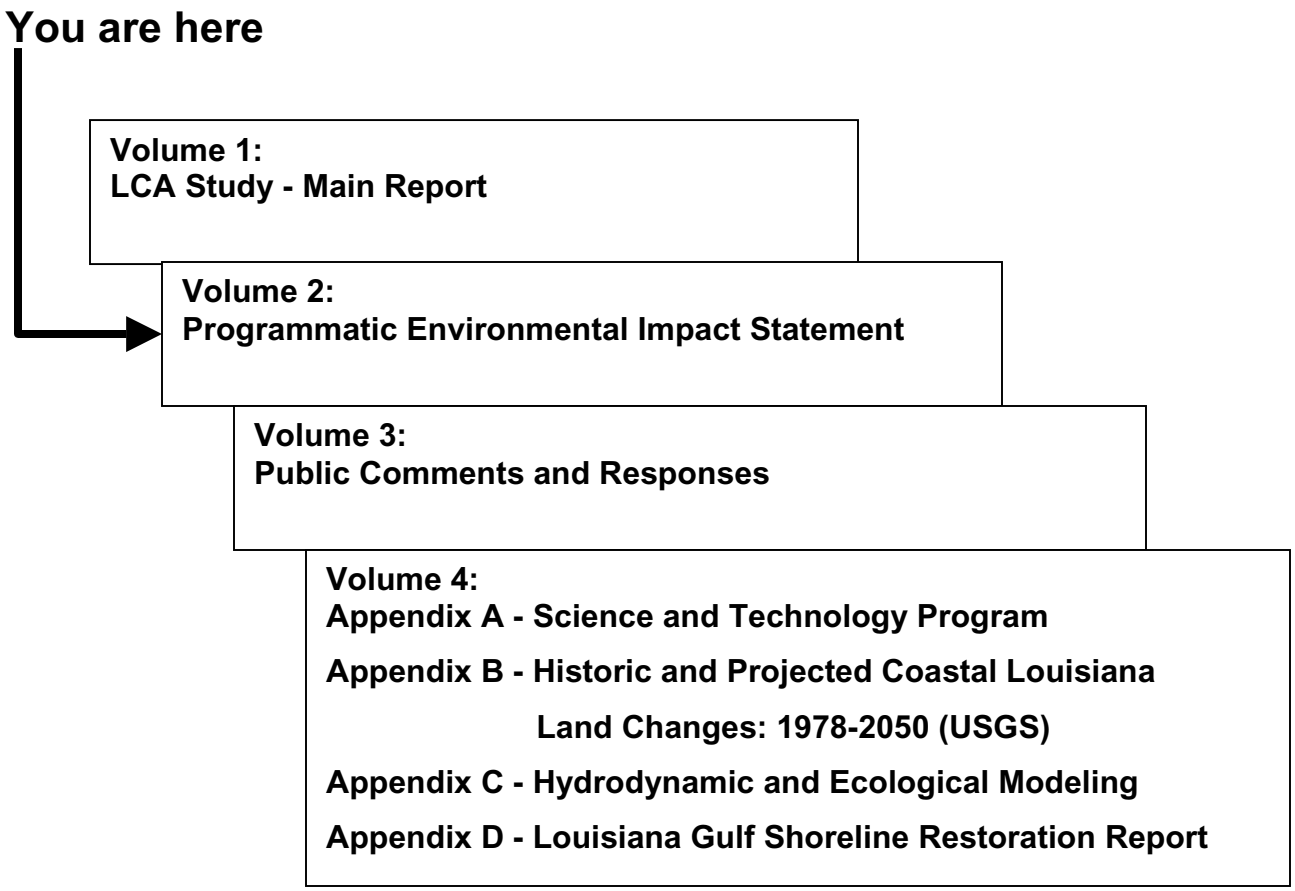
US Army Corps
of Engineers®
New Orleans District

Louisiana Coastal Area (LCA), Louisiana

Ecosystem Restoration Study

November 2004
Final
Volume 2:
Programmatic Environmental Impact Statement

This Report Contains 4 Volumes



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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.

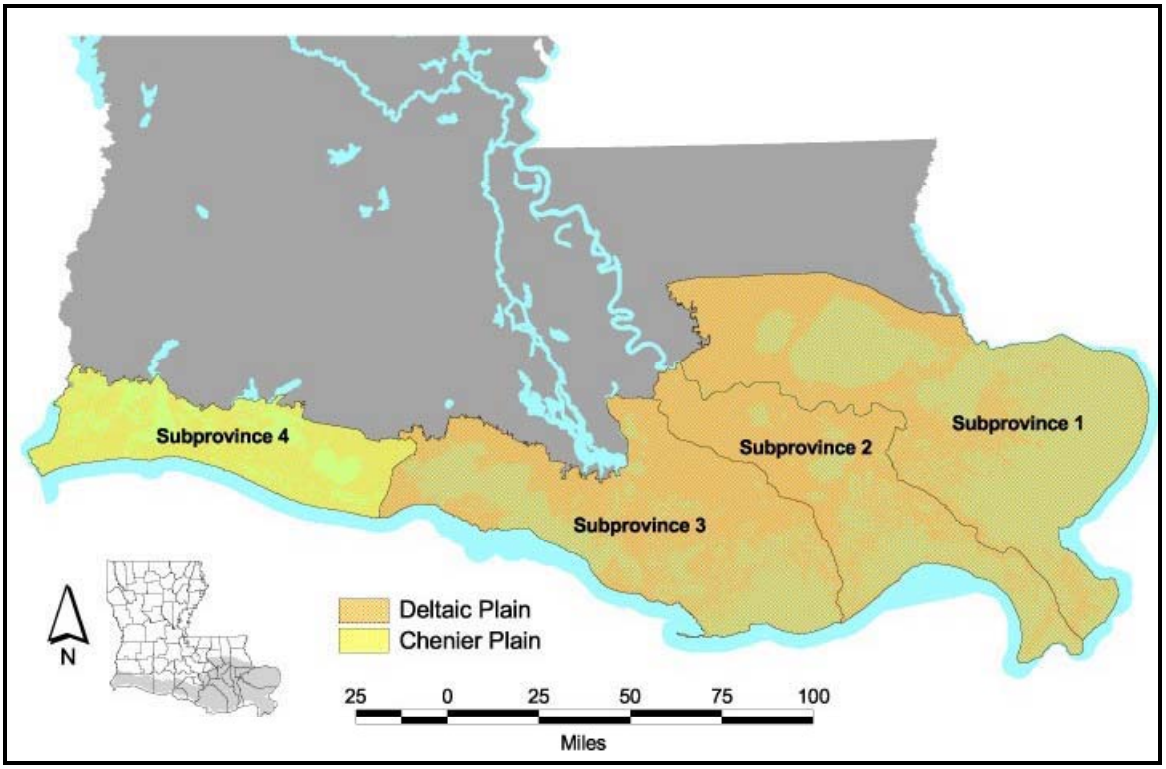

Figure S-1. LCA Study Area and Subprovinces.

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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PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMEMENT

Louisiana Coastal Area (LCA), Louisiana Ecosystem Restoration Study

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