaluated known black bear mortality in Louisiana between 1992 and 2000. Vehicular collisions were the most common cause of mortality, accounting for 45 percent of verified losses. Poaching was the second most common cause of death, with at least 12 bears illegally shot. Sixty-five percent of known mortalities occurred in the coastal subpopulation (the majority of which were adult females), 24 percent from Tensas River Basin subpopulation (the majority of which were males) and 11 percent from inland Atchafalaya River Basin subpopulation. Pace et al. (2000) concluded that anthropogenic causes of mortality are taking a relatively large toll on the coastal subpopulation in terms of absolute numbers and because adult females represent a high proportion of the take. Similarly, female losses in the inland Atchafalaya River Basin are high, relative to estimated population size.

Range and Population Dynamics

The Tensas River Basin subpopulation is 110 miles north of the inland Atchafalaya River Basin subpopulation. Some of the Tensas bears are located on Tensas River NWR and Big Lake Wildlife Management Area (WMA), which are protected from development and managed for bears and other wildlife. The refuge and adjacent WMA provide approximately 130 square miles of forested habitat (Weaver 1999). The nearby Deltic tracts support one of the highest densities of black bears reported for the southeastern coastal plain and the surrounding agriculture is probably the reason for that high density (Beausoleil 1999). Anderson (1997) reported that agricultural crops constituted 49 percent of the diet of Deltic bears; if crops grown on the surrounding lands change from corn and wheat (which are used by bears) to cotton, which is not, the sub-subpopulation would lose a food resource that it prefers. Also, bear density is not distributed evenly among tracts. Beausoleil (1999) reported 8 of 12 females studied had home ranges exclusively within the Bluecat tract, and 2 additional females had home ranges that overlapped the Bluecat tract and smaller adjacent forested areas to the south. The Deltic tracts are in private ownership, and are thus not under management protection and are potentially subject to development pressure. The presence of 4-lane highways and extensive agricultural lands limit bear movements from this subpopulation to Tensas River NWR.

The inland Atchafalaya River Basin subpopulation occupies 175 square miles of predominately private forestland interspersed with agriculture, and is located within and adjacent to the Morganza Floodway and adjoining the Atchafalaya Basin Floodway. The Morganza Floodway and adjoining Atchafalaya Basin Floodway together comprise approximately 1,039 square miles, although much of the land in the middle and lower Atchafalaya Floodway is believed to be currently unsuitable for bear occupancy due to extreme flooding. Through time, however, the swamp and forest floor of the Atchafalaya Basin are expected to rise with each succeeding flood and subsequent deposition of sediment. Those changes will eventually convert most of the basin forests to bottomland hardwoods, with some cypress/tupelo swamps remaining in former aquatic areas (especially in the southeastern portion of the basin). Those changes could expand the suitable habitat for the inland Atchafalaya River Basin and coastal subpopulations, and improve linkage of those populations.

The coastal subpopulation is located approximately 70 miles south of the inland Atchafalaya River Basin subpopulation, in southern Iberia and St. Mary Parishes, Louisiana. Habitat evaluation is underway to determine if suitable linkages between those two subpopulations can be identified. The coastal subpopulation occupies private lands, totaling approximately 218 square miles, and the recently established Bayou Teche NWR (currently 9,040 acres). Bear range expansion in the coastal area is limited by development along U.S. Highway 90 to the north, and by the surrounding coastal marsh, which is believed to be unsuitable for sustaining bear populations. Large blocks of public and private forest land exist to the north of the coastal subpopulation within the Atchafalaya Floodway, but are believed to be uninhabited by bears, and may be unsuitable for bear occupancy due to extent of flooding. Development of the majority of the occupied area is believed to be unlikely because most of the area remains flooded during most of the year, but some development pressure is expected on the eastern and western limits of the subpopulation. The densest portion of the coastal subpopulation is believed to be on the natural salt domes of Jefferson, Weeks, Avery, and Cote Blanche Islands (USFWS 2001a). Development that increases the number of roads, human presence, or reduces the amount of forest, especially the oak dominated habitat, could severely impact this population. Throughout the coastal subpopulation area, small forest patches on the edges of agriculture fields and developed areas may be at the greatest risk. These patches are protected from flooding by levees constructed to facilitate drainage and most are bottomland hardwood stands with a high proportion of oaks. Future changes to existing drainage systems could also alter coastal bear habitats.

Management and Protection

Black bears have relatively low reproductive potential; therefore, changes that influence reproduction can significantly impact population dynamics, an important management consideration. The most important natural factor regulating black bear populations appears to be variation in food supply and its effect on physiological status and reproduction (Rogers 1976).

Louisiana black bear habitat is believed to be stable to increasing overall as a result of regulatory programs (including Swampbuster and Section 404 of the Clean Water Act), and concerted efforts by Federal, state, and private entities that are currently targeting reforestation projects in bear habitat. Since 1992, approximately 150,000 acres of habitat have been reforested/protected through USDA's Wetland Reserve Program, and more than 50,000 acres of this restoration and protection have directly benefited bears. Nearly all of this effort has occurred in the upper Atchafalaya and Tensas River basins. Additional reforestation has occurred on NWRs, State-owned lands, and other Federal lands in areas where black bears will be benefited. In addition, the USFWS has acquired bear habitat in the coastal area for establishment of Bayou Teche NWR. The USACE has purchased about 50,000 acres in fee title, and is securing easements on 338,000 acres, in the Atchafalaya Basin. There is little opportunity for the establishment of conservation easements in the coastal area, however, due to the current profitability of sugarcane farming.

4.3.2 West Indian Manatee (*Trichechus manatus*)

Status

The West Indian manatee was listed as endangered throughout its range for both the Florida and Antillean subspecies in 1967, and received Federal protection with the passage of the ESA in 1973. Critical habitat was designated in 1976, 1994, 1998, 2002, and 2003 for the Florida subspecies.

Species and Habitat Description

The West Indian manatee is a large gray or brown aquatic mammal. Adults average approximately 10 feet in length and weigh up to 2,200 pounds. They have no hind limbs, and their forelimbs are modified as flippers. Manatee tails are flattened horizontally and rounded.

Their body is covered with sparse hairs and their muzzles with stiff whiskers (USFWS 2001c). The nostrils, located on the upper snout, open and close by means of muscular valves as the animal surfaces and dives (Husar 1977, Hartman 1979). Manatees will consume any aquatic vegetation (i.e., submerged, floating, and emergent) available to them and sometimes even shoreline vegetation. Although primarily herbivorous, they will occasionally feed on fish. Manatees may spend about 5 hours a day feeding, and may consume 4 to 9 percent of their body weight per day.

Observations of mating herds indicate that females mate with a number of males during their 2- to 4-week estrus period, and then they go through a pregnancy estimated to last 12 to 14 months (O'Shea et al. 1992). Births occur during all months of the year with a slight drop during winter months. Manatee cows usually bear a single calf, but 1.5 percent of births are twins. Calves reach sexual maturity at 3 to 6 years of age. Mature females may give birth every 2 to 5 years (USFWS 2001c).

Manatees inhabit both salt and freshwater of sufficient depth (5 feet to usually less than 20 feet) throughout their range. Shallow grassbeds with ready access to deep channels are preferred feeding areas in coastal and riverine habitats (USFWS 2001c). They may also be encountered in canals, rivers, estuarine habitats, saltwater bays, and have been observed as much as 3.7 miles off the Florida Gulf Coast. Between October and April, Florida manatees concentrate in areas of warmer water. Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges. During warmer months they appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water. Manatees may not need fresh water, but they are frequently observed drinking water from hoses, sewage outfalls, and culverts.

Range and Population Dynamics

During winter months, the United States' manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia. Power plant and paper mill outfalls create most of the artificial warm water refuges utilized by manatees. During summer months, they migrate as far north as coastal Virginia on the east coast and the Louisiana coast in the Gulf of Mexico.

During summer months, manatees disperse from winter aggregation areas, and are commonly found almost anywhere in Florida where water depths and access channels are greater than 3.3 to 6.6 feet (O'Shea 1988). In the warmer months, manatees usually occur alone or in pairs, although interacting groups of 5 to 10 animals are not unusual (USFWS 2001c). A few individuals have been known to stray as far north as the northern Georgia coast and as far west as the coastal waters of Louisiana.

In the early 1980s, scientists tried to develop procedures for estimating the overall manatee population in the southeastern United States (USFWS 2001c). The best estimate throughout the State of Florida was 1,200 manatees (Reynolds and Wilcox 1987). In the early 1990s, the State of Florida initiated a statewide aerial survey in potential winter habitats during periods of severe cold weather (Ackerman 1995), and the highest count of 3,276 manatees was recorded in January 2001.

Management and Protection

The most significant problem faced by manatees in Florida is death or injury from boat strikes (USFWS 2001c). Minimum flows and levels for warm water refuges need to be established to ensure their long-term availability for manatees. Their survival will depend on maintaining the ecosystems and habitat sufficient to support a viable manatee population (USFWS 2001c). The focus of recovery is on implementing, monitoring, and addressing the effectiveness of conservation measures to reduce or remove threats that will lead to a healthy and self-sustaining population (USFWS 2001c).

The West Indian manatee is also protected under the Marine Mammal Protection Act (MMPA) of 1972. The MMPA establishes a national policy for the maintenance of health and stability of marine ecosystems and for obtaining and maintaining optimum sustainable populations of marine mammals. It includes a moratorium on the taking of marine mammals. The recovery planning under the ESA includes conservation planning under the MMPA (USFWS 2001c).

4.4 REPTILES

4.4.1 Green Sea Turtle (*Chelonia mydas*)

Status

The green sea turtle was listed as endangered/threatened on July 28, 1978. The breeding populations off Florida and the Pacific coast of Mexico are listed as endangered while all others are threatened (USFWS 1991, NMFS www.nmfs.noaa.gov/). This species' current status in Louisiana is unknown (USFWS 1990b).

Species and Habitat Description

Although green sea turtles are found worldwide in oceans and gulfs with water temperatures greater than 68°F (20°C), their distribution can be correlated to grassbed distribution, location of nesting beaches, and associated ocean currents (Hirth 1971). Long migrations are often made between feeding and nesting grounds (Carr and Hirth 1962). Within Louisiana waters, these turtles probably occur all along the coast and may nest on the Chandeleur Islands (Dundee and Rossman 1989). Population decline has been attributed to heavy fishing pressure and human nest predation (Dundee and Rossman 1989). Historically, green sea turtles were fished off the Louisiana coast (Rebel 1974); exploitation and incidental drowning in shrimp trawls has contributed to the decline of this species and its eventual listing (King 1981). During their first year of life, green sea turtles are primarily carnivorous, feeding mainly on invertebrates. As adults they feed almost exclusively on seagrasses growing in shallow water flats (Fritts et al. 1983), but also feed on invertebrates and carrion (Dundee and Rossman 1989).

Green sea turtles feed in shallow water areas with abundant seagrasses or algae. The turtles migrate from nesting areas to feeding grounds, which are sometimes several thousand miles away. Most turtles migrate along the coasts, but some populations are known to migrate across the ocean from nesting area to feeding grounds. The major nesting beaches are always found in places where the seawater temperature is greater than 77°F (25°C). As a species that migrates long distances, these turtles face special problems associated with differing attitudes toward conservation in different countries.

Range and Population Dynamics

In the southeastern United States, green sea turtles are found around the U.S. Virgin Islands, Puerto Rico, and the continental U.S. from Texas to Massachusetts. Important feeding grounds in Florida include Indian River Lagoon, the Florida Keys, Florida Bay, Homosassa, Crystal River and Cedar Key. The primary nesting sites in U.S. Atlantic waters are along the east coast of Florida, with additional sites in the U.S. Virgin Islands and Puerto Rico.

Green sea turtles are also found throughout the North Pacific, ranging as far north as Eliza Harbor, Admiralty Island, Alaska, and Ucluelet, British Columbia. In the eastern North Pacific, green sea turtles have been sighted from Baja California to southern Alaska. In the central Pacific, green sea turtles can be found at most tropical islands. In U.S. Hawaiian waters, green sea turtles are found around most of the islands in the Hawaiian Archipelago. The primary nesting site is at French Frigate Shoals (http://www.nmfs.noaa.gov/prot_res/species/turtles/green.html).

Females deposit up to 7 clutches, and the number of nests has been estimated to be between 350 to 2,300 nests annually. Green sea turtles nest at 2-, 3-, or 4-year intervals. This nesting activity indicates a population of less than 1,000 females in the breeding population of Florida and Mexico.

Management and Protection

Recovery plan objectives consider the delisting of green sea turtles if, over a period of 25 years, the following conditions are met: 1) the level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years (nesting data must be based on standardized surveys), 2) at least 25 percent (105 km) of all available nesting beaches (420 km) is in public ownership and encompasses at least 50 percent of the nesting activity, and 3) a reduction in age class mortality is reflected in higher counts of individuals on foraging grounds. The 1995 Biological Assessment (BA) lists degradation of foraging grounds as one of the impediments to population recovery. There is evidence that supports foraging site as well as nesting site fidelity by green sea turtles (Renaud 1995). The recovery plans include prevention of marine pollution of green sea turtle habitat and protection of the nesting sites.

4.4.2 Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Status

The hawksbill was listed as an endangered species in June 1970 (USFWS 1991) and its current status in Louisiana is unknown (USFWS 1990).

Species and Habitat Description

Only one record of a hawksbill in Louisiana has been reported (Fuller and Tappen 1986). This species is an omnivore, feeding primarily on invertebrates and marine vegetation (Dundee and Rossman 1989). Hawksbill turtles are observed regularly in Florida and Texas. Florida is considered foraging habitat for those turtles, and Texas may be foraging habitat for hatchlings and juveniles (77 observations of small turtles were reported between 1972 and 1984) from the nesting sites in Mexico (NMFS and USFWS 1993).

Range and Population Dynamics

The hawksbill occurs in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf of Mexico (especially Texas); in the Greater and Lesser Antilles; and along the Central American mainland south to Brazil. Within the United States, hawksbills are most common in Puerto Rico and its associated islands, and in the U.S. Virgin Islands. In the continental U.S., the species is recorded from all the Gulf of Mexico states and from along the eastern seaboard as far north as Massachusetts, but sightings north of Florida are rare.

Hawksbills are observed in Florida with some regularity on the reefs off Palm Beach County and in the Florida Keys. Texas is the only other state where hawksbills are sighted with any regularity. Most sightings involve post hatchlings and juveniles, which are believed to originate from nesting beaches in Mexico.

Nesting within the southeastern United States occurs principally in Puerto Rico and the U.S. Virgin Islands. Within the continental United States, nesting is restricted to the southeast coast of Florida and the Florida Keys.

Hawksbill turtles nest at low densities in aggregations of 1 to 100 adults; in contrast, other sea turtles have concentrated nesting sites and aggregations of thousands of adults. The Yucatan Peninsula of Mexico is the most concentrated nesting site, where approximately 178 to 222 adult females nest each year (NMFS and USFWS 1993). Most of the countries in the Caribbean report less than 100 females nesting annually; less than two nests annually have been observed in Florida (NMFS and USFWS 1993) and Texas (htpp://www.noaa.gov).

Management and Protection

Recovery criteria are directed at nesting beaches with U.S. jurisdiction in the Caribbean Sea, including Mona Island, Puerto Rico, and the Virgin Islands. The hawksbill turtle can be delisted if the adult female population has an increasing trend over 25 years, as evidenced by increases in annual number of nests at five index beaches, including Mona Island. Numbers of turtles of all classes must show an increasing trend on at least five key foraging areas within Puerto Rico, the U.S. Virgin Islands, and Florida to meet recovery criteria. Actions needed to achieve recovery include long-term protection of foraging habitat and nesting beaches, and reduction of illegal exploitation (NMFS and USFWS 1993).

4.4.3 Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

Status

On December 2, 1970 the Kemp's ridley sea turtle was designated as endangered across its entire range (USFWS 1991) and has continued to decline in Louisiana (USFWS 1990).

Species and Habitat Description

This small sea turtle is believed to be the most frequently encountered (Dundee and Rossman 1989), if not the most abundant sea turtle, off the Louisiana coast (Viosca 1961). Predation on eggs by humans, other mammals, birds, and crabs, in addition to the capture of diurnal nesting females has contributed to the decline of the Kemp's ridley. Recent causes of mortality are fishing activities and accidental capture in shrimp trawls (Fuller 1978, Pritchard and Marquez 1973). These sea turtles are commonly captured by shrimpers off the Texas coast, as well as in heavily trawled areas off the coasts and in the bays of Louisiana and Alabama (Dundee and Rossman 1989, Carr 1980, Pritchard and Marquez 1973). Inshore areas of the Gulf of Mexico appear to be important habitat for Kemp's ridleys, as they tend to concentrate around the mouths of major rivers (Frazier 1980). Members of this genus are characteristically found in waters of low salinity and high turbidity and organic content, where shrimp are abundant (Hughes 1972 as cited in Frazier 1980, Zwinenberg 1977). Kemp's ridleys have been collected in Louisiana from Lake Borgne, Barataria and Terrebonne Bays, and near Calcasieu Pass (Dundee and Rossman 1989). Occurrence of these sea turtles in bays and estuaries along the Louisiana coast would not be unexpected, as many of their primary food items occur there. Stomach analyses of specimens collected in shrimp trawls off Louisiana revealed crabs, gastropods, and clams (Dobie et al. 1961). Although Kemp's ridleys are considered primarily carnivorous benthic feeders (Ernst and Barbour 1972), jellyfish as well as by-catch from shrimp trawlers have been reported as part of their diet (Landry 1986).

Trends in Kemp's ridley sea turtle populations in the Gulf of Mexico are identified through monitoring of their most accessible life stages on the nesting beaches, where hatchling production and the status of adult females can be directly measured. Most Kemp's ridley nesting occurs on a single beach at Rancho Nuevo, Mexico, about 30 kilometers south of the Rio Grande, with sporadic nesting along the Texas coast. Protection and monitoring by Mexico and the United States has occurred on that nesting beach since 1978. Nest production plummeted to only 742 nests in 1985, but has been steadily increasing since that time. Over 1,500 nests were observed during the 1994 nesting season. The latest data available show that the number of nests increased during 1994 through 2000; in 2000, 5,751 nests were observed. The possibility of Kemp's ridley nesting on the Louisiana coast has been suggested (Viosca 1961), but no documentation exists.

Range and Population Dynamics

The known range of this species includes the Gulf of Mexico and the Atlantic Ocean. The current range for Kemp's ridley in the United States includes marine habitat of the following coastal states: Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas.

Management and Protection

The Recovery Plan for the Kemp's ridley sea turtle (NMFS and USFWS 1992) identified a recovery criterion of 10,000 nesting females in one season as a prerequisite for downlisting to threatened status. Considering that 58 percent of all adult females appear to nest in any 1 year, and each female lays an estimated 2.7 nests, the 5,751 nests documented in the year 2000 represent approximately 3,700 adult female Kemp's ridleys in the entire population; that is about one third of the amount included in the downlisting criteria identified in the Recovery Plan. Continued protection of all life stages of the Kemp's ridley is necessary to increase recruitment to the reproducing population and insure recovery of the species.

4.4.4 Leatherback Sea Turtle (*Dermochelys coriacea*)

Status

The leatherback sea turtle was listed as an endangered species throughout its range in June 1970 (USFWS 199l).

Species and Habitat Description

The leatherback is the largest living turtle, and is so distinctive as to be placed in a separate taxonomic family, *Dermochelyidae*. The carapace is distinguished by a rubber-like texture, about 1.5 in (4 cm) thick, and made primarily of tough, oil-saturated connective tissue. No sharp angle is formed between the carapace and the plastron, resulting in the animal being somewhat barrel-shaped. The average curved carapace length for adult turtles is 5 ft (155 cm) and weight ranges from 440 to 1,543 lbs (200 to 700 kg). Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are margined in white, and rows of white scales appear as stripes along the length of the back. Hatchlings average 2.4 in (61.3 mm) long and 0.1 lbs (45.8 g) in weight. In the adult, the skin is black and scaleless. The undersurface is mottled pinkish-white and black. The front flippers are proportionally longer than in any other sea turtle, and may span 8.9 ft (270 cm) in an adult. In both adults and hatchlings, the upper jaw bears two tooth-like projections at the premaxillary-maxillary sutures. Age at sexual maturity is unknown (http://www.nmfs.noaa.gov/prot_res/species/turtles/leatherback.html).

The leatherback sea turtle occurs mostly in continental shelf waters, but will occasionally enter shallow waters and estuaries. Adults are highly migratory, and are believed to be the most pelagic of all sea turtles (NMFS and USFWS 1992). Habitat requirements for juvenile and post-hatchling leatherbacks are unknown.

Leatherback turtles are omnivorous but feed primarily on jellyfish and other cnidarians, and have been associated with large schools of cabbage head jellyfish *(Stomolophus meleagris)*. Fritts et al. (1983) reported that these turtles also ingest plastic, apparently mistaking it for food.

Range and Population Dynamics

The leatherback is found throughout the tropical waters of the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour 1972), the Gulf of Mexico, and the Caribbean (Carr 1952). Critical habitat for the leatherback includes the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands, up to and inclusive of the waters from the hundred fathom curve shoreward to the level of mean high tide with boundaries at 17°42'12" N and 64°50'00" W. This turtle exhibits seasonal fluctuations in distribution in response to the Gulf Stream and other warm water features (Fritts et al. 1983, Hirth 1980, Pritchard 1971). During the summer, leatherbacks tend to be found along the east coast of the U.S. from the Gulf of Maine south to mid-Florida.

Nesting occurs from February through July at sites located from Georgia to the U.S. Virgin Islands. Nesting leatherbacks occur along beaches in Florida, Nicaragua, and islands in the West Indies; however, no nesting has been reported in Louisiana (Gunter 1981, Dundee and Rossman 1989). In Louisiana, leatherbacks are believed to occur offshore in deep waters; however, they have been collected from or sighted in Cameron Parish, Atchafalaya Bay, Timbalier Bay, and Chandeleur Sound (Dundee and Rossman 1989).

Leatherbacks are seriously declining at all major nesting beaches throughout the Pacific. The decline is dramatic along the Pacific coasts of Mexico, Costa Rica and Malaysia. Nesting along the Pacific coast of Mexico declined at an annual rate of 22 percent over the last 12 years, and the Malaysian population represents 1 percent of the levels recorded in the 1950s. The collapse of those nesting populations was precipitated by a tremendous over-harvest of eggs, direct harvest of adults, and incidental mortality from fishing. In the Atlantic and Caribbean, the largest nesting assemblages are found in the U.S. Virgin Islands, Puerto Rico, and Florida. Nesting data for these locations have been collected since the early 1980s and indicate that the annual number of nests is likely stable; however, information regarding the status of the entire leatherback population in the Atlantic is lacking. Nesting activity has also declined in French Guiana due to erosion of nesting beaches. The population appears to have shifted to Surinam, where annual numbers of nests rose from less than 100 in 1967 to 5,565 in 1977 and 9,816 in 1987. Current estimates are that 20,000 to 30,000 female leatherbacks exist worldwide.

Management and Protection

Habitat destruction, incidental catch in commercial fisheries, and the harvest of eggs and flesh are the greatest threats to the survival of the leatherback. Recovery plans are directed at all leatherbacks in the U.S. portion of Caribbean, Atlantic, and Gulf of Mexico waters, whether they are nesting within this area or elsewhere. Stranding data for the United States shores indicate that stranded turtles are adult or near adult size, suggesting that leatherback turtles utilize the United States' coastal waters for foraging as well as nesting (NMFS and USFWS 1992). Leatherbacks begin nesting in February or March; other sea turtles begin nesting in May. Leatherback strandings are highest (84 percent) from October to April. Beach patrols are in place in May in most areas; however, few strandings (16 percent) occur from May to September. Aerial surveys indicate the presence of leatherback turtles in the southeastern U.S. in the winter months (NMFS and USFWS 1992). The recovery plan for the leatherback sea turtle concludes that nesting trends in the United States appear stable, but that the population faces significant threats from incidental take as a result of commercial fishing and marine pollution.

4.4.5 Loggerhead Sea Turtle (*Caretta caretta*)

Status

The loggerhead sea turtle was listed as a threatened species in July 1978 (USFWS 1991) and has continued to decline in Louisiana (USFWS 1990).

Species and Habitat Description

Loggerheads are capable of living in a variety of environments, such as in brackish waters of coastal lagoons and river mouths. During the winter, they may remain dormant, buried in the mud at the bottom of sounds, bays, and estuaries. The major nesting beaches are located in the southeastern United States, primarily along the Atlantic coast of Florida, North Carolina, South Carolina, and Georgia. Only minor and solitary nesting has been recorded along the coasts of the Gulf of Mexico.

The largest of the hard-shell sea turtles, the loggerhead is distributed worldwide in temperate and tropical bays and open oceans. Loggerheads probably range all along the Louisiana coast; however, Dundee and Rossman (1989) reported specimens only from Chandeleur Sound, Barataria Bay, and Cameron Parish. The population decline of loggerheads can be attributed to egg and nestling predation by mammals and birds (Dundee and Rossman 1989).

Nesting on the Gulf Coast occurs between the months of April and August, with 90 percent of the nesting effort occurring on the south-central Gulf Coast of Florida (Hildebrand 1981). Although loggerheads have been documented as nesting on the Chandeleurs in 1962 and Grand Isle in the 1930s, it is doubtful whether this species currently successfully nests on the Louisiana coast (Hildebrand 1981, Dundee and Rossman 1989). The loggerhead's diet includes marine invertebrates such as mollusks, shrimp, crabs, sponges, jellyfish, squid, sea urchins, and basket stars (Caldwell et al. 1955, Hendrickson 1980, Nelson 1986). Landry (1986) suggested that these turtles may also feed on discarded by-catch from shrimp trawling. Adult loggerheads feed in waters less than 50 meters deep, while the primary foraging areas for juveniles appears to be in estuaries and bays (Nelson 1986, Rabalais and Rabalais 1980).

Nesting in the U.S. accounts for about one third of the Federally listed threatened loggerhead worldwide population. Ninety-one percent of nesting occurs in Florida, particularly within the

Archie Carr NWR; the remaining U.S. nesting includes 6.5 percent in South Carolina, 1.5 percent in Georgia, and 1 percent in North Carolina. Nests are constructed from May through September in the United States. According to Gosselink, Coleman, and Stewart (http://biology.usgs.gov/s+t/SNT/noframe/cg138.htm), the only loggerhead turtle nesting sites observed in Louisiana were on the Chandeleur Islands. Because of storm processes, the Chandeleur Islands may no longer contain high beach and dune surfaces, i.e., beach structure suitable for nesting. Recent surveys by USFWS Refuge personnel have found no loggerhead nests in the area (James Harris, Southeast Louisiana Refuges, personal communication).

Range and Population Dynamics

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. In the Atlantic, the loggerhead turtle's range extends from Newfoundland to as far south as Argentina. During the summer, nesting occurs in the lower latitudes. The primary Atlantic nesting sites are along the east coast of Florida, with additional sites in Georgia, and the Carolinas; some nesting also occurs on the Gulf Coast of Florida. In the eastern Pacific, loggerheads are reported as far north as Alaska, and as far south as Chile. Occasional sightings are also reported from the coast of Washington, but most records are of juveniles off the coast of California. Southern Japan is the only known breeding area in the North Pacific(NMFS http://www.nmfs.noaa.gov/prot_res/species/turtles/loggerhead.html).

Management and Protection

The Recovery Plan is currently being revised, but its recovery criteria for delisting loggerhead sea turtles in the U.S. population include: 1) return to pre-listing nesting levels for North Carolina, South Carolina, and Georgia, and 2) demonstration of an increase in the adult female population of Florida (NMFS and USFWS 1993). Nesting trends are stable in Florida, but appear to be declining in Georgia and South Carolina; current trends in North Carolina have not been identified. Recent aerial survey data indicate a current population of 14,150 adult females. Female turtles deposit a mean of 4.1 nests per year, which would be approximately 58,000 nests in the southeastern U.S. That figure is supported by aerial and ground surveys that estimated between 50,000 and 70,000 nests annually in the southeastern U.S. Increasing the hatch success will necessitate improvement of nesting habitat and minimizing mortality from commercial fisheries.

5.0 POTENTIAL EFFECTS OF THE LCA ECOSYSTEM RESTORATION PLAN

Because the LCA Plan is programmatic and conceptual, the specific locations and design of features of the individual restoration measures have not been determined, and/or are subject to change. Hence, the following analyses are also expressed in conceptual terms for each of the major types of restoration measures recommended (e.g., river diversions, dredging, sediment delivery, barrier island restoration, and marsh creation). More specific and in-depth analyses will be completed during individual project-level consultations, once site-specific locations and designs have been developed.

5.1 BIRDS

5.1.1 Bald Eagle

There is suitable bald eagle habitat throughout much of the action area. Potential impacts to bald eagles may occur from construction activities that would disturb nest trees and/or cause noise-related disturbance to mating pairs during the nesting season. Impacts to nest trees can be avoided by circumventing the nest tree and other potential nest trees in the area. Noise disturbance to mating pairs can be avoided by conducting any work activities outside the nesting season and preventing those activities from encroaching within 1,500 feet of a nest during the nesting season (USFWS 1989c). Use of equipment that minimizes such disturbances may also help to minimize impacts to that species.

Bald eagles may also be impacted from contaminants introduced into their food source through water and sediments diverted from the Mississippi River into areas containing foraging and/or nest sites. The Davis Pond Freshwater Diversion Project is similar to diversion projects proposed in the final plan. The USFWS' 1984 Biological Opinion (BO) on the originally proposed Davis Pond project concluded the project was not likely to adversely affect eagles, but did propose implementation of a long-term contaminant sampling plan to monitor the health and population of bald eagles (including potential bald eagle prey items) within the project's ponding area. A study is currently being conducted on the effects of contaminants contained in water diverted from the Mississippi River on the bald eagle as a result of the implementation and operation of the Davis Pond Freshwater Diversion Structure. The USACE has begun implementation of that plan and is currently preparing a report on the result of those contaminant analyses. Furthermore, Mississippi River water quality used for diversions has improved measurably in the last ten years based on comparisons of data from the Caernarvon (Conzelmann et al. 1996) and Davis Pond (Jenkins and Jeske 2003) diversion studies.

Based on what is currently known, any proposed river or sediment delivery diversions would be similar to past projects and any proposed activities would be conducted according to bald eagle management guidelines. Therefore, the proposed action is not likely to adversely affect the bald eagle. In addition, habitat restoration that may occur due to the proposed action may also benefit bald eagles.

5.1.2 Brown Pelican

Suitable brown pelican feeding and/or nesting habitat occurs along the barrier islands, sand spits, and mud lumps along the Louisiana Gulf coast. Pelican nest sites (i.e., Rabbit Island in Calcasieu Lake, Raccoon Point on Isles Dernieres, Queen Bess Island, Plover Island [Baptiste Collette] Wine Island, and islands in the Chandeleur chain) and the birds themselves may be impacted by barrier island restoration activities or noise disturbance from work activities. Impacts to nesting brown pelicans can be avoided by preventing any work activities from encroaching within 2,000 feet of a nesting area during the nesting season. Furthermore, none of the barrier island restoration activities are expected to permanently affect suitable pelican nesting habitat, and are likely to create more nesting habitat and prolong the life of existing nesting habitat.

Noise disturbance to pelicans would be temporary and would be minimized by appropriate construction activity windows during the non-breeding season. Changes or impacts in coastal open water habitats providing suitable feeding and/or loafing areas would be temporary, and there is an abundance of suitable habitat should the birds be temporarily displaced. Changes in hydrology by measures to preserve existing marsh, create additional wetlands, and restore barrier islands would potentially enhance suitable feeding and/or loafing habitat for pelicans by enhancing the stability of those areas and the aquatic life upon which pelicans feed.

5.1.3 Piping Plover

Wintering piping plovers arrive from the breeding grounds as early as late July. Piping plovers are dependent on a mosaic of habitat patches, and move among these patches depending on local weather and tidal conditions. Wintering plovers in Louisiana depart for the breeding grounds during late March and early April. By May, most birds have left the wintering grounds. Potential impacts to piping plovers would be temporary displacement due to construction activities during barrier island restoration projects. To avoid disturbance to piping plovers, projects could be scheduled to occur outside the wintering season, or potentially disturbing activities could be phased to occur along the mainland side of the island.

Potential impacts to piping plover critical habitat may occur during barrier island restoration or enhancement activities, or as a result of activities that change the hydrology and/or dynamics of the barrier island system. The proposed action is expected to enhance and prolong the life of existing barrier islands, as well as create new barriers or structures that would function to protect the barrier islands. Any impacts that would occur to existing designated critical habitat would be temporary, and would only impact a small amount of habitat relative to the available critical habitat along the Gulf coast. No permanent impacts to critical habitat that would change the ecological processes that maintain it are expected as a result of the proposed action.

5.2 FISH

5.2.1 Gulf Sturgeon

Potential impacts to the Gulf sturgeon may result from river and/or sediment delivery diversions from the Mississippi River into the Labranche wetlands (located at the southwest corner of Lake Pontchartrain) and the “Golden Triangle” wetlands (located at the intersection of the Mississippi River Gulf Outlet and the Intracoastal Waterway in Orleans and St. Bernard Parishes). Those wetland complexes would receive fresh water from the river, and the affected brackish marshes could convert to intermediate marsh as a result. The Gulf sturgeon is an anadromous fish and should not be adversely impacted by an increase in intermediate marsh or a decrease in brackish marsh. Gulf sturgeon spawn in freshwater areas before returning to estuarine and marine environments. Because the above-referenced habitat changes would only slightly alter the proportion of intermediate to brackish marsh in those areas, no impacts to Gulf sturgeon critical habitat are expected.

5.2.2 Pallid Sturgeon

Potential impacts to the pallid sturgeon may occur due to proposed river diversions of or modifications to the Mississippi River and Atchafalaya River flows. Impacts associated with those proposed activities include but are not limited to increased turbidity, resuspension of contaminants, and physical disturbance associated with dredging or other project construction. A greater impact may result from the long-term habitat changes associated with construction of such projects. However, sturgeon are able to withstand habitat changes, provided that the affected aquatic habitat remains riverine (Gilbraith et al. 1988). The proposed action is not expected to change the hydrology or capacity of either the Mississippi or Atchafalaya Rivers since the diversions would mainly occur during high water levels.

The USACE has consulted with the USFWS on prior dredging activities conducted in 1991, 1992, 1993, 1994, and 1996, along the Mississippi River, and received concurrence that those activities were not likely to adversely affect the pallid sturgeon. Those proposed features involving dredging of sediment from the Mississippi River would be similar to projects conducted in the past. Pallid sturgeon, as well as their prey species, should be able to actively avoid dredging sites. The size and extent of the proposed action are minor in relation to the size of the river system, and many areas of refuge are available to the fish if needed. Currents in the area would quickly disperse suspended dredged material, returning turbidities to ambient levels. Benthic organisms capable of withstanding main channel conditions would quickly recolonize the area (Johnson 1976). Any resuspended contaminants would quickly be dispersed and diluted. Habitat loss in the Mississippi River would be almost negligible because of the minimal area affected. Therefore, no adverse impacts to the pallid sturgeon are expected from dredging activities.

Biological Assessments (BA) were prepared on March 14, 1991, and June 5, 1992, to address the impacts of river engineering works in the Mississippi and Atchafalaya Rivers, respectively, on Gulf and pallid sturgeon. A USACE funded study addressing the habitat, movement, and reproduction status of pallid sturgeon in the Mississippi and Atchafalaya Rivers was completed in January 1997. Pallid sturgeon are bottom dwellers and are not likely to be pulled into freshwater diversion structures, which draw water from the upper portion of the water column. Based on the findings of the BA, the 1997 study, and review of recent sightings data, the proposed action is not expected to impact the pallid sturgeon or its habitat.

5.3 MAMMALS

5.3.1 Louisiana Black Bear

Portions of the Atchafalaya River Basin and coastal St. Mary and Iberia Parishes are occupied (i.e., inhabited by denning females) by the Louisiana black bear. Potential impacts to black bears may include destruction of den trees from construction activities (e.g., disposal of dredged material, construction of new channels, or diversions) within occupied black bear habitat and disturbance to pregnant females during the denning season. Impacts to den trees could be avoided by preventing the removal of candidate or actual den trees, which are protected under the ESA. Candidate den trees include bald cypress or tupelo gum with visible cavities, having a diameter-at-breast height of 36 inches or greater, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies. Within occupied bear habitat, impacts to pregnant females and/or females with cubs could be avoided by preventing construction activities during the denning season.

Bears may also be encountered outside the denning season when construction activities occur within occupied bear habitat. Bears will typically avoid humans; however, sightings of bears may occur with activities that encroach upon occupied habitat. Outside the denning season, disturbance by construction activities would only temporarily displace bears, and there is an abundance of suitable foraging habitat in surrounding areas. Because bears can become attracted and accustomed to human food, keeping work areas clean and providing personnel with appropriate bear-proof trash receptacles would help to minimize the risk of disturbance and/or confrontations. Based on the available information, activities associated with the proposed action are not expected to adversely affect black bears.

5.3.2 West Indian Manatee

Sightings of the West Indian manatee in Louisiana have occurred in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana; however, there is no known population thriving in the State. Should any manatees be encountered during the proposed activities, an on-board observer would notify the proper personnel, and harmful activities (e.g., dredging) would be temporarily suspended until the animal(s) moves to safety. Furthermore, the disturbance to that species would only be temporary during project construction, and would result in temporary displacement. The manatees would likely move to another area for foraging or resting purposes, and there would be an abundance of available areas to which the animals may relocate.

5.4 REPTILES

5.4.1 Green Sea Turtle

Due to the lack of extensive seagrass beds in coastal Louisiana and the low incidence of sightings and strandings, impacts to the green sea turtle population as a result of any potential impacts from the proposed action are not expected.

5.4.2 Hawksbill Sea Turtle

The effects of any proposed action to hawksbill populations are likely to be negligible due to its rarity along the Louisiana coast.

5.4.3 Kemp's Ridley Sea Turtle

Potential impacts are not likely to include adverse effects on Kemp's ridley sea turtle populations. The proposed marsh creation features could provide more suitable inshore habitat (characterized by low salinity, and high turbidity and organic content, where shrimp and blue crabs are abundant) utilized by this species when foraging.

5.4.4 Leatherback Sea Turtle

Any potential project impact would have no effect on populations of the leatherback sea turtle. This species largely occupies oceanic water more than 50 meters in depth.

5.4.5 Loggerhead Sea Turtle

The restoration of the Terrebonne and Grand Isle barrier island chains would occur in Subprovinces 2 and 3 with the proposed action. Nesting loggerhead sea turtles have historically used barrier islands; however, it is doubtful that loggerhead sea turtles nest anywhere on the Louisiana coast. The restoration of barrier islands may or may not provide suitable nesting habitat, but suitable nesting habitat is nearly nonexistent due to the current degraded state of those islands. The proposed plans, therefore, would not negatively affect loggerheads, and may provide some benefit to the species by restoring nesting habitat.

6.0 SUMMARY OF DETERMINATIONS

The proposed LCA Plan would not be located within suitable habitat for the gopher tortoise, the inflated heelsplitter mussel, the Louisiana quillwort, the RCW, or the ringed sawback turtle, nor will it indirectly affect areas inhabited by those species. Hence, the proposed plan, would have no effect on those species.

6.1 BIRDS

Site-specific plans and construction activities could be designed to avoid potential impacts to bald eagles throughout the action area. By adhering to the primary activity exclusion zone and timing restrictions outlined in the Bald Eagle Recovery Plan (USFWS 1989), the USACE can avoid impacts to nest trees and breeding behaviors. Although data is not available at this time regarding effects on bald eagles from contaminants that may be associated with river and sediment diversions, the USACE would reinitiate consultation with the USFWS, if necessary, once those data are made available. Therefore, the proposed action is not likely to adversely affect the bald eagle.

Brown pelicans nest on barrier islands and feed in shallow estuarine waters, using sand pits and offshore sand bars as rest and roost areas. Any pelicans foraging or loafing within the proposed action area during project construction could easily relocate to other foraging areas in the vicinity. Potential impacts to nesting brown pelicans could be avoided by conducting activities outside the nesting season. Should the proposed activities occur during the nesting season, those activities could avoid impacting nesting pelicans by remaining outside 2,000 feet of nesting areas. Therefore, the proposed action is not likely to adversely affect the brown pelican.

Potential impacts to piping plovers could be avoided by conducting proposed construction activities outside the wintering season. If any proposed projects cannot be scheduled to take place outside the wintering season, piping plovers would be able to avoid areas of temporary disturbance as long as there are feeding and/or roosting areas available along the coast. Because any plovers remaining in the action area during construction would be temporarily displaced to other suitable habitats in the vicinity, the proposed action is not likely to adversely affect the piping plover.

Potential impacts on piping plover critical habitat would be minimal and temporary during projects associated with barrier island enhancement or restoration. Although the proposed action may impact a barrier island designated as critical habitat, only a relatively small amount of habitat will be affected when compared to the amount of critical habitat available. In addition, most of the proposed barrier island restoration projects may possibly create new potentially suitable habitat (beach) for the piping plover on the Gulf side of the islands and prevent/reduce erosion of existing habitat in the vicinity. Therefore, the proposed action is not likely to adversely modify critical habitat for wintering piping plovers.

6.2 FISH

The Gulf sturgeon is an anadromous fish that spawns in fresh water and migrates to estuarine and marine waters. Potential impacts to the Gulf sturgeon would involve relatively slight changes in marsh habitats along the southwestern edge of Lake Pontchartrain and the western edge of Lake Borgne. Those changes would involve creation of more intermediate marsh and a reduction in brackish marsh; however, there is an abundance of brackish marsh in surrounding areas. Therefore, the proposed action is not likely to adversely affect the Gulf sturgeon, its spawning behavior, or its critical habitat.

There are ways, through timing and use of different types of dredges, to minimize impacts to the pallid sturgeon caused by dredging activities. The pallid sturgeon is not likely be affected by construction or operation of freshwater diversion structures along the Mississippi or Atchafalaya Rivers; the species is a bottom dweller and is not likely to be entrained into diversion structures. Furthermore, the Mississippi and Atchafalaya Rivers are large enough to provide an abundance of refuge areas for the fish during construction activities or operation of any proposed diversion structures. Therefore, the proposed action is not likely to adversely affect the pallid sturgeon.

6.3 MAMMALS

Several proposed activities could potentially occur within occupied bear habitat along the coast of Iberia and St. Mary Parishes; however, developing project plans and construction activities that avoid or minimize work in occupied habitat during the black bear denning season would avoid disturbing pregnant females and/or females with cubs. Outside the denning season, bear sightings may still occur when working in occupied habitat, but maintaining clean work sites and providing bear-proof trash receptacles for construction crews could minimize the risk of bear disturbance and conflicts. If sightings do occur, bears are likely to avoid humans, and would only be temporarily displaced by disturbance from construction activities. Habitat loss should be minimal, if any. Therefore, the proposed action is not likely to adversely affect the Louisiana black bear.

The West Indian manatee is known to occur periodically in the coastal waters of Louisiana. If a manatee were to stray into the project areas, it may be attracted to noise from any proposed activities. Consequently, an on-board observer would be present to alert the proper personnel, and harmful activities (e.g., dredging) would be temporarily suspended until the animal can move to safety. Should a manatee be sighted within any work areas, the USFWS's Lafayette, Louisiana, Field Office would be contacted immediately. Therefore, the proposed action is not likely to adversely affect the West Indian manatee.

6.4 REPTILES

The proposed action would not disturb sea turtles, and is not likely to adversely affect green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtle populations. Most of those species are either rare along the Louisiana Gulf coast or feed in nearby waters.

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APPENDIX B2

U.S. FISH AND WILDLIFE COORDINATION LETTER FOR THREATENED AND ENDANGERED SPECIES ACT

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United States Department of the Interior

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

September 26, 2003

Colonel Peter J. Rowan
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Rowan:

The Corps of Engineers (Corps), in partnership with various other State, local, and Federal agencies and entities, is preparing a Programmatic Environmental Impact Statement (PEIS) on the Louisiana Coastal Area Comprehensive Coastwide Ecosystem Restoration Study (LCA). In response to a September 23, 2003, request from Mr. Bill Klein of your staff, the U.S. Fish and Wildlife Service (Service) is pleased to provide the following information regarding Federally listed threatened and endangered species, their critical habitat, and migratory birds that may be found in or near the LCA study area. This information will facilitate programmatic Section 7 consultation under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). In addition, we have also included information to facilitate compliance with the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

ESA Information
Seventeen threatened or endangered species, including the Louisiana black bear, West Indian manatee, bald eagle, brown pelican, piping plover, red-cockaded woodpecker, gopher tortoise, ringed map turtle, 5 species of marine turtles, pallid sturgeon, Gulf sturgeon, inflated heelsplitter, and Louisiana quillwort, occur within the four subprovinces comprising the LCA study area. In addition, the Service has designated critical habitat for the piping plover and the Gulf sturgeon.

Following the conclusion of programmatic consultation on the LCA PEIS, the Service will continue to assist the Corps and other Federal agencies responsible for funding or implementing selected LCA projects and/or plans to ensure they will not jeopardize the continued existence of threatened and endangered species, or adversely modify their designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will build upon the programmatic consultation.

Louisiana Black Bear
The threatened Louisiana black bear (*Ursus americanus luteolus*) is primarily associated with forested wetlands; however, it utilizes a variety of habitat types, including marsh, spoil banks, and upland forests. Within forested wetlands, black bear habitat requirements include soft and hard mast for food, thick vegetation for escape cover, vegetated corridors for dispersal, large trees for den sites, and isolated areas for refuge from human disturbance. Remaining Louisiana

black bear populations occur in the Tensas River Basin, the Upper Atchafalaya River Basin, and coastal St. Mary and Iberia Parishes. The primary threats to that species are continued loss of bottomland hardwoods, fragmentation of remaining forested tracts, and human-caused mortality (e.g., illegal killing and accidental collisions with motor vehicles).

Louisiana black bears, particularly pregnant females, normally den from December through April. To further protect denning bears, the Service (through the final listing rule published on January 7, 1992, in Volume 57, No. 4 of the Federal Register) has extended legal protection to candidate or actual den trees. These are defined in the final listing rule as bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa* sp.) with visible cavities, having a diameter at breast height of 36 inches or greater, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies. (Please note that additional information can be found at http://endangered.fws.gov.)

West Indian Manatee

Federally listed as endangered, West Indian manatees (*Trichechus manatus*) occasionally enter Lake Pontchartrain, Lake Maurepas, and their associated coastal waters and streams during the summer months (i.e., June through September). Manatees have also been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. Should the proposed project involve activities in those areas during summer months, further consultation with this office will be necessary. Manatees have also been occasionally observed elsewhere along the Louisiana Gulf coast. They have declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

Bald Eagle

Federally listed as threatened, bald eagles (*Haliaeetus leucocephalus*) nest in Louisiana from October through mid-May. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water in the southeastern Parishes. Areas with high numbers of nests include the Lake Verret Basin south to Houma, the southern marshes/ridge from Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area. Eagles also winter and infrequently nest near large lakes in central and northern Louisiana. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Brown Pelican

Federally listed as endangered, brown pelicans (*Pelecanus occidentalis*) are currently known to nest on Rabbit Island in Calcasieu Lake, Raccoon Point on Isles Dernieres, as well as Queen Bess Island, Plover Island (Baptiste Collette), Wine Island, and islands in the Chandeleur chain. Pelicans change nesting sites as habitat changes occur. Thus, pelicans may also be found nesting on mud lumps at the mouth of South Pass (Mississippi River Delta) and on small islands in St. Bernard Parish. In winter, spring, and summer, nests are built in mangrove trees or other shrubby vegetation, although occasional ground nesting may occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

Piping Plover

Federally listed as threatened, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months, arriving from the breeding grounds as early as late July and remaining until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no, or very sparse, emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependant on a mosaic of sites distributed throughout the landscape, as the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

Red-cockaded Woodpecker

The endangered red-cockaded woodpecker (RCW, *Picoides borealis*) inhabits open, park-like stands of mature (i.e., greater than 60 years of age) pine trees containing little hardwood understory or midstory. RCWs can tolerate small numbers of overstory hardwoods or large midstory hardwoods at low densities found naturally in many southern pine forests, but they are not tolerant of dense hardwood midstories resulting from fire suppression. RCWs excavate roost and nest cavities in large living pines (i.e., 10 inches or greater in diameter at breast height). The cavity trees and the foraging area within 200 feet of those trees are known as a cluster. Foraging habitat is defined as pine and pine-hardwood (i.e., 50 percent or more of the dominant trees are pine trees) stands over 30 years of age that are located within one-half mile of the cluster.

Gopher Tortoise

The threatened gopher tortoise (*Gopherus polyphemus*) is associated with areas that have well-drained, sand or gravel soils appropriate for burrow establishment, ample sunlight for nesting, and understory vegetation suitable for foraging (i.e., grasses and forbs). Gopher tortoises prefer "open" longleaf pine-scrub oak communities that are thinned and burned every few years. They also inhabit existing maintained transmission rights-of-way within Washington, Tangipahoa, and St. Tammany Parishes. The gopher tortoise is the only native tortoise found in the southeastern United States. Habitat degradation (lack of thinning or burning on pine plantations) and conversion to agriculture or urbanization have contributed to the decline of that species. That

habitat decline has concentrated remaining gopher tortoise populations along pipeline and powerline rights-of-way within their range.

Ringed Map Turtle

The threatened ringed map (= sawback) turtle (*Graptemys oculifera*) is endemic to the Pearl River system. In Louisiana, it occurs in the Bogue Chitto River south of Franklinton, and the Pearl River north of Louisiana Highway 190 in St. Tammany and Washington Parishes. It is found in riverine habitats with moderate currents, channels wide enough to permit sunlight penetration for several hours each day, numerous logs for basking, and large, sandy banks, that are used for nesting. Habitat loss (loss of exposed sand bars, basking areas) and water quality degradation (which decreases food supply) have contributed to the decline of this species.

Sea Turtles

Five species of threatened (T) and endangered (E) sea turtles, including the Kemp's ridley sea turtle (*Lepidochelys kempii*; E), green sea turtle (*Chelonia mydas*; T), hawksbill sea turtle (*Eretmochelys imbricata*; E), leatherback sea turtle (*Dermochelys coriacea*; E), and loggerhead sea turtle (*Caretta caretta*; T), forage in the near-shore waters, bays and sounds of Louisiana. Of those species, the two most commonly encountered are the loggerhead and Kemp's ridley sea turtles. The National Marine Fisheries Service is responsible for aquatic marine threatened or endangered species. Eric Hawk (727/570-5312) in St. Petersburg, Florida, should be contacted for additional information concerning those species.

Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered fish found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the Old River Control Structure Complex); it is possibly found in the Red River as well. The pallid sturgeon is adapted to large, free-flowing, turbid rivers with a diverse assemblage of physical habitats that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana. Habitat loss through river channelization and dams has adversely affected this species throughout its range.

Gulf Sturgeon

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

On March 19, 2003, the Fish and Wildlife Service and the National Marine Fisheries Service published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for

the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl River system, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. The primary constituent elements essential for the conservation of Gulf sturgeon are those habitat components that support feeding, resting, sheltering, reproduction, migration, and physical features necessary for maintaining the natural processes that support those habitat components; those elements should be considered when determining potential project impacts. The primary constituent elements for Gulf sturgeon critical habitat include:

- abundant prey items within riverine habitats for larval and juvenile life stages, and within estuarine and marine habitats for juvenile, subadult, and adult life stages;

- riverine spawning sites with suitable substrates for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;

- riverine aggregation areas, also referred to as resting, holding and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions;

- a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging; and necessary for maintaining spawning sites in suitable condition for egg attachment, eggs sheltering, resting, and larvae staging;

- water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;

- sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and

- safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by a permanent structure, or a dammed river that still allows for passage).

Please be aware that the Fish and Wildlife Service is responsible for ESA consultations regarding the Gulf sturgeon and its critical habitat for activities in riverine units. The National Marine Fisheries Service is responsible for ESA consultation regarding the Gulf sturgeon and its critical habitat for Corps activities within estuarine units, and is responsible for all ESA consultations regarding Gulf sturgeon and its critical habitat for activities in marine units.

Inflated Heelsplitter
Federally listed as threatened, the inflated heelsplitter mussel (*Potamilis inflatus*) occurs in the Amite River (Louisiana [with one report in the Pearl River]) and the Tombigbee and Black Warrior Rivers (Alabama). In Louisiana, the mussel occurs between Louisiana Highway 37 and Louisiana Highway 42, with the highest concentrations between Grangeville and Port Vincent. This freshwater mussel is typically found in soft, stable substrates such as sand, mud, silt, and sandy gravel, in slow to moderate currents. Heelsplitter mussels are usually found in depositional pools below sand point bars, and in shallow pools between sandbars and river banks. Major threats to this species in the Amite River are the loss of habitat resulting from sand and gravel dredging, and channel modifications for flood control.

Louisiana Quillwort
Federally listed as an endangered plant species, the Louisiana quillwort (*Isoetes louisianensis*) grows on sand and gravel bars on the accreting sides of streams and moist overflow channels within riparian forest communities in Washington and St. Tammany Parishes, Louisiana. The Louisiana quillwort is a small, semi-aquatic, facultative evergreen plant with spirally arranged leaves (sporophylls) arising from a globose, two-lobed corm. The hollow leaves are transversely septate, and measure approximately 0.12 inch wide and up to 16 inches long. Major threats to this species are habitat loss through hydrologic modifications of stream habitat, and land use practices that significantly alter stream quality and hydrology. Apparently, it is dependent on a special hydrologic regime resulting from the presence of small springs scattered at the bases of banks or bluffs.

MBTA Information
Colonial nesting waterbirds are protected under the MBTA. Colonies that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries may also be present. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect individual proposed project areas for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on individual proposed projects should be observed:

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

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

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and avoid impacting them during the breeding season.

We appreciate the Corps' continued cooperation in the conservation of threatened and endangered species and migratory birds. If your staff have any questions or need further information, please have them contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

Russell C. Watson
Acting Supervisor
Louisiana Field Office

cc: NOAA Fisheries, St. Petersburg, FL
LDWF, Natural Heritage Program, Baton Rouge, LA

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APPENDIX B3

NATIONAL MARINE FISHERIES SERVICE COORDINATION LETTERS FOR THREATENED AND ENDANGERED SPECIES ACT

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
9721 Executive Center Dr. N.
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://caldera.sero.nmfs.gov

SEP 18 2003

F/SER3:EGH

Mr. William P. Klein, Jr., Ed.D.
U.S. Army Corps of Engineers
P.O. Box 60267, New Orleans, LA 70160-0267

Dear Dr. Klein:

This responds to your request for comments on the draft threatened and endangered species section for the Louisiana Coastal Assessment (LCA) Preliminary Environmental Impact Statement (PEIS) and the Programmatic Biological Assessment (PBA). On March 14, 2003, NOAA Fisheries' Protected Resources Division (PRD) staff biologist Katie Moore provided initial comments and information for the draft programmatic supplemental EIS for the LCA Comprehensive Coastwide Ecosytem Restoration Feasibility Study (PRD consultation number I/SER/2003/00060). The study objectives were to identify restoration projects that would result in sustaining a coastal ecosystem that supports and protects the environment, economy and culture of southern Louisiana. In e-mail correspondence on August 15, 2003, with David Bernhart of the PRD staff, you requested review of portions of the PBA, specifically, chapters 3 and 5, to ensure that the document clearly states what will be done by the LCA team to meet requirements of the Endangered Species Act (ESA).

NOAA Fisheries PRD concurs with the PAB's assessment that wetlands habitat restoration in coastal Louisiana will ultimately benefit listed species under NOAA Fisheries' purview. The restoration actions/alternatives proposed include combining a series of measures, ultimately aimed at habitat restoration, that would be expected to achieve one or more of the following objectives: minimize and/or control salinity changes, provide continuous re-introduction of fresh water, mimic historic hydrology, maximize Atchafalaya River inflow, build land through delta development, and maximize geomorphic features. Those measures would include projects such as, but not limited to, constructing river and/or sediment delivery diversions, maintaining land bridges, restoring barrier islands, rebuilding historic reefs, installing water control structures, creating marsh, and achieving beneficial use of dredged material. Detailed descriptions of the plan that best meets the objectives (PMBO) and its alternatives are found in Chapters 3 of the PBA (incorporated herein by reference); however, the site-specific locations of each recommended measure have not been identified.

The BA does a good job of discussing the ESA-listed species under NOAA Fisheries' purview that may be present in the action area. The PEIS notes that sea turtles would likely benefit from increases in available coastal wetland habitats, especially barrier island/shoreline habitats, and that Louisiana coastwide restoration would help moderate impacts to this species felt nationwide. The PEIS notes that general direct, indirect, and cumulative impacts would be further developed on a project-by-project basis. The PBA notes that sea turtles may be found in Louisiana coastal shorelines as well as in various coastal water and that the COE has a long history of dredging and dealing with and avoiding adverse impacts to sea turtles during dredging operations. In addition, the PBA notes that the COE would maintain close coordination with NOAA Fisheries to avoid potential impacts to sea turtles during dredging operations.

Hopper dredging effects on sea turtles are currently considered, and takes authorized, in a 1995 Regional Biological Opinion (RBO) to the New Orleans (and Galveston) COE districts. The 1995 RBO will soon be superseded by a Gulf-wide RBO. The new RBO will consider the effects of hopper dredging and hopper-dredged material disposal on 1) sea turtles and 2) Gulf sturgeon; however, dredging/disposal effects on Gulf sturgeon critical habitat are not part of the RBO.

The COE should look closely at the potential effects to Gulf sturgeon and Gulf sturgeon critical habitat of the restoration projects when submitting them individually to PRD for review pursuant to section 7 of the ESA, particularly if dredging if involved. Dredging (hydraulic, hopper, clam shell, sidecast, etc.) may adversely affect Gulf sturgeon and Gulf sturgeon critical habitat. Dredging and/or disposal of dredged materials in Gulf sturgeon critical habitat, may require formal consultation with PRD. PRD notes that Subprovince 1 of the PBMO encompasses the coastal portion of the Pontchartarain Basin, Breton Sound basin, and the eastern half of the Mississippi River Delta; the eastern portion of Lake Pontchartrain is designated Gulf sturgeon critical habitat, and Gulf sturegon may occur as well in Subprovince 2 encompassing the deltaic plain between the Mississippi River and Bayour Lafourche, including the Bataria Basin and the western half of the Mississippi River Delta.

We note for the record that the Gulf sturgeon is jointly listed by both the U.S. Fish and Wildlife Service; its critical habitat is also jointly designated by both agencies (see page 9 of PBA).

While the PEIS generally considers all restoration projects it proposes as ultimately beneficial to ESA-listed species, and concludes that the actions if implemented are not likely to adversely affect listed species under NOAA Fisheries' purview, the PEIS does not grant approval for the implementation of any particular project at any specific site. Furthermore, PRD cannot evaluate site-specific actions for effects to threatened and endangered species and conclude section 7 consultation on them without knowing where, when, and how the actions will take place. However, since the final restoration projects selected are subject to New Orleans District Corps of Engineers (COE) permitting requirements before being implemented, section 7 consultation between the COE and NOAA Fisheries will be conducted at the time the project is presented to PRD for review.

We look forward to continued cooperation with the COE in conserving our endangered and threatened resources. If you have any questions regarding this ESA consultation, please contact Mr. David Bernhart, fishery biologist, at (727) 570-5779, or by e-mail at David.Bernhart@noaa.gov.

Sincerely,

Gerogia Cranmore.
Assistant Regional Administrator
for Protected Resources

Ref: I\SER\2003\00060; File: 1514-22 f.1. NOD; O:\section 7\informal\LCA-PEIS

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://caldera.sero.nmfs.gov

MAR 14 2003

F/SER3:KPB

Joy Merino
Coastal Ecologist
NOAA Fisheries
646 Cajundome Boulevard
Lafayette, LA 70506

Dear Ms. Merino:

We have received the draft documents for the Louisiana Coastal Area Comprehensive Coastwide Ecosystem Restoration Feasibility Study in development by the Army Corps of Engineers (COE) and Louisiana Department of Natural Resources (LA DNR) transmitted electronically on January 28, 2003. You have requested comments on any threatened and endangered species information while the restoration plan is being developed. Please refer to consultation number I/SER/2003/00060 in future correspondence on this project.

A list of federally-protected species under the jurisdiction of NOAA Fisheries for the state of Louisiana and guidelines for preparing a biological assessment are enclosed. Biological information on federally protected sea turtles, marine mammals, fishes, and other listed species can be found at the following website addresses:

- NOAA Fisheries Southeast Regional Office (http://caldera.sero.nmfs.gov/protect/protect.htm);
- NOAA Fisheries Office of Protected Resources (http://www.nmfs.noaa.gov/prot_res/prot_res.html);
- U.S. Fish and Wildlife Service (http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm);
- the Ocean Conservancy (http://www.cmc-ocean.org/main.php3);
- the Caribbean Conservation Corporation (http://www.cccturtle.org);
- Florida Fish and Wildlife Conservation Commission (http://floridaconservation.org/psm/turtles/turtle.htm);
- http://www.turtles.org; http://alabama.fws.gov/gs/; and
- http://obis.env.duke.edu/data/sp_profiles.php.

In addition, we request that you review the potential for your project to affect candidate species. Candidate species are species that are being considered for possible addition to the threatened and endangered species list. Candidate species currently have no legal protection. The list of candidate species' listings is also enclosed.

Incidental takes of marine mammals are not authorized through the ESA section 7 process. If you believe that bottlenose dolphins may be present in the action area of the proposed project and injury or harassment may result, an incidental take authorization under Marine Mammal Protection Act (MMPA) Section 101 (a)(5) may be necessary. Species descriptions for bottlenose dolphins and any other cetaceans found in the action area of the proposed ecosystem restoration plan should be included in your species description and analysis of effects of the restoration activities on those species.

The action agency is also reminded that, in addition to its protected species/critical habitat consultation requirements with NOAA Fisheries pursuant to section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NOAA Fisheries' Habitat Conservation Division (HCD) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat (EFH) consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NOAA Fisheries letterhead from HCD regarding their concerns and/or finalizing EFH consultation. Consultation is not complete until EFH and ESA concerns have been addressed to NOAA Fisheries' satisfaction.

If you have any questions about EFH consultation for this project, please contact Mr. Richard Hartman, at (225) 389-0508. We look forward to our continuing cooperation. If you have any questions regarding this letter, please contact Kyle Baker, fishery biologist, at the number above or via e-mail at Kyle.Baker@noaa.gov.

Sincerely,

Georgia Cranmore
Assistant Regional Administrator
for Protected Resources

cc: F/SER44 - Richard Hartman
COE - New Orleans District
File: 1514.22.F.1 LA
No. I/SER/2003/00060
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Louisiana List of Species Under the Jurisdiction of NOAA Fisheries

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaeangliae*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened(1)	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	09/30/91

Species Proposed for Listing
None

Designated Critical Habitat
None

Proposed Critical Habitat
Gulf Sturgeon (67 FR 39106)

Candidate Species(2) (64 FR 33466)	Scientific Name
dusky shark	*Carcharhinus obscurus*
sand tiger shark	*Odontaspis taurus*
night shark	*Carcharinus signatus*
speckled hind	*Epinephelus drummondhayi*
saltmarsh topminnow	*Fundulus jenkensi*
Jewfish	*Epinephelus itajara*
Warsaw grouper	*Epinephelus nigritus*

1. Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered.

2. Candidate species are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future.
Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

NOAA Fisheries
Recommendations for the Contents of
Biological Assessments and Biological Evaluations

When preparing a Biological Assessment (BA) or Biological Evaluation (BE), keep in mind that the people who read or review this document may not be familiar with the project area or what is proposed by the project. Therefore your BA or BE should present a clear line of reasoning that explains the proposed project and how you determined the effects of the project on each threatened or endangered species in the project area. Try to avoid technical jargon not readily understandable to people outside your agency or area of expertise. Remember, this is a **public document**. Some things to consider and, if appropriate, to include in your BA or BE follow.

1. What is the difference between a Biological Evaluation and a Biological Assessment?

By regulation, a Biological Assessment is prepared for "major construction activities" considered to be Federal actions significantly affecting the quality of the human environment as referred to in the National Environmental Policy Act of 1969 (NEPA) [(42 U.S.C. 4332(2)(C)]. A BA is required if listed species or critical habitat may be present in the action area. A BA also may be recommended for other activities to ensure the agency's early involvement and increase the chances for resolution during informal consultation. Recommended contents for a BA are described in 50 CFR §402.12(f).

Biological Evaluation is a generic term for all other types of analyses. Although agencies are not required to prepare a Biological Assessment for non-construction activities, if a listed species or critical habitat is likely to be affected, the agency must provide the Service with an evaluation on the likely effects of the action. Often this information is referred to as a BE. The Service uses this documentation along with any other available information to decide if concurrence with the agency's determination is warranted. Recommended contents are the same as for a BA, as referenced above.

The BAs and BEs should not be confused with Environmental Assessments (EA) or Environmental Impact Statements (EIS) which may be required for NEPA projects. These EAs and EISs are designed to provide an analysis of multiple possible alternative actions on a variety of environmental, cultural, and social resources, and often use different definitions or standards.

2. What are you proposing to do?

- Describe the project. A project description will vary, depending on the complexity of the project. For example, describing the placement and construction of a new microwave tower may be relatively simple, but describing an alternative for improving range management likely would be more detailed and complex. Include sketches if they will help others understand your proposed action and its relationship with the species' habitat.

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- How are you (or the project proponent) planning on carrying out the project? What tools or methods may be used? How will the site be accessed?

- Describe the project area. Always include a map (topographic maps are particularly helpful). Provide photographs including aerials, if available. Describe the project area (i.e., topography, vegetation, condition/trend).

- Describe current management or activities relevant to the project area. How will your project change the area?

- Supporting documents are very helpful. If you have a mining plan, research proposal, NEPA or other planning document or any other documents regarding the project, attach them to the BA or BE.

3. What threatened or endangered species may occur in the project area?

A request for a species list may be submitted to the Service, or the Federal action agency or its designated representative may develop the list. If you have information to develop your own lists, the Service should be contacted periodically to ensure that changes in species' status or additions/deletions to the list are included. Sources of information include, but are not limited to, the Forest Service or Bureau of Land Management, this office for marine species, members of the public or academic community, and books and various informational booklets. Due to budget constraints and staff shortages, we are only able to provide general, state-wide, or country-wide (territory-wide) species lists.

Use your familiarity with the project area when you develop your species lists. Sometimes a species may occur in the larger regional area near your project, but the habitat necessary to support the species is not in the project area (including areas that may be beyond the immediate project boundaries, but within the area of influence of the project). If, for example, you know that the specific habitat type used by a species does not occur in the project area, it does not need to appear on the species list for the project. However, documentation of your reasoning is helpful for Service biologists or anyone else that may review the document.

4. Have you surveyed for species that are known to occur or have potential habitat in the proposed project area?

The "not known to occur here" approach is a common flaw in many BA/BEs. The operative word here is "known." Unless adequate surveys have been conducted or adequate information sources have been referenced, this statement is difficult to interpret. It begs the questions "Have you looked?" and "How have you looked?" Always reference your information sources.

Include a clear description of your survey methods so the reader can have confidence in your results. Answer such questions as:

- How intensive was the survey? Did you look for suitable habitat or did you look for individuals? Did the survey cover the entire project area or only part of it? Include maps of areas surveyed if appropriate.

- Who did the surveys and when? Was the survey done during the time of year/day when the plant is growing or when the animal can be found (its active period)? Did the survey follow accepted protocols?

- If you are not sure how to do a good survey for the species, the Service recommends contacting species experts. Specialized training is required before you can obtain a permit to survey for some species.

- *Remember that your evaluation of potential impacts from a project does not end if the species is/are not found in the project area. You must still evaluate what effects would be expected to the habitat, even if it is not known to be occupied.*

5. Provide background information on the threatened or endangered species in the project area.

Describe the species in terms of overall range and population status. How many populations are known? How many occur in the project area? What part of the population will be affected by this project? Will the population's viability be affected? What is the current habitat condition and population size and status? Describe related items of past management for the species, such as stocking programs, habitat improvements, or loss of habitat or individuals caused by previous projects.

6. How will the project affect the threatened or endangered species or critical habitat that occurs in the project area?

- If you believe the project will not affect the species, explain why.

- If you think the project may affect the species, explain what the effects might be. The Endangered Species Act requires you consider <u>all</u> effects when determining if an action funded, permitted, or carried out by a Federal agency may affect listed species. Effects you must consider include direct, indirect, and cumulative effects. Effects include those caused by interrelated and interdependent actions, not just the proposed action. Direct effects are those caused by the action and occur at the same time and place as the action. Indirect effects are caused by the action and are later in time but are reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no significant independent utility apart from the action under consideration. Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal actions subject to consultation.

- Describe measures taken to avoid, reduce, or eliminate adverse effects or enhance beneficial effects to the species. Refer to conversations you had with species experts to achieve these results.

- Consider recovery potential if the project area contains historic range for a species.

- Evaluate designated critical habitat areas by reviewing the physical or biological features essential to the conservation of the species. *Even if no critical habitat has been designated for a species, the evaluation of the project effects must include effects to the habitat, not just the species.*

7. What is your decision? The Federal action agency must make a determination of effect.

Quite frequently, effect determinations are not necessarily *wrong;* they simply are not justified in the assessment. The assessment should lead the reviewer through a discussion of effects to a logical, well-supported conclusion. Do not assume that the Service biologist is familiar with the project and/or its location and that there is no need to fully explain the impact the project may have on listed species. If there is little or no connection or rationale provided to lead the reader from the project description to the effect determination, we cannot assume conditions that are not presented in the assessment. Decisions must be justified biologically. The responsibility for making the determination of effect falls on the Federal action agency; however, the Service may ask the agency to revisit its decision or provide more data if the conclusion is not adequately supported by biological information.

You have three choices for each listed species or area of critical habitat:

1. "No effect" means there are absolutely no effects of the project, positive or negative. "No effect" does not include a *small* effect or an effect that is *unlikely* to occur. If effects are insignificant (in size) or discountable (extremely unlikely), a "may affect, but not likely to adversely affect" determination is appropriate.

2. "May affect - is not likely to adversely affect" means that all effects are beneficial, insignificant, or discountable. Beneficial effects have concurrent positive effects without any adverse effects to the species or habitat (i.e., there can not be "balancing," wherein the benefits of the project would be expected to outweigh the adverse effects - see #3 below). Insignificant effects relate to the size of the impact (and should not reach the scale where take occurs). Discountable effects are those extremely unlikely to occur. These determinations require **written** concurrence from the Service. Based on best judgement, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

3. "May affect - is likely to adversely affect" means that all adverse effects can not be avoided. A combination of beneficial and adverse effects is still "likely to adversely affect," even if the net effect is neutral or positive. Adverse effects do not qualify as discountable simply because we are not certain they will occur. The probability of occurrence must be extremely small to achieve discountability. Likewise, adverse effects do not meet the definition of insignificant because they are less than major. If the adverse effect can be detected in any way or if it can be meaningfully articulated in a discussion of the results, then it is not insignificant, it is likely to adversely affect. This requires formal consultation with the Service.

A fourth finding is possible for proposed species or proposed critical habitat:

4. "Is likely to jeopardize/adversely modify proposed species/critical habitat" is the appropriate conclusion when the action agency identifies situations in which the proposed action is likely to jeopardize the proposed species, or destroy or adversely modify the proposed critical habitat. If this conclusion is reached, conference is required.

List the species experts you contacted when preparing the BE or BA but avoid statements that place the responsibility for the decision of "may affect" or "no effect" on the shoulders of the species experts. Remember, this decision is made by the Federal action agency.

Provide supporting documentation, especially any agency reports or data that may not be available to the Service. Include a list of literature cited.

Prepared by:
U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
January 1997

Revised by:
U.S. Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuña NE
Albuquerque, New Mexico 87113
(505) 761-4525
April 1997

Revised by:
National Marine Fisheries Service
Southeast Regional Office
Protected Resources Division
9721 Executive Center Dr. N.
St. Petersburg, FL 33702

(727) 570-5312
November 1998

OUTLINE EXAMPLE
FOR A
BIOLOGICAL ASSESSMENT OR BIOLOGICAL EVALUATION

A. Cover Letter - **VERY IMPORTANT** - Include purpose of consultation, project title, and consultation number (if available). A determination needs to be made for each species. You have three options: 1) a "no effect" determination; 2) requesting concurrence with an "is not likely to adversely affect" determination; 3) a "may affect, is likely to adversely affect" determination, and a request for formal consultation. If proposed species or critical habitat are included, state whether the project is likely to result in jeopardy to proposed species, or the destruction or adverse modification of proposed critical habitat.

B. Project Description - Describe the proposed action and the project area. Be specific and quantify whenever possible.

C. For Each Species
   1. Description of affected environment (quantify whenever possible)
   2. Description of species biology
   3. Describe current conditions for each species
      a. Rangewide
      b. In project area
      c. Cumulative effects of State and private actions in project area
      d. Other consultations of Federal action agency in area to date
   4. Describe critical habitat (if applicable)
   5. Describe effects of proposed action on each species and/or critical habitat.
      a. Direct
      b. Indirect
      c. Interrelated and interdependent actions
      d. Incidental take

D. Conservation Measures (protective measures to minimize effects for each species)

E. Conclusions (effects determination for each species)

F. Literature Cited

G. List of Contacts Made/Preparers

H. Maps/ Photographs

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APPENDIX B4

U.S. FISH AND WILDLIFE COORDINATION ACT REPORT

LCA Comprehensive Study

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LOUISIANA COASTAL AREA
LOUISIANA - COMPREHENSIVE COASTWIDE ECOSYSTEM RESTORATION STUDY

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

U.S. FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

SEPTEMBER 2003

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LOUISIANA COASTAL AREA
LOUISIANA - COMPREHENSIVE COASTWIDE ECOSYSTEM RESTORATION STUDY

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

PROVIDED TO
NEW ORLEANS DISTRICT
U.S. ARMY, CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY
RONNY PAILLE, SENIOR FIELD BIOLOGIST
AND
KEVIN ROY, SENIOR FIELD BIOLOGIST

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

SEPTEMBER 2003

EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (Service) has prepared the following Draft Fish and Wildlife Coordination Act Report on the alternative plans evaluated in the Draft Louisiana Coastal Area (LCA) Comprehensive Coastwide Ecosystem Restoration Study Report. The purpose of that study is to ". . . to determine the feasibility of sustaining a coastal ecosystem that supports and protects the environment, economy and culture of southern Louisiana and that contributes greatly to the economy and well being of the nation." The LCA Comprehensive Study is a critically important component of the cooperative Federal-State effort to address the loss of Louisiana's coastal wetlands.

The study area includes all of Louisiana's coastal wetlands and supports nationally important fish and wildlife resources. Those wetlands are currently being lost at an average rate of approximately 24 square miles per year due to a variety of causes. Through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), the Corps, the Service, and other Federal and State agencies have worked together to develop and evaluate plans to protect and restore Louisiana's rapidly disappearing coastal wetlands. This study is a further development of the Coast 2050 Plan (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998) developed by the above-mentioned agencies to identify comprehensive strategies for addressing the State's coastal wetland loss problems.

Within each of Louisiana's four coastal subprovinces, restoration projects were grouped into alternatives that would achieve varying levels of benefits, from reducing the rate of wetland loss to producing net wetland gains. Of the many initial alternatives, seven coastwide plans were selected for additional study. Each of those plans consist of numerous projects, including the introduction of flows from the Mississippi River and, to a lesser extent, the Atchafalaya River.

Under the No Action Plan, approximately 463,000 acres of Louisiana's coastal wetlands would be lost during the 50-year evaluation period. According to current estimates developed for the LCA study, the implementation of Plan 7002 would yield a net wetland gain of more than 114,000 acres during the same 50-year period. Plan 5610 would essentially achieve no net wetland loss. The remaining action plan alternatives would reduce future wetland losses and, by year 50, would save roughly 365,000 to 430,000 acres, compared to the No Action Plan.

It must be noted that the analyses and findings in the Service's report are of an interim nature, due to current technical limitations in various habitat models and salinity calculations. The Service will continue working closely with the LCA Modeling Team to further refine those models and reduce the current degree of risk and uncertainty associated with their outputs.

Interim benefits for each of the alternatives were determined for the 10 coastal fish and wildlife species and expressed in average annual habitat units (AAHU). Species which utilize fresh or intermediate marshes during all or part of their lives generally would benefit from implementation of the action plan alternatives compared to the No Action Plan. The American alligator and dabbling ducks would receive the greatest benefits. Habitat quality for mink, river otter, Atlantic croaker, and white shrimp would increase under all the action plan alternatives.

Habitat quality for species which utilize brackish marsh would decrease by varying amounts. For muskrat, Gulf menhaden, and spotted seatrout, habitat values would decrease under all action plan alternatives, except under Plan 7002, where those species would also experience AAHU increases. For brown shrimp, all action plans would result in a net coastwide reduction in habitat quality, with the least impact occurring under Plan 7002.

Many other species of fish and wildlife which utilize Louisiana’s coastal wetlands would benefit from the restoration actions proposed under the action plan alternatives. The Service believes that implementation of any of the proposed action plan alternatives would result in major benefits to nationally significant fish and wildlife resources which are threatened by the continuing, severe loss of the Louisiana coastal wetlands. Consequently, the Service would support implementation of any of the proposed action plans.

According to the present interim evaluation results, however, only Plan 7002 would reverse the severe loss of Louisiana’s coastal wetlands. It would also provide the greatest level of benefits to Louisiana’s nationally significant fish and wildlife resources. Consequently, we currently favor implementation of that plan. However, Plan 7002 includes very expensive and highly complex projects, such as the large-scale diversion of Mississippi River water into the Barataria and Terrebonne Basins known as the “Third Delta;” hence, the benefits associated with that plan may not ultimately be achievable and/or affordable. As Plan 5610 is presently the second-most beneficial plan, we would favor its implementation in lieu of Plan 7002 if the latter is found to be infeasible.

Regardless of the alternative that is ultimately identified for implementation, should the “Third Delta” diversion project not be included, the Service recommends that the Subprovince 3 benefits lost through elimination of that project be replaced to the greatest extent possible through the comprehensive implementation of features and projects designed to maximize Atchafalaya River flows/influence in the Atchafalaya and Terrebonne Basins. The proposed restoration of the reefs extending from Point au Fer Island to the southern end of the Point Chevreuil reef would greatly enhance land-building in the Atchafalaya Delta and increase riverine influences in western Terrebonne Basin marshes. Because that reef restoration project is believed to be one of the most beneficial features of that strategy, the Service recommends that it be made part of any preferred implementation alternative that may be designated in the future. Similarly, the Service recommends the following modifications be incorporated in any plan ultimately selected for implementation:

1. Install a new Calcasieu Lock and use of the old lock for improved management of water levels in the Lakes Subbasin, and for moderating salinity levels in the Calcasieu Basin.
2. Delete the proposed Gulf Intracoastal Lock at the Alkali Ditch, as many of the wetlands intended to be benefitted by that feature have already been lost and others are now protected by other means.
3. Sufficient funding should be provided for full Service participation throughout post-authorization engineering and design studies, and to facilitate fulfillment of its responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.

4. The Corps should obtain a right-of-way from the Service prior to conducting any work on a National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established.

To ensure that optimum fish and wildlife resource benefits are achieved, the Service plans to remain actively involved throughout the plan implementation process. Our findings and recommendations on the design and operation of projects approved for implementation will be provided under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This report is provided in accordance with, but does not entirely fulfill the requirements of, Section 2 (b) of that Act.

INTRODUCTION

The Louisiana Coastal Area, Louisiana - Comprehensive Coastwide Ecosystem Restoration Study Draft Report (DLCAR) has been prepared by the New Orleans District Corps of Engineers, Louisiana Department of Natural Resources, and other State and Federal natural resource agencies, with the assistance of scientists from several institutions. The DLCAR is envisioned as the vehicle for building a comprehensive array of projects to implement the most effective coastal wetland restoration and conservation strategies that were identified in the Coast 2050 Plan, which was prepared by the Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetland Conservation and Restoration Authority. The Louisiana Coastal Area (LCA) study was authorized by Resolutions adopted by the U.S. House of Representatives and Senate Committees on Public Works, on October 19, 1967, and April 19, 1967, respectively, seeking to improve existing hurricane protection features and the ". . . prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resource purposes."

Louisiana's 3.67 million acres of coastal wetlands and their associated waters are of national importance to fish and wildlife resources. Coastal Louisiana contains an estimated 45 percent of the tidal marshes in the conterminous United States. Those wetlands and associated shallow waters provide essential habitat to a diverse and abundant assemblage of fish and wildlife.

The coastal wetlands of Louisiana produce the largest commercial fish and shellfish harvest in the lower 48 States. More than 1.1 billion pounds of fish and shellfish (including shrimp, crabs, crawfish, and oysters) are harvested annually in coastal Louisiana. That harvest is nearly twice as much as in any other state and was valued at more than $400 million in 2000 (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2001).

Recreational saltwater anglers spend approximately $245 million annually to fish for spotted seatrout, red drum, snapper, tuna and other species (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2001). Fresh and low-salinity coastal wetlands also provide important habitat for numerous freshwater sport fishes, the pursuit of which is also an important recreational activity in the coastal areas.

Louisiana's coastal marshes provide winter habitat for more than 50 percent of the duck population of the Mississippi Flyway, an estimated 20 percent of North America's puddle duck population, and large concentrations of diving ducks. Those wetlands are vitally important to the habitat mission of the Gulf Coast Joint Venture, which was established to help achieve the goals of the North American Waterfowl Management Plan. Fresh and intermediate marshes support the greatest concentrations of wintering waterfowl in coastal Louisiana.

Louisiana's coastal marshes, swamps, and associated habitats also support many other migratory birds, such as rails, gallinules, shorebirds, seabirds, wading birds, and numerous songbirds. More than 196 nesting colonies of wading birds, shorebirds, and seabirds (representing 27 species and more than 430,000 nesting pairs) were observed in coastal Louisiana during a 1990 survey conducted by the Louisiana Department of Wildlife and Fisheries. The cheniers and natural levee forests of coastal Louisiana provide essential stop-over habitat to numerous neotropical migratory passerine birds.

Coastal Louisiana has long been a leading fur-producing area in North America. Common fur-bearers in that area include nutria, mink, muskrat, raccoon, and river otter. Those coastal marshes and swamps also support game animals such as white-tailed deer and swamp rabbit. That area also supports 1.5 million alligators, and closely regulated sport and commercial hunting for that species.

DESCRIPTION OF THE STUDY AREA

The study area encompasses all of Louisiana's coastal wetlands, which include cypress-tupelo swamp, natural levee forest, fresh marsh, intermediate marsh, brackish marsh, saline marsh, and barrier islands. The study area is divided into four subprovinces, each of which include one or more coastal watersheds having similar hydrologic characteristics. The LCA Subprovinces are very similar to those identified under the Coast 2050 Plan, except that the boundary between Subprovinces 1 and 2 has been relocated from the Mississippi River-Gulf Outlet to the Mississippi River under the LCA.

Subprovince 1 consists of all coastal wetlands east of the Mississippi River (and South Pass) and includes the Pontchartrain and Breton Sound Basins. Subprovince 2 consists of the coastal wetlands located between the Mississippi River and Bayou Lafourche (i.e., the Barataria Basin). Subprovince 3 extends from Bayou Lafourche westward to the Freshwater Bayou Channel and includes the Terrebonne, Atchafalaya, and Teche/Vermilion Basins. Subprovince 4 extends from the Freshwater Bayou Channel westward to the Louisiana State line (i.e., the Sabine River/Sabine Lake) and includes the Mermentau and Calcasieu/Sabine Basins.

FISH AND WILDLIFE CONCERNS IN THE STUDY AREA

The foremost study-area concern is the rapid deterioration and loss of coastal wetlands. During the 1900s, coastal Louisiana lost approximately 1.2 million acres of its coastal wetlands. Coastwide loss rates were approximately 44 square miles per year during the 1956 to 1978 period, and averaged nearly 24 square miles per year between 1990 and 2000. Large areas of fresh marsh and swamp have either converted to open water or to more brackish wetland types.

To address this serious problem, a number of coastal wetland restoration projects have been constructed and/or authorized for construction throughout coastal Louisiana. Those projects are being funded via the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), and two large freshwater introduction projects (Davis Pond and Caernarvon) have been implemented by the Corps of Engineers under other authorities. Those efforts, though, will address less than one third of the 448,000-acre wetland loss projected to occur by the year 2050. That continuing loss of coastal wetlands and associated habitats threatens the nationally significant fish and wildlife resources that depend on them.

EVALUATION METHODOLOGY

A team of scientists led by Dr. Robert Twilley of the University of Louisiana at Lafayette (i.e., the LCA Modeling Team) is assisting in the development and evaluation of restoration alternatives for the LCA. That team has developed a comprehensive modeling approach which utilizes numerical modeling and coarser-scale "desktop" modeling to forecast wetland conditions under future without-project (FWOP) and alternative future with-project (FWP) scenarios. Their approach includes the use of hydrodynamic, ecological, and water quality simulation models to predict hydroperiod, salinity, and sediment distribution. The desktop modeling involves the development of a set of modules to convert numerical modeling results into landscape and ecological responses (e.g., acres of wetlands created). Outputs from the numerical models are utilized in the desktop models at different time intervals and spatial scales to predict habitat change, habitat loss, salinity, and a host of other pertinent variables. Desktop modules developed for this study include 1) Land-Building, 2) Habitat Switching, 3) Water Quality, and 4) Habitat Use.

The Habitat Use module provides a methodology for estimating the impacts of restoration alternatives on fish and wildlife resources. That methodology is very similar to the Habitat Evaluation Procedures (HEP) developed by the Service. The LCA Modeling Team selected 12 representative species/species groups of fish, shellfish, and wildlife for evaluation. Those species/species groups include white shrimp, brown shrimp, American oyster, Gulf menhaden, spotted seatrout, Atlantic croaker, largemouth bass, American alligator, muskrat, mink, river otter, and dabbling ducks. The LCA Modeling Team modified the Service's published Habitat Suitability Index (HSI) models for the fish and shellfish species to include only those variables for which output would be available from numerical or other desktop models. Variables retained for those species included salinity, temperature, water depth, and percent wetland area. Models for the wildlife species were developed with methods similar to those used for the fish and shellfish models. All of the wildlife models utilized three variables, i.e., habitat type, percent wetland area, and water depth.

Originally, the Service intended to use the Habitat Use module outputs (see the LCA draft Report, Appendix A) to determine project-related impacts to fish and wildlife resources in the study area. Several inconsistencies and problems were noted, however, when comparing outputs among the proposed restoration alternatives and across the four coastal Subprovinces. Of particular concern were the projected increases in habitat values for most of the evaluation species under the No Action Plan, and the inverse relationship between wetland-dependent wildlife benefits and increases in their preferred habitats under some scenarios. The Service, therefore, decided to use an interim assessment methodology, until the LCA numerical and desktop models are further refined to more accurately project impacts to fish and wildlife resources. The Service fully intends to continue assisting the LCA Modeling Team and the other involved agencies in the ongoing effort to refine model outputs.

To determine impacts of the FWOP and FWP alternative plans on fish and wildlife resources, the Service used a modification of the HEP. Biologists with the Corps, LDWF, NMFS, and the

Service selected 10 of the 12 evaluation species utilized in the Habitat Use module. The species selected represent fish and wildlife resources which utilize coastal wetland habitats, from swamp to saline marsh. Estuarine-dependent species selected for evaluation include Atlantic croaker, spotted seatrout, Gulf menhaden, brown shrimp, and white shrimp. Wildlife species selected for evaluation include mink, river otter, muskrat, American alligator, and dabbling ducks. The

largemouth bass was not selected as an evaluation species because its HSI model is primarily used for lacustrine and riverine habitats, rather than estuarine habitats. In addition, largemouth bass prefer low-salinity habitats such as fresh and intermediate marsh; thus, impacts to that species could be inferred from impacts to other low-salinity species (e.g., dabbling ducks and American alligator). The American oyster was not selected as an evaluation species because it is not impacted by the quality of emergent wetland habitat. Habitat suitability for each of the selected species is dependent on habitat conditions.

To determine impacts on each evaluation species/species group, the Service incorporated changes in habitat types and wetland acreage projected by the LCA numerical and desktop models; we also incorporated an HSI into the HEP methodology for each species/species group within each wetland type to determine impacts in terms of net Average Annual Habitat Units (AAHUs). To derive AAHUs, a species' HSI for a specific habitat type is multiplied by the acreage of that habitat type to obtain Habitat Units, which are annualized over the evaluation period (i.e., 50 years). Net AAHUs represent the difference in AAHUs between the action plan alternative (i.e., FWP conditions) and the No Action Plan (i.e., FWOP conditions).

Because the models used to project future habitat types assigned a single average salinity value to a very large area or "salinity box," salinities are essentially averaged across those areas. In some cases, this has eliminated actual salinity gradients and caused unrealistic shifts in projected salinities (those shifts appear at target year 10, the first projection). Lacking a better method for projecting future habitat-type changes, however, the Service has decided to use the existing habitat type data until the methodology can be improved. Because the plan evaluation and selection process is continuing, the preliminary benefit estimates presented in this evaluation should therefore be viewed as interim values, subject to a considerable degree of risk, uncertainty, and future refinement.

HSI values for each wetland type were derived for the selected wildlife species using the wetland type-habitat suitability relationships found in the LCA Habitat Use module. For the estuarine-dependent fish and shellfish species, HSI values by wetland type, were provided by the National Marine Fisheries Service, utilizing the published salinity-habitat suitability relationships found in each species' HSI model. Those HSI values for each evaluation species, by wetland type, are displayed in Table 1.

Table 1. HSI values for each evaluation species by wetland type

Evaluation Species	Swamp	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Saline Marsh
Atlantic Croaker	0.00	0.40	0.80	1.00	0.60
Spotted Seatrout	0.00	0.10	0.20	0.50	0.90
Gulf Menhaden	0.00	0.20	0.40	0.60	0.90
Brown Shrimp	0.00	0.10	0.30	0.80	1.00
White Shrimp	0.00	0.20	1.00	1.00	0.70
Mink	0.68	0.40	0.29	0.24	0.00
River Otter	0.68	0.39	0.67	1.00	0.00
Muskrat	0.04	0.21	0.11	1.00	0.43
American Alligator	0.26	0.55	1.00	0.55	0.00
Dabbling Ducks	0.66	1.00	0.69	0.66	0.08

EXISTING FISH AND WILDLIFE RESOURCES

Description of Habitats

Forested Wetlands - Forested wetlands in the study area were divided into two major types; i.e., bottomland hardwood forests and cypress-tupelo swamps. Bottomland hardwood forests found in coastal portions of the project area occur primarily on the natural levees of distributary channels. Dominant vegetation may include sugarberry, water oak, live oak, bitter pecan, black willow, American elm, Drummond red maple, Chinese tallow-tree, boxelder, green ash, baldcypress, and elderberry. Cypress-tupelo swamps are located along the flanks of larger distributary ridges as a transition zone between bottomland hardwoods and lower-elevation marsh or scrub-shrub habitats. Cypress-tupelo swamps exist where there is little or no salinity and usually minimal daily tidal action.

Scrub-Shrub - Scrub-shrub habitat is often found along the flanks of distributary ridges. Typically it is bordered by marsh at lower elevations and by developed areas, cypress-tupelo swamp, or bottomland hardwoods at higher elevations. Typical scrub-shrub vegetation includes elderberry, wax myrtle, buttonbush, black willow, Drummond red maple, Chinese tallow-tree, and groundselbush.

Fresh Marsh - Fresh marshes occur at the upper ends of interdistributary basins and are often characterized by floating or semi-floating organic soils. Most fresh marshes exhibit minimal daily tidal action; however, fresh marshes in the Atchafalaya River delta and adjacent to Atchafalaya Bay are the exceptions. Vegetation may include maidencane, bulltongue, cattail, California bulrush, pennywort, giant cutgrass, American cupscale, spikerushes, bacopa, and alligatorweed. Associated open water habitats may often support extensive beds of floatingleafed and submerged aquatic vegetation including water hyacinth, Salvinia, duckweeds, American lotus, white water lily, water lettuce, coontail, Eurasian milfoil, hydrilla, pondweeds, naiads, fanwort, wild celery, water stargrass, elodea, and others.

Intermediate Marsh - Intermediate marshes are a transitional zone between fresh and brackish marshes and are often characterized by organic, semi-floating soils. Typically, intermediate marshes experience low levels of daily tidal action. Salinities are negligible or low throughout much of the year, with salinity peaks occurring during late summer and fall. Vegetation includes saltmeadow cordgrass, deer pea, three-cornered grass, cattail, bulltongue, California bulrush, seashore paspalum, wild millet, fall panicum, and bacopa. Ponds and lakes within the intermediate marsh zone often support extensive submerged aquatic vegetation including southern naiad, Eurasian milfoil, and wigeongrass.

Brackish Marsh - Brackish marshes are characterized by low to moderate daily tidal energy and by soils ranging from firm mineral soils to organic semi-floating soils. Freshwater conditions may prevail for several months during early spring; however, low to moderate salinities occur during much of the year, with peak salinities in the late summer or fall. Vegetation is usually dominated by saltmeadow cordgrass, but also includes saltgrass, three-cornered grass, leafy three-square, and deer pea. Shallow brackish marsh ponds occasionally support abundant beds of wigeongrass.

Saline Marsh - Saline marshes occur along the southern fringe of the coastal wetlands. Those marshes usually exhibit fairly firm mineral soils and experience moderate to high daily tidal energy. Vegetation is dominated by saltmarsh cordgrass but may also include saltgrass, saltmeadow cordgrass, black needlerush, and leafy three-square. Submerged aquatic vegetation is rare. Within the study area, intertidal mud flats are most common in saline marshes.

Ponds and Lakes - Natural marsh ponds and lakes, interspersed throughout the coastal wetlands, are typically shallow, ranging in depth from 6 inches to more than 2 feet. Typically, the smaller ponds are shallow and the larger lakes are deeper. In fresh and low-salinity areas, ponds and lakes may support varying amounts of submerged and/or floating-leaved aquatic vegetation. Brackish and, much less frequently, saline marsh ponds and lakes may support wigeongrass beds.

Canals and Bayous - Canals and larger bayous typically range in depth from 4 or 5 feet, to more than 15 feet. Strong tidal flows may occur at times through those waterways, especially where they provide hydrologic connections to other large waterbodies. Such canals and bayous may have mud or clay bottoms that range from soft to firm. Dead-end canals and small bayous are typically shallow and their bottoms may be filled in to varying degrees with semi-fluid organic material. Erosion due to wave action and boat wakes, together with shading from overhanging woody vegetation, tends to retard the amount of intertidal marsh vegetation growing along the edges of those waterways.

Developed Areas - Most developed areas are located on higher elevations of former distributary channels and are typically well drained. They include agricultural lands, and commercial and residential developments.

Fishery Resources

Wetlands throughout the study area abound with small resident fishes and shellfishes such as least killifish, rainwater killifish, sheepshead minnow, mosquitofish, sailfin molly, grass shrimp, and others. Those species are typically found along marsh edges or among submerged aquatic vegetation, and provide forage for a variety of fish and wildlife. Fresh and low-salinity marshes provide habitat for commercially and recreationally important resident freshwater fishes such as largemouth bass, yellow bass, black crappie, bluegill, redear sunfish, warmouth, blue catfish, channel catfish, buffalo, freshwater drum, bowfin, and gar. Freshwater fishes may also utilize low-salinity areas (intermediate marsh zone), provided they have access to fresher areas during periods of high salinity.

The coastal marshes also provide nursery habitat for many estuarine-dependent commercial and recreational fishes and shellfishes. Because of the protection and abundant food afforded by those wetlands, they are critical to the growth and production of species such as blue crab, white shrimp, brown shrimp, Gulf menhaden, Atlantic croaker, red drum, spotted seatrout, black drum, sand seatrout, spot, southern flounder, striped mullet, and others. Those species are generally most abundant in the brackish and saline marshes; however, blue crab, Gulf menhaden, and Atlantic croaker and several other species also utilize fresh and low-salinity marshes.

Because tidal marshes provide essential nursery habitat, commercial shrimp harvests are positively correlated with the area of tidal emergent wetlands, not open water area (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes could be adversely impacted by the high rates of marsh loss throughout the study area (Turner 1982).

The American oyster occurs throughout much of the brackish and saline marsh zones within the study area. Oyster harvesting constitutes a valuable fishery in the northern portions of that zone, where salinities range from 10 to 15 parts per thousand (ppt).

Essential Fish Habitat

The generic amendment to Gulf of Mexico Fishery Management Plan identifies Essential Fish Habitat in the project area to be intertidal emergent wetlands, submerged aquatic vegetation, estuarine waters, and mud, sand, and shell water bottoms. Habitat Areas of Particular Concern have not been identified for the project area. Under the Magnuson-Stevens Fishery Conservation and Management Act, the Gulf of Mexico Fishery Management Council has determined that project-area habitats are utilized by Federally managed species such as brown shrimp, white shrimp, and red drum. Although those species utilize the project area primarily as nursery habitat, all life stages may occur therein. When they move to offshore waters, blue crabs and other species of fishes and shellfishes which utilize project-area habitats may also provide forage for Federally managed marine fishes such as groupers, snappers, and mackerel.

Wildlife Resources

Numerous species of birds utilize study-area marshes, including large numbers of migratory waterfowl which winter there. Project-area fresh and intermediate marshes provide excellent wintering habitat for migratory waterfowl, especially puddle (dabbling) ducks. Brackish marshes having abundant submerged aquatic vegetation may also support large numbers of puddle ducks. Puddle ducks that occur in the study area include mallard, gadwall, northern pintail, blue-winged teal, green-winged teal, American widgeon, wood duck, and northern shoveler. The resident mottled duck also utilizes project-area coastal marshes for nesting, feeding, and brood-rearing. Diving ducks prefer larger ponds, lakes, and open water areas. Common diving duck species include lesser scaup, ruddy duck, canvasback, redhead, ring-necked duck, red-breasted merganser, and hooded merganser. The lesser snow goose and the white-fronted goose also utilize coastal marshes. Other migratory game birds found in coastal marshes include the king rail, clapper rail, Virginia rail, sora, American coot, common moorhen, and common snipe.

Marshes and associated shallow, open-water areas provide habitat for a number of wading birds, shorebirds, seabirds, and other nongame birds. Common wading birds include the little blue heron, great blue heron, green-backed heron, yellow-crowned night heron, black-crowned night heron, great egret, snowy egret, cattle egret, reddish egret, white-faced ibis, white ibis, and roseate spoonbill. Shorebirds include the killdeer, American avocet, black-necked stilt, common snipe, and various species of plovers and sandpipers. Seabirds include white pelican, brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. More than 190 wading and seabird nesting colonies have been identified within coastal Louisiana during surveys conducted in 1983, 1990, and 2001 (Michot et al. 2003). Other nongame birds such as boat-tailed grackle, red-winged blackbird, seaside sparrow, olivaceous cormorant, northern harrier, belted kingfisher, and sedge wren also utilize coastal-area habitats.

Common mammals occurring in the coastal marshes include nutria, muskrat, mink, river otter, raccoon, swamp rabbit, white-tailed deer, and coyote. Muskrat and river otter prefer brackish marsh. Nutria, mink, swamp rabbit, and white-tailed deer prefer fresh marsh and low salinity habitats. Saline marsh provides very poor habitat for the above listed species. For muskrat, however, saline marsh may provide fair to poor habitat quality.

Reptiles are most abundant in fresh and low-salinity coastal wetlands. Common species include the American alligator, western cottonmouth, water snakes, mud snake, speckled kingsnake, ribbon snakes, rat snakes, red-eared turtle, common snapping turtle, alligator snapping turtle, mud turtles, and softshell turtles. Amphibians commonly found in those areas include the bullfrog, pig frog, bronze frog, leopard frog, cricket frogs, tree frogs, chorus frogs, three-toed amphiuma, sirens, and several species of toads. In brackish and saline marshes, reptiles are limited primarily to the American alligator and the diamond-backed terrapin, respectively.

Forested wetlands and scrub-shrub areas provide habitats for songbirds such as the mockingbird, yellow-billed cuckoo, northern parula, yellow-rumped warbler, prothonotary warbler, white-eyed vireo, Carolina chickadee, and tufted titmouse. Additionally, these areas also provide important resting and feeding areas for songbirds migrating across the Gulf of Mexico. Other avian species found in forested wetlands include the American woodcock, common flicker, brown thrasher, white-eyed vireo, belted kingfisher, loggerhead shrike, pileated woodpecker, red-headed woodpecker, downy woodpecker, common grackle, common crow, and mockingbird. Numerous other bird species use forested wetlands throughout the study area.

Forested habitats and associated waterbodies also support raptors such as the red-tailed hawk, red-shouldered hawk, osprey, American kestrel, Mississippi kite, northern harrier, screech owl, great horned owl, and barred owl. Wading bird colonies typically occur in cypress swamp and scrub-shrub habitat. Species found in those nesting colonies include anhinga, great egret, great blue heron, black-crowned night heron, tricolored heron, little blue heron, cattle egret, snowy egret, white-faced and glossy ibises, and reddish egret. Waterfowl species found in forested wetlands and adjacent waterbodies in the project area include, but are not limited to, wood duck, mallard, green-winged teal, gadwall, and hooded merganser.

Game mammals associated with forested wetlands include eastern cottontail, swamp rabbit, gray and fox squirrels, and white-tailed deer. Commercially important fur bearers include river otter, muskrat, nutria, mink, and raccoon. Other mammals found in forested wetlands include striped skunk, coyote, Virginia opossum, bobcat, armadillo, gray fox, and red bat. Smaller mammal species serve as forage for both mammalian and avian carnivores and include the cotton rat, marsh rice rat, white-footed mouse, eastern wood rat, harvest mouse, least shrew, and southern flying squirrel.

Reptiles which utilize study area bottomland hardwoods, cypress swamps, and associated shallow waters include the American alligator, ground skink, five-lined skink, broadbanded skink, green anole, Gulf coast ribbon snake, yellow-bellied water snake, speckled kingsnake, southern copperhead, western cottonmouth, pygmy rattlesnake, broad-banded water snake, diamond-backed water snake, spiny softshell turtle, red-eared turtle, southern painted turtle, Mississippi mud turtle, stinkpot, and common and alligator snapping turtle, in addition to numerous other species.

Representative amphibians in study-area forested wetlands include dwarf salamander, three-toed amphiuma, lesser western siren, central newt, Gulf coast toad, eastern narrow-mouthed toad, green treefrog, squirrel treefrog, pigfrog, bullfrog, southern leopard frog, bronze frog, upland chorus frog, southern cricket frog, and spring peeper.

Most developed areas provide low-quality wildlife habitat. Sites developed for agricultural purposes are usually located at elevations slightly higher than the wetlands, or they may have improved drainage. In agricultural areas, wildlife habitat is primarily provided by unmaintained ditch banks and field edges, fallow fields, pasture lands, and/or occasionally flooded fields. Cultivated crops, especially soybeans, provide forage for some wildlife species. Game species that utilize agricultural lands include the white-tailed deer, mourning dove, bobwhite quail, eastern cottontail, and common snipe. Seasonally flooded cropland and fallow fields may also provide important feeding habitat for wintering waterfowl, wading birds, and other waterbirds.

Threatened and Endangered Species

Federally listed threatened and endangered species occurring in coastal Louisiana wetlands and associated habitats include in the Louisiana black bear (threatened), West Indian manatee (endangered), bald eagle (threatened), brown pelican (endangered), piping plover (threatened), several species of sea turtles, Gulf sturgeon (threatened), and the pallid sturgeon (endangered).

The Louisiana black bear is primarily associated with forested wetlands; however, it also utilizes a variety of other habitat types, including marsh, spoil banks, and upland forests. Louisiana black bear populations occur in the Tensas River Basin, the Upper Atchafalaya River Basin, and coastal St. Mary and Iberia Parishes.

The West Indian manatee occasionally enters Lakes Pontchartrain and Maurepas, and associated coastal waters and streams, during the summer months. Manatees have been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana coast.

Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in baldcypress trees near fresh to intermediate marshes or open water in the southeastern parishes. Areas with high numbers of nests include the Lake Verret Basin, the marshes/swamp interface from Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area.

Brown pelicans are currently known to nest on Rabbit Island (in Calcasieu Lake), Raccoon Point (Isles Dernieres), Queen Bess Island, Plover Island (Baptiste Collette), and islands in the Chandeleur chain. Pelicans change nesting sites as habitat changes occur; thus, they may also be found nesting on mud lumps at the mouth of South Pass (Mississippi River Delta) and on small islands in St. Bernard Parish. In winter, spring, and summer, nests are built in mangrove trees or other shrubby vegetation, although occasional ground nesting may occur. Brown pelicans feed in shallow estuarine waters, using sand pits and offshore sand bars as rest and roost areas.

The piping plover winters in Louisiana from late July to March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sandflats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Critical habitat (i.e., specific areas that are essential to the conservation of the species) has been designated within coastal Louisiana, and consists of intertidal beaches and flats (between annual low tide and annual high tide) with no, or very sparse, emergent vegetation, and associated dune systems and flats above annual high tide. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Those elements should be considered when determining potential project impacts.

Endangered and threatened sea turtles forage in the nearshore waters, bays and sounds of Louisiana. The National Marine Fisheries Service is responsible for aquatic marine threatened or endangered species. Eric Hawk (727/570-5312) in St. Petersburg, Florida, should be contacted for further information, and consultation regarding those species.

The endangered Kemp's ridley sea turtle occurs mainly in the coastal areas of the Gulf of Mexico and northwestern Atlantic. Juveniles and sub-adults occupy shallow, coastal regions and are commonly associated with crab-laden, sandy or muddy water bottoms. Small turtles are generally found nearshore from May through October. Adults may be abundant near the mouth of the Mississippi River in spring and summer. Adults and juveniles move offshore to deeper, warmer water during the winter. Between the East Gulf Coast of Texas and the Mississippi River Delta, Kemp's ridleys use nearshore waters, ocean sides of jetties, small boat passageways through jetties, and dredged and natural channels. They have been observed within both Sabine and Calcasieu Lakes.

Threatened loggerhead sea turtles nest within the continental United States from Louisiana to Virginia, with major nesting concentrations occurring on the coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida. In Louisiana, loggerheads are known to nest on the Chandeleur Islands. Nesting and hatching dates for the loggerhead in the northern Gulf of Mexico are from May 1 through November 30.

The Gulf sturgeon is an anadromous fish that occurs in many coastal rivers, streams, and estuarine waters from the Atchafalaya River to the Suwanee River, Florida. Adults and sub-adults spend 8 to 9 months in rivers and streams, and 3 to 4 of the cooler months in estuarine or marine waters. Spawning occurs in coastal rivers between late winter and early spring. Sturgeon less than 2 years old appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain basin, and adjacent estuarine areas.

Critical habitat for the Gulf sturgeon has been designated in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl River system, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. The primary constituent elements essential for the conservation of Gulf sturgeon are those habitat components that support feeding, resting, sheltering, reproduction, migration, and physical features necessary for maintaining the natural processes that support those habitat components; those elements should be considered when determining potential project impacts.

The pallid sturgeon is found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the Old River Control Structure Complex); it may occur in the Red River as well. The pallid sturgeon is adapted to riverine conditions that can be described as large, free-flowing, turbid water with a diverse assemblage of physical habitats that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana.

Refuges and Wildlife Management Areas

The Service administers 10 National Wildlife Refuges (NWR) encompassing more than 301,700 acres in coastal Louisiana. Those refuges include Sabine, Cameron Prairie, Lacassine, Shell Keys, Bayou Teche, Delta, Breton, Bayou Sauvage, Big Branch Marsh, and Mandalay. The Louisiana Department of Wildlife and Fisheries operates 17 refuges, preserves, and wildlife management areas in coastal Louisiana, comprising more than 572,000 acres. Coastal wetlands make up the vast majority of those Federal and State wildlife areas.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

Under the No Action Plan, more than 462,000 additional wetland acres would be lost by year 50 (Table 2). Habitat distribution would continue shifting toward more brackish and saline wetlands and open water as more salt-sensitive freshwater vegetation is lost. Because of the current degree of risk and uncertainty associated with the salinity/habitat type projection methodologies, however, the data in Table 2 do not reflect this anticipated trend. Associated with the projected wetland losses, corresponding decreases in habitat values for fish and wildlife that use those wetlands would also occur.

ALTERNATIVE PLAN DESCRIPTIONS

Within in each Subprovince, individual restoration projects were grouped to provide varying levels of wetland loss reduction. *Reduce* alternatives were developed to reduce existing loss rates by 50 percent. *Maintain* alternatives were developed to achieve no net wetland loss, and *Enhance* alternatives were developed to produce net wetland gains equal to half the annual net wetland loss. Subprovince alternatives were grouped into the coastwide alternative action plans shown in Table 3.

<u>Subprovince 1</u>

Restoration features of the Maintain 2 (M2) Alternative are as follows: 1) install a 5,000 cubic foot per second (cfs) diversion into the Maurepas Swamp at Convent/Blind River; 2) install a 1,000 cfs diversion into the Maurepas Swamp at Hope Canal; 3) install a 10,000 cfs diversion into the Breton Sound Basin at White's Ditch; 4) install a 110,000 cfs diversion with sediment enrichment into the Breton Sound Basin at American/California Bay; 5) install a 12,000 cfs diversion at Bayou Lamoque; and, 6) install the Seabrook salinity control structure.

Restoration features of the Modified Maintain 2 (M2 modified) Alternative are as follows: 1) install a 5,000 cubic foot per second (cfs) diversion into the Maurepas Swamp at Convent/Blind River; 2) install a 1,000 cfs diversion into the Maurepas Swamp at Hope Canal; 3) install a 10,000 cfs diversion into the Breton Sound Basin at White's Ditch; 4) install a 110,000 cfs diversion with sediment enrichment into the Breton Sound Basin at American/California Bay; 5) install a 12,000 cfs diversion at Bayou Lamoque; 6) install the Seabrook salinity control structure; 7) optimize operation of the Caernarvon Freshwater Diversion Project to optimize marsh creation; 8) opportunistically use the Bonnet Carre Spillway to introduce additional Mississippi River flows into the Pontchartrain Basin; 9) gap the Amite River Diversion Canal spoil banks; 9) restore the Labranche wetlands through delivery of Mississippi River sediment; 10) rehabilitate and operate the Violet Siphon; 11) evaluate the potential diversion of fresh water from the Mississippi River through the Inner Harbor Navigation Canal into St. Bernard Parish wetlands; and, 12) nourish the Lake Pontchartrain land bridge marshes.

Table 2. Wetland type acreages, under the No Action Planby Subprovince and coastwide

Subprovince 1

Wetland Type	TY0 (acres)	TY50 (acres)	Acreage change	Percent change
Swamp	353,904	327,350	-26,554	-7.5
Fresh marsh	71,279	207,760	136,481	191.5
Intermediate marsh	160,752	98,156	-62,596	-38.9
Brackish marsh	180,441	142,972	-37,469	-20.8
Saline marsh	113,149	54,802	-58,348	-51.6
Total wetlands	879,525	831,040	-48,486	-5.5

Subprovince 2

Wetland Type	TY0 (acres)	TY50 (acres)	Acreage change	Percent change
Swamp	294,397	282,291	-12,106	-4.1
Fresh marsh	180,876	244,994	64,117	35.4
Intermediate marsh	85,267	488	-84,779	-99.4
Brackish marsh	65,338	52,168	-13,170	-20.2
Saline marsh	117,809	0	-117,809	-100.0
Total wetlands	743,687	579,940	-163,747	-22.0

Subprovince 3

Wetland Type	TY0 (acres)	TY50 (acres)	Acreage change	Percent change
Swamp	388,811	337,828	-50,983	-13.1
Fresh marsh	341,733	33,294	-308,439	-90.3
Intermediate marsh	193,569	619,079	425,510	219.8
Brackish marsh	201,216	40,046	-161,170	-80.1
Saline marsh	113,513	5,355	-108,158	-95.3
Total wetlands	1,238,841	1,035,601	-203,240	-16.4

Subprovince 4

Wetland Type	TY0 (acres)	TY50 (acres)	Acreage change	Percent change
Swamp	3,674	2,239	-1,435	-39.1
Fresh marsh	346,923	312,800	-34,123	-9.8
Intermediate marsh	284,702	238,517	-46,184	-16.2
Brackish marsh	137,529	202,292	64,763	47.1
Saline marsh	30,307	0	-30,307	-100.0
Total wetlands	803,134	755,848	-47,286	-5.9

Coastwide

Wetland Type	TY0 (acres	TY50 (acres	Acreage change	Percent change
Swamp	1,040,785	949,707	-91,078	-8.8
Fresh marsh	940,811	798,847	-141,964	-15.1
Intermediate marsh	724,289	956,240	231,951	32.0
Brackish marsh	584,524	437,477	-147,046	-25.2
Saline marsh	374,778	60,157	-314,622	-83.9
Total wetlands	3,665,188	3,202,429	-462,759	-12.6

Restoration features of the Enhance 1 (E1) Alternative are as follows: 1) install a 5,000 cubic foot per second (cfs) diversion into the Maurepas Swamp at Convent/Blind River; 2) install a 10,000 cfs diversion into Lake Pontchartrain at the Bonnet Carre Spillway; 3) re-create marshes near the junction of the the Mississippi River Gulf Outlet and the GIWW through delivery of Mississippi River sediment; 4) re-create marsh in the Labranche wetlands through delivery of Mississippi River sediment; 5) re-create marsh adjacent to the Mississippi River Gulf Outlet near Violet Canal through delivery of Mississippi River sediment; 6) install a 10,000 cfs diversion into the Breton Sound Basin at White's Ditch; 7) re-create marsh in the Breton Sound Basin at American/California Bay through delivery of Mississippi River sediment; 8) rebuild marsh in the Quarantine Bay area through delivery of Mississippi River sediment; 9) rebuild marsh in the

Fort St. Phillip area through delivery of Mississippi River sediment; 10) install a 15,000 cfs diversion into the Breton Sound Basin at American/California Bayou; and, 11) install a 15,000 cfs diversion into the Breton Sound Basin at Fort St. Phillip.

Table 3. Combinations of Subprovince alternatives for the coastwide alternative action plans

Subprovince Alternatives	Coastwide Alternative Action Plans						
	5110	5610	5410	7610	7410	7002	10130
Subprovince 1							
Maintain 2	X	X	X				
Enhance 1				X	X	X	
Modified Maintain 2							X
Subprovince 2							
Reduce 1	X						
Maintain 1			X		X		
Maintain 3		X		X			
Enhance 3						X	
Modified Reduce 1							X
Subprovince 3							
Reduce 1	X	X	X	X	X		
Maintain 1						X	
Modified Reduce 1							X
Subprovince 4							
Enhance 2	X	X	X	X	X	X	
Modified Enhance 2							X

<u>Subprovince 2</u>

Restoration features of the Reduce 1 (R1) Alternative include: 1) install a 5,000 cfs sediment diversion with sediment enrichment at Edgard; 2) install a 5,000 cfs pulsed diversion at Myrtle Grove; 3) install a 60,000 cfs diversion at Fort Jackson; 4) use dredged material to create wetlands near Bayou L'Ours and the area north of Fourchon; and, 5) rebuild the barrier islands to a 3,000-foot-width using material dredged offshore.

Restoration features of the Modified Reduce 1 (R1 modified) Alternative include: 1) install a 1,000 cfs diversion at Des Allemands; 2) install a 1,000 cfs diversion at Donaldsonville; 3) install a 1,000 cfs diversion at Pikes Peak; 4) install a 1,000 cfs diversion at Edgard; 5) install a 5,000 cfs diversion at Myrtle Grove with sediment enrichment; 6) install a 60,000 cfs diversion at Boothville with sediment enrichment; 7) rebuild the barrier islands to a 3,000-foot-width using material dredged offshore; 8) re-authorize Davis Pond Freshwater Diversion Project operation to flow at 5,000 cfs and build marsh; and, 9) use dredged material to create wetlands near Bayou L'Ours and the area north of Fourchon.

Restoration features of the Maintain 1 (M1) Alternative include: 1) install a 5,000 cfs diversion at Des Allemands with sediment enrichment; 2) rebuild Myrtle Grove area marshes through delivery of Mississippi River sediment; 3) install a 5,000 cfs diversion at Myrtle Grove; 4) rebuild the barrier islands to a 3,000-foot-width using material dredged offshore; 5) install a 60,000 cfs diversion at Fort Jackson; 6) build marsh near Empire through delivery of Mississippi River sediment; 7) build marsh near Bastion Bay through delivery of Mississippi River sediment; 8) build marsh near Head of Passes through delivery of Mississippi River sediment; and, 9) use dredged material to re-create wetlands near Bayou L'Ours and the area north of Fourchon.

Restoration features of the Maintain 3 (M3) Alternative include: 1) install a 1,000 cfs diversion at Des Allemands; 2) install a 1,000 cfs diversion at Donaldsonville; 3) install a 1,000 cfs diversion at Pikes Peak; 4) install a 1,000 cfs diversion at Edgard; 5) install a 75,000 cfs pulsed diversion at Myrtle Grove with sediment enrichment; 6) install a 60,000 cfs diversion at Fort Jackson; and, 7) rebuild the barrier islands to a 3,000-foot-width using material dredged offshore.

Restoration features of the Enhance 3 (E3) Alternative include: 1) install a 5,000 cfs diversion at Des Allemands with sediment enrichment; 2) use dredged material to rebuild wetlands near Bayou L'Ours and the area north of Fourchon; 3) install a 120,000 cfs diversion at Bayou Lafourche (Mississippi River Third Delta); 4) install a 90,000 cfs diversion at Fort Jackson with sediment enrichment; 5) relocate the Deep Draft Navigation Channel from Southwest Pass; and, 6) rebuild the barrier islands to a 3,000-foot-width using material dredged offshore.

Subprovince 3

Features of the Reduce1 (R1) Alternative are as follows: 1) install a 1,000 cfs pump at Bayou Lafourche to deliver additional Mississippi River inflows; 2) implement features to convey additional Atchafalaya River water to the eastern Terrebonne Basin marshes; 3) increase Atchafalaya River inflows into tidal marshes via Blue Hammock Bayou; 4) increase freshwater flows to marshes south of Lake DeCade; 5) implement the Penchant Basin Hydrologic Restoration Plan; 6) relocate the Atchafalaya Bay navigation channel to Shell Island Pass; 7) increase sediment transport down the Wax Lake Outlet for delta-building purposes; 8) modify the Old River Control Structure operational scheme to increase downstream sediment transport for improved building and maintenance of coastal wetlands; 9) implement multi-purpose operation of the Houma Navigation Canal Lock to better distribute freshwater inflows; 10) rebuild the historic reef from Pointe au Fer Island to Eugene Island; and, 11) maintain the landbridge between Bayou Dularge and Bayou Grand Caillou.

Features of the Modified Reduce 1 (R1 modified) Alternative include: 1) install a 1,000 cfs pump at Bayou Lafourche to deliver additional Mississippi River inflows; 2) implement features to convey additional Atchafalaya River water to the eastern Terrebonne Basin marshes; 3) increase Atchafalaya River inflows into tidal marshes via Blue Hammock Bayou; 4) implement the

Penchant Basin Hydrologic Restoration Plan; 5) relocate the Atchafalaya Bay navigation channel to Shell Island Pass; 6) increase sediment transport down the Wax Lake Outlet for delta-building purposes; 7) modify the Old River Control Structure operational scheme to increase downstream sediment transport for improved building and maintenance of coastal wetlands; 8) implement multi-purpose operation of the Houma Navigation Canal Lock to better distribute freshwater inflows; 9) maintain the northern shoreline of East Cote Blanche Bay; 10) restore the Pointe Chevreuil reef; 11) restore the Isle Dernieres-Timbalier Island complex; 12) restore and maintain the landbridge between Caillou Lake and the Gulf; 13) armor the Gulf shoreline at Pointe au Fer Island; and, 14) maintain the landbridge between Bayou Dularge and Bayou Grand Caillou.

Features of the Maintain 1 (M1) Alternative are as follows: 1) implement the Mississippi River Third Delta (120,000 cfs diversion); 2) install a 1,000 cfs pump at Bayou Lafourche to deliver additional Mississippi River inflows; 3) implement features to convey additional Atchafalaya River water to the eastern Terrebonne Basin marshes; 4) increase Atchafalaya River inflows into tidal marshes via Blue Hammock Bayou; 5) implement the Penchant Basin Hydrologic Restoration Plan; 6) relocate the Atchafalaya Bay navigation channel to Shell Island Pass; 7) increase sediment transport down the Wax Lake Outlet for delta-building purposes; 8) modify the Old River Control Structure operational scheme to increase downstream sediment transport for improved building and maintenance of coastal wetlands; 9) implement a multi-purpose operation of the Houma Navigation Canal Lock to better distribute freshwater inflows; 10) maintain the northern shoreline of East Cote Blanche Bay; 11) restore the Pointe Chevreuil reef; 12) restore the Isle Dernieres-Timbalier Island complex; 13) restore and maintain the landbridge between Caillou Lake and the Gulf; 14) armor the Gulf shoreline at Pointe au Fer Island; 15) maintain the landbridge between Bayou Dularge and Bayou Grand Caillou; 16) rebuild the historic reef from Pointe au Fer Island to Eugene Island; 17) construct a segmented reef/breakwater from Eugene Island to Marsh Island; 18) increase Atchafalaya River inflows into marshes south of Lake DeCade; 19) stabilize the banks of Southwest Pass; 20) rehabilitate the northern shorelines of Terrebonne/Timbalier Bays; 21) backfill pipeline canals south of Catfish Lake; and, 22) maintain the Timbalier land bridge in the upper salt marsh zone.

Subprovince 4

Features of the Enhance 2 (E2) Alternative include: 1) install salinity control structures at Oyster Bayou, Long Point Bayou, Black Lake Bayou, Alkali Ditch, Black Bayou, and the Highway 82 Causeway; 2) modify the existing Cameron-Creole Watershed Project structures to improve water-level and salinity management; 3) implement the East Sabine Lake Hydrologic Restoration Project; 4) introduce fresh water from the Lakes Subbasin at Pecan Island, Rollover Bayou, Highway 82, Little Pecan Bayou, and South Grand Chenier; 5) install shoreline stabilization measures along the Gulf at Rockefeller Refuge; 6) beneficially use dredged material along the Calcasieu Ship Channel; 7) install a new lock in the GIWW east of the Alkali Ditch; and, 8) conduct dedicated dredging for marsh restoration.

Features of the Modified Enhance 2 (E2 modified) Alternative include: 1) install salinity control structures at Oyster Bayou, Long Point Bayou, Black Lake Bayou, Alkali Ditch, Black Bayou, and the Highway 82 Causeway; 2) modify the existing Cameron-Creole Watershed Project structures to improve water-level and salinity management; 3) implement the East Sabine Lake

Hydrologic Restoration Project; 4) introduce fresh water from the Lakes Subbasin at Pecan Island, Rollover Bayou, Highway 82, Little Pecan Bayou, and South Grand Chenier; 5) install shoreline stabilization measures along the Gulf shoreline at Rockefeller Refuge; 6) beneficially use dredged material along the Calcasieu Ship Channel; and, 7) implement the Black Bayou Bypass Culverts Project.

EVALUATION OF ALTERNATIVE PLANS

Subprovince 1

Under the No Action Plan, wetland loss in Subprovince 1 would continue, with more than -48,000 acres being lost by year 50 (Table 2). Compared to the present total wetland acreage (879,525 acres), each of the alternative action plans would produce net wetland acreage gains throughout the 50-year evaluation period (Table 4). Compared to the No Action Plan, Plan 10130 would result in the greatest wetland gain, i.e., nearly 167,000 acres over 50 years. The least gain (75,000 acres) would occur under Plans 7002, 7410, and 7610. Plans 5110, 5410, and 5610, would result in gains of 102,000 acres over 50 years when compared to the No Action Plan. Freshwater diversions (i.e., introduction of Mississippi River water) associated with each action alternative would increase fresh and intermediate marsh acreages, compared to the No Action Plan under which the acreage of all habitat types would decrease between years 10 and 50. The proposed river diversions into brackish and/or saline marsh areas (at White's Ditch, American/California Bay, and Bayou Lamoque) would result in greater amounts of fresh and intermediate marsh at the expense of brackish and saline marsh, compared to the No Action Plan.

The above-referenced habitat type acreage projections will likely change as the locations, designs, and operation of project features are refined during the post-authorization planning and design process. Projected habitat acreages may also change as current habitat-change methodologies (and their associated the levels of risk and uncertainty) are refined in the future.

Table 4. Wetland acres at year 50, by type, for alternative plans in Subprovince 1

Wetland Type	No Action (acres)	Plan 5110 (acres)	Plan 5410 (acres)	Plan 5610 (acres)	Plan 7002 (acres)	Plan 7410 (acres)	Plan 7610 (acres)	Plan 10130 (acres)
Swamp	327,350	329,188	329,188	329,188	334,919	334,919	334,919	315,646
Fresh marsh	207,760	261,793	261,793	261,793	239,772	239,772	239,772	300,482
Intermediate marsh	98,156	225,541	225,541	225,541	117,269	117,269	117,269	269,920
Brackish marsh	142,972	62,772	62,772	62,772	104,187	104,187	104,187	60,190
Saline marsh	54,802	53,770	53,770	53,770	110,133	110,133	110,133	51,558
Total wetlands	**831,040**	**933,064**	**933,064**	**933,064**	**906,280**	**906,280**	**906,280**	**997,796**

Table 5. Wetland type difference (percent) at year 50, between the No Action Plan and alternative action plans in Subprovince 1

Wetland Type	No Action (% diff)	Plan 5110 (% diff)	Plan 5410 (% diff)	Plan 5610 (% diff)	Plan 7002 (% diff)	Plan 7410 (% diff)	Plan 7610 (% diff)	Plan 10130 (% diff)
Swamp	0.0	0.6	0.6	0.6	2.3	2.3	2.3	-3.6
Fresh marsh	0.0	26.0	26.0	26.0	15.4	15.4	15.4	44.6
Intermediate marsh	0.0	129.8	129.8	129.8	19.5	19.5	19.5	175.0
Brackish marsh	0.0	-56.1	-56.1	-56.1	-27.1	-27.1	-27.1	-57.9
Saline marsh	0.0	-1.9	-1.9	-1.9	101.0	101.0	101.0	-5.9
Total wetlands	**0.0**	**12.3**	**12.3**	**12.3**	**9.1**	**9.1**	**9.1**	**20.1**

Of the five wildlife species evaluated, mink, American alligator, and dabbling ducks would benefit from each of the proposed action alternatives (Table 6). Benefits to American alligator and dabbling ducks, which prefer fresh and intermediate marsh habitats, would be greatest under Plan 10130 (with 22.2 and 11.7 percent AAHU increases, respectively). Mink, which prefer swamp, fresh marsh and intermediate marsh, would receive benefits ranging from a 1.7 to 5.7 percent AAHU increase, depending on the action plan implemented. The river otter prefers brackish marsh, but swamp, fresh marsh, and intermediate marsh also provide desirable habitat for that species. The negative effects of the projected decreases in brackish marsh acreage under all the action plans would, in some cases, be offset by projected increases in swamp, fresh, and intermediate marshes. Consequently, habitat value for river otters would increase 2.5 percent for Plans 5110, 5410, and 5610, and 5.5 percent for Plan 10130; however, river otter habitat value would be slightly reduced (-0.8 percent) under Plans 7002, 7410, and 7610. Brackish marsh is considered the muskrat's preferred habitat and has a much higher habitat value for that species than do fresh and intermediate marshes. Due to the anticipated decline in brackish marsh acreage, a net decrease in muskrat AAHUs ranging from -12.6 to -21.3 percent is projected under FWP conditions, depending on the alternative.

Over the 50-year analysis period, all five fish and shellfish species evaluated would be adversely affected by every action plan (Table 6), except for a slight white shrimp habitat value increase (0.1 percent) under Plan 10130. Atlantic croaker and white shrimp, which typically utilize low-salinity habitats as juveniles and more brackish habitats as subadults and adults, would experience the least impacts to habitat value under the action plans (-0.2 to -9.1 percent). Gulf menhaden also utilize low-salinity habitats, but they would experience a moderate habitat value (AAHU) decrease ranging from -15.8 to -20.3 percent, compared to the No Action Plan. In response to the reduced acreage of their preferred brackish habitats under the FWP alternatives, spotted seatrout and brown shrimp would experience habitat value decreases ranging from -18.3 to -29.5 percent, over the 50 year period.

Table 6. Comparison of year 50 net AAHU differences (percent) between the No Action Plan and action alternatives for selected fish and wildlife species in Subprovince 1

Evaluation Species	Plan 5110	Plan 5410	Plan 5610	Plan 7002	Plan 7410	Plan 7610	Plan 10130
Mink	4.3	4.3	4.3	1.7	1.7	1.7	5.7
Otter	2.5	2.5	2.5	-0.8	-0.8	-0.8	5.5
Muskrat	-21.3	-21.3	-21.3	-12.6	-12.6	-12.6	-19.7
Alligator	14.5	14.5	14.5	2.2	2.2	2.2	22.2
Ducks	6.7	6.7	6.7	1.4	1.4	1.4	11.7
Croaker	-5.9	-5.9	-5.9	-8.4	-8.4	-8.4	-0.2
Menhaden	-20.3	-20.3	-20.3	-15.8	-15.8	-15.8	-16.8
Spotted seatrout	-29.5	-29.5	-29.5	-20.0	-20.0	-20.0	-27.6
White shrimp	-5.8	-5.8	-5.8	-9.1	-9.1	-9.1	0.1
Brown shrimp	-26.7	-26.7	-26.7	-18.3	-18.3	-18.3	-24.7

Subprovince 2

Under the No Action Plan, more than -163,000 acres of wetlands would be lost in Subprovince 2 over the 50-year planning horizon (Table 2). Action Plans 5610, 7002, and 7610 would result in more total wetland acres, after 50 years, than the present Subprovince 2 total of 743,687 acres (Table 7). Compared to the present wetland acreage, Plan 7002 would produce the greatest net wetland gain, i.e., nearly 44,000 acres (over 50 years). Similarly, Plans 5410 and 7410 would reduce the future wetland losses to approximately -13,000 acres over 50 years, and Plans 5110 and 10130 would reduce future wetland losses to -59,000 acres at the end of the 50-year evaluation period. At year 50, the action plan alternatives would produce net wetland increases ranging from 104,000 to 207,000 acres when compared to the No Action Plan.

The No Action Plan used for this analysis does not include the Davis Pond Freshwater Diversion Project, which is now being operated in an interim manner following construction completion in early 2002. The Service believes that the current LCA modeling analysis for the No Action Plan, which included the Davis Pond Diversion, does not currently project the likely distribution of wetland types in Subprovince 2 under No Action conditions with a reasonable degree of accuracy or confidence.

Proposed action plan features to introduce fresh water from the Mississippi River would shift habitat types toward lower-salinity conditions in Subprovince 2, compared to the No Action Plan. River diversions at Myrtle Grove and Fort Jackson would produce greater amounts of fresh and intermediate marsh, at the expense of brackish marsh and open water acreage. Those diversions, with their associated sediment enrichment, would also restore/establish several thousand acres of wetlands. The Service is not confident that the current habitat change projections, which indicate that brackish and saline marsh would not exist beyond year 10 under some action plans, are accurate. Future refinement of the habitat change model and associated methodologies will likely result in revisions to those habitat acreage projections.

Table 7. Wetland acres at year 50, by type, for alternative plans in Subprovince 2

Wetland Type	No Action (acres)	Plan 5110 (acres)	Plan 5410 (acres)	Plan 5610 (acres)	Plan 7002 (acres)	Plan 7410 (acres)	Plan 7610 (acres)	Plan 10130 (acres)
Swamp	282,291	270,386	265,991	249,174	231,943	265,991	249,174	270,386
Fresh marsh	244,994	352,130	396,585	513,345	487,736	396,585	513,345	352,130
Intermediate marsh	488	61,949	68,156	19,283	67,973	68,156	19,283	61,949
Brackish marsh	52,168	0	0	0	0	0	0	0
Saline marsh	0	0	0	0	0	0	0	0
Total wetlands	**579,940**	**684,465**	**730,732**	**781,801**	**787,652**	**730,732**	**781,801**	**684,465**

Table 8. Wetland type difference (percent) at year 50, between the No Action Plan and alternative action plans in Subprovince 2

Wetland Type	No Action (% diff)	Plan 5110 (% diff)	Plan 5410 (% diff)	Plan 5610 (% diff)	Plan 7002 (% diff)	Plan 7410 (% diff)	Plan 7610 (% diff)	Plan 10130 (% diff)
Swamp	0.0	-4.2	-5.8	-11.7	-17.8	-5.8	-11.7	-4.2
Fresh marsh	0.0	43.7	61.9	109.5	99.1	61.9	109.5	43.7
Intermediate marsh	0.0	12,606.2	13,879.3	3,855.0	13,841.8	13,879.3	3,855.0	12,606.2
Brackish marsh	0.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0
Saline marsh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All wetlands	**0.0**	**18.0**	**26.0**	**34.8**	**35.8**	**26.0**	**34.8**	**18.0**

Except for muskrat, each of the wildlife species evaluated would benefit from implementation of the proposed plans (Table 9). Because of large increases in their preferred fresh and intermediate marsh habitats, the American alligator and dabbling ducks would benefit the most, with over 20 percent increases in habitat value (AAHUs) under several of the proposed plans. Mink, which prefer swamp and fresh marsh, would also benefit from the projected increase in those wetland types, experiencing a 4.4 to 8.2 percent increase in habitat value. The river otter prefers brackish marsh, but swamp, fresh marsh, and intermediate marsh also provide desirable habitat for that species. Although brackish marsh habitats are projected to be lost under the action alternatives, the projected increase in swamp and fresh and intermediate marshes would offset the decline of the otter's preferred habitat. Brackish marsh is preferred muskrat habitat and has a much higher value for that species than do fresh and intermediate marshes. The projected loss of brackish marsh under the action alternatives, compared to the No Action Plan, would result in a -7.9 percent decrease in muskrat habitat value under Plans 5110 and 10130, and a -4.6 percent decrease under Plans 5410 and 7410. Plans 5610, 7002, and 7610 would provide small increases in muskrat habitat value over the 50-year period.

The proposed action plans would generally increase habitat value for the fish and shellfish species evaluated (Table 9). However, brown shrimp, which prefer brackish marshes, would experience small AAHU decreases of -2.2 to -4.4 percent under the various action plans. Spotted seatrout, which also prefer more saline habitats, would experience slight habitat value decreases under Plans 5110 and 10130. Atlantic croaker, Gulf menhaden, and white shrimp, which typically utilize low-salinity habitats as juveniles and more-brackish habitats as subadults and adults, would receive the greatest benefits (AAHU increases of 22.6 percent, 14.5 percent, and 23.4 percent, respectively) under Plan 7002.

Table 9. Comparison of year 50 net AAHU differences (percent) between the No Action Plan and action alternatives for selected fish and wildlife species in Subprovince 2

Evaluation Species	Plan 5110	Plan 5410	Plan 5610	Plan 7002	Plan 7410	Plan 7610	Plan 10130
Mink	4.4	6.3	8.2	6.6	6.3	8.2	4.4
Otter	3.0	5.5	5.7	7.1	5.5	5.7	3.0
Muskrat	-7.9	-4.6	1.7	1.4	-4.6	1.7	-7.9
Alligator	16.2	21.6	23.6	29.1	21.6	23.6	16.2
Ducks	11.0	15.7	23.1	22.8	15.7	23.1	11.0
Croaker	9.1	14.3	16.0	22.6	14.3	16.0	9.1
Menhaden	4.8	8.6	9.8	14.5	8.6	9.8	4.8
Spotted seatrout	-1.6	1.3	2.3	6.0	1.3	2.3	-1.6
White shrimp	10.8	15.8	15.4	23.4	15.8	15.4	10.8
Brown shrimp	-4.4	-2.2	-3.2	1.0	-2.2	-3.2	-4.4

Subprovince 3

At year 50, wetland losses under the No Action Plan (more than -203,000 acres) would be greater in Subprovince 3 than in any other Subprovince (Table 2). Of the proposed action plans, only Plan 7002 would reverse wetland loss in that Subprovince and provide a net wetland gain (compared to current wetland acreage) of nearly 52,000 acres (Table 10). The remaining plans would reduce future wetland losses to approximately -84,000 acres over the 50-year analysis period, and compared to the year 50 total wetland acreage under the No Action Plan, they would save more than 119,000 wetland acres.

According to model projections, the action plans would save substantially more fresh marsh than would the No Action Plan. This would be achieved through enhancing marsh-building processes in the Atchafalaya and Wax Lake Deltas by relocation of the navigation channel and by sediment enrichment of the Wax Lake Outlet. The Penchant Basin Restoration Plan would improve the health and productivity of floating freshwater marshes in the western Terrebonne Basin, and would deliver greater volumes of fresh water, sediments, and nutrients to the marshes south of the Penchant Basin. Increased conveyance of Atchafalaya River flows to the eastern Terrebonne Basin would improve productivity and reduce marsh loss in areas where marine processes are advancing inland. Compared to the No Action Plan at year 50, all the action plans, except Plan 7002, would result in nearly a 20 percent reduction in brackish marsh acreage; however, Plan 7002 would result in nearly a 400 percent increase in brackish marsh. Similarly, saline marsh would be increased by more than 200 percent (except under Plan 7002 in which all saline marsh would be converted to other habitat types), and swamp would decrease by nearly -4 percent (Table 11).

Table 10. Wetland acres at year 50, by type, for alternative plans in Subprovince 3

Wetland Type	No Action (acres)	Plan 5110 (acres)	Plan 5410 (acres)	Plan 5610 (acres)	Plan 7002 (acres)	Plan 7410 (acres)	Plan 7610 (acres)	Plan 10130 (acres)
Swamp	337,828	325,335	325,335	325,335	321,614	325,335	325,335	325,335
Fresh marsh	33,294	175,592	175,592	175,592	240,836	175,592	175,592	175,592
Intermediate marsh	619,079	605,659	605,659	605,659	531,250	605,659	605,659	605,659
Brackish marsh	40,046	32,088	32,088	32,088	197,028	32,088	32,088	32,088
Saline marsh	5,355	16,490	16,490	16,490	0	16,490	16,490	16,490
Total wetlands	**1,035,601**	**1,155,164**	**1,155,164**	**1,155,164**	**1,290,729**	**1,155,164**	**1,155,164**	**1,155,164**

Table 11. Wetland type difference (percent) at year 50, between the No Action Plan and alternative action plans in Subprovince 3

Wetland Type	No Action (% diff)	Plan 5110 (% diff)	Plan 5410 (% diff)	Plan 5610 (% diff)	Plan 7002 (% diff)	Plan 7410 (% diff)	Plan 7610 (% diff)	Plan 10130 (% diff)
Swamp	0.0	-3.7	-3.7	-3.7	-4.8	-3.7	-3.7	-3.7
Fresh marsh	0.0	427.4	427.4	427.4	623.4	427.4	427.4	427.4
Intermediate marsh	0.0	-2.2	-2.2	-2.2	-14.2	-2.2	-2.2	-2.2
Brackish marsh	0.0	-19.9	-19.9	-19.9	392.0	-19.9	-19.9	-19.9
Saline marsh	0.0	207.9	207.9	207.9	-100.0	207.9	207.9	207.9
Total wetlands	**0.0**	**11.5**	**11.5**	**11.5**	**24.6**	**11.5**	**11.5**	**11.5**

Each of the five wildlife species evaluated would benefit from implementation of the proposed action plans (Table 12). Benefits to wildlife species evaluated are identical across all action plans, except Plan 7002. Compared to the No Action Plan, Plan 7002 would provide the greatest habitat value increases for all evaluation species than would the other action plans. Among all five plans, otter would be benefitted the least and American alligator and dabbling ducks would be benefitted the most.

Each of the five fish/shellfish species evaluated would benefit from implementation of the proposed action plans (Table 12). Benefits to the fish/shellfish species evaluated are identical across all action plans, except for Plan 7002. As with the evaluated wildlife species, Plan 7002 would also provide much greater habitat value increases among the fisheries species than would the other action plans. Spotted seatrout, white shrimp, and brown shrimp, would benefit the most under Plan 7002, with 17.5 percent, 17.5 percent, and 18.9 percent AAHU increases, respectively.

Table 12. Comparison of year 50 net AAHU differences (percent) between the No Action Plan and action alternatives for selected fish and wildlife species in Subprovince 3

Evalution Species	Plan 5110	Plan 5410	Plan 5610	Plan 7002	Plan 7410	Plan 7610	Plan 10130
Mink	3.2	3.2	3.2	6.6	3.2	3.2	3.2
Otter	2.1	2.1	2.1	11.5	2.1	2.1	2.1
Muskrat	4.9	4.9	4.9	37.3	4.9	4.9	4.9
Alligator	4.9	4.9	4.9	37.3	4.9	4.9	4.9
Ducks	7.4	7.4	7.4	14.8	7.4	7.4	7.4
Croaker	4.0	4.0	4.0	14.7	4.0	4.0	4.0
Menhaden	4.2	4.2	4.2	14.4	4.2	4.2	4.2
Spotted seatrout	4.0	4.0	4.0	17.5	4.0	4.0	4.0
White shrimp	4.0	4.0	4.0	17.5	4.0	4.0	4.0
Brown shrimp	2.5	2.5	2.5	18.9	2.5	2.5	2.5

Subprovince 4

Under the No Action Plan, Subprovince 4 would lose more than -47,000 acres over the 50-year evaluation period (Table 2). Each of the action plans would produce the same result, reducing those future losses to slightly more than -8,000 acres, and at year 50, and they would save more than 39,000 acres compared to the No Action Plan (Table 13).

The action plans, which utilize perimeter (structural) salinity control and small freshwater introduction measures, would reduce the encroachment of marine processes and protect fresh and intermediate mashes throughout Subprovince 4. Under those plans, fresh and intermediate marsh acreage would experience a net increase, while brackish marsh would decrease (Table 14).

Table 13. Wetland acres at year 50, by type, for alternative plans in Subprovince 4

Wetland Type	No Action (acres)	Plan 5110 (acres)	Plan 5410 (acres)	Plan 5610 (acres)	Plan 7002 (acres)	Plan 7410 (acres)	Plan 7610 (acres)	Plan 10130 (acres)
Swamp	2,239	2,311	2,311	2,311	2,311	2,311	2,311	2,311
Fresh marsh	312,800	326,685	326,685	326,685	326,685	326,685	326,685	326,685
Intermediate marsh	238,517	310,088	310,088	310,088	310,088	310,088	310,088	310,088
Brackish marsh	202,292	155,884	155,884	155,884	155,884	155,884	155,884	155,884
Saline marsh	0	0	0	0	0	0	0	0
Total wetlands	**755,848**	**794,968**	**794,968**	**794,968**	**794,968**	**794,968**	**794,968**	**794,968**

Table 14. Wetland type difference (percent) at year 50, between the No Action Plan and alternative action plans in Subprovince 4

Wetland Type	No Action (% diff)	Plan 5110 (% diff)	Plan 5410 (% diff)	Plan 5610 (% diff)	Plan 7002 (% diff)	Plan 7410 (% diff)	Plan 7610 (% diff)	Plan 10130 (% diff)
Swamp	0.0	3.2	3.2	3.2	3.2	3.2	3.2	3.2
Fresh marsh	0.0	4.4	4.4	4.4	4.4	4.4	4.4	4.4
Intermediate marsh	0.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0
Brackish marsh	0.0	-22.9	-22.9	-22.9	-22.9	-22.9	-22.9	-22.9
Saline marsh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total wetlands	**0.0**	**5.2**	**5.2**	**5.2**	**5.2**	**5.2**	**5.2**	**5.2**

Compared to the No Action Plan, each of the action plans would produce the same results in terms of impacts to evaluated wildlife species. Mink and American alligator would receive the greatest benefits, experiencing AAHU increases of 3.0 percent, and 4.9 percent, respectively (Table 15). River otter would receive only a 0.7 percent AAHU increase compared to the No Action Plan. Because of anticipated plan-induced decreases in its preferred brackish marsh habitat, muskrat would experience a -6.4 percent AAHU decrease.

Each action plan would have the same effect on the evaluated fishery species (Table 15). Gulf menhaden would receive the negligible benefit of a 0.6 percent AAHU increase under the action plans. Of the evaluated species, Atlantic croaker and white shrimp would receive the greatest benefits, with AAHU increases of 1.5 percent and 2.6 percent, respectively (Table 15). Those benefits are largely attributable to increases in fresh and intermediate marsh under this alternative. Gains in fresh and intermediate marsh would not compensate for the loss of preferred brackish marsh habitat used by species such as spotted seatrout and brown shrimp; thus, those species would experience small decreases in AAHUs of -2.0 percent and -2.7 percent, respectively, over the 50-year analysis period.

Table 15. Comparison of year 50 net AAHU differences (percent) between the No Action Plan and action alternatives for selected fish and wildlife species in Subprovince 4

Evaluation Species	Plan 5110	Plan 5410	Plan 5610	Plan 7002	Plan 7410	Plan 7610	Plan 10130
Mink	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Otter	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Muskrat	-6.4	-6.4	-6.4	-6.4	-6.4	-6.4	-6.4
Alligator	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Ducks	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Croaker	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Menhaden	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Spotted seatrout	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
White shrimp	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Brown shrimp	-2.7	-2.7	-2.7	-2.7	-2.7	-2.7	-2.7

Coastwide Benefits Summary

Under the No Action Plan, a net loss of -463,000 acres would occur by year 50, even with projected gains in the Atchafalaya River Delta (Table 2). When the alternative action plans are compared against the No Action Plan at year 50, they would provide a net wetlands saving ranging from 365,000 acres under Plan 5110, to over 577,000 acres under Plan 7002 (Table 16). Compared to the today's coastwide wetland acreage of 3,665,188, however, only Plan 7002 would produce a net wetland gain, and Plan 5610 would roughly maintain the present wetland acreage over the 50-year evaluation period. Compared to the No Action Plan, the action plans would, over 50 years, also result in a substantial percentage increase in fresh marsh, a moderate increase in intermediate marsh, a substantial reduction in brackish marsh, a small gain in saline marsh, and a slight decrease in swamp (Table 17).

Table 16. Coastwide wetland acreage at year 50, by type, for alternative plans

Wetland Type	No Action (acres)	Plan 5110 (acres)	Plan 5410 (acres)	Plan 5610 (acres)	Plan 7002 (acres)	Plan 7410 (acres)	Plan 7610 (acres)	Plan 10130 (acres)
Swamp	949,707	927,220	922,826	906,008	890,787	928,557	911,739	913,678
Fresh marsh	798,847	1,116,200	1,160,655	1,277,415	1,295,029	1,138,634	1,255,393	1,154,889
Intermediate marsh	956,240	1,203,237	1,209,444	1,160,571	1,026,580	1,101,172	1,052,299	1,247,616
Brackish marsh	437,477	250,744	250,744	250,744	457,099	292,159	292,159	368,413
Saline marsh	60,157	70,259	70,259	70,259	110,133	126,623	126,623	68,047
Total wetlands	**3,202,429**	**3,567,661**	**3,613,928**	**3,664,997**	**3,779,628**	**3,600,099**	**3,638,213**	**3,632,392**

Table 17. Coastwide wetland type difference (percent) at year 50, between the No Action Plan and alternative action plans

Wetland Type	No Action (% diff)	Plan 5110 (% diff)	Plan 5410 (% diff)	Plan 5610 (% diff)	Plan 7002 (% diff)	Plan 7410 (% diff)	Plan 7610 (% diff)	Plan 10130 (% diff)
Swamp	0	-2	-3	-5	-6	-2	-4	-4
Fresh marsh	0	40	45	60	62	43	57	45
Intermediate marsh	0	26	26	21	7	15	10	30
Brackish marsh	0	-43	-43	-43	4	-33	-33	-16
Saline marsh	0	17	17	17	83	110	110	13
Total wetlands	**0**	**11**	**13**	**14**	**18**	**12**	**14**	**13**

The above habitat type projections are interim values (subject to a considerable degree of risk and uncertainty) and likely will be modified with future improvements in the salinity and/or habitat modeling methodologies. They will likely also be changed to reflect the anticipated phased implementation of the various action plan features over a long period of time.

Coastwide effects on the fish and wildlife evaluation species reflect the acreage changes for the various wetland types. Due to the large increase in their preferred fresh and intermediate marsh habitats, the American alligator and dabbling ducks would be most benefitted (Table 18). Other fish and wildlife species that utilize low-salinity habitats, such as white shrimp, Atlantic croaker, and mink, would also benefit, but to a lesser degree. Gulf menhaden, which utilize low-salinity habitats as juveniles, are projected to experience a coastwide reduction in habitat quality due to the substantial impacts of the alternative action plans on that species in Subprovince 1. Consistent with the projected decreases in brackish marsh acreage, species which prefer brackish habitats (such as brown shrimp, spotted seatrout, and muskrat), would experience coastwide habitat value decreases.

Table 18. Coastwide comparison of year 50 AAHU differences (percent) between the No Action Plan and alternative action plans for selected wildlife and fish species

Evaluation Species	Plan 5110	Plan 5410	Plan 5610	Plan 7002	Plan 7410	Plan 7610	Plan 10130
Mink	14.9	16.8	18.7	17.9	14.2	16.1	16.3
Otter	8.3	10.8	11.0	18.6	7.5	7.7	11.3
Muskrat	-30.6	-27.3	-21.0	19.7	-18.6	-12.4	-29.1
Alligator	40.5	45.9	47.9	73.5	33.6	35.6	48.2
Ducks	27.7	32.4	39.8	41.6	27.2	34.5	32.7
Croaker	8.7	13.8	15.6	30.4	11.4	13.1	14.4
Menhaden	-10.7	-6.9	-5.7	13.7	-2.4	-1.1	-7.1
Spotted seatrout	-29.1	-26.2	-25.2	1.5	-16.7	-15.7	-27.2
White shrimp	11.6	16.6	16.2	34.4	13.4	12.9	17.5
Brown shrimp	-31.3	-29.0	-30.1	-1.1	-20.7	-21.7	-29.3

Plan 7002 is the only action plan alternative of those evaluated that would produce net wetland gains (relative to present baseline wetland acreage); it would also produce the greatest fish and wildlife benefits (in AAHUs), and it would avoid project-related adverse impacts to species of fish and wildlife that prefer brackish marsh. Based solely on fish and wildlife considerations, it is obviously the most beneficial of the evaluated action alternatives. All the action alternatives would, however, to varying degrees restore marsh-building and marsh-maintenance processes through freshwater and sediment inputs, and would substantially reduce or nearly halt (Plan 5610) coastal wetland loss. Hence, implementing any of the proposed action plans would be preferable to the continued loss and degradation of coastal wetlands under the No Action Plan.

Current projections suggest that fish and wildlife species which prefer brackish and saline marsh habitats might be negatively impacted by the freshwater/sediment diversion features included in the proposed action plan alternatives. However, given the rapid loss and likely future collapse of brackish and salt marshes systems under the No Action Plan, we believe that, over the long term, the action plan alternatives would provide a substantial net benefit to those species. Additionally, the Service anticipates that refinements in model-based habitat and salinity projections will ultimately reveal that projected impacts to those brackish marsh fish and wildlife species will be substantially less than presently estimated. Additionally, the Service will recommend, through involvement in subsequent planning and design, that design and operational measures be incorporated into project features to increase their benefits to wetland-associated fish and wildlife and to minimize adverse effects on those resources.

Because of the interim nature (i.e., their current degree of risk and uncertainty) of some habitat change estimates, and because many details regarding the design, operation, and associated effects of the action plans are not yet available, nor has a preferred plan yet been identified, we cannot complete our evaluation of the preferred plan's effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, and design of specific project measures, along with more-definitive project information that will be available during that plan implementation phase, will be required so that we can fulfill our responsibilities under that Act.

The National Wildlife Refuge System Improvement Act of 1997 mandates that no new or expanded use of a NWR may be allowed unless it is first determined to be compatible with the objectives for which that NWR was established and managed. A compatibility determination is a written determination, indicating that a proposed or existing use of a NWR is, or is not, a compatible use. Compatible uses are defined as proposed or existing wildlife-dependent recreational uses or any other uses of a NWR that, based on sound professional judgement, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the NWR. A compatibility determination is only required when the Service has jurisdiction over the use. Prior to initiating implementation of a project that would affect any NWR, the Corps of Engineers should contact the Refuge Manager to determine if the proposed project constitutes a "refuge use" subject to a compatibility determination. To determine the anticipated impacts of any proposed use, the Corps may be required to provide sufficient data and information sources to document any short-term, long-term, direct, indirect or cumulative impacts on refuge resources. Compatibility determinations will include a public review and comment period before issuance of a final decision by the appropriate Refuge Manager.

FUTURE SERVICE INVOLVEMENT

Because of the LCA's large scope, complexity, and programmatic nature, extensive funding will be required by the Service for full participation throughout future detailed planning and post-authorization engineering and design studies, and to facilitate fulfillment of our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Accordingly, the Service plans to work closely with the Corps and the State of Louisiana to formulate detailed funding estimates to support our continuing and extensive involvement in the LCA.

Under provisions of Section 7 of the Endangered Species Act of 1973, as amended, the Service will also assist the Corps and any other Federal agencies responsible for funding or implementing selected projects and/or plans to ensure that they will not jeopardize the continued existence of threatened and endangered species, or adversely modify any designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will build upon the programmatic consultation contained in the Programmatic Environmental Impact Statement for the LCA study.

SUMMARY AND SERVICE POSITION

The Service has actively participated in the formulation and evaluation of the seven action plan alternatives. Given the severe future impacts to coastal wetlands and their associated fish and wildlife resources under the No Action Plan, we would support implementation of any one of the proposed action plans. According to the present interim evaluation results, however, only Plan 7002 would reverse the severe loss of Louisiana's coastal wetlands. It would also provide the greatest level of benefits to Louisiana's nationally significant fish and wildlife resources. Consequently, we currently favor implementation of that plan. However, Plan 7002 includes very expensive and highly complex projects, such as the large-scale diversion of Mississippi River water into the Barataria and Terrebonne Basins known as the "Third Delta;" hence, the benefits associated with that plan may not ultimately be achievable and/or affordable. As Plan 5610 is presently the second-most beneficial plan, we would favor its implementation in lieu of Plan 7002 if the latter is found to be infeasible.

Regardless of the alternative that is ultimately identified for implementation, should the "Third Delta" diversion project not be included, the Service recommends that the Subprovince 3 benefits lost through elimination of that project be replaced to the greatest extent possible through the comprehensive implementation of features and projects designed to maximize Atchafalaya River flows/influence in the Atchafalaya and Terrebonne Basins. The proposed restoration of the reefs extending from Point au Fer Island to the southern end of the Point Chevreuil reef would greatly enhance land-building in the Atchafalaya Delta and increase riverine influences in western Terrebonne Basin marshes. Because that reef restoration project is believed to be one of the most beneficial features of that strategy, the Service recommends that it be made part of any preferred implementation alternative that may be designated in the future. Similarly, the Service recommends the following modifications be incorporated in any plan ultimately selected for implementation:

1. Install a new Calcasieu Lock and use of the old lock for improved management of water levels in the Lakes Subbasin, and for moderating salinity levels in the Calcasieu Basin.
2. Delete the proposed Gulf Intracoastal Lock at the Alkali Ditch, as many of the wetlands intended to be benefitted by that feature have already been lost and others are now protected by other means.
3. Sufficient funding should be provided for full Service participation throughout post-authorization engineering and design studies, and to facilitate fulfillment of its responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act.
4. The Corps should obtain a right-of-way from the Service prior to conducting any work on a National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the Refuge was established.

To ensure that optimum fish and wildlife resource benefits are achieved, the Service plans to remain actively involved throughout the plan implementation process. Our findings and recommendations on the design and operation of projects approved for implementation will be provided under the authority of the Fish and Wildlife Coordination Act.

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APPENDIX B5

Draft

U.S. FISH AND WILDLIFE COORDINATION ACT REPORT

LCA Near-Term Plan

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United States Department of the Interior

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

May 28, 2004

Colonel Peter J. Rowan
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Rowan:

Enclosed is the Draft Fish and Wildlife Coordination Act Report on the Near-Term Ecosystem Restoration Plan for the Louisiana Coastal Area, Louisiana Coastwide Ecosystem Restoration Feasibility Study. Copies of that revised draft report have been provided to the National Oceanographic and Atmospheric Administration - Fisheries and the Louisiana Department of Wildlife and Fisheries for their review. Their comments will be forwarded to you upon receipt, and will be fully addressed in our final report for the study. The enclosed document does not constitute the final report of the Secretary of the Interior, as required by Section 2(b) Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Should your staff have any questions regarding the enclosed report, please have them contact Ms. Catherine Grouchy (504/862-2689) of this office.

Sincerely,

Russell Watson
Supervisor
Louisiana Field Office

cc: LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CRD & CMD), Baton Rouge, LA
National Oceanographic and Atmospheric Adm. - Fisheries, Baton Rouge, LA
Fish and Wildlife Service, Atlanta, GA (AES)
Environmental Protection Agency, Baton Rouge, LA
Natural Resources Conservation Service, Alexandria, LA

NEAR-TERM ECOSYSTEM RESTORATION PLAN FOR THE LOUISIANA COASTAL AREA

FISH AND WILDLIFE COORDINATION ACT REPORT

U.S. FISH AND WILDLIFE SERVICE

ECOLOGICAL SERVICES

LAFAYETTE, LOUISIANA

MAY 2004

NEAR-TERM ECOSYSTEM RESTORATION PLAN FOR THE LOUISIANA COASTAL AREA

FISH AND WILDLIFE COORDINATION ACT REPORT

PROVIDED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY
CATHERINE GROUCHY, FISH AND WILDLIFE BIOLOGIST
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U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

MAY 2004

EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (Service) has prepared the following Fish and Wildlife Coordination Act Report for inclusion in the forthcoming draft Near-term Ecosystem Restoration Plan (NTP) for the Louisiana Coastal Area (LCA), Louisiana Coastwide Ecosystem Restoration Feasibility Study. The purpose of that study is " . . . to determine the feasibility of sustaining a coastal ecosystem that supports and protects the environment, economy and culture of southern Louisiana and that contributes greatly to the economy and well being of the nation." Although the NTP is largely programmatic, it is a critically important component of the continuing cooperative Federal-State effort to address the loss of Louisiana's coastal wetlands. The NTP, together with its supporting documentation (including this report), will be the basis upon which the Corps will request further authorization and funding from Congress to address that issue.

The study area includes all of Louisiana's coastal wetlands. Those wetlands, which support nationally important fish and wildlife resources, are being lost at an average rate of approximately 24 square miles per year due to a variety of causes. The NTP, developed by the Corps, the State of Louisiana, and the other cooperating Federal agencies, identifies the first 10-year increment of highly effective restoration features targeting critical ecological need areas—those areas of the coast plagued by the greatest ecosystem degradation, and those with the greatest potential for ecosystem recovery and infrastructure protection, as well as large-scale, long-term restoration features.

Each of the three major NTP action alternatives would, to varying degrees, reduce coastal wetland loss. Hence, implementing any of the proposed action plans would be preferable to the continued loss and degradation of coastal wetlands under the no-action scenario. The Tentatively Selected Plan (TSP) encompasses a variety of restoration strategies such as freshwater and sediment diversions, interior shoreline protection, barrier island and barrier headland protection, and dredged material/marsh restoration. The Service believes that the TSP, which focuses on preventing future land loss, restoring deltaic processes, restoring critical geomorphic structures, and protecting vital socio-economic resources, would provide the greatest fish and wildlife benefits, and would best achieve long-term sustainability of Louisiana’s coastal wetland ecosystem.

Coastwide, the TSP would restore marsh-building and marsh-maintenance processes through freshwater and sediment inputs. The TSP would increase coastal wetland acreage compared to taking no action; thus, it would have a major positive impact on most, if not all, of the fish and wildlife resources that utilize those wetlands. The project-related conversion of some brackish and saline marshes to fresh and low-salinity marshes would displace brown shrimp, spotted seatrout, and other fishes and shellfishes which prefer more saline habitats. Those displacement impacts would be partially compensated for by project-induced increases in the productivity of remaining high salinity habitats, and by the improved sustainability of those habitats, compared to taking no action. Additionally, the abundance and productivity of white shrimp, Gulf menhaden, and other fishes and shellfishes which utilize low-salinity habitats would likely be increased under the preferred plan. Given the continued rapid loss and likely future collapse of brackish

and salt marsh systems with no action, the TSP may also provide a long-term net benefit to species utilizing those areas. Accordingly, the Service recommends that, during future planning iterations, design and operational measures be incorporated into project features to minimize adverse effects on those resources and to increase benefits to other fish and wildlife species, to the greatest extent practical.

Because of the uncertainties regarding some of the currently proposed habitat prediction methodologies, and because many details regarding the design, operation, and associated effects of the TSP are not yet available at the current programmatic level of planning, we cannot complete our evaluation of the TSP's effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information that will be available during those planning phases, will be required so that we can fulfill our responsibilities under that Act. Additionally, improvements in the hydrologic and desktop models will be needed to predict environmental impacts and benefits of plan features, as indicated in our previous draft Fish and Wildlife Coordination Act Report (Paille, R. and K. Roy, September 2003b) for the LCA Comprehensive Study.

The Service has actively participated throughout the formulation and evaluation of the LCA coastwide alternatives and the selection of near-term restoration features, as well as the large-scale studies and the demonstration projects that comprise the NTP. Given the substantial adverse future impacts to coastal wetlands and their associated fish and wildlife resources under future without-project conditions, we strongly support authorization and implementation of the near-term TSP for the NTP, as it would provide the greatest level of benefits to Louisiana's nationally significant fish and wildlife resources. Accordingly, the Service also provides the following procedural recommendations for future authorization and implementation of the NTP:

1. In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Service and the Corps, sufficient continuous funding should be provided to the Service to fulfill our responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act throughout post-authorization engineering and design studies (for demonstration projects and NTP projects) and the long-term project feasibility studies.

2. The Corps should obtain a right-of-way from the Service prior to conducting any work on a National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the refuge was established.

To ensure that optimum fish and wildlife resource benefits are achieved, the Service plans to remain actively involved throughout the plan implementation process. Our findings and recommendations for each of the projects ultimately approved for implementation will be provided as supplements to this report under the authority of the Fish and Wildlife Coordination Act.

INTRODUCTION

The Near-term Ecosystem Restoration Plan (NTP) for the Louisiana Coastal Area (LCA), Louisiana Coastwide Ecosystem Restoration Feasibility Study has been prepared by the New Orleans District Corps of Engineers (Corps), Louisiana Department of Natural Resources, and other State and Federal natural resource agencies, with the assistance of scientists from several institutions. The LCA study was originally authorized by Resolutions adopted by the U.S. House of Representatives and Senate Committees on Public Works, on October 19, 1967, and April 19, 1967, respectively. Those resolutions sought to improve existing hurricane protection features and the ". . . prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resource purposes."

As currently formulated, the LCA is envisioned as the mechanism for developing and implementing a program to achieve system-wide sustainable restoration of Louisiana's coastal wetlands. That program would maximize use of restoration strategies that promote the reintroduction of riverine fresh water, nutrients, and sediments, and that would maintain the structural integrity of the estuarine basins. The program's near-term component would also include a process to develop better techniques for meeting the critical needs of the ecosystem and to advance our understanding of the coastal ecosystem. To put the scope and significance of the LCA in proper perspective, it is important to understand the magnitude of the problems to which it will respond, as well as the unprecedented level of coordinated efforts that have already been undertaken to address those problems.

In 1990, passage of the Coastal Wetlands Planning, Protection and Restoration Act, (PL-101-646, Title III, CWPPRA), provided authorization and funding for the Louisiana Coastal Wetlands Conservation and Restoration Task Force to begin actions to curtail the annual loss of approximately 24 square miles per year Louisiana's coastal wetlands. In 1998, after extensive studies and construction of a number of coastal restoration projects had been accomplished under CWPPRA, the State of Louisiana and the Federal agencies charged with restoring and protecting the remainder of Louisiana's valuable coastal wetlands developed the "Coast 2050: Toward a Sustainable Coastal Louisiana" report, popularly known as the *Coast 2050 Plan*. In recognition of the national significance of Louisiana's coastal wetlands, that plan proposes ecosystem restoration strategies and efforts larger in scale than any previously implemented, including restoration of the natural processes that built and maintained coastal Louisiana.

In 2000, the Corps used the *Coast 2050 Plan* as the basis for a section 905(b) reconnaissance report intended to gain approval for a coastwide feasibility study, the purpose of which would be to obtain Water Resources Development Act authorization of, and funding for, a comprehensive coastal wetlands restoration plan to include projects larger in scope than those implemented under CWPPRA. In 2000, it was envisioned that a series of feasibility reports would be prepared over a 10-year period. The first of those feasibility efforts focused on the Barataria Basin and involved marsh creation and barrier shoreline restoration.

By Fiscal Year (FY) 2002, however, it had become widely recognized that, despite the excellent progress of other programs, a much more comprehensive approach - one that could be submitted to Congress as a blueprint for future restoration efforts - would be needed to effectively address Louisiana's coastal wetland loss. As a result, the Corps and the State of Louisiana initiated the LCA Comprehensive Coastwide Ecosystem Restoration Study (LCA Comprehensive Study), an interagency planning effort to develop a comprehensive plan to restore Louisiana's coastal ecosystem. Although they were not publically released, a preliminary Draft LCA Comprehensive Study Report and preliminary Draft Programmatic Environmental Impact Statement (PEIS) were subsequently prepared. Associated with those documents, the Service provided a Draft Fish and Wildlife Coordination Act Report (Paille, R. and K. Roy, August 2003a). Immediately thereafter, the Corps and the local sponsor revised those documents to describe seven action alternatives, although a preferred alternative was not identified. Subsequently, the Service prepared a revised Draft Fish and Wildlife Coordination Act Report (Paille, R. and K. Roy, September 2003b). Following review by the Office of Management and Budget and the Council on Environmental Quality, public release of that draft LCA Comprehensive Study Report was deferred pending revisions to satisfy FY 2005 administrative budget guidance. Key elements of that guidance included requirements to: 1) identify the most critical ecological needs of the coastal area, 2) identify projects to address these needs that provide a very high return in net benefits (non-monetary and monetary) per dollar of cost, 3) present and evaluate alternatives for meeting those needs, 4) identify the key long-term scientific uncertainties and engineering challenges facing the effort to protect and restore the ecosystem, and 5) propose a strategy for resolving the identified challenges.

In a coordinated response to that guidance, the Corps, the State of Louisiana, and the other cooperating Federal agencies (including the Service), re-focused the larger comprehensive ecosystem restoration plan into the current NTP. The NTP identifies the first 10-year increment of highly effective restoration features targeting critical ecological need areas—those areas of the coast plagued by the greatest ecosystem degradation, and those with the greatest potential for ecosystem recovery and infrastructure protection, as well as large-scale, long-term restoration features. The balance of this report documents the Service's programmatic assessment of the NTP and provides our recommendations for future planning and implementation of the NTP and its features.

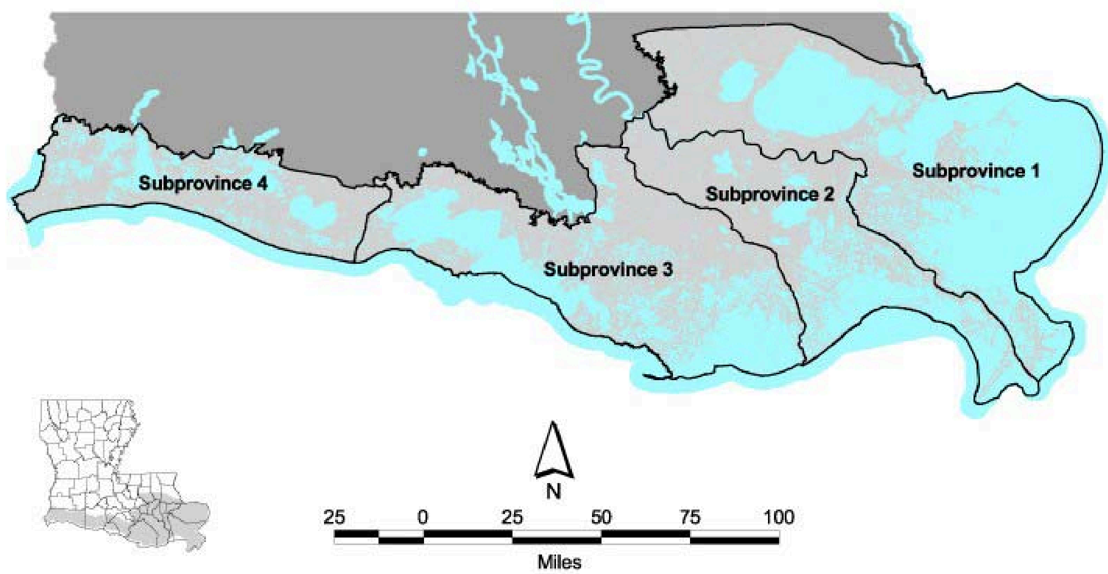
DESCRIPTION OF THE STUDY AREA

The study area encompasses all of Louisiana's coastal wetlands, which include natural levee forest, swamp, fresh marsh, intermediate marsh, brackish marsh, saline marsh, and barrier islands. The study area is divided into four subprovinces (Figure 1), each of which includes one or more coastal watersheds. The LCA subprovinces are very similar to those identified under the Coast 2050 Plan (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority

1998), except that the boundary between Subprovinces 1 and 2 has been relocated from the Mississippi River-Gulf Outlet to the Mississippi River under the LCA.

Subprovince 1 consists of all coastal wetlands east of the Mississippi River (and South Pass) and includes the Pontchartrain and Breton Sound Basins. Subprovince 2 consists of the coastal wetlands between the Mississippi River and Bayou Lafourche (i.e., the Barataria Basin). Subprovince 3 extends from Bayou Lafourche westward to the Freshwater Bayou Canal and includes the Terrebonne, Atchafalaya, and Teche/Vermilion Basins. Subprovince 4 extends from the Freshwater Bayou Canal westward to the Louisiana State line (i.e. the Sabine River/Sabine Lake) and includes the Mermentau and Calcasieu/Sabine Basins.

Figure 1. LCA Near-Term Ecosystem Recreation Plan Study Area.



EXISTING FISH AND WILDLIFE RESOURCES

Description of Habitats

Forested Wetlands - Forested wetlands in the study area consist primarily of bottomland hardwood forests and cypress-tupelo swamps. Bottomland hardwood forests found in coastal portions of the project area occur primarily on the natural levees of distributary channels. Dominant vegetation may include sugarberry, water oak, live oak, bitter pecan, black willow, American elm, Drummond red maple, Chinese tallow-tree, boxelder, green ash, baldcypress, and elderberry. Cypress-tupelo swamps are located along the flanks of larger distributary ridges as a transition zone between bottomland hardwoods and lower-elevation marsh or scrub-shrub habitats. Cypress-tupelo swamps exist where there is little or no salinity and (usually) minimal daily tidal action.

Scrub-Shrub - Scrub-shrub habitat is often found along the flanks of distributary ridges. Typically, it is bordered by marsh at lower elevations and by developed areas, cypress-tupelo swamp, or bottomland hardwoods at higher elevations. Typical scrub-shrub vegetation includes elderberry, wax myrtle, buttonbush, black willow, Drummond red maple, Chinese tallow-tree, and groundselbush.

Fresh Marsh - Fresh marshes occur at the upper ends of interdistributary basins and are often characterized by floating or semi-floating organic soils. Most fresh marshes exhibit minimal daily tidal action; however, fresh marshes in the Atchafalaya River delta and adjacent to Atchafalaya Bay are the exceptions. Vegetation may include maidencane, bulltongue, cattail, California bulrush, pennywort, giant cutgrass, American cupscale, spikerushes, bacopa, and alligatorweed. Associated open-water habitats may often support extensive beds of floating-leaved and submerged aquatic vegetation including water hyacinth, Salvinia, duckweeds, American lotus, white water lily, water lettuce, coontail, Eurasian milfoil, hydrilla, pondweeds, naiads, fanwort, wild celery, water stargrass, elodea, and others.

Intermediate Marsh - Intermediate marshes are a transitional zone between fresh and brackish marshes, and are often characterized by organic, semi-floating soils. Typically, intermediate marshes experience low levels of daily tidal action. Salinities are negligible or low throughout much of the year, with salinity peaks occurring during late summer and fall. Vegetation includes saltmeadow cordgrass, deer pea, three-cornered grass, cattail, bulltongue, California bulrush, seashore paspalum, wild millet, fall panicum, and bacopa. Ponds and lakes within the intermediate marsh zone often support extensive submerged aquatic vegetation including southern naiad, Eurasian milfoil, and wigeongrass.

Brackish Marsh - Brackish marshes are characterized by low-to-moderate daily tidal energy and by soils ranging from firm mineral soils to organic semi-floating soils. Freshwater conditions may prevail for several months during early spring; however, low-to-moderate salinities occur during much of the year, with peak salinities in the late summer to fall. Vegetation is usually dominated by saltmeadow cordgrass, but also includes saltgrass, three-cornered grass, leafy three-square, and deer pea. Shallow brackish marsh ponds occasionally support abundant beds of wigeongrass.

Saline Marsh - Saline marshes occur along the southern fringe of the coastal wetlands. Those marshes usually exhibit fairly firm mineral soils and experience moderate to high daily tidal energy. Vegetation is dominated by saltmarsh cordgrass, but may also include saltgrass, saltmeadow cordgrass, black needlerush, and leafy three-square. Submerged aquatic vegetation is rare. Within the study area, intertidal mud flats are most common in saline marshes.

Ponds and Lakes - Natural marsh ponds and lakes, interspersed throughout the coastal wetlands, are typically shallow, ranging in depth from 6 inches to more than 2 feet. The smaller ponds are typically shallow and the larger lakes are deeper. In fresh and low-salinity areas, ponds and lakes may support varying amounts of submerged and/or floating-leaved aquatic vegetation. Brackish and, much less frequently, saline marsh ponds and lakes may support wigeongrass beds.

Canals and Bayous - Canals and larger bayous typically range in depth from 4 or 5 feet, to more than 15 feet. Strong tidal flows may occur at times through those waterways, especially where they provide hydrologic connections to other large waterbodies. Such canals and bayous may have mud or clay bottoms that range from soft to firm. Dead-end canals and small bayous are typically shallow and their bottoms may be filled to varying degrees with semi-fluid organic material. Erosion, due to wave action and boat wakes, together with shading from overhanging woody vegetation, may retard the amount of intertidal marsh vegetation growing along the edges of those waterways.

Navigation Channels - A number of large (300 feet wide or wider) navigation channels have been dredged across the coastal zone. Such channels include the Sabine-Neches Waterway, the Calcasieu Ship Channel, the Freshwater Bayou Channel, the Houma Navigation Canal, the Barataria Waterway, and the Mississippi River Gulf Outlet. Such channels may range in depth from 15 feet to over 40 feet, and often cut through natural distributary ridges and disrupted local hydrology by increasing tidal exchange, saltwater intrusion, and freshwater discharge rates. The Gulf Intracoastal Waterway traverses the coastal zone from east to west and has also caused hydrologic disruptions. Boat wakes and water displacement surges from the passage of large vessels has also resulted in severe erosion of adjoining marshes in some locations.

Developed Areas - Most developed areas are located on higher elevations of former distributary channels and are typically well drained. They include agricultural lands, and commercial and residential developments.

<u>Fishery Resources</u>

Wetlands throughout the study area abound with small resident fishes and shellfishes such as least killifish, rainwater killifish, sheepshead minnow, mosquitofish, sailfin molly, grass shrimp, and others. Those species are typically found along marsh edges or among submerged aquatic vegetation, and provide forage for a variety of fish and wildlife. Fresh and low-salinity marshes provide habitat for commercially and recreationally important resident freshwater fishes such as largemouth bass, yellow bass, black crappie, bluegill, redear sunfish, warmouth, blue catfish, channel catfish, buffalo, freshwater drum, bowfin, and gar. Freshwater fishes may also utilize low-salinity areas (intermediate marsh zone), provided they have access to fresher areas during periods of high salinity.

Louisiana's coastal marshes also provide nursery habitat for many estuarine-dependent commercial and recreational fishes and shellfishes. Because of the protection and abundant food afforded by those wetlands, they are critical to the growth and production of species such as blue crab, white shrimp, brown shrimp, Gulf menhaden, Atlantic croaker, red drum, spotted seatrout, black drum, sand seatrout, spot, southern flounder, striped mullet, and others. Those species are generally most abundant in the brackish and saline marshes; however, blue crab, Gulf menhaden, Atlantic croaker, and several other species also utilize fresh and low-salinity marshes.

Because tidal marshes provide essential nursery habitat, commercial shrimp harvests are positively correlated with the area of tidal emergent wetlands, but not open-water areas (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes could be adversely impacted by the high rates of marsh loss throughout the study area (Turner 1982).

The American oyster also occurs throughout much of the brackish and saline marsh zones within the study area. Oyster harvesting constitutes a valuable fishery in the northern portions of that zone, where salinities range from 10 to 15 parts per thousand (ppt).

Essential Fish Habitat

The generic amendment to Gulf of Mexico Fishery Management Plan identifies Essential Fish Habitat in the project area to be intertidal emergent wetlands, submerged aquatic vegetation, estuarine waters, and mud, sand, and shell water bottoms. Habitat Areas of Particular Concern have not been identified for the project area. Under the Magnuson-Stevens Fishery Conservation and Management Act, the Gulf of Mexico Fishery Management Council has determined that project-area habitats are utilized by federally managed species such as brown shrimp, white shrimp, and red drum. Although those species utilize the project area primarily as nursery habitat, all life stages may occur therein. When they move to offshore waters, blue crabs and other species of fishes and shellfishes that utilize project-area estuarine habitats may also provide forage for Federally managed marine fishes such as groupers, snappers, and mackerel.

Wildlife Resources

Numerous species of birds utilize the study-area marshes, including large numbers of migratory waterfowl. Project-area fresh and intermediate marshes provide excellent wintering habitat for migratory waterfowl, especially puddle (dabbling) ducks. Brackish marshes with abundant submerged aquatic vegetation may also support large numbers of puddle ducks. Puddle ducks that commonly migrate to, or through, the study area include mallard, gadwall, northern pintail, blue-winged teal, green-winged teal, American wigeon, wood duck, and northern shoveler. The resident mottled duck and wood duck also utilize project-area coastal marshes for nesting, feeding, and brood-rearing. Diving ducks prefer larger ponds, lakes, and open-water areas. Common diving duck species include lesser scaup, ruddy duck, canvasback, redhead, ringnecked duck, red-breasted merganser, and hooded merganser. The lesser snow goose and the white-fronted goose also utilize coastal marshes as wintering habitat. Other migratory game birds found in Louisiana's coastal marshes include the king rail, clapper rail, Virginia rail, sora, American coot, common moorhen, and common snipe.

Marshes and associated shallow, open-water areas also provide habitat for a number of wading birds, shorebirds, seabirds, and other nongame birds. Common wading birds include the little blue heron, great blue heron, green-backed heron, yellow-crowned night heron, black-crowned night heron, great egret, snowy egret, cattle egret, reddish egret, white-faced ibis, white ibis, and roseate spoonbill. Shorebirds include the killdeer, American avocet, black-necked stilt, common snipe, and various species of plovers and sandpipers. Seabirds include white pelican, endangered brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. More than 190 wading and seabird nesting colonies have been identified within coastal Louisiana during surveys conducted in 1983, 1990, and 2001 (Michot et al. 2003). Other nongame birds, such as boat-tailed grackle, red-winged blackbird, seaside sparrow, olivaceous cormorant, northern harrier, belted kingfisher, and sedge wren, also utilize coastal-area habitats.

Common mammals occurring in the coastal marshes include nutria, muskrat, mink, river otter, raccoon, swamp rabbit, white-tailed deer, and coyote. Muskrat and river otter prefer brackish marsh. Nutria, mink, swamp rabbit, and white-tailed deer prefer fresh marsh and low salinity habitats. Saline marsh provides very poor habitat for the above listed species. For muskrat, however, saline marsh may provide fair-to-poor habitat quality.

Reptiles are most abundant in fresh and low-salinity coastal wetlands. Common species include the American alligator, western cottonmouth, water snakes, mud snake, speckled kingsnake, ribbon snakes, rat snakes, red-eared turtle, common snapping turtle, alligator snapping turtle, mud turtles, and softshell turtles. Amphibians commonly found in those areas include the bullfrog, pig frog, bronze frog, leopard frog, cricket frogs, tree frogs, chorus frogs, three-toed amphiuma, sirens, and several species of toads. In brackish and saline marshes, reptiles are limited primarily to the American alligator and the diamond-backed terrapin, respectively.

Coastal forested and scrub-shrub wetlands provide key habitats for songbirds such as the mockingbird, yellow-billed cuckoo, northern parula, yellow-rumped warbler, prothonotary warbler, white-eyed vireo, Carolina chickadee, and tufted titmouse. Those areas also provide vitally important resting and feeding areas for songbirds migrating across the Gulf of Mexico. Other avian species found in forested wetlands include the American woodcock, common flicker, brown thrasher, white-eyed vireo, belted kingfisher, loggerhead shrike, pileated woodpecker, red-headed woodpecker, downy woodpecker, common grackle, common crow, and mockingbird.

Forested habitats and associated waterbodies also support raptors such as the red-tailed hawk, red-shouldered hawk, osprey, American kestrel, Mississippi kite, northern harrier, screech owl, great horned owl, and barred owl. Wading bird colonies typically occur in cypress swamp and scrub-shrub habitats. Species found in those nesting colonies include anhinga, great egret, great blue heron, black-crowned night heron, tricolored heron, little blue heron, cattle egret, snowy egret, white-faced and glossy ibises, and reddish egret. Resident and migratory waterfowl species found in forested wetlands and adjacent waterbodies in the project area include, but are not limited to, wood duck, mallard, green-winged teal, gadwall, and hooded merganser.

Game mammals associated with coastal forested wetlands include eastern cottontail, swamp rabbit, gray and fox squirrels, and white-tailed deer. Commercially important furbearers include river otter, muskrat, nutria, mink, and raccoon. Other mammals found in forested wetlands include striped skunk, coyote, Virginia opossum, bobcat, armadillo, gray fox, and red bat. Smaller mammal species serve as forage for both mammalian and avian carnivores and include the cotton rat, marsh rice rat, white-footed mouse, eastern wood rat, harvest mouse, least shrew, and southern flying squirrel.

Reptiles, which utilize study area bottomland hardwoods, cypress swamps, and associated shallow waters, include the American alligator, ground skink, five-lined skink, broadbanded skink, green anole, Gulf coast ribbon snake, yellow-bellied water snake, speckled kingsnake, southern copperhead, western cottonmouth, pygmy rattlesnake, broad-banded water snake, diamond-backed water snake, spiny softshell turtle, red-eared turtle, southern painted turtle, Mississippi mud turtle, stinkpot, and common and alligator snapping turtle, in addition to numerous other species.

Representative amphibians in study-area forested wetlands include dwarf salamander, three-toed amphiuma, lesser western siren, central newt, Gulf coast toad, eastern narrow-mouthed toad, green treefrog, squirrel treefrog, pigfrog, bullfrog, southern leopard frog, bronze frog, upland chorus frog, southern cricket frog, and spring peeper.

Most developed areas provide low-quality wildlife habitat. Sites developed for agricultural purposes are usually located at elevations slightly higher than the wetlands, or they may have improved drainage. In agricultural areas, wildlife habitat is primarily provided by unmaintained ditch banks and field edges, fallow fields, pasture lands, and/or occasionally flooded fields. Cultivated crops, especially soybeans, provide forage for some wildlife species. Game species that utilize agricultural lands include the white-tailed deer, mourning dove, bobwhite quail, eastern cottontail, and common snipe. Seasonally flooded cropland and fallow fields may also provide important feeding habitat for wintering waterfowl, wading birds, and other waterbirds.

Threatened and Endangered Species

As a cooperating agency, the Service provided a September 26, 2003, letter to the Corps detailing Federally listed threatened and endangered species, their critical habitat, and migratory birds that may be found in or near the study area for the draft LCA Comprehensive Study (Appendix A). That information, and the draft Biological Assessment which Service staff also helped to prepare, remain applicable to the NTP alternatives, and should be used to facilitate programmatic Section 7 consultation under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and compliance with the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.). In keeping with the consultation requirements of the ESA, informal and formal (if needed) consultation must be completed before the Record of Decision for the NTP and PEIS can be signed. Accordingly, the Service will continue to work closely with the Corps through the consultation period.

Fish and Wildlife Summary

Coastal Louisiana contains an estimated 45 percent of the tidal marshes in the conterminous United States. Louisiana's 3.67 million acres of coastal wetlands and their associated waters support nationally important fish and wildlife resources, and sustain the largest commercial fish and shellfish harvest in the lower 48 States. More than 1.1 billion pounds of fish and shellfish (including shrimp, crabs, crawfish, and oysters) are harvested annually in coastal Louisiana. That harvest is nearly twice that of any other State, and was valued at more than $400 million in 2000 (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2001).

Recreational saltwater anglers spend approximately $245 million annually to fish for spotted seatrout, red drum, snapper, tuna and other species (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2001). Fresh and low-salinity coastal wetlands also provide important habitat for numerous freshwater sport fishes, the pursuit of which is also an important recreational activity in those coastal areas.

Louisiana's coastal marshes provide winter habitat for more than 50 percent of the duck population of the Mississippi Flyway. Fresh and intermediate marshes support the greatest concentrations of wintering waterfowl in coastal Louisiana. Those wetlands are vitally important to the mission of the Gulf Coast Joint Venture, which was established to help achieve the goals of the North American Waterfowl Management Plan.

Louisiana's coastal marshes, swamps, and associated habitats also support many other migratory birds, such as rails, gallinules, shorebirds, seabirds, wading birds, and numerous songbirds. One hundred ninety-seven colonies of wading birds and seabirds (representing 215,249 pairs of nesting birds) were observed in coastal Louisiana during a 2001 survey (Michot 2003). The cheniers and natural levee forests of coastal Louisiana provide essential stopover habitat to numerous neotropical migratory passerine birds.

Coastal Louisiana has long been a leading fur-producing area in North America. Common furbearers include nutria, mink, muskrat, raccoon, and river otter. Those coastal marshes and swamps also support game animals such as the white-tailed deer and swamp rabbit. The area also supports 1.5 million alligators for which sport and commercial hunting is closely regulated.

Refuges and Wildlife Management Areas

The Service administers 10 National Wildlife Refuges (NWR) encompassing more than 301,700 acres in coastal Louisiana. They include Sabine, Cameron Prairie, Lacassine, Shell Keys, Bayou Teche, Delta, Breton, Bayou Sauvage, Big Branch Marsh, and Mandalay NWRs. The Louisiana Department of Wildlife and Fisheries operates 17 refuges, preserves, and wildlife management areas in coastal Louisiana, comprising more than 572,000 acres. Coastal wetlands make up the vast majority of those Federal and State wildlife areas.

FISH AND WILDLIFE CONCERNS IN THE STUDY AREA

The foremost study-area concern, particularly from a fish and wildlife resource standpoint, is the rapid deterioration and loss of coastal wetlands. During the 1900s, Louisiana lost approximately 1.2 million acres of its coastal wetlands. Coastwide loss rates peaked at approximately 42 square miles per year during 1950s and 1960s. Currently, Louisiana's coastal wetland loss rate is approximately 24 square miles per year. Additionally, large areas of fresh marsh and low-salinity wetlands have converted to deteriorated brackish and saline marshes, or open water.

To address this serious problem, a number of coastal wetland restoration projects have been constructed and/or authorized for construction throughout coastal Louisiana. More than 140 projects are funded and authorized via the CWPPRA of 1990. Two large freshwater introduction projects (Davis Pond and Caernarvon) have been implemented by the Corps under other authorities. Despite their success, those efforts will, together, address less than one third of the 448,000-acre wetland loss projected to occur by the year 2050 in Louisiana. The continuing loss of coastal wetlands and their associated habitat values are the principal threats to the nationally significant fish and wildlife resources that depend on them.

PLAN FORMULATION AND EVALUATION METHODOLOGY

Individual restoration projects previously identified during development of the October 2003 Draft LCA Comprehensive Study Report were evaluated for inclusion in the NTP by applying 3 "sorting" criteria and 4 "critical need" criteria to each project identified. Sorting criteria were used to classify individual features into the major NTP components (i.e., Near-term restoration features, Large-scale studies, and Demonstration projects). The four critical need criteria (preventing future land loss, restoring fundamentally impaired deltaic processes, restoring critical geomorphic structures, and protecting vital socio-economic resources) were developed to assess the potential for project features to address critical needs. Those sorting and critical needs criteria include:

Sorting Criterion #1 - Engineering and design completed, and construction started within 10 years.

> This criterion would require the completion of feasibility studies including further modeling to optimize expected environmental outcome, full analysis of National Economic Development (NED) benefits, real estate acquisition, etc. in time to initiate construction in 10 years or less. It also includes completion of necessary NEPA documentation, pre-construction engineering & design, and receipt of construction authorization and commencement of construction during that period. A candidate restoration feature not deemed to meet this criterion would not be included in the NTP; however, it might be a candidate for the large-scale, long-range study component of the NTP.

Sorting Criterion #2 - Based upon sufficient scientific and engineering understanding of processes.

To satisfy this criterion, individual project features must have a sound basis in science, technology, and the engineering principles specific to those features must have been applied within coastal Louisiana to successfully achieve the desired ecosystem response. Individual features that do not meet this criterion were not included as potential near-term projects. The scientific and/or engineering uncertainties associated with those restoration features may, however, provide a basis for potential demonstration projects, and for review and analysis through the Science and Technology component of the NTP.

Sorting Criterion #3 - Construction is independent of, and does not eliminate, other near-term opportunities; construction is not dependent on the completion of another project and/or restoration feature.

If a feature is dependent on one or more other restoration features, that feature may be combined and reassessed to determine if the composite meets the other sorting criteria. If so, the composite project is then classified appropriately. If the evaluated individual feature might preclude the later implementation of another restoration feature, then it is not included in the NTP, but might become a candidate for long-range study.

Individual features that met all of the above sorting criteria were then evaluated against the below listed "critical need" criteria to determine if they should be included in the NTP. When the criteria were applied, the reasoning for the subsequent decisions was recorded so that the study team could make relative comparisons and refine the overall application of the "critical needs" criteria. Those criteria are as follows:

Critical Need Criterion #1 - Prevent future land loss where predicted to occur, and restore past land loss.

Future ecosystem condition should be based upon future patterns of land and water. According to the U.S. Geological Survey open file report 03-334 "Historical and Predicted Coastal Louisiana Land Changes: 1978-2050," proposed restoration features should prevent or reduce future predicted land loss or cypress swamp degradation in areas with existing fragmented marsh or degraded cypress swamp.

Critical Need Criterion #2 - (Sustainability) Restore fundamentally impaired deltaic processes through river reintroductions, or mimic deltaic processes.

This criterion refers to features that would restore or mimic natural connections between the river and the basins (or estuaries) and includes river diversions, crevasses, and over-bank flows. Mechanical marsh creation with river sediment is also viewed as mimicking the deltaic function of sediment introduction, if supported by sustainable freshwater and nutrient reintroduction.

Critical Need Criterion #3 - (Sustainability) Restore endangered or critical geomorphic structure.

This criterion pertains to project features that would restore or maintain natural geomorphic features such as barrier islands, distributary ridges, cheniers, land bridges, and beach and lake rims that are essential to maintaining the integrity of coastal ecosystems.

Critical Need Criterion #4 - Protect vital local, regional, and national socio-economic resources.

This criterion would be met by project features which protect key local, regional, and national resources of social, economic, and cultural significance, such as cultural features and points of interest, communities, infrastructure, and businesses and industries.

Modeling to quantify wetland changes and associated impacts/benefits to fish and wildlife resources of the selected NTP features was not conducted, due to the short time frame to complete the NTP and because that plan is of a highly programmatic nature at present. Instead, the results of modeling conducted during the earlier LCA Comprehensive Study were used as a basis for estimating benefits to fish and wildlife resources, despite the known problems and uncertainties associated with those assessment methods. Beyond this programmatic level evaluation, when individual project features are undergoing further engineering and design, more rigorous assessments will be required to quantify fish and wildlife benefits and impacts, complete NEPA documentation, meet various water development planning policies, and to enable the Service to fulfill its Fish and Wildlife Coordination Act mandates.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

Within coastal Louisiana under future with no action conditions, more than 462,000 additional wetland acres would be lost by year 50 (Table 1). Habitat types would continue shifting toward more brackish and saline wetlands, and open water, with the continual loss of more salt-sensitive freshwater vegetation. Because of the current degree of risk and uncertainty associated with the salinity/habitat type projection methodologies, however, the data in Table 1 do not reflect this anticipated trend. Nonetheless, corresponding decreases in habitat values for fish and wildlife that use those wetlands would also occur in association with the projected wetland losses.

Table 1. Coastwide wetland type acreages under the No Action Plan

Wetland Type	TY0 (acres)	TY50 (acres)	Acreage change	Percent change
Swamp	1,040,785	949,707	-91,078	-8.8
Fresh marsh	940,811	798,847	-141,964	-15.1
Intermediate Marsh	724,289	956,240	231,951	32.0
Brackish marsh	584,524	437,477	-147,046	-25.2
Saline marsh	374,778	60,157	-314,622	-83.9
Total wetlands	3,665,188	3,202,429	-462,759	-12.6

RESTORATION OPPORTUNITY DESCRIPTIONS

As detailed above, application of the sorting criteria and critical needs criteria were the basis for selecting the NTP restoration features, large-scale studies, and candidate science and technology demonstration projects. The following paragraphs describe those restoration opportunities in greater detail.

Near-Term Restoration Features

Of the 78 features that the sorting criteria were applied to, those features that met all three sorting criteria were considered as possible NTP features. Alternative combinations of those features were developed by applying each of the critical needs criteria individually or in various combinations. Application of the critical needs criteria yielded 15 possible alternatives. While that analysis indicated some similarity between alternatives, distinct alternatives were identified that were focused on critical needs criterion #2 only (Restoration Opportunity 1), critical needs criterion #3 only (Restoration Opportunity 2), and all four critical needs criteria combined (the Tentatively Selected Plan or TSP).

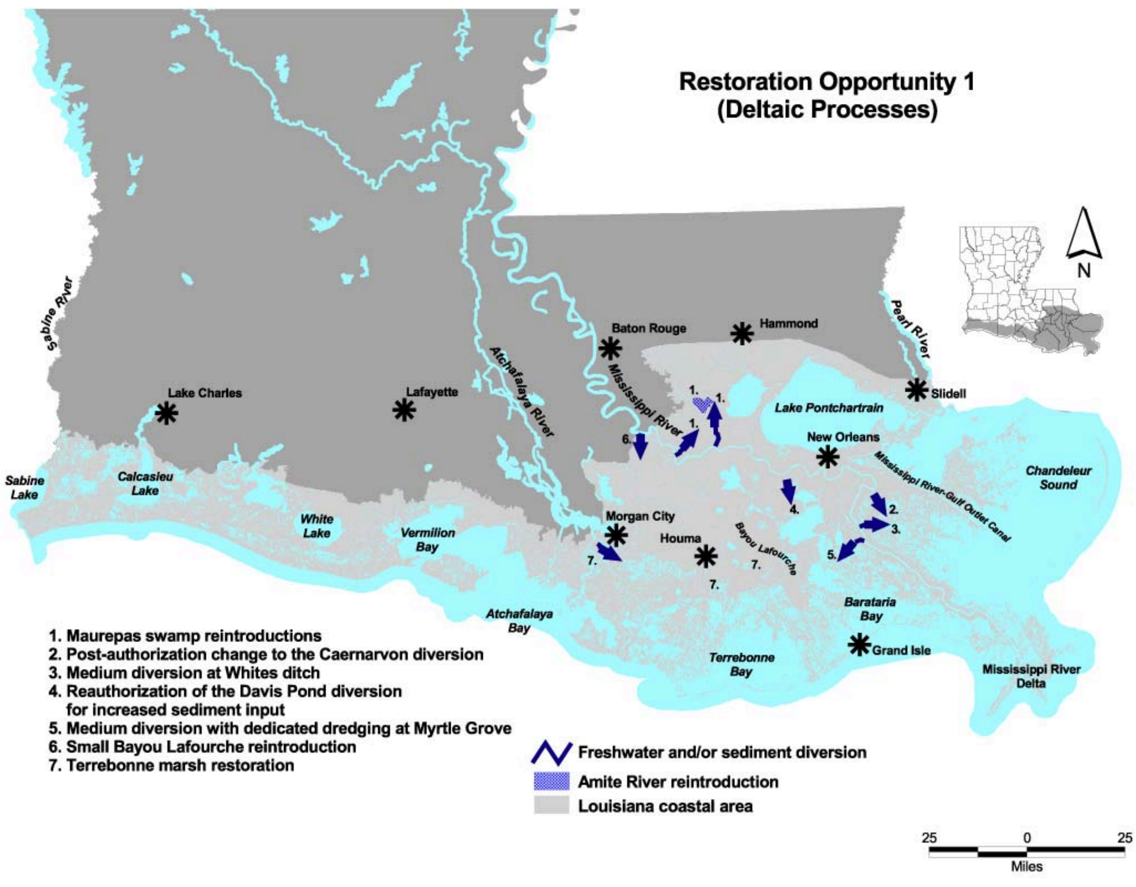
Restoration Opportunity 1 focuses on restoration of deltaic processes and includes seven near-term restoration features (Figure 2). Those features and their respective subprovinces (SP) are as follows:

1) Maurepas Swamp Reintroductions (SP 1)
    a. Small Diversion at Hope Canal (CWPPRA River Reintroduction to Maurepas Swamp)
    b. Small Diversion at Convent/Blind River
    c. Increase Amite River Influence by Gapping Spoil Banks
2) Post-authorization Change to the Caernarvon Diversion (SP1)
3) Medium Diversion at Whites Ditch (SP1)

4) Reauthorization of the Davis Pond Diversion for Increased Sediment Input (SP2)
5) Medium Diversion with Dedicated Dredging at Myrtle Grove (SP 2)
6) Small Bayou Lafourche Reintroduction (SP 3);
7) Terrebonne Marsh Restoration Opportunities (SP 3)
    a. Multi-purpose Operation of Houma Navigation Canal (HNC) Lock
    b. Convey Atchafalaya River Water to Terrebonne Marshes via a Small Diversion in the Avoca Island Levee, Repair Eroding Banks of the GIWW, Enlarge Constrictions in the GIWW below Gibson and in Houma, and Construct/Enlarge Lake Boudreaux and Grand Bayou Conveyance Channel.

Diversion features range from 1,000 cfs to 5,000 cfs for small diversions, 5,001 cfs to 15,000 cfs for medium diversions, and greater than 15,000 cfs for large diversions.

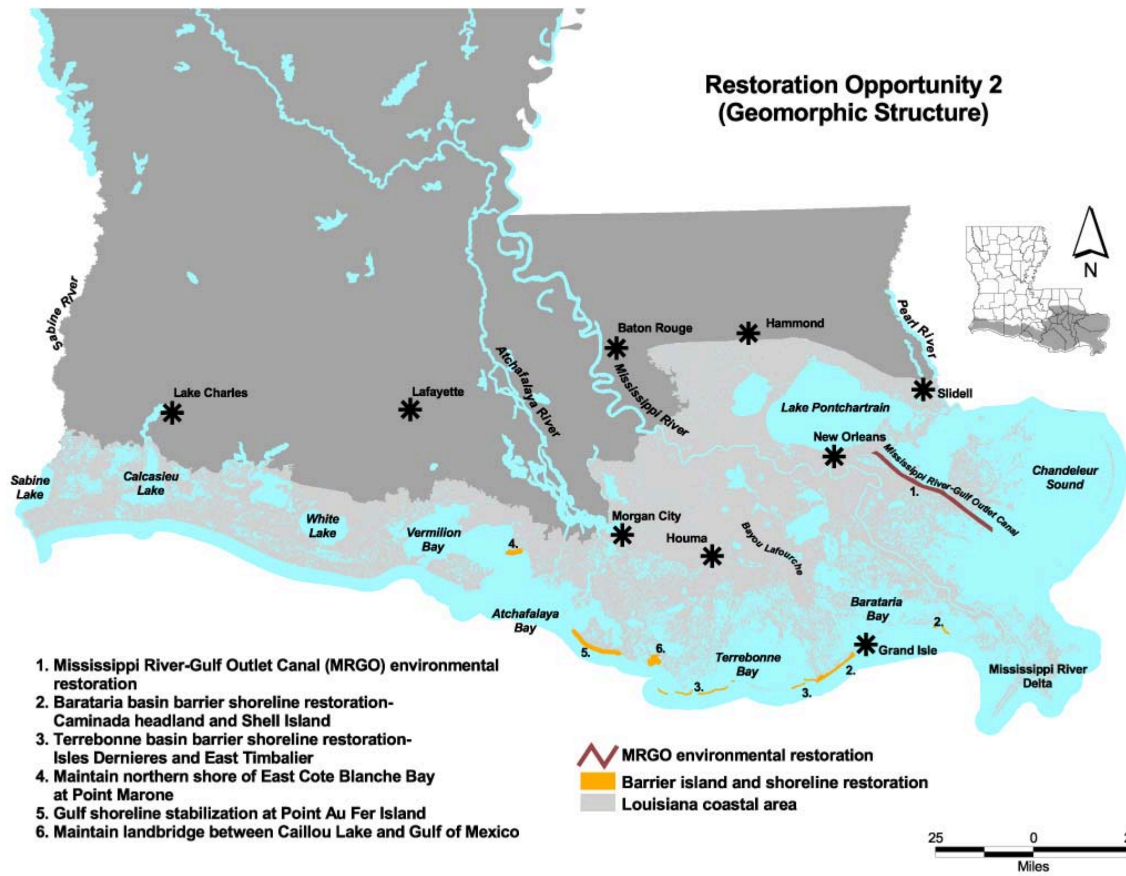
Figure 2. LCA Near-Term Ecosystem Restoration Plan Restoration Opportunity 1 - Restoration of Deltaic Processes.



Restoration Opportunity 2 is the alternative that focuses on restoration of geomorphic structure. It consists of six restoration opportunities which include shoreline protection, barrier island restoration, and marsh-creation features (Figure 3). The restoration features of this alternative and their respective subprovinces (SP) are as follows:

1) Mississippi River Gulf Outlet Environmental Restoration (SP 1)
2) Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island (SP 2)
3) Terrebonne Basin Barrier Shoreline Restoration-Isles Dernieres and East Timbalier (SP3)
4) Maintain Northern Shore of East Cote Blanche Bay at Point Marone (SP3)
5) Gulf Shoreline Stabilization at Pt. Au Fer Island (SP 3)
6) Maintain Land Bridge Between Caillou Lake and Gulf of Mexico (SP3)

Figure 3. LCA Near-Term Ecosystem Restoration Plan Restoration Opportunity 2 - Restoration of Geomorphic Structure.



The third alternative restoration opportunity, or the TSP, encompasses all four critical needs criteria, and includes 12 potential restoration features including freshwater and sediment diversions, interior shoreline protection, barrier island and barrier headland protection, and dredged material/marsh creation (Figure 4). The restoration features of this alternative and their respective subprovinces (SP) are as follows:

1) Maurepas Swamp Reintroductions (SP 1)
    a. Small Diversion at Hope Canal (CWPPRA River Reintroduction into Maurepas Swamp)
    b. Small Diversion at Convent/Blind River

    c. Increase Amite River Influence by Gapping Spoil Banks
2) MRGO Environmental Restoration (SP 1)
3) Post-authorization Change to the Caernarvon Diversion (SP1)
4) Medium Diversion at Whites Ditch (SP1)
5) Reauthorization of the Davis Pond Diversion for Increased Sediment Input (SP2)
6) Medium Diversion with Dedicated Dredging at Myrtle Grove (SP 2)
7) Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island (SP 2)
8) Terrebonne Basin Barrier Shoreline Restoration-Isles Dernieres and East Timbalier (SP3)
9) Small Bayou Lafourche Reintroduction (SP 3)
10) Gulf Shoreline Stabilization at Point Au Fer Island (SP 3)
11) Terrebonne Marsh Restoration Opportunities (SP 3)
    a. Multi-purpose Operation of Houma Navigation Canal (HNC) Lock
    b. Convey Atchafalaya River Water to Terrebonne Marshes via a Small Diversion in the Avoca Island Levee, Repair Eroding Banks of the GIWW, Enlarge Constrictions in the GIWW below Gibson and in Houma, and Construct/Enlarge Lake Boudreaux and Grand Bayou Conveyance Channel
12) Maintain Land Bridge between Caillou Lake and Gulf of Mexico (SP 3)

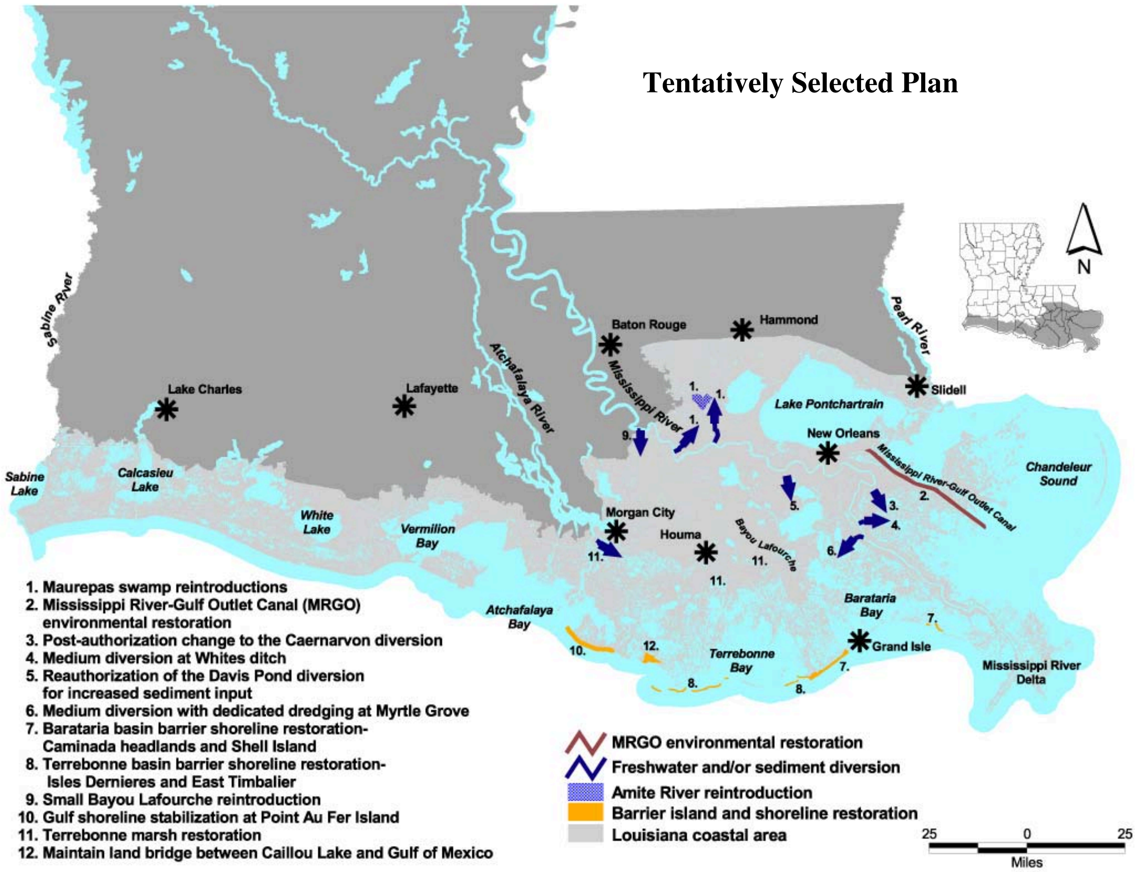
More detailed descriptions of the above-listed features are found in Appendix B.

<u>Large-scale Studies</u>

The NTP also recommends five feasibility studies of large-scale restoration concepts which have a high level of complexity and/or uncertainty associated with them. Those conceptual projects would affect (both positively and negatively) significant ecological and economic resources, but could potentially contribute to a more sustainable coastal Louisiana. However, the feasibility of undertaking those large-scale restoration concepts is not, at this time, fully known. In addition, it is unlikely that the requisite detailed investigations and the resolution of issues (e.g., land acquisition) associated with implementation could be completed in time to begin construction within the next 10 years. The large-scale, long-term initiatives selected for detailed study (and their respective subprovinces) are as follows:

1. Mississippi River Hydrodynamic Study
    a. Mississippi River Delta Management Study (SP 1 and 2)
    b. Third Delta (SP 2 and 3)
2. Post-authorization Change for Diversion of Water Through Inner-Harbor Navigation Canal (IHNC) Lock (SP 1)
3. Upper Atchafalaya Basin Study including Evaluation of Modified Operational Scheme of Old River Control Structure Conducted under Mississippi River and Tributaries (SP 3)
4. Point Chevreuil Reef Restoration (SP3)
5. Chenier Plain Freshwater Management and Allocation Reassessment (SP 4).

Figure 4. LCA Near-Term Ecosystem Restoration Plan - Tentatively Selected Plan



The Mississippi River Delta Management Study would require extensive investigations to maximize the use of riverine freshwater and sediments for wetland restoration without adversely impacting navigation. Sediments, nutrients, and freshwater would be re-directed to restore the quality and sustainability of the Mississippi River Deltaic Plain, its coastal wetland complex, and the Gulf of Mexico. The study would investigate potential modifications to existing navigation channel alignments and associated maintenance procedures and requirements.

The Third Delta feature consists of a control structure in the vicinity of Donaldsonville that would divert approximately 240,000 cfs at maximum river stage. Flows would be diverted into a newly constructed conveyance channel (parallel to Bayou Lafourche) extending approximately 55 miles from the initial point of diversion to the eventual point of discharge. The diverted flow would be divided equally at a point north of the GIWW to enable the creation of a delta lobe within the Terrebonne and Barataria Basins. Sediment enrichment of this diversion, using a 30-inch dredge for three months yielding 6,293, 000 yd^3 each year, would also be considered. Significant feasibility-level investigation would be required to determine its effects on flood control, drainage, navigation, and environmental impacts.

Post-authorization change for diversion of water through IHNC Lock calls for a post-authorization modification of the Inner Harbor Navigation Canal Lock. Modifications would incorporate culverts and controls to divert freshwater through the IHNC to the wetlands downstream of that structure. The proposed modifications would reduce salinities and increase nutrient supply to the affected intermediate and brackish marshes.

Upper Atchafalaya Basin Study, including evaluation of modified operational scheme of Old River Control Structure (ORCS) would alter that structure's operational plan to increase the sediment load transported down the Atchafalaya River. Detailed studies would determine impacts (beneficial and adverse) to the interior of the Atchafalaya Basin, the distribution of the additional flow and sediment, and the increased costs of maintaining the flood control, navigation, and environmental features along the Lower Mississippi, Red, and Atchafalaya Rivers.

The Point Chevreuil Reef Restoration Study provides for rebuilding the historic shell reefs that were removed by shell dredging at the historic Point Chevreuil Reef (which formerly extended toward Marsh Island) and rehabilitating the Bayou Sale natural levee between Point Chevreuil and the Gulf of Mexico. The natural levee would be rebuilt in the form of a shallow sub-aqueous platform, small islands, and/or reefs. This feature would be designed to restore a semblance of the historic hydrologic conditions in the Teche/Vermilion Basin.

The Chenier Plain Freshwater Management and Allocation Reassessment would require detailed investigations involving water allocation needs and trade-off analyses in the eastern Chenier Plain, including the Teche/Vermillion Basin, to provide for wetland restoration, and support continued agriculture and navigation in the region. A series of navigation and salinity control structures are currently authorized and operated in the eastern portion of the Chenier Plain. Those structures maintain a freshwater source for agricultural applications and prevent salinity intrusion in the area. Tidal stages often exceed stages within the managed area, creating an inundation problem for the fresh and intermediate marshes in the area. In addition, the natural ridges that define this area continue to be impacted by erosion, which threatened to reduce continued management and sustainability of the interior marshes. That study must address water management and allocation issues including salinity control, drainage, and fisheries accessibility.

Science and Technology Plan

Although the NTP is based upon the best available science and takes advantage of over 25 years of experience gained through previous Louisiana coastal wetland restoration efforts via CWPPRA and other programs, there remain substantial scientific and engineering uncertainties associated with some of the proposed LCA restoration features.

Accordingly, the Corps and the State of Louisiana propose to develop and implement a Science and Technology Plan to ensure the LCA restoration effort continues to be supported by the best available science, and to resolve scientific and engineering uncertainties associated with the ecological processes of the ecosystem and their response(s) to restoration projects. Potential methods for resolving scientific and engineering uncertainties include the development and implementation of demonstration projects and adaptive management and monitoring.

Demonstration Projects

An integral component of the LCA Science and Technology Plan is the development and implementation of demonstration projects that will further develop engineering techniques, improve understanding of the ecological processes within coastal Louisiana, and provide insights on ecosystem responses associated with proposed restoration projects and features. Proposed demonstration projects are intended to: 1) reduce scientific and engineering uncertainties regarding the effectiveness of particular restoration techniques; 2) test new, innovative technologies and engineering techniques; and, 3) test ecosystem responses to engineering techniques and operational schedules. The proposed demonstration projects include: 1) a small marsh creation project to evaluate the application of saltwater sediments to support long-term sustainable marsh; 2) barrier island restoration to evaluate the effects of different wave environments, and optimize different island dimensions and shoreline protection measures; 3) pipeline conveyance of sediments to maintain land bridges; 4) chenier unit marsh creation; and, 5) Gulf shoreline stabilization near Rockefeller Refuge.

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Beneficial-Use of Dredged Material Program

In addition to the above-listed features, the NTP would also seek from Congress programmatic authority and increased funding for the Corps' Beneficial-use of Dredged Material Program. The New Orleans District Corps annually dredges approximately 71,000,000 cubic yards (yd^3) of material from key navigation channels and waterways in coastal Louisiana. Approximately 42 percent of those dredged sediments, or approximately 30,000,000 yd^3, are used to restore, protect, and/or create aquatic and wetland habitats. Funding limits on that program, however, preclude using the remaining dredged material for ecosystem restoration. By obtaining Congressional authorization and funding for a comprehensive beneficial use of dredged material program under the NTP, a significant increase in the quantity of dredged sediments could be made available for use in coastal restoration efforts.

EVALUATION OF THE TENTATIVELY SELECTED PLAN

Under no action conditions, a net coastal wetland loss of nearly 463,000 acres would occur by year 50, even with projected gains in the Atchafalaya River Delta (Table 1). Each of the NTP action alternatives would, to varying degrees, reduce that acreage of coastal wetland loss, if implemented. Hence, implementing any of the proposed alternative plans would be preferable to the continued loss and degradation of coastal wetlands under the no-action scenario. Restoration Opportunity 2 (which focuses on restoring geomorphic structures) would have little, if any, effect on habitat type distribution, compared to the No-action Alternative. The river diversion features included in the other two restoration opportunities would likely result in greater amounts of fresh and intermediate marsh, compared to the No-action Alternative. The Service believes that, while both of the Restoration Opportunities 1 (which focuses on restoring deltaic processes) and 2 would have significant environmental benefits, the TSP (which focuses on preventing future land loss, restoring deltaic processes, restoring critical geomorphic structures, and protecting vital socio-economic resources) would provide the greatest fish and wildlife benefits. The TSP would likely best achieve long-term coastal wetland sustainability, because the restored geomorphic structures would help to protect and enhance the diversion feature influence areas from erosive coastal wave action and storm surge. Because sediment diversions are connected to the river resource and continually nourish receiving areas with sediments and nutrients, those features would more effectively achieve a sustainable ecosystem. Based solely on fish and wildlife considerations, those measures would likely be the most beneficial of the three evaluated alternative restoration plans currently under consideration in the NTP.

Proposed TSP features to introduce fresh water from the Mississippi River into the Maurepas Swamp, Upper Breton Sound, and the Mid-Barataria Basin would shift habitat types toward lower-salinity conditions in Subprovinces 1 and 2, compared to taking no action. Those diversions, along with marsh creation, beneficial use of dredged material, and barrier island restoration, would also restore/establish several thousands of acres of wetlands.

At year 50, wetland losses under the No-action Alternative (more than 203,000 acres) would be greater in Subprovince 3 than in any other Subprovince (Table 1). The TSP includes projects to address losses in that area. Gulf shoreline stabilization at Point Au Fer Island and increased conveyance of Atchafalaya River flows to central and eastern portions of the Terrebonne Basin would improve wetland productivity and reduce marsh loss in those areas where marine processes are advancing inland.

The TSP would have a positive effect on wildlife resources by increasing riverine and sediment inputs from the Mississippi River within Subprovinces 1 through 3, in concert with marsh creation in key areas. In combination, those features would help sustain and rejuvenate existing wetland habitats, promote significant landbuilding, and restore fresh and low salinity habitats. Marshes and swamps would be more productive and would provide improved habitat conditions for several species of wildlife.

Coastwide, the TSP would restore marsh-building and marsh-maintenance processes through freshwater and sediment inputs. The TSP would increase coastal wetland acreage compared to taking no action; thus, it would have a major positive impact on most, if not all, of the fish and wildlife resources that utilize those wetlands. The project-related conversion of brackish and saline marshes to fresh and low-salinity marshes would displace brown shrimp, spotted seatrout, and other fishes and shellfishes which prefer more saline habitats. Those displacement impacts would be partially compensated for by project-induced increases in the productivity of remaining high salinity habitats, and by the improved sustainability of those habitats, compared to the No-action Alternative. Additionally, the abundance and productivity of white shrimp, Gulf menhaden, and other fishes and shellfishes which utilize low-salinity habitats may be increased under the preferred plan. Given the continued rapid loss and likely future collapse of brackish and salt marsh systems with no action, however, the TSP may also provide a long-term net benefit to species utilizing those areas. The Service will later recommend specific design and operational measures for incorporation into project features to minimize adverse effects on those resources and increase benefits to other fish and wildlife species, to the greatest extent practical.

Because of the uncertainties regarding some of the currently proposed habitat prediction methodologies, and because many details regarding the design, operation, and associated effects of the TSP are not yet available at the current programmatic level of planning, we cannot complete our evaluation of the TSP's effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information that will be available during those planning implementation phases, will be required so that we can fulfill our responsibilities under that Act. Additionally, improvements in the hydrologic and desktop models will be needed to predict environmental impacts and benefits of plan features, as indicated in our previous draft Fish and Wildlife Coordination Act Report (Paille, R. and K. Roy, September 2003b) for the LCA Comprehensive Study.

FUTURE SERVICE INVOLVEMENT

Because of the LCA's large scope, complexity, and programmatic nature, extensive and continuing funding will be required by the Service to enable our full participation throughout future detailed planning and post-authorization engineering and design studies, and to facilitate fulfillment of our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Accordingly, the Service plans to work closely with the Corps and the State of Louisiana to formulate detailed funding estimates to support our future involvement in the LCA, as provided for in the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Corps and the Service. Given its scope, duration, and significance, the Service will, in cooperation with the New Orleans Corps District, draft and execute an LCA-specific set of operating guidelines for negotiating transfer funds (similar to those used for the Comprehensive Everglades Restoration Plan) to facilitate and expedite our future involvement.

Under provisions of Section 7 of the ESA of 1973, as amended, the Service will also assist the Corps and any other Federal agencies responsible for funding or implementing selected projects and/or plans to ensure that they will neither jeopardize the continued existence of threatened and endangered species, nor adversely modify any designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will tier from the current programmatic consultation, details of which will be contained in the Programmatic Environmental Impact Statement (PEIS) for the NTP. In keeping with the consultation requirements of the ESA, informal and formal (if needed) consultation must be completed before the Record of Decision for the NTP and PEIS can be signed. Accordingly, the Service will continue to work closely with the Corps through the consultation period.

The National Wildlife Refuge System Improvement Act of 1997 mandates that no new or expanded use of a NWR may be allowed unless it is first determined to be compatible with the objectives for which that NWR was established. A compatibility determination is a written determination, indicating that a proposed or existing use of a NWR is, or is not, a compatible use. Compatible uses are defined as proposed or existing wildlife-dependent recreational uses or any other uses of a NWR that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the NWR. A compatibility determination is only required when the Service has jurisdiction over the use. Prior to initiating implementation of an LCA project that would affect any NWR, the Corps should, therefore, contact the appropriate Refuge Manager to determine if the proposed project constitutes a "refuge use" subject to a compatibility determination. To determine the anticipated impacts of any proposed use, the Corps may be required to provide sufficient data and information to document any short-term, long-term, direct, indirect or cumulative impacts on refuge resources. Compatibility determinations will include a public review and comment period before issuance of a final decision by the appropriate Refuge Manager. To facilitate such contacts, the Louisiana Field Office may be contacted at (337) 291-3100.

SUMMARY AND SERVICE POSITION

The Service has actively participated throughout the formulation and evaluation of the LCA coastwide alternatives and the selection of near-term restoration features, the large-scale studies, and the potential demonstration projects that comprise the NTP. Service involvement and input includes the preparation of two previous Draft Fish and Wildlife Coordination Act Reports (Paille, R., and K. Roy, 2003a and 2003b), a letter listing threatened and endangered species within coastal parishes (Appendix A), Service assistance in preparation of the draft Biological Assessment for Comprehensive Plan effects on threatened and endangered species, and a (May 11, 2004) letter affirming our continued participation as a Cooperating Agency in accordance with the implementing regulations of the National Environmental Policy Act of 1969. Those documents are incorporated herein by reference, and should be considered as integral components of the administrative record for the forthcoming PEIS and NTP Report.

Given the substantial adverse future impacts to coastal wetlands and their associated fish and wildlife resources that are expected to occur under future without-project conditions, we strongly support authorization and implementation of the near-term TSP for the NTP, as it would provide the greatest level of sustainable benefits to Louisiana's nationally significant coastal fish and wildlife resources. Accordingly, the Service provides the following procedural recommendations for authorization and implementation of the NTP:

1. In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Service and the Corps, sufficient continuous funding should be provided to the Service to fulfill our responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Funding should cover Service participation in post-authorization engineering and design studies (for demonstration projects and NTP projects) and in the long-term project feasibility studies.

2. The Corps should obtain a right-of-way from the Service prior to conducting any work on a National Wildlife Refuge, in conformance with Section 29.21-1, Title 50, Right-of-way Regulations. Issuance of a right-of-way will be contingent on a determination by the Service's Regional Director that the proposed work will be compatible with the purposes for which the refuge was established.

To ensure that optimum fish and wildlife resource benefits are achieved, the Service plans to remain actively involved throughout the plan implementation process. Our findings and recommendations for each of the projects ultimately approved for implementation will be provided as supplements to this report under the authority of the Fish and Wildlife Coordination Act.

LITERATURE CITED

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APPENDIX A

September 26, 20003, U.S. Fish and Wildlife Service letter identifying Federally listed threatened and endangered species within coastal parishes of Louisiana

United States Department of the Interior

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

September 26, 2003

Colonel Peter J. Rowan
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Rowan:

The Corps of Engineers (Corps), in partnership with various other State, local, and Federal agencies and entities, is preparing a Programmatic Environmental Impact Statement (PEIS) on the Louisiana Coastal Area Comprehensive Coastwide Ecosystem Restoration Study (LCA). In response to a September 23, 2003, request from Mr. Bill Klein of your staff, the U.S. Fish and Wildlife Service (Service) is pleased to provide the following information regarding Federally listed threatened and endangered species, their critical habitat, and migratory birds that may be found in or near the LCA study area. This information will facilitate programmatic Section 7 consultation under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). In addition, we have also included information to facilitate compliance with the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

ESA Information

Seventeen threatened or endangered species, including the Louisiana black bear, West Indian manatee, bald eagle, brown pelican, piping plover, red-cockaded woodpecker, gopher tortoise, ringed map turtle, 5 species of marine turtles, pallid sturgeon, Gulf sturgeon, inflated heelsplitter, and Louisiana quillwort, occur within the four subprovinces comprising the LCA study area. In addition, the Service has designated critical habitat for the piping plover and the Gulf sturgeon.

Following the conclusion of programmatic consultation on the LCA PEIS, the Service will continue to assist the Corps and other Federal agencies responsible for funding or implementing selected LCA projects and/or plans to ensure they will not jeopardize the continued existence of threatened and endangered species, or adversely modify their designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will build upon the programmatic consultation.

Louisiana Black Bear

The threatened Louisiana black bear (*Ursus americanus luteolus*) is primarily associated with forested wetlands; however, it utilizes a variety of habitat types, including marsh, spoil banks, and upland forests. Within forested wetlands, black bear habitat requirements include soft and hard mast for food, thick vegetation for escape cover, vegetated corridors for dispersal, large trees for den sites, and isolated areas for refuge from human disturbance. Remaining Louisiana

black bear populations occur in the Tensas River Basin, the Upper Atchafalaya River Basin, and coastal St. Mary and Iberia Parishes. The primary threats to that species are continued loss of bottomland hardwoods, fragmentation of remaining forested tracts, and human-caused mortality (e.g., illegal killing and accidental collisions with motor vehicles).

Louisiana black bears, particularly pregnant females, normally den from December through April. To further protect denning bears, the Service (through the final listing rule published on January 7, 1992, in Volume 57, No. 4 of the Federal Register) has extended legal protection to candidate or actual den trees. These are defined in the final listing rule as bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa* sp.) with visible cavities, having a diameter at breast height of 36 inches or greater, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies. (Please note that additional information can be found at http://endangered.fws.gov.)

West Indian Manatee

Federally listed as endangered, West Indian manatees (*Trichechus manatus*) occasionally enter Lake Pontchartrain, Lake Maurepas, and their associated coastal waters and streams during the summer months (i.e., June through September). Manatees have also been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. Should the proposed project involve activities in those areas during summer months, further consultation with this office will be necessary. Manatees have also been occasionally observed elsewhere along the Louisiana Gulf coast. They have declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

Bald Eagle

Federally listed as threatened, bald eagles (*Haliaeetus leucocephalus*) nest in Louisiana from October through mid-May. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water in the southeastern Parishes. Areas with high numbers of nests include the Lake Verret Basin south to Houma, the southern marshes/ridge from Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area. Eagles also winter and infrequently nest near large lakes in central and northern Louisiana. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Brown Pelican

Federally listed as endangered, brown pelicans (*Pelecanus occidentalis*) are currently known to nest on Rabbit Island in Calcasieu Lake, Raccoon Point on Isles Dernieres, as well as Queen Bess Island, Plover Island (Baptiste Collette), Wine Island, and islands in the Chandeleur chain. Pelicans change nesting sites as habitat changes occur. Thus, pelicans may also be found nesting on mud lumps at the mouth of South Pass (Mississippi River Delta) and on small islands in St. Bernard Parish. In winter, spring, and summer, nests are built in mangrove trees or other shrubby vegetation, although occasional ground nesting may occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

Piping Plover

Federally listed as threatened, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months, arriving from the breeding grounds as early as late July and remaining until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no, or very sparse, emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependant on a mosaic of sites distributed throughout the landscape, as the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

Red-cockaded Woodpecker

The endangered red-cockaded woodpecker (RCW, *Picoides borealis*) inhabits open, park-like stands of mature (i.e., greater than 60 years of age) pine trees containing little hardwood understory or midstory. RCWs can tolerate small numbers of overstory hardwoods or large midstory hardwoods at low densities found naturally in many southern pine forests, but they are not tolerant of dense hardwood midstories resulting from fire suppression. RCWs excavate roost and nest cavities in large living pines (i.e., 10 inches or greater in diameter at breast height). The cavity trees and the foraging area within 200 feet of those trees are known as a cluster. Foraging habitat is defined as pine and pine-hardwood (i.e., 50 percent or more of the dominant trees are pine trees) stands over 30 years of age that are located within one-half mile of the cluster.

Gopher Tortoise

The threatened gopher tortoise (*Gopherus polyphemus*) is associated with areas that have well-drained, sand or gravel soils appropriate for burrow establishment, ample sunlight for nesting, and understory vegetation suitable for foraging (i.e., grasses and forbs). Gopher tortoises prefer "open" longleaf pine-scrub oak communities that are thinned and burned every few years. They also inhabit existing maintained transmission rights-of-way within Washington, Tangipahoa, and St. Tammany Parishes. The gopher tortoise is the only native tortoise found in the southeastern United States. Habitat degradation (lack of thinning or burning on pine plantations) and conversion to agriculture or urbanization have contributed to the decline of that species. That

habitat decline has concentrated remaining gopher tortoise populations along pipeline and powerline rights-of-way within their range.

Ringed Map Turtle

The threatened ringed map (= sawback) turtle (*Graptemys oculifera*) is endemic to the Pearl River system. In Louisiana, it occurs in the Bogue Chitto River south of Franklinton, and the Pearl River north of Louisiana Highway 190 in St. Tammany and Washington Parishes. It is found in riverine habitats with moderate currents, channels wide enough to permit sunlight penetration for several hours each day, numerous logs for basking, and large, sandy banks, that are used for nesting. Habitat loss (loss of exposed sand bars, basking areas) and water quality degradation (which decreases food supply) have contributed to the decline of this species.

Sea Turtles

Five species of threatened (T) and endangered (E) sea turtles, including the Kemp's ridley sea turtle (*Lepidochelys kempii*; E), green sea turtle (*Chelonia mydas*; T), hawksbill sea turtle (*Eretmochelys imbricata*; E), leatherback sea turtle (*Dermochelys coriacea*; E), and loggerhead sea turtle (*Caretta caretta*; T), forage in the near-shore waters, bays and sounds of Louisiana. Of those species, the two most commonly encountered are the loggerhead and Kemp's ridley sea turtles. The National Marine Fisheries Service is responsible for aquatic marine threatened or endangered species. Eric Hawk (727/570-5312) in St. Petersburg, Florida, should be contacted for additional information concerning those species.

Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered fish found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the Old River Control Structure Complex); it is possibly found in the Red River as well. The pallid sturgeon is adapted to large, free-flowing, turbid rivers with a diverse assemblage of physical habitats that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana. Habitat loss through river channelization and dams has adversely affected this species throughout its range.

Gulf Sturgeon

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

On March 19, 2003, the Fish and Wildlife Service and the National Marine Fisheries Service published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for

the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl River system, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. The primary constituent elements essential for the conservation of Gulf sturgeon are those habitat components that support feeding, resting, sheltering, reproduction, migration, and physical features necessary for maintaining the natural processes that support those habitat components; those elements should be considered when determining potential project impacts. The primary constituent elements for Gulf sturgeon critical habitat include:

- abundant prey items within riverine habitats for larval and juvenile life stages, and within estuarine and marine habitats for juvenile, subadult, and adult life stages;

- riverine spawning sites with suitable substrates for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;

- riverine aggregation areas, also referred to as resting, holding and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions;

- a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging; and necessary for maintaining spawning sites in suitable condition for egg attachment, eggs sheltering, resting, and larvae staging;

- water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;

- sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and

- safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by a permanent structure, or a dammed river that still allows for passage).

Please be aware that the Fish and Wildlife Service is responsible for ESA consultations regarding the Gulf sturgeon and its critical habitat for activities in riverine units. The National Marine Fisheries Service is responsible for ESA consultation regarding the Gulf sturgeon and its critical habitat for Corps activities within estuarine units, and is responsible for all ESA consultations regarding Gulf sturgeon and its critical habitat for activities in marine units.

Inflated Heelsplitter
Federally listed as threatened, the inflated heelsplitter mussel (*Potamilis inflatus*) occurs in the Amite River (Louisiana [with one report in the Pearl River]) and the Tombigbee and Black Warrior Rivers (Alabama). In Louisiana, the mussel occurs between Louisiana Highway 37 and Louisiana Highway 42, with the highest concentrations between Grangeville and Port Vincent. This freshwater mussel is typically found in soft, stable substrates such as sand, mud, silt, and sandy gravel, in slow to moderate currents. Heelsplitter mussels are usually found in depositional pools below sand point bars, and in shallow pools between sandbars and river banks. Major threats to this species in the Amite River are the loss of habitat resulting from sand and gravel dredging, and channel modifications for flood control.

Louisiana Quillwort
Federally listed as an endangered plant species, the Louisiana quillwort (*Isoetes louisianensis*) grows on sand and gravel bars on the accreting sides of streams and moist overflow channels within riparian forest communities in Washington and St. Tammany Parishes, Louisiana. The Louisiana quillwort is a small, semi-aquatic, facultative evergreen plant with spirally arranged leaves (sporophylls) arising from a globose, two-lobed corm. The hollow leaves are transversely septate, and measure approximately 0.12 inch wide and up to 16 inches long. Major threats to this species are habitat loss through hydrologic modifications of stream habitat, and land use practices that significantly alter stream quality and hydrology. Apparently, it is dependent on a special hydrologic regime resulting from the presence of small springs scattered at the bases of banks or bluffs.

MBTA Information
Colonial nesting waterbirds are protected under the MBTA. Colonies that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries may also be present. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect individual proposed project areas for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on individual proposed projects should be observed:

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

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

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and avoid impacting them during the breeding season.

We appreciate the Corps' continued cooperation in the conservation of threatened and endangered species and migratory birds. If your staff have any questions or need further information, please have them contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

Russell C. Watson
Acting Supervisor
Louisiana Field Office

cc: NOAA Fisheries, St. Petersburg, FL
LDWF, Natural Heritage Program, Baton Rouge, LA

APPENDIX B

Descriptions of the Near-Term Restoration Project Concepts

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Small Diversion at Hope Canal consists of a small freshwater diversion through a newly constructed control structure at Hope Canal. The objective is to introduce sediments and nutrients into Maurepas Swamp south of Lake Maurepas. The introduction of additional freshwater via the proposed diversion would facilitate organic deposition, improve biological productivity, and prevent further deterioration of the swamp.

Small Diversion at Convent/Blind River consists of a small freshwater diversion into Blind River through a new control structure. The objective of this feature is to introduce sediments and nutrients into the southeast portion of Maurepas Swamp. This feature would operate in conjunction with the Hope Canal freshwater diversion to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

Increase Amite River Influence by Gapping Spoil Banks consists of gapping the existing spoil banks of the Amite River Diversion Canal. The objective of this project is to introduce additional nutrients and sediment into western Maurepas Swamp primarily during flood events and localized rainfall events. This feature would provide nutrients and sediment to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

MRGO Environmental Restoration involves the implementation of the environmental restoration features under consideration by the MRGO Environmental Restoration Study. In response to public concerns, past environmental effects, and national economic development considerations, an ongoing study is re-evaluating the viability of operation and maintenance of this feature. Since the construction of the MRGO, saltwater intrusion has degraded large expanses of freshwater marshes and accelerated habitat switching from freshwater marshes to brackish and intermediate marshes in the Biloxi marshes, the Central Wetlands, and the Golden Triangle wetlands. This study will evaluate the stabilization of the MRGO banks and various environmental restoration projects that would reduce saltwater intrusion into Lake Pontchartrain, the Biloxi marshes, the Central Wetlands, and the Golden Triangle marshes. Implementation should result in hydrologic restoration via implementation of environmental mitigations recommended in the Mississippi River Gulf Outlet (MRGO) Study.

The Caernarvon Diversion, constructed in 1992 near the Breton Sound marshes, has been operated to manage salinities in the central Breton Sound estuary through the introduction of freshwater at rates ranging between 1,000 cubic feet per second (cfs) and 8,000 cfs. This restoration project would seek a post-authorization change to the original project purpose to include wetland creation and restoration via increasing freshwater introduction rates, up to perhaps 5,000 cfs on average, to provide greater wetland-building function. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Medium Diversion at Whites Ditch, located at White's Ditch downstream of the Caernarvon diversion structure, would implement a medium diversion into central River aux Chene area through the construction and operation of a new water control structure. The objective of this project is to provide additional freshwater, nutrients, and fine sediments to the area between the

Mississippi River and River aux Chene ridge which is currently isolated from the beneficial effects of the Caernarvon freshwater diversion. The introduction of additional freshwater would facilitate organic sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Reauthorization of the Davis Pond Diversion for increased sediment input. The Davis Pond Freshwater Diversion structure, constructed in 2002 in the upper Barataria Basin, has been operated as to control central basin salinities through freshwater introductions ranging between 1,000 cfs to 10,000 cfs. This restoration feature would seek a re-authorization of the original project purpose to include wetland creation. To achieve this goal, the freshwater introduction rate would be increased up to perhaps 5,000 cfs on average, to accelerate wetland-building functions. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Medium Diversion with Dedicated Dredging at Myrtle Grove consists of a medium freshwater diversion near Myrtle Grove through a new control structure. The diversion would provide additional sediment and nutrients to nourish highly degraded existing fresh to brackish wetlands and shallow, open-water areas. This would ensure the long-term sustainability of these marshes by increasing vegetative productivity and preventing future loss. The introduction of sediment to this area would also promote the infilling of shallow, open-water areas through both deposition and marsh expansion. This diversion would be complimented by dedicated dredging of sediment mined from the Mississippi River. The objective of the component is to create 1,500 acres of additional wetlands by placing dredged sediments in the shallow, open-waters within the fragmented marsh.

Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island consists of mining offshore sediments to re-create eroded barrier islands. Based on designs developed in the LCA Barrier Island Restoration Study, a 3,000-foot-wide island footprint would be restored.

Terrebonne Basin Barrier Shoreline Restoration-Isles Derniere and East Timbalier consists of restoring some of the Timbalier and Dernieres barrier island chains. This restoration would simulate historical conditions by reducing the current number of breaches, and enlarging the width and dune crest of the Isles Dernieres (East Island, Trinity Island, and Whiskey Island) and East Timbalier Island.

Small Bayou Lafourche Reintroduction would reintroduce flow from the Mississippi River into Bayou Lafourche. The proposed year-round flows would provide water supply benefits and reduce marsh-loss rates for the wetlands south of the GIWW, between Bayous Lafourche and Terrebonne.

Gulf Shoreline Stabilization at Point au Fer Island would stabilize the Gulf shoreline of Point au Fer Island to prevent direct connections from forming between the Gulf and interior water bodies as that shoreline erodes. In addition to Gulf shoreline protection, this feature would reduce marine influence on fresher Atchafalaya Bay water, protecting the adjacent wetland habitats from saltwater impacts.

Multi-purpose Operation of Houma Navigation Canal (HNC) Lock consists of operation of the proposed Houma Navigation Canal Lock located at the southern end of the HNC, for multiple purposes, rather than for navigation only. The Corps' Morganza to the Gulf Hurricane Protection Study includes construction of the lock, but does not include the multi-purpose operation of the lock. This restoration feature would reduce saltwater intrusion, modify water circulation in the HNC to increase the distribution of Atchafalaya River water within Terrebonne Basin wetlands, especially within the Lake Boudreaux area wetlands to the north; the Lake Decade wetlands to the west; and the Grand Bayou wetlands to the east.

Convey Atchafalaya River Water to Terrebonne marshes includes a number of features to improve the distribution and supply of freshwater to deteriorated Terrebonne Basin marshes via the Gulf Intracoastal Waterway (GIWW). Construction of new channels and enlargement of existing channels would increase seasonal flows of Atchafalaya River water to central (Lake Boudreaux) and eastern (Grand Bayou) Terrebonne marshes. All channel alternatives would include a gated control structure to restrict saltwater intrusion during low river stages. Project features to increase the supply of Atchafalaya River within the GIWW include repairing banks along the GIWW, enlarging constrictions in the GIWW, and diverting additional freshwater from Bayou Shaffer into Avoca Island Lake. Those conveyance features would increase suspended sediment supply to Bayou Penchant and other wetlands receiving the Atchafalaya River water via the GIWW.

Maintain Land Bridge between Caillou Lake and Gulf of Mexico by installing shore protection along deteriorated portions of Grand Bayou DuLarge to prevent establishment of a major new hydrologic connection between the Gulf and Sister Lake. Some shore armoring would likely be needed to protect these features from erosion on the Gulf shoreline. A more systemic and comprehensive solution would involve a much greater amount of Gulf shoreline armoring, especially toward the west where shoreline retreat and loss of shoreline oyster reefs has allowed for increased water exchange between the Gulf and the interior waterbodies (i.e., between Bay Junop and Caillou Lake). Some of the newly opened channels would be closed to restore the historic cross-sections of exchange points. By reducing marine influences in these interior areas, these features might also allow increased riverine influences from Four League Bay to benefit area marshes.

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APPENDIX B6

Final

U.S. FISH AND WILDLIFE COORDINATION ACT REPORT

LCA Near-Term Plan

United States Department of the Interior

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

October 6, 2004

Colonel Peter J. Rowan
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Rowan:

Enclosed is our programmatic Fish and Wildlife Coordination Act Report on the Near-Term Ecosystem Restoration Plan for the Louisiana Coastal Area (LCA), Louisiana, Feasibility Study. Comments received from the National Oceanographic and Atmospheric Administration – National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries on our May 2004 Draft Fish and Wildlife Coordination Report are included in the enclosed report which constitutes the final programmatic-level report of the Secretary of the Interior, as required by Section 2(b) Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This report should be appended to, and its recommendations addressed in, your forthcoming main report on the LCA study.

Should your staff have any questions regarding the enclosed report, please have them contact Ms. Catherine Grouchy (504/862-2689) of this office.

Sincerely,

Russell C. Watson
Supervisor
Louisiana Field Office

Enclosure

cc: Fish and Wildlife Service, Atlanta, GA (AES)
National Marine Fisheries Service, Baton Rouge, LA
Environmental Protection Agency, Baton Rouge, LA
Natural Resources Conservation Service, Alexandria, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CRD & CMD), Baton Rouge, LA

NEAR-TERM ECOSYSTEM RESTORATION PLAN FOR THE LOUISIANA COASTAL AREA

FISH AND WILDLIFE COORDINATION ACT REPORT

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

OCTOBER 2004

NEAR-TERM ECOSYSTEM RESTORATION PLAN FOR THE LOUISIANA COASTAL AREA

FISH AND WILDLIFE COORDINATION ACT REPORT

PROVIDED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY
CATHERINE GROUCHY, FISH AND WILDLIFE BIOLOGIST
AND
RONNY PAILLE, SENIOR FIELD BIOLOGIST

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

OCTOBER 2004

EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (Service) has prepared the following programmatic Fish and Wildlife Coordination Act Report for inclusion in the U.S. Army Corps of Engineers' (Corps) forthcoming final Near-term Ecosystem Restoration Plan (NTP) for the Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Feasibility Study. The purpose of that study is to determine the feasibility of sustaining a coastal ecosystem that supports and protects the environment, economy, and culture of southern Louisiana, and that contributes greatly to the economy and well-being of the nation. Although the NTP is largely programmatic, it is a critically important component of continuing cooperative Federal-State efforts to address the continued loss of Louisiana's coastal wetlands. The NTP, together with its supporting documentation (including this report), will be the basis upon which the Corps will request further authorization and funding from Congress to more comprehensively and sustainably address that issue.

The study area includes all of Louisiana's coastal wetlands. Those wetlands, which support nationally important fish and wildlife resources, are being lost at an average rate of approximately 24 square miles per year due to a variety of causes. The NTP, developed by the Corps, the State of Louisiana, and the other cooperating Federal agencies, identifies the first 10-year increment of highly effective restoration features targeting critical ecological need areas - those areas of the coast plagued by the greatest ecosystem degradation, and those with the greatest potential for ecosystem recovery and infrastructure protection, as well as large-scale, long-term restoration features.

Each of the three major NTP action alternatives would, to varying degrees, reduce coastal wetland loss. Hence, implementing any of the proposed action plans would be preferable to the continued loss and degradation of coastal wetlands under the no-action scenario. The Tentatively Selected Plan (TSP) encompasses a variety of restoration strategies such as freshwater and sediment diversions, interior shoreline protection, barrier island and barrier headland protection, and beneficial use of dredged material/marsh restoration. The Service believes that the TSP - which focuses on preventing future land loss, restoring deltaic processes, restoring critical geomorphic structures, and protecting vital socio-economic resources - would provide the greatest fish and wildlife benefits, and would best achieve long-term sustainability of Louisiana's coastal wetland ecosystem.

Coastwide, the TSP would restore marsh-building and marsh-maintenance processes through freshwater and sediment inputs. The TSP would increase coastal wetland acreage compared to taking no action; thus, it would have a major positive impact on most, if not all, of the fish and wildlife resources that utilize those wetlands. The project-related conversion of some brackish and saline marshes to fresh and low-salinity marshes would displace brown shrimp, spotted seatrout, and other fishes and shellfishes which prefer more saline habitats. Additionally, the abundance and productivity of white shrimp, Gulf menhaden, and other fishes and shellfishes which utilize low-salinity habitats would likely be increased under the preferred plan. Given the continued rapid loss and likely future collapse of brackish and salt marsh systems with no action, the TSP may also provide a long-term net benefit to species utilizing those areas. Accordingly,

the Service recommends that, to the greatest extent practicable during future planning iterations, design and operational measures be refined and incorporated into project features to minimize adverse effects on those resources and to increase benefits to other fish and wildlife species.

Because of the uncertainties regarding some of the currently proposed habitat prediction methodologies, and because many details regarding the design, operation, and associated effects of the TSP are not yet available at the current programmatic level of planning, we cannot complete our evaluation of the individual TSP features' effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) for each of those features. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information that will be available during those planning phases, will be required so that we can fulfill our responsibilities under that Act. Additionally, improvements in the hydrologic and desktop models will be needed to predict environmental impacts and benefits of individual plan features, as indicated in our previous draft Fish and Wildlife Coordination Act Reports (Paille and Roy 2003b, Grouchy and Paille 2004).

The Service has actively participated throughout the formulation and evaluation of the LCA coastwide alternatives and the selection of near-term restoration features, as well as the large-scale studies and the demonstration projects that comprise the TSP. Given the substantial adverse future impacts to coastal wetlands and their associated fish and wildlife resources under future without-project conditions, we strongly support programmatic authorization and implementation of the TSP, as it would provide the greatest level of benefits to Louisiana's nationally significant fish and wildlife resources.

To expedite construction of restoration measures, the TSP proposes the programmatic authorization of five projects, including the Small Bayou Lafourche Diversion Project. The coastal wetland restoration benefits of that project would be synergistically enhanced within eastern Terrebonne Basin critical needs areas by simultaneously constructing the Grand Bayou area features of the Convey Atchafalaya River Water to Northern Terrebonne Basin Project. Accordingly, post-authorization studies for the Bayou Lafourche Project should, to the maximum extent practicable, incorporate those potentially synergistic features.

In support of the TSP, and to expedite its implementation, the Service provides the following technical and procedural recommendations for future authorization and implementation of the TSP:

1. In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Service and the Corps, sufficient continuous funding should be provided to the Service to fulfill our responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act throughout post-

authorization engineering and design studies for demonstration projects, participation in the Science and Technology Program, NTP projects, and planning and evaluation for long-term project feasibility studies. To facilitate that level of cooperation, the Service intends to negotiate an LCA-specific Memorandum of Agreement with the Corps (similar to that used for Florida's Everglades Restoration study) soon after the NTP is authorized.

2. The Corps should coordinate closely with individual refuge managers prior to conducting any work on a National Wildlife Refuge, in conformance with the National Wildlife Refuge System Improvement Act of 1997. Such coordination will be essential to the timely completion of the Service's determination that the proposed work will/will not be compatible with the purposes for which those refuges were established, and to secure any appropriate permits that may be required. Likewise, LCA activities occurring on State-administered Wildlife Management Areas or refuges should also be fully coordinated with the Louisiana Department of Wildlife and Fisheries.

3. The proposed Science and Technology Program should give high priority to refining the land gain/loss and habitat change models to enable determination of and evaluation of project-level effects and facilitate completion of FWCA reporting.

4. For purposes of maximizing synergistic wetland restoration benefits within the eastern Terrebonne Basin critical needs area, the post-authorization studies for the proposed Small Bayou Lafourche Diversion Project should, to the maximum extent possible, incorporate key Grand Bayou-area features of the Convey Atchafalaya River Water to Northern Terrebonne Basin Project.

To ensure that optimum fish and wildlife resource benefits are achieved, the Service plans to remain actively involved throughout the plan implementation process. Our findings and recommendations for each of the projects ultimately approved for implementation will be provided in draft and final supplements to this programmatic report under the authority of the Fish and Wildlife Coordination Act.

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INTRODUCTION

The Near-term Ecosystem Restoration Plan (NTP) for the Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Feasibility Study has been prepared by the New Orleans District Corps of Engineers (Corps), Louisiana Department of Natural Resources, and other State and Federal natural resource agencies, with the assistance of scientists from several institutions. The LCA study was originally authorized by Resolutions adopted by the U.S. House of Representatives and Senate Committees on Public Works, on October 19, 1967, and April 19, 1967, respectively. Those resolutions sought to improve existing hurricane protection features and the ". . . prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resource purposes."

As currently formulated, the LCA is envisioned as the mechanism for developing and implementing a program to achieve system-wide sustainable restoration of Louisiana's coastal wetlands. That program would maximize use of restoration strategies that promote the reintroduction of riverine fresh water, nutrients, and sediments, and that would maintain the structural integrity of the estuarine basins. The program's near-term component would also include a process to develop better techniques for meeting the critical needs of the ecosystem and to advance our understanding of the coastal ecosystem. To put the scope and significance of the LCA in proper perspective, it is important to understand the magnitude of the problems to which it will respond, as well as the unprecedented level of cooperative efforts that have already been undertaken to address those problems.

In 1990, passage of the Coastal Wetlands Planning, Protection and Restoration Act, (PL-101-646, Title III, CWPPRA) provided authorization and funding for the Louisiana Coastal Wetlands Conservation and Restoration Task Force to initiate actions to curtail the annual loss of approximately 24 square miles per year of Louisiana's coastal wetlands. In 1998, after extensive studies and construction of a number of coastal restoration projects had been accomplished under CWPPRA, the State of Louisiana and the Federal agencies charged with restoring and protecting the remainder of Louisiana's valuable coastal wetlands developed the "Coast 2050: Toward a Sustainable Coastal Louisiana" report, popularly known as the *Coast 2050 Plan*. In recognition of the national significance of Louisiana's coastal wetlands, that plan proposed ecosystem restoration strategies and efforts larger in scale than any previously implemented, including restoration of the natural processes that built and maintained coastal Louisiana.

In 2000, the Corps used the *Coast 2050 Plan* as the basis for a section 905(b) reconnaissance report intended to gain approval for a coastwide feasibility study, the purpose of which would be to obtain Water Resources Development Act authorization of, and funding for, a comprehensive coastal wetlands restoration plan to include projects larger in scope than any implemented under CWPPRA. In 2000, it was envisioned that a series of feasibility reports would be prepared over a 10-year period. The first of those feasibility efforts focused on the Barataria Basin and involved marsh creation and barrier shoreline restoration.

By Fiscal Year (FY) 2002, however, it had become widely recognized that, despite the excellent progress of other programs, a much more comprehensive approach - one that could be submitted to Congress as a blueprint for future restoration efforts - would be needed to effectively address Louisiana's coastal wetland loss. As a result, the Corps and the State of Louisiana initiated the LCA Comprehensive Coastwide Ecosystem Restoration Study (LCA Comprehensive Study), an interagency planning effort to develop a comprehensive plan to restore Louisiana's coastal ecosystem. Although they were not publicly released, a preliminary Draft LCA Comprehensive Study Report and preliminary Draft Programmatic Environmental Impact Statement (PEIS) were subsequently prepared. Associated with those documents, the Service provided a Draft Fish and Wildlife Coordination Act Report (Paille and Roy 2003a). Immediately thereafter, the Corps and the local sponsor revised those documents to describe seven action alternatives, although a preferred alternative was not identified. Subsequently, the Service prepared a revised Draft Fish and Wildlife Coordination Act Report (Paille and Roy 2003b). Following review by the Office of Management and Budget and the Council on Environmental Quality, public release of that draft LCA Comprehensive Study Report was deferred pending revisions to satisfy FY 2005 administrative budget guidance. Key elements of that guidance included requirements to: 1) identify the most critical ecological needs of the coastal area; 2) identify projects to address these needs that provide a very high return in net benefits (non-monetary and monetary) per dollar of cost; 3) present and evaluate alternatives for meeting those needs; 4) identify the key long-term scientific uncertainties and engineering challenges facing the effort to protect and restore the ecosystem; and, 5) propose a strategy for resolving the identified challenges.

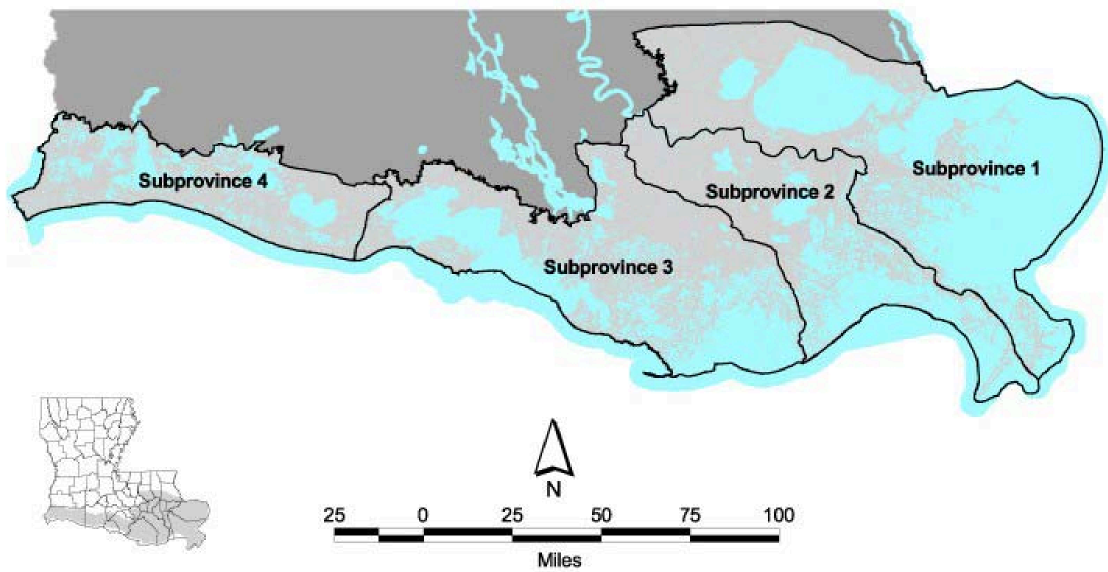
In a coordinated response to that guidance, the Corps, the State of Louisiana, and the other cooperating Federal agencies (including the Service), re-focused the previous draft comprehensive ecosystem restoration plan into the current NTP. The NTP identifies the first 10-year increment of highly effective restoration features targeting critical ecological need areas—those areas of the coast plagued by the greatest ecosystem degradation, and those with the greatest potential for ecosystem recovery and infrastructure protection, as well as a science and technology (S&T) program, potential demonstration projects, programmatic authority for the beneficial use of dredged material, programmatic authority to initiate studies of modifications to existing water control structures, and large-scale, long-term restoration features. The balance of this report [originally released in draft (Grouchy and Paille 2004)] documents the Service's programmatic assessment of the NTP and provides our position on, and recommendations for future planning and implementation of the NTP and its features.

DESCRIPTION OF THE STUDY AREA

The study area encompasses all of Louisiana's coastal wetlands, which include natural levee forest, swamp, fresh marsh, intermediate marsh, brackish marsh, saline marsh, and barrier islands. The study area is divided into four subprovinces (Figure 1), each of which includes one or more coastal watersheds. The LCA subprovinces are very similar to those identified under the *Coast 2050 Plan* (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998), except that the boundary between Subprovinces 1 and 2 has been relocated from the Mississippi River-Gulf Outlet to the Mississippi River under the LCA.

Subprovince 1 consists of all coastal wetlands east of the Mississippi River (and South Pass) and includes the Pontchartrain and Breton Sound Basins. Subprovince 2 consists of the coastal wetlands between the Mississippi River and Bayou Lafourche (i.e., the Barataria Basin). Subprovince 3 extends from Bayou Lafourche westward to the Freshwater Bayou Canal and includes the Terrebonne, Atchafalaya, and Teche/Vermilion Basins. Subprovince 4 extends from the Freshwater Bayou Canal westward to the Louisiana State line (i.e. the Sabine River/Sabine Lake) and includes the Mermentau and Calcasieu/Sabine Basins.

Figure 1. LCA Near-term Ecosystem Restoration Plan Study Area.



EXISTING FISH AND WILDLIFE RESOURCES

<u>Description of Habitats</u>

Forested Wetlands - Forested wetlands in the study area consist primarily of bottomland hardwood forests and cypress-tupelo swamps. Bottomland hardwood forests found in coastal portions of the project area occur primarily on the natural levees of distributary channels. Dominant vegetation may include sugarberry, water oak, live oak, bitter pecan, black willow, American elm, Drummond red maple, Chinese tallow-tree, boxelder, green ash, baldcypress, and elderberry. Cypress-tupelo swamps are located along the flanks of larger distributary ridges as a transition zone between bottomland hardwoods and lower-elevation marsh or scrub-shrub habitats. Cypress-tupelo swamps exist where there is little or no salinity and (usually) minimal daily tidal action.

Scrub-Shrub - Scrub-shrub habitat is often found along the flanks of distributary ridges. Typically, it is bordered by marsh at lower elevations and by developed areas, cypress-tupelo swamp, or bottomland hardwoods at higher elevations. Typical scrub-shrub vegetation includes elderberry, wax myrtle, buttonbush, black willow, Drummond red maple, Chinese tallow-tree, and groundselbush.

Fresh Marsh - Fresh marshes occur at the upper ends of interdistributary basins and are often characterized by floating or semi-floating organic soils. Most fresh marshes exhibit minimal daily tidal action; however, fresh marshes in the Mississippi and Atchafalaya River deltas and adjacent to Atchafalaya Bay are the exceptions. Vegetation may include maidencane, bulltongue, cattail, California bulrush, pennywort, giant cutgrass, American cupscale, spikerushes, bacopa, and alligatorweed. Associated open-water habitats may often support extensive beds of floating-leaved and submerged aquatic vegetation including water hyacinth, Salvinia, duckweeds, American lotus, white water lily, water lettuce, coontail, Eurasian milfoil, hydrilla, pondweeds, naiads, fanwort, wild celery, water stargrass, elodea, and others.

Intermediate Marsh - Intermediate marshes are a transitional zone between fresh and brackish marshes, and are often characterized by organic, semi-floating soils. Typically, intermediate marshes experience low levels of daily tidal action. Salinities are negligible or low throughout much of the year, with salinity peaks occurring during late summer and fall. Vegetation includes saltmeadow cordgrass, deer pea, three-cornered grass, cattail, bulltongue, California bulrush, seashore paspalum, wild millet, fall panicum, and bacopa. Ponds and lakes within the intermediate marsh zone often support extensive submerged aquatic vegetation including southern naiad, Eurasian milfoil, and wigeongrass.

Brackish Marsh - Brackish marshes are characterized by low-to-moderate daily tidal energy and by soils ranging from firm mineral soils to organic semi-floating soils. Freshwater conditions may prevail for several months during early spring; however, low-to-moderate salinities occur during much of the year, with peak salinities in the late summer to fall. Vegetation is usually dominated by saltmeadow cordgrass, but also includes saltgrass, three-cornered grass, leafy three-square, and deer pea. Shallow brackish marsh ponds occasionally support abundant beds of wigeongrass.

Saline Marsh - Saline marshes occur along the southern fringe of the coastal wetlands. Those marshes usually exhibit fairly firm mineral soils and experience moderate to high daily tidal energy. Vegetation is dominated by saltmarsh cordgrass, but may also include saltgrass, saltmeadow cordgrass, black needlerush, and leafy three-square. Submerged aquatic vegetation is rare. Within the study area, intertidal mud flats are most common in saline marshes.

Ponds and Lakes - Natural marsh ponds and lakes interspersed throughout the coastal wetlands are typically shallow, ranging in depth from 6 inches to more than 2 feet. The smaller ponds are typically shallow and the larger lakes are deeper. In fresh and low-salinity areas, ponds and lakes may support varying amounts of submerged and/or floating-leaved aquatic vegetation. Brackish and, much less frequently, saline marsh ponds and lakes may support wigeongrass beds.

Canals and Bayous - Canals and larger bayous typically range in depth from 4 or 5 feet, to more than 15 feet. Strong tidal flows may occur at times through those waterways, especially where they provide hydrologic connections to other large waterbodies. Such canals and bayous may have mud or clay bottoms that range from soft to firm. Dead-end canals and small bayous are typically shallow and their bottoms may be filled to varying degrees with semi-fluid organic material. Erosion, due to wave action and boat wakes, together with shading from overhanging woody vegetation, may retard the amount of intertidal marsh vegetation growing along the edges of those waterways.

Navigation Channels - A number of large (300-feet-wide or more) navigation channels have been dredged across Louisiana's coastal zone. Such channels include the Sabine-Neches Waterway, the Calcasieu Ship Channel, the Freshwater Bayou Channel, the Houma Navigation Canal, the Barataria Waterway, and the Mississippi River Gulf Outlet. Such channels may range in depth from 15 feet to over 40 feet, and often cut through natural distributary ridges and disrupt local hydrology by increasing tidal exchange, saltwater intrusion, and freshwater discharge rates. The Gulf Intracoastal Waterway traverses the coastal zone from east to west and has also caused hydrologic disruptions. Boat wakes and water displacement surges from the passage of large vessels have resulted in severe erosion of adjoining marshes in some locations.

Developed Areas - Most developed areas are located on higher elevations of former distributary channels and are typically well-drained. They include agricultural lands, and commercial and residential developments.

Fishery Resources

Wetlands throughout the study area abound with small resident fishes and shellfishes such as least killifish, rainwater killifish, sheepshead minnow, mosquitofish, sailfin molly, grass shrimp, and others. Those species are typically found along marsh edges or among submerged aquatic vegetation, and provide forage for a variety of fish and wildlife. Fresh and low-salinity marshes provide habitat for commercially and recreationally important resident freshwater fishes such as largemouth bass, yellow bass, black crappie, bluegill, redear sunfish, warmouth, blue catfish, channel catfish, buffalo, freshwater drum, bowfin, and gar. Freshwater fishes may also utilize low-salinity areas (intermediate marsh zone), provided they have access to fresher areas during periods of high salinity.

Louisiana's coastal marshes also provide nursery habitat for many estuarine-dependent commercial and recreational fishes and shellfishes. Because of the protection and abundant food afforded by those wetlands, they are critical to the growth and production of species such as blue crab, white shrimp, brown shrimp, Gulf menhaden, Atlantic croaker, red drum, spotted seatrout, black drum, sand seatrout, spot, southern flounder, striped mullet, and others. Those species are generally most abundant in the brackish and saline marshes; however, blue crab, Gulf menhaden, Atlantic croaker, and several other species also utilize fresh and low-salinity marshes.

Because tidal marshes provide essential nursery habitat, commercial shrimp harvests are positively correlated with the area of tidal emergent wetlands, but not open-water areas (Turner 1977 and 1982). Future commercial harvests of shrimp and other fishes and shellfishes could be adversely impacted by the high rates of marsh loss throughout the study area (Turner 1982).

The American oyster also occurs throughout much of the brackish and saline marsh zones within the study area. Oyster harvesting constitutes a valuable fishery in the northern portions of that zone, where salinities range from 10 to 15 parts per thousand (ppt).

Essential Fish Habitat

The generic amendment to Gulf of Mexico Fishery Management Plans identifies Essential Fish Habitat in the project area to be intertidal emergent wetlands, submerged aquatic vegetation, estuarine waters, and mud, sand, and shell water bottoms. Habitat Areas of Particular Concern have not been identified for the project area. Under the Magnuson-Stevens Fishery Conservation and Management Act, the Gulf of Mexico Fishery Management Council has determined that project-area habitats are utilized by federally managed species such as brown shrimp, white shrimp, red drum, red snapper, Spanish mackerel, and bluefish. Although those species utilize the project area primarily as nursery habitat, all life stages may occur therein. When they move to offshore waters, blue crabs and other species of fishes and shellfishes that utilize project-area estuarine habitats may also provide forage for Federally managed marine fishes such as groupers, snappers, mackerel and highly migratory species (e.g., billfishes and sharks) managed by the NOAA - National Marine Fisheries Service.

Wildlife Resources

Numerous species of birds utilize the study-area marshes, including large numbers of migratory waterfowl. Project-area fresh and intermediate marshes provide excellent wintering habitat for migratory waterfowl, especially puddle (dabbling) ducks. Brackish marshes with abundant submerged aquatic vegetation may also support large numbers of puddle ducks. Puddle ducks that commonly migrate to, or through, the study area include mallard, gadwall, northern pintail, blue-winged teal, green-winged teal, American wigeon, wood duck, and northern shoveler. The resident mottled duck and wood duck also utilize project-area coastal marshes for nesting, feeding, and brood-rearing. Diving ducks prefer larger ponds, lakes, and open-water areas. Common diving duck species include lesser scaup, ruddy duck, canvasback, redhead, ringnecked duck, red-breasted merganser, and hooded merganser. The lesser snow goose and the white-fronted goose also utilize coastal marshes as wintering habitat. Other migratory game birds found in Louisiana's coastal marshes include the king rail, clapper rail, Virginia rail, sora, American coot, common moorhen, and common snipe.

Marshes and associated shallow, open-water areas also provide habitat for a number of wading birds, shorebirds, seabirds, and other nongame birds. Common wading birds include the little blue heron, great blue heron, green-backed heron, yellow-crowned night heron, black-crowned night heron, great egret, snowy egret, cattle egret, reddish egret, white-faced ibis, white ibis, and roseate spoonbill. Shorebirds include the killdeer, American avocet, black-necked stilt, common snipe, and various species of plovers and sandpipers. Seabirds include white pelican, endangered brown pelican, black skimmer, herring gull, laughing gull, and several species of terns. More than 190 wading and seabird nesting colonies have been identified within coastal Louisiana during surveys conducted in 1983, 1990, and 2001 (Michot et al. 2003). Other nongame birds, such as boat-tailed grackle, red-winged blackbird, seaside sparrow, olivaceous cormorant, northern harrier, belted kingfisher, and sedge wren, also utilize coastal-area habitats.

Common mammals occurring in the coastal marshes include nutria, muskrat, mink, river otter, raccoon, swamp rabbit, white-tailed deer, and coyote. Muskrat and river otter prefer brackish marsh. Nutria, mink, swamp rabbit, and white-tailed deer prefer fresh marsh and low salinity habitats. Saline marsh provides very poor habitat for the above listed species. For muskrat, however, saline marsh may provide fair-to-poor habitat quality.

Reptiles are most abundant in fresh and low-salinity coastal wetlands. Common species include the American alligator, western cottonmouth, water snakes, mud snake, speckled kingsnake, ribbon snakes, rat snakes, red-eared turtle, common snapping turtle, alligator snapping turtle, mud turtles, and softshell turtles. Amphibians commonly found in those areas include the bullfrog, pig frog, bronze frog, leopard frog, cricket frogs, tree frogs, chorus frogs, three-toed amphiuma, sirens, and several species of toads. In brackish and saline marshes, reptiles are limited primarily to the American alligator and the diamond-backed terrapin, respectively.

Coastal forested and scrub-shrub wetlands provide key habitats for songbirds such as the mockingbird, yellow-billed cuckoo, northern parula, yellow-rumped warbler, prothonotary warbler, white-eyed vireo, Carolina chickadee, and tufted titmouse. Those areas also provide vitally important resting and feeding areas for songbirds migrating across the Gulf of Mexico. Other avian species found in forested wetlands include the American woodcock, common flicker, brown thrasher, white-eyed vireo, belted kingfisher, loggerhead shrike, pileated woodpecker, red-headed woodpecker, downy woodpecker, common grackle, common crow, and mockingbird.

Forested habitats and associated waterbodies also support raptors such as the red-tailed hawk, red-shouldered hawk, osprey, American kestrel, Mississippi kite, northern harrier, screech owl, great horned owl, and barred owl. Wading bird colonies typically occur in cypress swamp and scrub-shrub habitats. Species found in those nesting colonies include anhinga, great egret, great blue heron, black-crowned night heron, tricolored heron, little blue heron, cattle egret, snowy egret, white-faced and glossy ibises, and reddish egret. Resident and migratory waterfowl species found in forested wetlands and adjacent waterbodies in the project area include, but are not limited to, wood duck, mallard, green-winged teal, gadwall, and hooded merganser.

Game mammals associated with coastal forested wetlands include eastern cottontail, swamp rabbit, gray and fox squirrels, and white-tailed deer. Commercially important furbearers include river otter, muskrat, nutria, mink, and raccoon. Other mammals found in forested wetlands include striped skunk, coyote, Virginia opossum, bobcat, armadillo, gray fox, and red bat. Smaller mammal species serve as forage for both mammalian and avian carnivores and include the cotton rat, marsh rice rat, white-footed mouse, eastern wood rat, harvest mouse, least shrew, and southern flying squirrel.

Reptiles, which utilize study area bottomland hardwoods, cypress swamps, and associated shallow waters, include the American alligator, ground skink, five-lined skink, broadbanded skink, green anole, Gulf coast ribbon snake, yellow-bellied water snake, speckled kingsnake, southern copperhead, western cottonmouth, pygmy rattlesnake, broad-banded water snake, diamond-backed water snake, spiny softshell turtle, red-eared turtle, southern painted turtle, Mississippi mud turtle, stinkpot, and common and alligator snapping turtle, in addition to numerous other species.

Representative amphibians in study-area forested wetlands include dwarf salamander, three-toed amphiuma, lesser western siren, central newt, Gulf coast toad, eastern narrow-mouthed toad, green treefrog, squirrel treefrog, pigfrog, bullfrog, southern leopard frog, bronze frog, upland chorus frog, southern cricket frog, and spring peeper.

Most developed areas provide low-quality wildlife habitat. Sites developed for agricultural purposes are usually located at elevations slightly higher than the wetlands, or they may have improved drainage. In agricultural areas, wildlife habitat is primarily provided by unmaintained ditch banks and field edges, fallow fields, pasture lands, and/or occasionally flooded fields. Cultivated crops, especially soybeans, provide forage for some wildlife species. Game species that utilize agricultural lands include the white-tailed deer, mourning dove, bobwhite quail, eastern cottontail, and common snipe. Seasonally flooded cropland and fallow fields may also provide important feeding habitat for wintering waterfowl, wading birds, and other waterbirds.

Threatened and Endangered Species

As a cooperating agency, the Service provided a September 26, 2003, letter to the Corps detailing Federally listed threatened and endangered species, their critical habitat, and migratory birds that may be found in or near the study area for the draft LCA Comprehensive Study (Appendix A). That information, and the draft Biological Assessment which Service staff also helped to prepare, remain applicable to the NTP alternatives, and were used to facilitate programmatic Section 7 consultation under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and compliance with the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.). In keeping with the consultation requirements of the ESA, informal and formal (if needed) consultation must be completed before the Record of Decision for the NTP and PEIS can be signed. The Service has, via the Department of Interior's August 23, 2004, letter, concurred with the Corps' programmatic "not likely to adversely affect determination" for the TSP.

Consultations such as this one, involving a Federal agency proposal to adopt or approve a management plan or strategy that would be used to guide the development and implementation of future projects, are termed "programmatic consultations." Several courts have ruled that the decision to adopt plans or strategies that guide the implementation of future individual actions, as well as each future individual action itself, must fulfill the requirements for consultation under Section 7 of the ESA. Accordingly, while potential impacts associated with the proposed Louisiana Coastal Area Ecosystem Restoration Study TSP have been addressed at the programmatic level, an additional Biological Assessment/Biological Evaluation should be prepared when individual projects that tier off that plan/PEIS may affect a Federally listed threatened or endangered species and/or adversely affect designated critical habitats.

Fish and Wildlife Summary

Coastal Louisiana contains an estimated 45 percent of the tidal marshes in the conterminous United States but sustains approximately 80 percent of the nation-wide loss of those habitats. Louisiana's 3.67 million acres of coastal wetlands and their associated waters support nationally important fish and wildlife resources, and sustain the largest commercial fish and shellfish harvest in the lower 48 States. More than 1.1 billion pounds of fish and shellfish (including shrimp, crabs, crawfish, and oysters) are harvested annually in coastal Louisiana. That harvest is nearly twice that of any other State, and was valued at more than $400 million in 2000 (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2001).

Recreational saltwater anglers spend approximately $245 million annually to fish for spotted seatrout, red drum, snapper, tuna and other species (Louisiana Coastal Wetlands Conservation and Restoration Task Force 2001). Fresh and low-salinity coastal wetlands also provide important habitat for numerous freshwater sport fishes, the pursuit of which is also an important recreational activity in those coastal areas.

Louisiana's coastal marshes provide winter habitat for more than 50 percent of the duck population of the Mississippi Flyway. Fresh and intermediate marshes support the greatest concentrations of wintering waterfowl in coastal Louisiana. Those wetlands are vitally important to the mission of the Gulf Coast Joint Venture, which was established to help achieve the goals of the North American Waterfowl Management Plan.

Louisiana's coastal marshes, swamps, and associated habitats also support many other migratory birds, such as rails, gallinules, shorebirds, seabirds, wading birds, and numerous songbirds. One hundred ninety-seven colonies of wading birds and seabirds (representing 215,249 pairs of nesting birds) were observed in coastal Louisiana during a 2001 survey (Michot 2003). The cheniers and natural levee forests of coastal Louisiana provide essential stopover habitat to numerous neotropical migratory passerine birds.

Coastal Louisiana has long been a leading fur-producing area in North America. Common furbearers include nutria, mink, muskrat, raccoon, and river otter. Those coastal marshes and swamps also support game animals such as the white-tailed deer and swamp rabbit. The area also supports 1.5 million alligators for which sport and commercial hunting is closely regulated.

Refuges and Wildlife Management Areas

The Service administers 10 National Wildlife Refuges (NWR) encompassing more than 301,700 acres in coastal Louisiana. They include Sabine, Cameron Prairie, Lacassine, Shell Keys, Bayou Teche, Delta, Breton, Bayou Sauvage, Big Branch Marsh, and Mandalay NWRs. Additional information on each of those NWRs can be found on the Service's web page (www.fws.gov). The Louisiana Department of Wildlife and Fisheries also operates 17 refuges, preserves, and wildlife management areas in coastal Louisiana, comprising more than 572,000 acres (www.wlf.state.la.us). Where threatened by significant losses, future LCA investments may be needed to protect and restore those public lands. Such public lands may also provide highly cost-effective and secure sites for future LCA demonstration and research projects.

FISH AND WILDLIFE CONCERNS IN THE STUDY AREA

The foremost study-area concern, particularly from a fish and wildlife resource standpoint, is the rapid deterioration and loss of coastal wetlands. During the 1900s, Louisiana lost approximately 1.2 million acres of its coastal wetlands. Coastwide loss rates peaked at approximately 42 square miles per year during the 1950s and 1960s. Currently, Louisiana's coastal wetland loss rate is approximately 24 square miles per year. Additionally, large areas of fresh marsh and low-salinity wetlands have converted to deteriorated brackish and saline marshes, or open water.

To address this serious problem, a number of coastal wetland restoration projects have been constructed and/or authorized for construction throughout coastal Louisiana. More than 140 projects are funded and authorized via CWPPRA. Two large freshwater introduction projects (Davis Pond and Caernarvon) have been implemented by the Corps under other authorities. Despite their success, those efforts will, together, address less than one-third of the 462,000-acre wetland loss projected to occur by the year 2050 in Louisiana. Thus, the past and continuing loss of coastal wetlands and their associated habitat values during the future without-project are the principal threat to the nationally significant fish and wildlife resources that depend on them.

PLAN FORMULATION AND EVALUATION METHODOLOGY

Individual restoration projects previously identified during development of the October 2003 Draft LCA Comprehensive Study Report were evaluated for inclusion in the NTP by applying 3 "sorting" criteria and 4 "critical need" criteria to each project identified. Sorting criteria were used to classify individual features into the major NTP components (i.e., near-term restoration features, large-scale studies, and demonstration projects). The four critical need criteria (preventing future land loss, restoring fundamentally impaired deltaic processes, restoring critical geomorphic structures, and protecting vital socio-economic resources) were developed to assess the potential for project features to address critical needs. Those sorting and critical needs criteria include:

Sorting Criterion #1 - Engineering and design completed, and construction started within 5 to10 years.

This criterion would require the completion of feasibility studies including further modeling to optimize expected environmental outcome, full analysis of National Economic Development (NED) benefits, real estate acquisition, etc. in time to initiate construction in 10 years or less. It also includes completion of necessary NEPA documentation, pre-construction engineering & design, and receipt of construction authorization and commencement of construction during that period. A candidate restoration feature not deemed to meet this criterion would not be included in the NTP; however, it might be a candidate for the large-scale, long-range study component of the NTP.

Sorting Criterion #2 - Based upon sufficient scientific and engineering understanding of processes.

To satisfy this criterion, individual project features must have a sound basis in science, technology, and the engineering principles specific to those features must have been applied within coastal Louisiana to successfully achieve the desired ecosystem response. Individual features that do not meet this criterion were not included as potential near-term projects. The scientific and/or engineering uncertainties associated with those restoration features may, however, provide a basis for potential demonstration projects, and for review and analysis through the Science and Technology component of the NTP.

Sorting Criterion #3 - Implementation is independent of and does not require another restoration feature to be implemented first.

If a feature is dependent on one or more other restoration features, that feature may be combined and reassessed to determine if the composite meets the other sorting criteria. If so, the composite project is then classified appropriately. If the evaluated individual feature might preclude the later implementation of another restoration feature, then it is not included in the NTP, but might become a candidate for long-range study.

Individual features that met all of the above sorting criteria were then evaluated against the below listed "critical need" criteria to determine if they should be included in the NTP. When the criteria were applied, the reasoning for the subsequent decisions was recorded so that the study team could make relative comparisons and refine the overall application of the "critical needs" criteria. Those criteria are as follows:

Critical Need Criterion #1 - Prevent future land loss where predicted to occur.

One of the most fundamental drivers of ecosystem degradation in coastal Louisiana has been the conversion of land (mostly emergent vegetated wetland habitat) to open water. One of the most fundamental critical needs is to stem this loss. Thus, the projection of the future condition of the ecosystem must be based upon the determination of future patterns of land and water. Future patterns of land loss were based on the USGS open file report 03-334 "Historical and Predicted Coastal Louisiana Land Changes: 1978-2050." This also applies to future predicted conversion of cypress swamp in areas with existing fragmenting marsh.

Critical Need Criterion #2 - (Sustainability) Restore fundamentally impaired deltaic processes through river reintroductions, or mimic deltaic processes.

This criterion refers to features that would restore or mimic natural connections between the river and the basins (or estuaries) and includes river diversions, crevasses, and over-bank flows. Mechanical marsh creation with river sediment is also viewed as mimicking the deltaic function of sediment introduction, if supported by sustainable freshwater and nutrient reintroduction.

Critical Need Criterion #3 - (Sustainability) Restore endangered or critical geomorphic structure.

This criterion pertains to project features that would restore or maintain natural geomorphic features such as barrier islands, distributary ridges, cheniers, land bridges, and beach and lake rims that are essential to maintaining the integrity of coastal ecosystems.

Critical Need Criterion #4 - Protect vital socio-economic resources.

This criterion would be met by project features which protect key local, regional, and national resources of social, economic, and cultural significance, such as cultural features and points of interest, communities, infrastructure, and businesses and industries.

Modeling to compare impacts/benefits to fish and wildlife resources of alternative plans was not conducted, due to the short time frame to complete the NTP and because those plans are of a highly programmatic nature at present. Instead, the results of modeling conducted during the earlier LCA Comprehensive Study were used as the basis for estimating NTP benefits to fish and wildlife resources. Although those assessment methods are adequate for a coastwide programmatic-level evaluation, when individual project features are undergoing further engineering and design, more rigorous assessments will be required to quantify fish and wildlife benefits and impacts, complete NEPA documentation, meet various water development planning policies, and to enable the Service to fulfill its Fish and Wildlife Coordination Act mandates.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

Under future with no-action conditions, more than 462,000 additional wetland acres would be lost by year 50 (Table 1). Habitat types would continue shifting toward more brackish and saline wetlands and open water, with the continual loss of more salt-sensitive freshwater vegetation. Because of the current degree of risk and uncertainty associated with the salinity/habitat type projection methodologies, however, the data in Table 1 do not reflect this anticipated trend. Nonetheless, corresponding decreases in habitat values for fish and wildlife that use those wetlands would also occur in association with the projected wetland losses.

Table 1. Coastwide Wetland Type Acreages Under the No-action Alternative

Wetland Type	TY0 (acres)	TY50 (acres)	Acreage change	Percent change
Swamp	1,040,785	949,707	-91,078	-8.8
Fresh marsh	940,811	798,847	-141,964	-15.1
Intermediate marsh	724,289	956,240	231,951	32.0
Brackish marsh	584,524	437,477	-147,046	-25.2
Saline marsh	374,778	60,157	-314,622	-83.9
Total wetlands	3,665,188	3,202,428	-462,760	-12.6

RESTORATION OPPORTUNITY DESCRIPTIONS

As detailed above, application of the sorting criteria and critical needs criteria were the basis for selecting the NTP restoration features, large-scale studies, and candidate science and technology demonstration projects. The following paragraphs describe those restoration opportunities in greater detail.

Near-Term Restoration Features

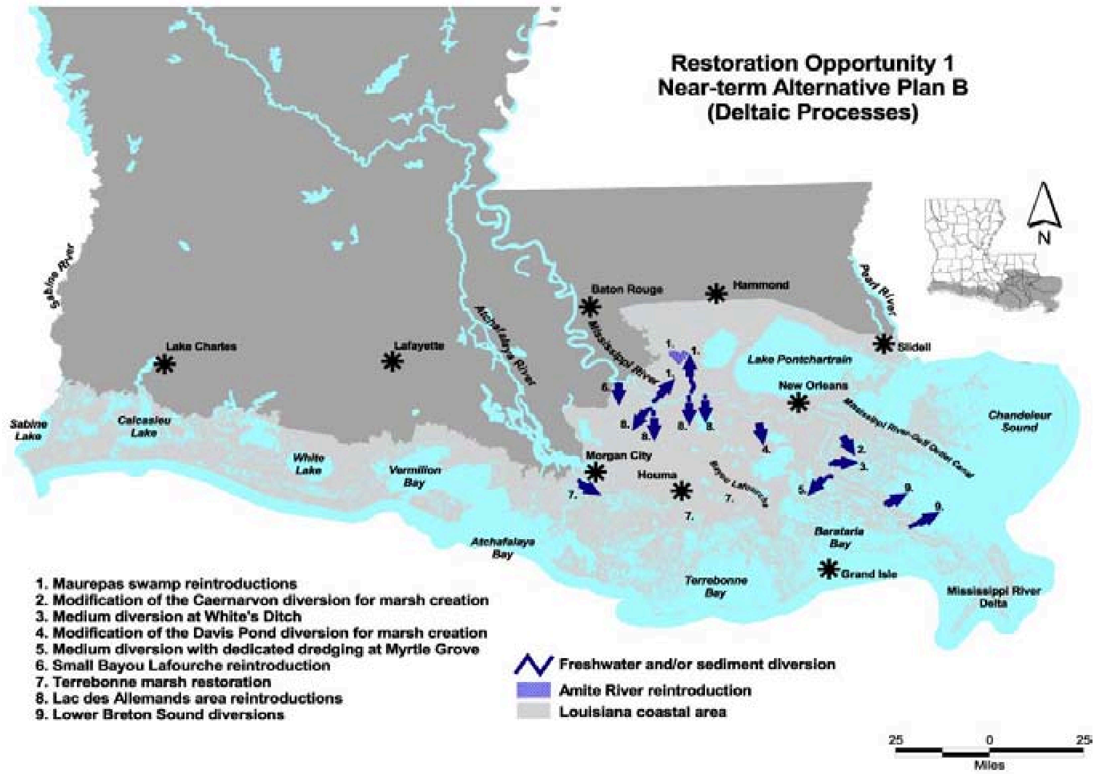
Of the 78 features that the sorting criteria were applied to, those features that met all three sorting criteria were considered as possible NTP features. Alternative combinations of those features were developed by applying each of the critical needs criteria individually or in various combinations. Application of the critical needs criteria yielded 15 possible alternatives. While that analysis indicated some similarity between alternatives, distinct alternatives were identified that were focused on critical needs criterion #2 only (Restoration Opportunity 1), critical needs criterion #3 only (Restoration Opportunity 2), and all four critical needs criteria combined (the Tentatively Selected Plan or TSP).

Restoration Opportunity 1 focuses on restoration of deltaic processes and includes nine near-term restoration features (Figure 2). This plan exhibits some shortcomings because it does not address critical geomorphic structures. Those features and their respective subprovinces (SP) are as follows:

1) Maurepas Swamp Reintroductions (SP 1)
    a. Small Diversion at Hope Canal (CWPPRA River Reintroduction to Maurepas Swamp)
    b. Small Diversion at Convent/Blind River
    c. Increase Amite River Influence by Gapping Spoil Banks
2) Modification of the Caernarvon Diversion for Marsh Creation (SP1)
3) Medium Diversion at Whites Ditch (SP1)
4) Modification of the Davis Pond Diversion for Marsh Creation (SP2)
5) Medium Diversion with Dedicated Dredging at Myrtle Grove (SP 2)
6) Small Bayou Lafourche Reintroduction (SP 3);
7) Terrebonne Marsh Restoration Opportunities (SP 3)
    a. Optimize Flows and Atchafalaya River Influence in Penchant Basin
    b. Multi-purpose Operation of Houma Navigation Canal (HNC) Lock
    c. Convey Atchafalaya River Water to Terrebonne Marshes
8) Lac Des Allemands Area Reintrocuctions
    a. Small Diversion at Lac Des Allemands
    b. Small Diversion at Donaldsonville
    c. Small Diversion at Pikes Peak
    d. Small Diversion at Edgard
9) Lower Breton Sound Diversions

Diversion features range from 1,000 cfs to 5,000 cfs for small diversions, 5,001 cfs to 15,000 cfs for medium diversions, and greater than 15,000 cfs for large diversions.

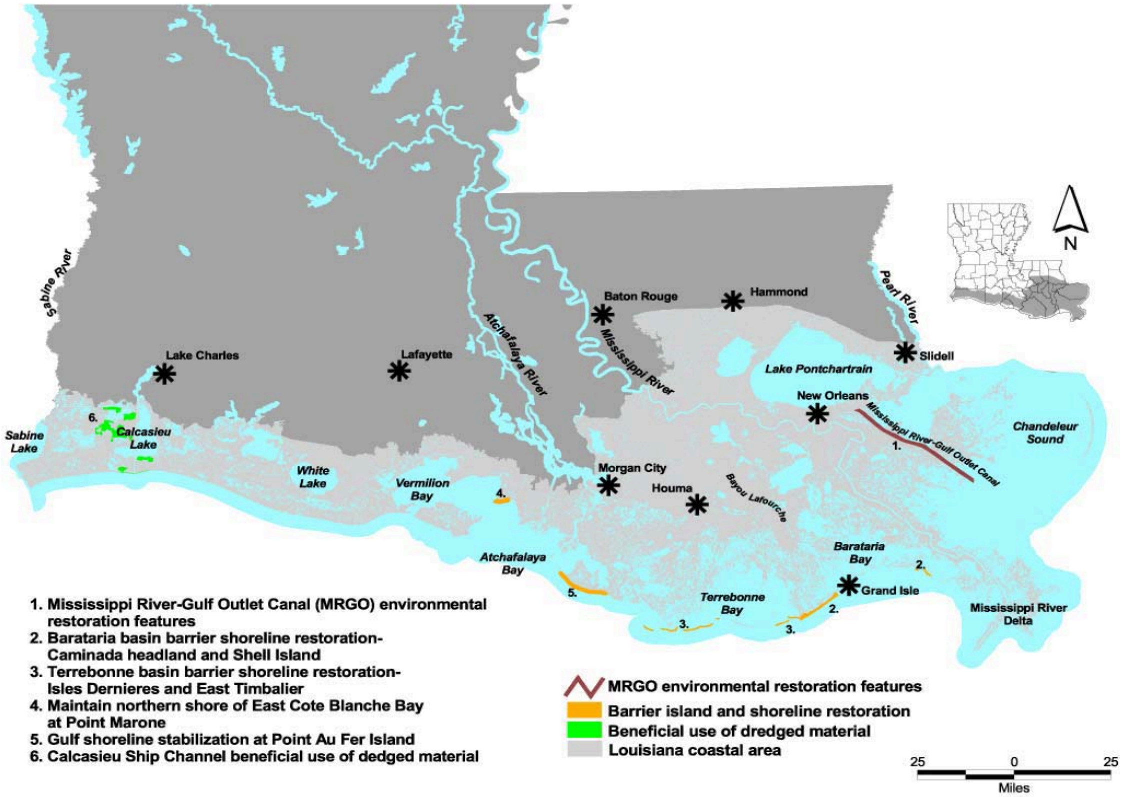
Figure 2. LCA Near-term Ecosystem Restoration Plan Restoration Opportunity 1 - Restoration of Deltaic Processes.



Restoration Opportunity 2 focuses on restoration of geomorphic structure. It consists of six restoration opportunities which include shoreline protection, barrier island restoration, and marsh-creation features (Figure 3). This plan exhibits some shortcomings because it does not address the river reintroductions. Features of this alternative and their respective SPs are as follows:

1) Mississippi River Gulf Outlet Environmental Restoration (SP 1)
2) Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island (SP 2)
3) Terrebonne Basin Barrier Shoreline Restoration-Isles Dernieres and East Timbalier (SP3)
4) Gulf Shoreline Stabilization at Pt. Au Fer Island (SP 3)
5) Maintain Land Bridge Between Caillou Lake and Gulf of Mexico (SP3)
6) Calcasieu Ship Channel Beneficial Use of Dredged Material (SP4)

Figure 3. LCA Near-term Ecosystem Restoration Plan Restoration Opportunity 2 - Restoration of Geomorphic Structure.



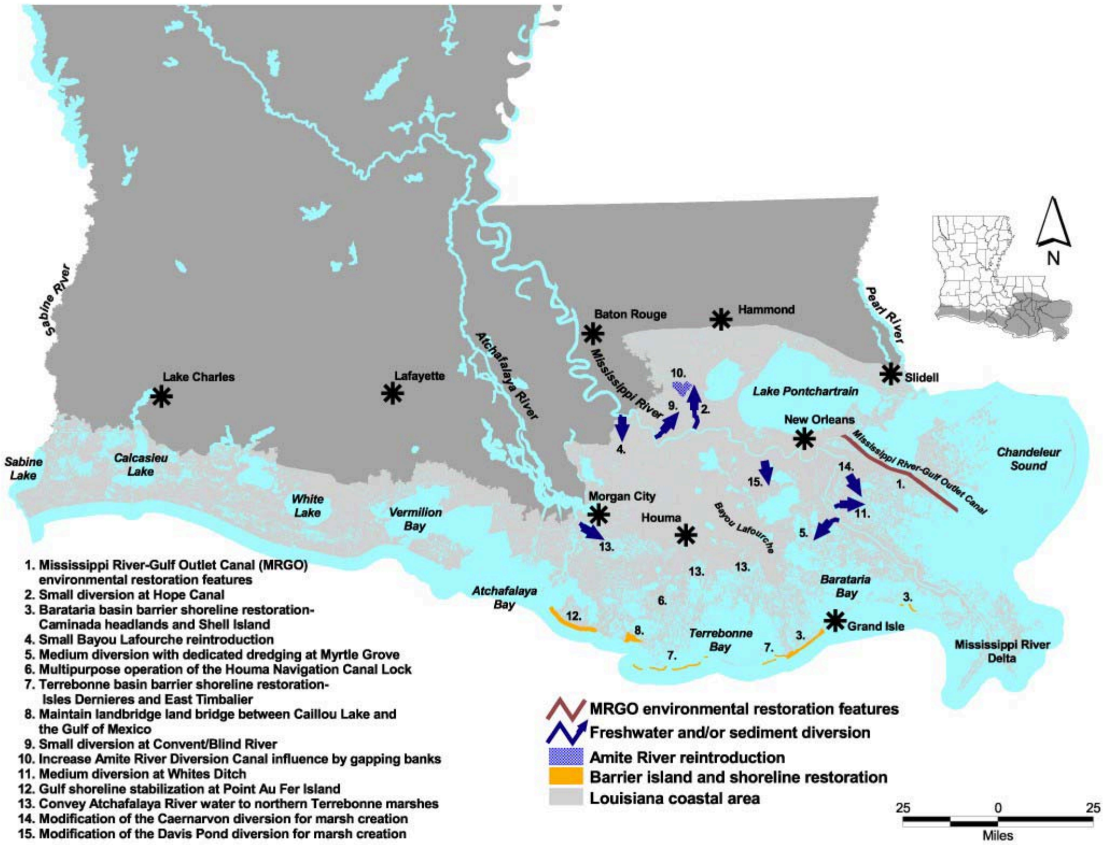
The third alternative restoration opportunity, or the TSP, encompasses all 4 critical needs criteria, and includes 15 potential restoration features including freshwater and sediment diversions, interior shoreline protection, barrier island and barrier headland protection, and dredged material/marsh creation (Figure 4). The restoration features of this alternative and their respective SPs are as follows:

1) Mississippi River-Gulf Outlet Canal (MRGO) Environmental Restoration (SP 1)
2) Small Diversion at Hope Canal (CWPPRA River Reintroduction into Maurepas Swamp)
3) Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island (SP 2)
4) Small Bayou Lafourche Reintroduction (SP 3)
5) Medium Diversion with Dedicated Dredging at Myrtle Grove (SP 2)
6) Multi-purpose Operation of Houma Navigation Canal (HNC) Lock
7) Terrebonne Basin Barrier Shoreline Restoration-Isles Dernieres and East Timbalier (SP3)
8) Maintain Land Bridge between Caillou Lake and Gulf of Mexico (SP 3)
9) Small Diversion at Convent/Blind River
10) Increase Amite River Influence by Gapping Spoil Banks
11) Medium Diversion at Whites Ditch (SP1)

12) Gulf Shoreline Stabilization at Point Au Fer Island (SP 3)
13) Convey Atchafalaya River Water to Terrebonne Marshes
14) Modification of the Caernarvon Diversion for Marsh Creation (SP1)
15) Modification of the Davis Pond Diversion for Marsh Creation (SP2)

More detailed descriptions of the above-listed features are found in Appendix B.

Figure 4. LCA Near-term Ecosystem Restoration Plan – Tentatively Selected Plan



COMPONENTS OF THE TENTATIVELY SELECTED PLAN

Of the three alternative plans selected for further comparison, the TSP best meets the programmatic planning objectives and the critical needs criteria. This plan addresses the immediate and critical needs of the ecosystem in terms of attaining the study objectives. The rehabilitation of the coastal ecosystem by promoting the distribution of riverine freshwater, nutrients, and sediments using natural processes and ensuring the structural integrity of the estuarine basins is the key to this sustainable solution.

Significant technical and scientific uncertainties underscore the need for strong and continued science and technology (S&T) development supported by demonstration projects. In addition, existing water resource projects could potentially be modified to advance sustainable restoration. To better achieve completeness and effectiveness, these two additional programmatic plan components were incorporated into the TSP to provide the most effective near-term approach to address coastal ecosystem degradation in Louisiana. The LCA program will depend on Congressional approval of the TSP as a framework for programmatic and future authorization actions. Components of the TSP are summarized in Tables 2a and 2b at the end of this section, and include:

- Programmatic authorization of initial Near-term Critical Restoration Features;
- Programmatic authorization of S&T Program;
- Programmatic authorization of S&T Program Demonstration Projects;
- Programmatic authorization for the Beneficial Use of Dredged Material, and
- Programmatic authorization to Initiate Studies of Modifications to Existing Water Control Structures;
- Future Congressional authorization required for the remaining components of the TSP in subsequent WRDAs; and
- Feasibility studies for the continued development of long-term and large-scale restoration concepts.

Initial Near-term Critical Restoration Features

The TSP includes 15 near-term critical restoration features (Figure 4 and Table 2a and 2b), 5 of which are recommended for implementation through programmatic authorization. Implementation of these five restoration features would be subject to subsequent completion of NED/National Ecosystem Restoration (NER) analyses, NEPA, ESA, and FWCA compliance, and appropriate feasibility-level decision documents. Those feasibility-level decision documents would be developed pursuant to current policies and guidelines, and would be subject to review and approval by the Secretary of the Army. The five near-term critical restoration features are:

- MRGO Environmental Restoration Features
- Small Diversion at Hope Canal
- Barataria Basin Barrier Shoreline Restoration, Caminada Headland, Shell Island
- Small Bayou Lafourche Reintroduction
- Medium Diversion at Myrtle Grove with Dedicated Dredging

Science and Technology Plan

Although the TSP is based upon the best available science and takes advantage of over 25 years of experience gained through previous Louisiana coastal wetland restoration efforts via CWPPRA and other programs, there remain substantial scientific and engineering uncertainties associated with some of the proposed LCA restoration features. Accordingly, the Corps and the State of Louisiana propose to develop and implement a Science and Technology Plan to ensure the LCA restoration effort continues to be supported by the best available science, and to resolve scientific and engineering uncertainties associated with coastal ecological processes and their response(s) to restoration projects. Methods for resolving scientific and engineering uncertainties may include the implementation of demonstration projects, adaptive management, and monitoring.

Demonstration Projects

An integral component of the LCA Science and Technology Plan is the development and implementation of demonstration projects that will further develop engineering techniques, improve understanding of the ecological processes within coastal Louisiana, and provide insights on ecosystem responses associated with proposed restoration projects and features. Proposed demonstration projects are intended to: 1) reduce scientific and engineering uncertainties regarding the effectiveness of particular restoration techniques; 2) test new, innovative technologies and engineering techniques; and, 3) test ecosystem responses to engineering techniques and operational schedules. The TSP proposed demonstration projects include (see Appendix B for description):

- Wetland Creation in Vicinity of Barataria Chenier Unit;
- Pipeline Conveyance of Sediments to Maintain Land Bridges;
- Pipeline Canal Restoration (various methods and locations);
- Shoreline Erosion Protection Test Sections in or near Rockefeller Refuge; and
- Barrier Island Sediment Sources Demo in the Vicinity of Terrebonne Barrier Islands.

Programmatic Authority for the Beneficial Use of Dredged Material

In addition to the above-listed features, the TSP seeks from Congress programmatic authority and increased funding for the Corps' Beneficial-use of Dredged Material Program. The New Orleans District Corps annually dredges approximately 71,000,000 cubic yards (yd^3) of material from key navigation channels and waterways in coastal Louisiana. Approximately 42 percent of those dredged sediments, or approximately 30,000,000 yd^3, are used to restore, protect, and/or create aquatic and wetland habitats. Funding limits on that program, however, preclude using the remaining dredged material for ecosystem restoration. By obtaining Congressional authorization and funding for a comprehensive beneficial use of dredged material program under the TSP, the quantity of dredged sediments available for use in coastal restoration efforts could be substantially increased.

Programmatic Authority to Initiate Studies of Modifications to Existing Water Control Structures

The TSP recommends programmatic authorization to plan and evaluate potential modifications of existing water control structures and/or their operation/ management plans for the purpose of contributing to the attainment of LCA ecosystem restoration objectives.

Standard Authorization of Other Near-Term Critical Restoration Features

In addition to the five programmatically authorized critical near-term restoration features discussed above, the other ten TSP features are recommended for approval under the Corps' (i.e., WRDA) standard authorization process. The 10 features include:

- Multi-purpose operation of the Houma Canal Lock;
- Terrebonne Basin barrier-shoreline restoration, East Timbalier, Isle Dernieres;
- Maintain land bridge between Caillou Lake and Gulf of Mexico;
- Small diversion at Convent/Blind River;
- Increase Amite River diversion canal influence by gapping banks;
- Medium diversion at White's Ditch;
- Stabilize gulf shoreline at Pointe Au Fer Island;
- Convey Atchafalaya River water to northern Terrebonne marshes;
- Re-Authorization of Caernarvon diversion – optimize for marsh creation; and,
- Re-Authorization of Davis Pond diversion – optimize for marsh creation.

Large-scale Studies

The TSP also recommends feasibility studies of large-scale restoration concepts which have a high level of complexity and/or uncertainty associated with them. Those conceptual projects would affect (both positively and negatively) significant ecological and economic resources, but could potentially contribute to a more sustainable coastal Louisiana. The feasibility of implementing such large-scale restoration concepts is not fully known, nor is it likely that the requisite detailed investigations and the resolution of issues (e.g., land acquisition) associated with implementation could be completed in time to begin construction within the next 10 years. The large-scale, long-term initiatives selected for initiation under the TSP are as follows (see Appendix B for description):

1) Mississippi River Hydrodynamic Study
    a. Mississippi River Delta Management Study (SP 1 and 2)
    b. Third Delta (SP 2 and 3)
    c. Upper Atchafalaya Basin Study including Evaluation of Modified Operational Scheme of Old River Control Structure Conducted under Mississippi River and Tributaries (SP 3)
2) Acadiana Bay Estuarine Restoration Study (SP3)
3) Chenier Plain Freshwater Management and Allocation Reassessment (SP 4).

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Table 2a. Components of the LCA Tentatively Selected Plan Recommended for Programmatic Authorization
1. <u>Near-term Critical Restoration Features</u> • (1) MRGO Environmental Restoration features • (2) Small Diversion at Hope Canal • (3) Barataria Basin Barrier shoreline restoration, Caminada Headland, Shell Island • (4) Small Bayou Lafourche Reintroduction • (5) Medium Diversion at Myrtle Grove with Dedicated Dredging 2. <u>S&T Program</u> 3. <u>Initial S&T Program Demonstration Projects</u> • Wetland Creation in Vicinity of Barataria Chenier Unit (freshwater chenier restoration) • Pipeline Conveyance of Sediment to Maintain Land Bridge • Pipeline Canal Restoration (various methods and locations • Shoreline Erosion Protection Test Sections in the Vicinity of Rockefeller Refuge • Barrier Island Sediment Sources Demo in Vicinity of Terrebonne Barrier Islands 4. <u>Programmatic Authority for the Beneficial Use of Dredged Material</u> 5. <u>Programmatic Authority to Initiate Studies of Modifications to Existing Water Control Structures</u>

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Table 2b. Components of the LCA Tentatively Selected Plan Recommended for Approval With Future Authorization
6. <u>Other Near-term Critical Restoration Features</u> • (6) Multi-purpose Operation of the Houma Navigation Canal Lock • (7) Terrebonne Basin Barrier-shoreline Restoration, E. Timbalier, Isles Dernieres • (8) Maintain Land Bridge between Caillou Lake and Gulf of Mexico • (9) Small Diversion at Convent / Blind River • (10) Increase Amite River Diversion Canal Influence by gapping banks • (11) Medium Diversion at White's Ditch • (12) Stabilize Gulf Shoreline at Pointe Au Fer Island • (13) Convey Atchafalaya River water to Northern Terrebonne Marshes • (14) Re-authorization of Caernarvon Diversion – optimize for marsh creation • (15) Re-authorization of Davis Pond – optimize for marsh creation 7. <u>Large-scale and Long-term Concepts Requiring Detailed Study</u> • Mississippi River Hydrodynamic Model ▪ Mississippi River Delta Management Study ▪ Third Delta Study ▪ Upper Atchafalaya Basin Study including evaluation of alternative operational schemes of Old River Control Structure *funded under MR&T* • Chenier Plain Freshwater Management and Allocation Reassessment Study • Acadiana Bay Estuarine Restoration Study

EVALUATION OF THE TENTATIVELY SELECTED PLAN

Under no-action conditions, a net coastal wetland loss of nearly 463,000 acres would occur by year 50, even with projected gains in the Atchafalaya River Delta (Table 1). Each of the NTP action alternatives would, to varying degrees, reduce that acreage of coastal wetland loss, if implemented. Hence, implementing any of the proposed alternative plans would be preferable to the continued loss and degradation of coastal wetlands under the no-action scenario. Restoration Opportunity 2 (which focuses on restoring geomorphic structures) would have little, if any, effect on habitat type distribution, compared to the No-action Alternative. The river diversion features included in the other two restoration opportunities would likely result in greater amounts of fresh and intermediate marsh, compared to the No-action Alternative. The Service believes that, while both Restoration Opportunities 1 (which focuses on restoring deltaic processes) and 2 would have significant environmental benefits, the TSP (which focuses on preventing future land loss, restoring deltaic processes, restoring critical geomorphic structures, and protecting vital socio-economic resources) would provide the greatest fish and wildlife benefits. The TSP would likely best achieve long-term coastal wetland sustainability, because the restored geomorphic structures would help to protect and enhance the diversion-feature influence areas from erosive coastal wave action and storm surge. Because sediment diversions are connected to the river and continually nourish receiving areas with sediments and nutrients, those features would more effectively achieve a sustainable coastal wetland ecosystem. Based solely on fish and wildlife considerations, those TSP measures would likely be the most beneficial of the three evaluated alternative restoration plans in the NTP.

Although initial modeling estimates indicate that implementation of the TSP would save over 280,000 wetland acres, compared to the year 50 no-action condition (Table 3), the TSP features, alone, would not fully offset the 462,700 acres (Table 1) expected to be lost over 50 years under the no-action condition.

Table 3. Coastwide Wetland Type Acreages Under the No-action Alternative and the TSP

Wetland Type	Year 50 No Action (acres)	Year 50 TSP (acres)	Difference (percent)
Swamp	949,707	937,673	-1.3
Fresh marsh	798,847	1,010,518	26.5
Intermediate marsh	956,240	1,033,688	8.1
Brackish marsh	437,477	438,328	0.2
Saline marsh	60,157	71,689	19.2
Total Wetlands	3,202,428	3,491,895	9.0

Proposed TSP features to introduce fresh water from the Mississippi River into the Maurepas Swamp, Upper Breton Sound, and the Mid-Barataria Basin would shift habitat types toward lower-salinity conditions in Subprovinces 1 and 2, compared to taking no action. Those diversions, along with marsh creation, beneficial use of dredged material, and barrier island restoration, would also restore/establish several thousands of acres of wetlands.

At year 50, wetland losses under the No-action Alternative (more than 203,000 acres) would be greater in Subprovince 3 than in any other Subprovince. The TSP includes projects to address losses in that area. Gulf shoreline stabilization at Point Au Fer Island and increased conveyance of Atchafalaya River fresh water to central and eastern portions of the Terrebonne Basin would improve wetland productivity and reduce the already critical rates of marsh loss in those areas where marine processes are advancing inland. Those wetland restoration benefits could be significantly increased if the Small Bayou Lafourche project is synergistically modified to incorporate key Grand Bayou-area features of the Convey Atchafalaya River Water to Northern Terrebonne Basin Project.

The TSP would have a positive effect on wildlife resources by increasing riverine and sediment inputs from the Mississippi River within Subprovinces 1 through 3, in concert with marsh creation in key areas. In combination, those features would help sustain and rejuvenate existing wetland habitats, promote significant landbuilding, and restore fresh and low salinity habitats. Marshes and swamps would be more productive and would provide improved habitat conditions for several species of wildlife.

Coastwide, the TSP would restore marsh-building and marsh-maintenance processes through freshwater and sediment inputs. The TSP would increase coastal wetland acreage compared to taking no action; thus, it would have a major positive impact on most, if not all, of the fish and wildlife resources that utilize those wetlands. The project-related conversion of brackish and saline marshes to fresh and low-salinity marshes would displace brown shrimp, spotted seatrout, and other fishes and shellfishes which prefer more saline habitats. Additionally, the abundance and productivity of white shrimp, Gulf menhaden, and other fishes and shellfishes which utilize low-salinity habitats may be increased under the preferred plan. Given the continued rapid loss and likely future collapse of brackish and salt marsh systems with no action, however, the TSP may also provide a long-term net benefit to species utilizing those areas. The Service will later recommend specific design and operational measures for incorporation into TSP project features to minimize adverse effects on those resources and increase benefits to other fish and wildlife species, to the greatest extent practical.

Because of the uncertainties regarding some of the currently proposed habitat prediction methodologies, and because many specific details regarding the design, operation, and associated effects of the TSP are not yet available at the current programmatic level of planning, we cannot complete our evaluation of individual TSP feature effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific TSP project measures, along with more-definitive project information that will be available during those planning and mplementation phases, will be required so that we can fulfill our responsibilities under that Act. Additionally, improvements in the hydrologic and desktop models will be needed to predict environmental impacts and benefits of specific plan features, as indicated in our previous draft Fish and Wildlife Coordination Act Report (Paille and Roy 2003b, Grouchy and Paille 2004) for the LCA Comprehensive and NTP Studies.

FUTURE SERVICE INVOLVEMENT

Because of the LCA's large scope, complexity, and programmatic nature, extensive and continuing funding will be required by the Service to enable our full participation throughout future detailed planning and post-authorization engineering and design studies, and to fulfill our reporting responsibilities for the TSP component features under Section 2(b) of the Fish and Wildlife Coordination Act. Accordingly, the Service will continue to work closely with the Corps and the State of Louisiana to formulate detailed funding estimates to support our future involvement in the LCA, as provided for in the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Corps and the Service. Given its scope, duration, and significance, the Service will, in cooperation with the New Orleans Corps District, draft and execute an LCA-specific Memorandum of Agreement that details operating guidelines for negotiating transfer funds (similar to those used for the Comprehensive Everglades Restoration Plan) to facilitate and expedite our future involvement.

Under provisions of Section 7 of the ESA of 1973, as amended, the Service will also assist the Corps and any other Federal agencies responsible for funding or implementing selected projects and/or plans to ensure that they will neither jeopardize the continued existence of threatened and endangered species, nor adversely modify any designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will tier from the current programmatic consultation, details of which are contained in the Programmatic Environmental Impact Statement (PEIS) for the NTP. In keeping with the consultation requirements of the ESA, informal and formal (if needed) consultation must be completed before the Record of Decision for the NTP and PEIS can be signed. The Service (via the Department of the Interior’s August 2004 letter) has concurred with the Corps’ determination that the TSP is not likely to adversely effect any currently listed threatened or endangered species or designated critical habitat for which the Service has consultative jurisdiciton.

The National Wildlife Refuge System Improvement Act of 1997 mandates that no new or expanded use of a NWR may be allowed unless it is first determined to be compatible with the objectives for which that NWR was established. A compatibility determination is a written determination, indicating that a proposed or existing use of a NWR is, or is not, a compatible use. Compatible uses are defined as proposed or existing wildlife-dependent recreational uses or any other uses of a NWR that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the NWR. A compatibility determination is only required when the Service has jurisdiction over the use. Prior to initiating implementation of an LCA project that would affect any NWR, the Corps should, therefore, contact the appropriate Refuge Manager to determine if the proposed project constitutes a "refuge use" subject to a compatibility determination. To determine the anticipated impacts of any proposed use, the Corps may be required to provide sufficient data and information to document any short-term, long-term, direct, indirect, or cumulative impacts on NWR resources. Compatibility determinations will include a public review and comment period before issuance of a final decision by the Service. To facilitate such contacts, the Louisiana Field Office may be contacted at (337) 291-3100.

SUMMARY AND SERVICE POSITION

Because of the uncertainties regarding some of the currently proposed habitat prediction methodologies, and because many details regarding the design, operation, and associated effects of the TSP are not yet available at the current programmatic level of planning, we cannot complete our evaluation of the individual TSP features' effects on fish and wildlife resources, nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) for each of those features. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information that will be available during those planning phases, will be required so that we can fulfill our responsibilities under that Act. Additionally, improvements in the hydrologic and desktop models will be needed to predict environmental impacts and benefits of individual plan features, as indicated in our previous draft Fish and Wildlife Coordination Act Reports (Paille and Roy 2003, Grouchy and Paille 2004).

The Service has actively participated throughout the formulation and evaluation of the LCA coastwide alternatives and the selection of near-term restoration features, the large-scale studies, and the potential demonstration projects that comprise the TSP. Service involvement and input includes the preparation of three previous draft Fish and Wildlife Coordination Act Reports (Paille and Roy 2003a, and 2003b, and Grouchy and Paille 2004), a letter listing threatened and endangered species within coastal parishes (Appendix A), assistance in preparation of the draft Biological Assessment for Comprehensive Plan effects on threatened and endangered species, a May 11, 2004, letter affirming our continued participation as a Cooperating Agency in accordance with the implementing regulations of the National Environmental Policy Act of 1969, and concurrence with the Corps' programmatic "not likely to adversely affect" threatened and endangered species determinations (via an August 23, 2004, Department of the Interior letter). Those documents are incorporated herein by reference, and should be considered as integral components of the administrative record for the forthcoming final PEIS and NTP Report.

Given the substantial adverse future impacts to coastal wetlands and their associated fish and wildlife resources that are expected to occur under future without-project conditions, the Service strongly supports authorization and implementation of the TSP, as it would provide the greatest level of sustainable benefits to Louisiana's nationally significant coastal fish and wildlife resources.

To expedite construction of restoration measures, the TSP proposes the programmatic authorization of five projects, including the Small Bayou Lafourche Diversion Project. The benefits of that project would be synergistically enhanced within eastern Terrebonne Basin critical needs areas by simultaneously constructing the Grand Bayou-area features of the Convey Atchafalaya River Water to Northern Terrebonne Basin Project. Accordingly, future post-authorization studies for the Bayou Lafourche Project should, to the maximum extent practicable, incorporate those potentially synergistic features. Given the rapid wetland loss within the Grand Bayou area, the substantial synergistic effects of those features, and the ease of landrights acquisition and construction, if those features cannot be included as integral components of the Bayou Lafourche Project, they should be implemented as soon as possible to achieve maximum wetland benefits in critical wetland loss areas of the eastern Terrebonne Basin.

In support of the TSP, and to expedite its implementation, the Service also provides the following technical and procedural recommendations for future authorization and implementation of the TSP:

1. In accordance with the January 2003 Partnership Agreement for Water Resources and Fish and Wildlife between the Service and the Corps, sufficient continuous funding should be provided to the Service to fulfill our responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act throughout post-authorization engineering and design studies for demonstration projects, participation in the Science and Technology Program, NTP projects, and planning and evaluation for long-term project feasibility studies. To facilitate that level of cooperation, the Service intends to negotiate an LCA-specific Memorandum of Agreement with the Corps (similar to that used for Florida’s Everglades Restoration study) soon after the NTP is authorized.

2. The Corps should coordinate closely with individual refuge managers prior to conducting any work on a National Wildlife Refuge, in conformance with the National Wildlife Refuge System Improvement Act of 1997. Such coordination will be essential to the timely completion of the Service's determination that the proposed work will/will not be compatible with the purposes for which those refuges were established, and to secure any appropriate permits that may be required. Likewise, LCA activities occurring on State-administered Wildlife Management Areas or refuges should also be fully coordinated with the Louisiana Department of Wildlife and Fisheries.

3. The proposed Science and Technology Program should give high priority to refining the land gain/loss and habitat change models to enable determination of and evaluation of project-level effects and facilitate completion of FWCA reporting.

4. For purposes of maximizing synergistic wetland restoration benefits within the eastern Terrebonne Basin critical needs area, the post-authorization studies for the proposed Small Bayou Lafourche Diversion Project should, to the maximum extent possible, incorporate key Grand Bayou-area features of the Convey Atchafalaya River Water to Northern Terrebonne Basin Project.

To ensure that optimum fish and wildlife resource benefits are achieved, the Service plans to remain actively involved throughout the plan implementation process. Our findings and recommendations for each of the projects ultimately approved for implementation will be provided in draft and final supplements to this programmatic report under the authority of the Fish and Wildlife Coordination Act.

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APPENDIX A

September 26, 2003, U.S. Fish and Wildlife Service Letter Identifying Federally Listed Threatened and Endangered Species within Coastal Parishes of Louisiana

United States Department of the Interior

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

September 26, 2003

Colonel Peter J. Rowan
District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Rowan:

The Corps of Engineers (Corps), in partnership with various other State, local, and Federal agencies and entities, is preparing a Programmatic Environmental Impact Statement (PEIS) on the Louisiana Coastal Area Comprehensive Coastwide Ecosystem Restoration Study (LCA). In response to a September 23, 2003, request from Mr. Bill Klein of your staff, the U.S. Fish and Wildlife Service (Service) is pleased to provide the following information regarding Federally listed threatened and endangered species, their critical habitat, and migratory birds that may be found in or near the LCA study area. This information will facilitate programmatic Section 7 consultation under the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). In addition, we have also included information to facilitate compliance with the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.).

ESA Information

Seventeen threatened or endangered species, including the Louisiana black bear, West Indian manatee, bald eagle, brown pelican, piping plover, red-cockaded woodpecker, gopher tortoise, ringed map turtle, 5 species of marine turtles, pallid sturgeon, Gulf sturgeon, inflated heelsplitter, and Louisiana quillwort, occur within the four subprovinces comprising the LCA study area. In addition, the Service has designated critical habitat for the piping plover and the Gulf sturgeon.

Following the conclusion of programmatic consultation on the LCA PEIS, the Service will continue to assist the Corps and other Federal agencies responsible for funding or implementing selected LCA projects and/or plans to ensure they will not jeopardize the continued existence of threatened and endangered species, or adversely modify their designated critical habitat. The required consultations will be accomplished on a project-by-project basis, and will build upon the programmatic consultation.

Louisiana Black Bear

The threatened Louisiana black bear (*Ursus americanus luteolus*) is primarily associated with forested wetlands; however, it utilizes a variety of habitat types, including marsh, spoil banks, and upland forests. Within forested wetlands, black bear habitat requirements include soft and hard mast for food, thick vegetation for escape cover, vegetated corridors for dispersal, large trees for den sites, and isolated areas for refuge from human disturbance. Remaining Louisiana

black bear populations occur in the Tensas River Basin, the Upper Atchafalaya River Basin, and coastal St. Mary and Iberia Parishes. The primary threats to that species are continued loss of bottomland hardwoods, fragmentation of remaining forested tracts, and human-caused mortality (e.g., illegal killing and accidental collisions with motor vehicles).

Louisiana black bears, particularly pregnant females, normally den from December through April. To further protect denning bears, the Service (through the final listing rule published on January 7, 1992, in Volume 57, No. 4 of the Federal Register) has extended legal protection to candidate or actual den trees. These are defined in the final listing rule as bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa* sp.) with visible cavities, having a diameter at breast height of 36 inches or greater, and occurring in or along rivers, lakes, streams, bayous, sloughs, or other water bodies. (Please note that additional information can be found at http://endangered.fws.gov.)

West Indian Manatee

Federally listed as endangered, West Indian manatees (*Trichechus manatus*) occasionally enter Lake Pontchartrain, Lake Maurepas, and their associated coastal waters and streams during the summer months (i.e., June through September). Manatees have also been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. Should the proposed project involve activities in those areas during summer months, further consultation with this office will be necessary. Manatees have also been occasionally observed elsewhere along the Louisiana Gulf coast. They have declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

Bald Eagle

Federally listed as threatened, bald eagles (*Haliaeetus leucocephalus*) nest in Louisiana from October through mid-May. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water in the southeastern Parishes. Areas with high numbers of nests include the Lake Verret Basin south to Houma, the southern marshes/ridge from Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area. Eagles also winter and infrequently nest near large lakes in central and northern Louisiana. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Brown Pelican

Federally listed as endangered, brown pelicans (*Pelecanus occidentalis*) are currently known to nest on Rabbit Island in Calcasieu Lake, Raccoon Point on Isles Dernieres, as well as Queen Bess Island, Plover Island (Baptiste Collette), Wine Island, and islands in the Chandeleur chain. Pelicans change nesting sites as habitat changes occur. Thus, pelicans may also be found nesting on mud lumps at the mouth of South Pass (Mississippi River Delta) and on small islands in St. Bernard Parish. In winter, spring, and summer, nests are built in mangrove trees or other shrubby vegetation, although occasional ground nesting may occur. Brown pelicans feed along the Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

Piping Plover

Federally listed as threatened, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months, arriving from the breeding grounds as early as late July and remaining until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no, or very sparse, emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependant on a mosaic of sites distributed throughout the landscape, as the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change. Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

Red-cockaded Woodpecker

The endangered red-cockaded woodpecker (RCW, *Picoides borealis*) inhabits open, park-like stands of mature (i.e., greater than 60 years of age) pine trees containing little hardwood understory or midstory. RCWs can tolerate small numbers of overstory hardwoods or large midstory hardwoods at low densities found naturally in many southern pine forests, but they are not tolerant of dense hardwood midstories resulting from fire suppression. RCWs excavate roost and nest cavities in large living pines (i.e., 10 inches or greater in diameter at breast height). The cavity trees and the foraging area within 200 feet of those trees are known as a cluster. Foraging habitat is defined as pine and pine-hardwood (i.e., 50 percent or more of the dominant trees are pine trees) stands over 30 years of age that are located within one-half mile of the cluster.

Gopher Tortoise

The threatened gopher tortoise (*Gopherus polyphemus*) is associated with areas that have well-drained, sand or gravel soils appropriate for burrow establishment, ample sunlight for nesting, and understory vegetation suitable for foraging (i.e., grasses and forbs). Gopher tortoises prefer "open" longleaf pine-scrub oak communities that are thinned and burned every few years. They also inhabit existing maintained transmission rights-of-way within Washington, Tangipahoa, and St. Tammany Parishes. The gopher tortoise is the only native tortoise found in the southeastern United States. Habitat degradation (lack of thinning or burning on pine plantations) and conversion to agriculture or urbanization have contributed to the decline of that species. That

habitat decline has concentrated remaining gopher tortoise populations along pipeline and powerline rights-of-way within their range.

Ringed Map Turtle

The threatened ringed map (= sawback) turtle (*Graptemys oculifera*) is endemic to the Pearl River system. In Louisiana, it occurs in the Bogue Chitto River south of Franklinton, and the Pearl River north of Louisiana Highway 190 in St. Tammany and Washington Parishes. It is found in riverine habitats with moderate currents, channels wide enough to permit sunlight penetration for several hours each day, numerous logs for basking, and large, sandy banks, that are used for nesting. Habitat loss (loss of exposed sand bars, basking areas) and water quality degradation (which decreases food supply) have contributed to the decline of this species.

Sea Turtles

Five species of threatened (T) and endangered (E) sea turtles, including the Kemp's ridley sea turtle (*Lepidochelys kempii*; E), green sea turtle (*Chelonia mydas*; T), hawksbill sea turtle (*Eretmochelys imbricata*; E), leatherback sea turtle (*Dermochelys coriacea*; E), and loggerhead sea turtle (*Caretta caretta*; T), forage in the near-shore waters, bays and sounds of Louisiana. Of those species, the two most commonly encountered are the loggerhead and Kemp's ridley sea turtles. The National Marine Fisheries Service is responsible for aquatic marine threatened or endangered species. Eric Hawk (727/570-5312) in St. Petersburg, Florida, should be contacted for additional information concerning those species.

Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered fish found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the Old River Control Structure Complex); it is possibly found in the Red River as well. The pallid sturgeon is adapted to large, free-flowing, turbid rivers with a diverse assemblage of physical habitats that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana. Habitat loss through river channelization and dams has adversely affected this species throughout its range.

Gulf Sturgeon

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

On March 19, 2003, the Fish and Wildlife Service and the National Marine Fisheries Service published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for

the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl River system, Lake Pontchartrain east of the Lake Pontchartrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. The primary constituent elements essential for the conservation of Gulf sturgeon are those habitat components that support feeding, resting, sheltering, reproduction, migration, and physical features necessary for maintaining the natural processes that support those habitat components; those elements should be considered when determining potential project impacts. The primary constituent elements for Gulf sturgeon critical habitat include:

- abundant prey items within riverine habitats for larval and juvenile life stages, and within estuarine and marine habitats for juvenile, subadult, and adult life stages;
- riverine spawning sites with suitable substrates for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;
- riverine aggregation areas, also referred to as resting, holding and staging areas, used by adult, subadult, and/or juveniles, generally, but not always, located in holes below normal riverbed depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions;
- a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging; and necessary for maintaining spawning sites in suitable condition for egg attachment, eggs sheltering, resting, and larvae staging;
- water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;
- sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and
- safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by a permanent structure, or a dammed river that still allows for passage).

Please be aware that the Fish and Wildlife Service is responsible for ESA consultations regarding the Gulf sturgeon and its critical habitat for activities in riverine units. The National Marine Fisheries Service is responsible for ESA consultation regarding the Gulf sturgeon and its critical habitat for Corps activities within estuarine units, and is responsible for all ESA consultations regarding Gulf sturgeon and its critical habitat for activities in marine units.

Inflated Heelsplitter

Federally listed as threatened, the inflated heelsplitter mussel (*Potamilis inflatus*) occurs in the Amite River (Louisiana [with one report in the Pearl River]) and the Tombigbee and Black Warrior Rivers (Alabama). In Louisiana, the mussel occurs between Louisiana Highway 37 and Louisiana Highway 42, with the highest concentrations between Grangeville and Port Vincent. This freshwater mussel is typically found in soft, stable substrates such as sand, mud, silt, and sandy gravel, in slow to moderate currents. Heelsplitter mussels are usually found in depositional pools below sand point bars, and in shallow pools between sandbars and river banks. Major threats to this species in the Amite River are the loss of habitat resulting from sand and gravel dredging, and channel modifications for flood control.

Louisiana Quillwort

Federally listed as an endangered plant species, the Louisiana quillwort (*Isoetes louisianensis*) grows on sand and gravel bars on the accreting sides of streams and moist overflow channels within riparian forest communities in Washington and St. Tammany Parishes, Louisiana. The Louisiana quillwort is a small, semi-aquatic, facultative evergreen plant with spirally arranged leaves (sporophylls) arising from a globose, two-lobed corm. The hollow leaves are transversely septate, and measure approximately 0.12 inch wide and up to 16 inches long. Major threats to this species are habitat loss through hydrologic modifications of stream habitat, and land use practices that significantly alter stream quality and hydrology. Apparently, it is dependent on a special hydrologic regime resulting from the presence of small springs scattered at the bases of banks or bluffs.

MBTA Information

Colonial nesting waterbirds are protected under the MBTA. Colonies that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries may also be present. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect individual proposed project areas for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on individual proposed projects should be observed:

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

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

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and avoid impacting them during the breeding season.

We appreciate the Corps' continued cooperation in the conservation of threatened and endangered species and migratory birds. If your staff have any questions or need further information, please have them contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

Russell C. Watson
Acting Supervisor
Louisiana Field Office

cc: NOAA Fisheries, St. Petersburg, FL
LDWF, Natural Heritage Program, Baton Rouge, LA

APPENDIX B

Descriptions of the Restoration Project Concepts

NEAR-TERM PROJECT CONCEPTS

Small Diversion at Hope Canal consists of a small freshwater diversion through a newly constructed control structure at Hope Canal. The objective is to introduce Mississippi River sediments and nutrients into the Maurepas Swamp south of Lake Maurepas. The introduction of additional freshwater via the proposed diversion would facilitate organic deposition, improve biological productivity, and prevent further deterioration of the swamp.

Small Diversion at Convent/Blind River consists of a small freshwater diversion into Blind River through a new control structure. The objective of this feature is to introduce Mississippi River sediments and nutrients into the southeast portion of Maurepas Swamp. This feature would operate in conjunction with the Hope Canal freshwater diversion to facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

Increase Amite River Influence by Gapping Spoil Banks consists of gapping the existing spoil banks of the Amite River Diversion Canal. The objective of this project is to introduce additional nutrients and sediments into portions of the western Maurepas Swamp primarily during flood events and localized rainfall events. This would facilitate organic deposition in the swamp, improve biological productivity, and prevent further swamp deterioration.

MRGO Environmental Restoration involves the implementation of the environmental restoration features under consideration by the MRGO Environmental Restoration Study. In response to public concerns, past environmental effects, and national economic development considerations, an ongoing study is re-evaluating the viability of operation and maintenance of the MRGO. Since the construction of the MRGO, saltwater intrusion has degraded large expanses of freshwater marshes and accelerated habitat switching from freshwater marshes to brackish and intermediate marshes in the Biloxi marshes, the Central Wetlands, and the Golden Triangle wetlands. This study will evaluate the stabilization of the MRGO banks and various environmental restoration projects that would reduce saltwater intrusion into Lake Pontchartrain, the Biloxi marshes, the Central Wetlands, and the Golden Triangle marshes. Implementation should result in hydrologic restoration via implementation of environmental mitigation recommended in the Mississippi River Gulf Outlet (MRGO) Study.

The Caernarvon Diversion, constructed in 1992 near the Breton Sound marshes, has been operated to manage salinities in the central Breton Sound estuary through the introduction of fresh water at rates ranging between 1,000 cubic feet per second (cfs) and 8,000 cfs. This restoration project would seek a post-authorization change of the original project purpose to include wetland creation and restoration via increasing freshwater introduction rates, up to perhaps 5,000 cfs on average, to provide greater wetland-building. The introduction of additional fresh water would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Medium Diversion at Whites Ditch, located at White's Ditch downstream of the Caernarvon diversion structure, would implement a medium-sized diversion into the central River aux Chene area through the construction and operation of a new water control structure. The objective of this project is to provide additional fresh water, nutrients, and fine sediments to the area between the Mississippi River and River aux Chene ridge, an area which is currently isolated from the beneficial effects of the Caernarvon freshwater diversion. The introduction of additional fresh water would facilitate organic sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

*Reauthorization of the Davis Pond Diversion for increased sediment input***.** The Davis Pond Freshwater Diversion structure, constructed in 2002 in the upper Barataria Basin, has been operated to control central basin salinities through freshwater introductions ranging between 1,000 cfs and 10,000 cfs. This restoration feature would seek re-authorization of the original project purpose to include wetland creation. To achieve this goal, the freshwater introduction rate would be increased up to perhaps 5,000 cfs on average, to accelerate wetland-building. The introduction of additional fresh water would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes.

Medium-sized Diversion with Dedicated Dredging at Myrtle Grove consists of a medium-sized freshwater diversion near Myrtle Grove through a new control structure. The diversion would provide additional sediments and nutrients to nourish highly degraded existing fresh to brackish wetlands and shallow, open-water areas. This would ensure the long-term sustainability of these marshes by increasing vegetative productivity and preventing future loss. The introduction of sediment to this area would also promote the infilling of shallow, open-water areas through both deposition and marsh expansion. This diversion would be complimented by dedicated dredging of sediment mined from the Mississippi River. The objective of this component is to create 1,500 acres of additional wetlands by placing dredged sediments in the shallow, open-waters within the fragmented marsh.

Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island consists of mining offshore sediments to re-create eroded barrier islands. Based on designs developed in the LCA Barrier Island Restoration Study, a 3,000-foot-wide island footprint would be restored.

Terrebonne Basin Barrier Shoreline Restoration-Isles Derniere and East Timbalier consists of restoring some of the Timbalier and Isle Dernieres barrier island chains. This restoration would simulate historical conditions by reducing the current number of breaches, and enlarging the width and dune crest of the Isles Dernieres (East Island, Trinity Island, and Whiskey Island) and East Timbalier Island.

Small Bayou Lafourche Reintroduction would reintroduce flow from the Mississippi River into Bayou Lafourche. The proposed year-round flows would provide water supply benefits and reduce marsh-loss rates for the wetlands south of the GIWW, between Bayous Lafourche and Terrebonne.

Gulf Shoreline Stabilization at Point au Fer Island would stabilize the Gulf shoreline of Point au Fer Island to prevent direct connections from forming between the Gulf and interior water bodies as that shoreline erodes. In addition to Gulf shoreline protection, this feature would reduce marine influence on fresher Atchafalaya Bay water, protecting the adjacent wetland habitats from saltwater impacts.

Multi-purpose Operation of Houma Navigation Canal (HNC) Lock consists of operating the proposed Houma Navigation Canal Lock located at the southern end of the HNC, for multiple purposes, rather than for navigation only. The Corps' Morganza to the Gulf Hurricane Protection Study includes construction of the lock, but does not include the multi-purpose operation of the lock. This restoration feature would reduce saltwater intrusion, modify water circulation in the HNC to increase the distribution of Atchafalaya River water within Terrebonne Basin wetlands, especially within the Lake Boudreaux area wetlands to the north; the Lake Decade wetlands to the west; and the Grand Bayou wetlands to the east.

Convey Atchafalaya River Water to Terrebonne marshes includes a number of features to improve the distribution of freshwater to deteriorated Terrebonne Basin marshes via the Gulf Intracoastal Waterway (GIWW). Construction of new channels and enlargement of existing channels would increase seasonal flows of Atchafalaya River water to central (Lake Boudreaux) and eastern (Grand Bayou) Terrebonne marshes. All channel alternatives would include a gated control structure to restrict saltwater intrusion during low river stages. The project also includes features to increase the supply of Atchafalaya River within the GIWW include repairing banks along the GIWW, enlarging constrictions in the GIWW, and possibly diverting additional freshwater from Bayou Shaffer into Avoca Island Lake provided there are no negative impacts to Penchant Basin marshes. Those features would increase suspended sediment supply to Bayou Penchant and other wetlands receiving the Atchafalaya River water via the GIWW.

Maintain Land Bridge between Caillou Lake and Gulf of Mexico by installing shore protection along deteriorated portions of Grand Bayou DuLarge to prevent establishment of a major new hydrologic connection between the Gulf and Sister Lake. Some shore armoring would likely be needed to protect these features from erosion on the Gulf shoreline. A more systemic and comprehensive solution would involve a much greater amount of Gulf shoreline armoring, especially toward the west where shoreline retreat and loss of shoreline oyster reefs has allowed for increased water exchange between the Gulf and the interior waterbodies (i.e., between Bay Junop and Caillou Lake). Some of the newly opened channels would be closed to restore the historic cross-sections of exchange points. By reducing marine influences in these interior areas, these features might also allow increased riverine influences from Four League Bay to benefit area marshes.

POTENTIAL DEMONSTRATION PROJECTS

Wetland Creation in Vicinity of the Barataria Chenier Unit would address the uncertainty involved in selecting sources of material for marsh creation, restoration of maritime forests, and restoration of freshwater cheniers. There is uncertainty regarding the efficacy of using saline mineral sediments to support freshwater habitats. Uncertainties exist regarding the time required for salts to leach out of those sediments and other processes to occur that would make the soils more suitable for the establishment of freshwater vegetation. Those uncertainities would need to be resolved prior to using this technique on a large scale.

This demonstration project would be located in southwestern Barataria Basin, just north of Port Fourchon, in the "Chenier Unit." This project would be constructed in four 200-acre cells, each using different methods for placement of thin sediment layers using techniques such as spray deposition and unconfined/semi-confined traditional hydraulic techniques. The demonstration project would be monitored to determine plant mortality, landform stability, borrow area impacts, and effects on the local ecosystem.

Pipeline Conveyance of Sediments to Maintain Land Bridges would address the uncertainty involved in land bridge restoration through long distance conveyance of sediments via pipeline. Concerns about the cost effectiveness of using conventional dredging techniques to transport large quantities of sediments long distances need to be addressed. Conventional dredging equipment typically requires large pipelines for transport of sediments. However, there are uncertainties about how the material can be effectively transported efficiently over long distances and distributed. Variability in the sections of the land bridge would facilitate monitoring to determine optimal final grade vs. design grade, dewatering periods, and potential water quality effects of transported materials. Tests should also be conducted to apply a two-tiered approach whereby large pipeline systems are used to convey high volumes of material but smaller dredges could be used to then disperse the material into final locations. This demonstration project would be located along the degrading land bridge between Bayous Dularge and Grand Caillou in the lower Terrebonne Basin.

Pipeline canal restoration using different methods would address uncertainties involved in the restoration of pipeline canals. Pipeline canals have been cut throughout the coastal marshes and have resulted in fragmentation and accelerated erosion of many marshes. There has been considerable uncertainty and debate about the most effective approach to restoring existing and future pipeline canals. There are also uncertainties about the viability of restoration efforts and the timing of restoration. Different approaches to restoration should be examined and monitored including: 1) backfill with a small hydraulic dredge; 2) mechanical backfill; 3) gap spoil banks to restore natural hydrology; and 4) install canal plugs to reduce erosion within the canal. If backfilling is used, impacts related to the acquisition of borrow material and its effect on the local ecosystem must be addressed. This demonstration project would be constructed in locations in both the Barataria and Terrebonne basins, with planned closure of twenty different canal sections via the methods described above.

Shoreline erosion prevention using different methods would address uncertainties involved in restoration of eroding shorelines throughout the coastal area. Erosion along open bays and channels has lead to wetland losses across the coast. Different approaches to impede future erosion would be examined and monitored for long-term effectiveness and sustainability. Project monitoring would include the settlement of the various erosion protection/foreshore features. This demonstration project would be implemented through construction and monitoring of erosion protection/foreshore protection features in a variety of foundation conditions. The project would consist of fifteen different one-mile treatments along the rapidly eroding Gulf of Mexico shoreline at Rockefeller Refuge.

Barrier island restoration using offshore sources of sediments would address uncertainties involved in restoration of barrier islands with offshore sources of sand. Two sand sources already identified are Ship Shoal and the Lower Mississippi River. Issues related to Ship Shoal include the quantity of available material and the cost-effectiveness of using this source relative to other sources. The sources of sands must be quantified and different transport mechanisms tested to determine a cost-effective approach to transport the material. The demonstration project test sections would also vary in the types of sediment (percentage of sand/silt/clay) used for barrier islands and back barrier marsh creation. Monitoring would focus on vegetation growth and island stability. This demonstration project would be constructed along sections of the Terrebonne barrier islands.

LARGE-SCALE STUDIES

The Mississippi River Delta Management Study would require extensive investigations to maximize the use of riverine freshwater and sediments for wetland restoration without adversely impacting navigation. Sediments, nutrients, and fresh water would be re-directed to restore the quality and sustainability of coastal wetlands, and to improve Gulf of Mexico water quality. The study would investigate potential modifications to existing navigation channel alignments and associated maintenance procedures and requirements.

The Third Delta feature consists of a control structure in the vicinity of Donaldsonville that would divert approximately 240,000 cfs at maximum river stage. Flows would be diverted into a newly constructed conveyance channel (parallel to Bayou Lafourche) extending approximately 55 miles from the initial point of diversion to the eventual point of discharge. The diverted flow would be divided equally at a point north of the GIWW to enable the creation of a delta lobe within the Terrebonne and Barataria Basins. Sediment enrichment of this diversion, using a 30-inch dredge for three months yielding 6,293, 000 yd^3 each year, would also be considered. Significant feasibility-level investigation would be required to determine its effects on flood control, drainage, navigation, and environmental impacts.

Upper Atchafalaya Basin Study, including evaluation of modified operational scheme of Old River Control Structure (ORCS) would alter that structure's operational plan to increase the sediment load transported down the Atchafalaya River. Detailed studies would determine impacts (beneficial and adverse) to the interior of the Atchafalaya Basin, the distribution of the additional flow and sediment, and the increased costs of maintaining the flood control, navigation, and environmental features along the Lower Mississippi, Red, and Atchafalaya Rivers.

Acadiana Bay Estuarine Restoration Study provides for rebuilding the Point Chevreuil Reef (which formerly extended toward Marsh Island) and rehabilitating the Bayou Sale natural levee between Point Chevreuil and the Gulf of Mexico. The natural levee would be rebuilt in the form of a shallow sub-aqueous platform, small islands, and/or reefs. This feature would be designed to restore a semblance of the historic hydrologic conditions in the Teche/Vermilion Basin.

The Chenier Plain Freshwater Management and Allocation Reassessment would require detailed investigations involving water allocation needs and trade-off analyses in the eastern Chenier Plain, including the Teche/Vermillion Basin, to provide for wetland restoration, and support continued agriculture and navigation in the region. A series of navigation and salinity control structures are currently authorized and operated in the eastern portion of the Chenier Plain. Those structures maintain a freshwater source for agriculture and prevent salinity intrusion in the area. Tidal stages outside the managed area often exceed stages within the managed area, creating an inundation problem for the fresh and intermediate marshes in the area. In addition, the natural ridges that define this area continue to be impacted by erosion, which threaten the management and sustainability of the interior marshes. This study would address water management and allocation issues including salinity control, drainage, and fisheries accessibility.

APPENDIX C

Resource Agency Comment Letters on the May 2004 Draft Fish and Wildlife Coordination Act Report

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, Florida 33702

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July 19, 2004

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225/389-0508

Mr. Russell C. Watson, Supervisor
Louisiana Field Office
U.S. Fish and Wildlife Service
646 Cajundome Blvd., Suite 400
Lafayette, Louisiana 70506

Dear Mr. Watson:

The National Marine Fisheries Service (NOAA Fisheries) has received the draft Fish and Wildlife Coordination Act Report (Report) titled "Near-Term Ecosystem Restoration Plan for the Louisiana Coastal Area" transmitted by your letter dated May 28, 2004. The Report discusses the potential impacts of implementing a near-term plan (NTP) designed to achieve system-wide sustainable restoration of Louisiana's coastal wetlands and develop better techniques for meeting the critical needs and advancing our understanding of the coastal ecosystem.

We have reviewed the Report and find it to be well written. However, we have the following comments regarding information provided within the Report.

EXISTING FISH AND WILDLIFE RESOURCES
Essential Fish Habitat

Page 6, paragraph 3. The word "Plan" should be changed to "Plans" in the first sentence.

Some features of the NTP involve mining offshore sediments for the restoration of barrier islands and headlands (e.g., Barataria Basin Barrier Shoreline Restoration-Caminada Headland and Shell Island). As such, the following species should be added to the third sentence of this paragraph: red snapper, Spanish mackerel, and bluefish. Additionally, the wording "and highly migratory species managed by NOAA Fisheries (e.g., billfishes and sharks)" should be added at the end of the final sentence of the paragraph.

We appreciate the opportunity to review and comment on this Report. If you wish to discuss our recommendations, please contact Bren Haase at (225) 389-0508.

Sincerely,

for Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

c:
NOD, Planning Division - Constance
LDNR, CRD - Duffy
EPA, Dallas - McQuiddy
NRCS, Lafayette - Paul
SER4
Files

KATHLEEN BABINEAUX BLANCO
GOVERNOR

State of Louisiana
DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF SECRETARY

DWIGHT LANDRENEAU
SECRETARY

June 28, 2004

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Mr. Russell Watson
Supervisor
Louisiana Field Office
U.S. Fish and Wildlife Service
646 Cajundome Blvd., Suite 400
Lafayette, LA 70506

RE: Draft Fish and Wildlife Coordination Act Report for the Near-Term Ecosystem Restoration Plan, Louisiana Coastal Area, Louisiana Coastwide Ecosystem Restoration Feasibility Study

Dear Mr. Watson:

Louisiana Department of Wildlife and Fisheries staff have reviewed the captioned draft report. As the report points out, the LCA Near-Term report is in an early programmatic stage. It is impossible at this stage, to make very detailed predictions or recommendations regarding the proposed habitat changes, and their impacts on fish and wildlife resources. The "Plan that Best Meets the Objective" (PBMO) provides a list of projects that will rehabilitate portions of the coast. The Department concurs with the US Fish and Wildlife Service (USFWS) that the PBMO will provide the greatest fish and wildlife benefits and potentially provide for long term sustainability of the newly created or rehabilitated coastal landforms.

It is clear, however, that coastal and estuarine habitats will change significantly as a result of the projects in the PBMO. Changes in salinity resulting from freshwater and sediment diversions will displace estuarine fish and wildlife resources, and the degree to which increases in marsh productivity will compensate for those displacements is not at all clear. We strongly recommend that future planning efforts emphasize the importance of estuarine environments and their connections to coastal wetland habitats. We concur with the USFWS conclusion that improvements and refinements in the hydrologic and desktop models will be needed to predict impacts of proposed projects, in both coastal wetlands and estuarine habitats. In addition, as part of the socio-economic analyses performed under this study, we strongly recommend that there be a clear discussion of the impacts of these landscape changes, both long-term and short-term, on Louisiana's important fish and wildlife resources and their users.

P.O. BOX 98000 • BATON ROUGE, LOUISIANA 70898-9000 • PHONE (225) 765-2623 • FAX (225) 765-2607
AN EQUAL OPPORTUNITY EMPLOYER

Mr. Russell Watson
Page 2
June 28, 2004

We also concur with the USFWS report as to the importance of continued participation by fish and wildlife agencies in the LCA study. The Louisiana Department of Wildlife and Fisheries participated in the early planning phases of the LCA study as much as possible and we intend to play a more substantive role in future planning efforts for coastal and estuarine restoration. In addition, we give notice that any activities occurring on state administered Wildlife Management Areas or refuges must be pursued through the Department.

We welcome the opportunity to work with the USFWS under the Fish and Wildlife Coordination Act to improve coastal habitats for our jointly-held trust resources.

Sincerely,

Dwight Landreneau
Secretary

jhwf