LOUISIANA COASTAL AREA, BARATARIA BASIN BARRIER SHORELINE RESTORATION PROJECT LAFOURCHE, JEFFERSON, AND PLAQUEMINES PARISHES, LOUISIANA FINAL REPORT

COMMUNICATION

FROM

THE ASSISTANT SECRETARY, ARMY, CIVIL WORKS, THE DEPARTMENT OF DEFENSE

TRANSMITTING

LOUISIANA COASTAL AREA, BARATARIA BASIN BARRIER SHORELINE RESTORATION PROJECT LAFOURCHE, JEFFERSON, AND PLAQUEMINES PARISHES, LOUISIANA FINAL REPORT

PART 1 OF 3

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DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

20 MAR 2013

Honorable John Boehner
Speaker of the House
of Representatives
U.S. Capitol Building, Room H-232
Washington, D.C. 20515-0001

Dear Mr. Speaker:

Pursuant to Section 7006(c) of the Water Resources Development Act (WRDA) of 2007, the Secretary of the Army submits this Final Integrated Construction Report and Environmental Impact Statement for the Louisiana Coastal Area (LCA), Barataria Basin Barrier Shoreline (BBBS) Restoration Project, Lafourche, Jefferson and Plaquemines Parishes, Louisiana. The project was authorized by section 7006, and I approve the LCA BBBS project, consisting of both the Caminada Headland component and the Shell Island component, as described in the report of the Chief of Engineers, dated June 22, 2012. The recommendation of the Chief of Engineers is consistent with the report of the Chief of Engineers for ecosystem restoration for the Louisiana Coastal Area, dated January 31, 2005, which describes a program to address the most critical restoration needs to reduce the severe wetland losses occurring in Louisiana.

An increase in the authorized cost cap is required because the cost of the recommended LCA BBBS project now exceeds the cost cap established by section 7006(c)(1)(C). The Chief's report for LCA BBBS recommends that the Caminada Headland component of the recommended plan be constructed under the existing authorization. The Chief's report also recommends that the Shell Island work be carried out after Congressional action to increase the cost. The views of the State of Louisiana, the Department of Commerce and the Choctaw Nation of Oklahoma are set forth in the enclosed communications. The Secretary of the Army plans to implement the restoration project recommended by the Chief of Engineers through the normal budget process at the appropriate time, considering national priorities and the availability of funds.

The recommended plan is the national ecosystem restoration plan. It would restore the barrier system's geomorphic and hydrologic form and provide critical habitat for the threatened piping plover. Additionally, it would restore valuable stopover habitats for migratory birds and help maintain the Barataria estuary which contains significant fish and wildlife habitat. It would help reduce further degradation of the interior coastal wetlands. The sediment input would supplement long shore sediment transport processes and increase the sustainability of the restored areas. Both the Caminada Headland and Shell Island would continue to erode. On an average annual basis, considering the initial construction, natural erosion and the renourishment cycles, sea level rise and subsidence, the net average annual benefits of the habitat created would be about 1,895 acres at the Caminada Headland and about 694 acres at Shell Island. Post-construction monitoring and adaptive management costs for a period of no more than ten years are included in the project first cost to ensure project performance. The project does not have any significant adverse environmental effects. No compensatory mitigation measures would be required.

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Based on October 2012 price levels, the estimated project first cost for the recommended plan is $435,000,000. In accordance with the cost sharing provisions in WRDA 1986, as amended, the Federal share of the total project cost would be about $283,000,000 (65 percent) and the non-Federal share would be about $152,000,000 (35 percent). The project cost includes an estimated $1,320,000 for environmental monitoring and adaptive management. The State of Louisiana, acting as the non-Federal sponsor, is required to provide all lands, easements, relocations, rights-of-way and dredged or excavated material disposal areas (LERRDs), the costs of which are estimated at $3,720,000.

The recommended plan includes renourishment as part of the non-Federal sponsor's operation, maintenance, repair, replacement and rehabilitation (OMRR&R) responsibilities to maintain both the Caminada Headland and Shell Island. Renourishment of the Caminada Headland would be implemented every 1.5 to 2 years in conjunction with the U.S. Army Corps of Engineers operation and maintenance dredging of the Bayou Lafourche, Louisiana (Belle Pass) navigation project. Shell Island would be renourished to the original construction template at approximately 20-year intervals after initial construction. The State of Louisiana, acting through the Coastal Protection and Restoration Authority of Louisiana, is the non-Federal sponsor.

The State would continue to maintain the existing public access and recreational use of the seashore, including the limitations and prohibitions on dune access in order to protect the restoration project. The non-Federal sponsor is responsible for OMRR&R of the project after construction, including renourishment, currently estimated at about $6,330,000 annually. Based on a 3.75 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the recommended plan are estimated to be $26,500,000, including OMRR&R.

The recommended plan for the Caminada Headland consists of dredging and placing approximately 5.1 million cubic yards (mcy) of sand to construct about 880 acres of dune. The proposed borrow source for Caminada dune material is Ship Shoal, located about 40 miles from the project site. Approximately 5.4 mcy of material would be placed landward of the dune to construct approximately 1,186 acres of marsh. The proposed borrow source for Caminada marsh material is located approximately 1.5 miles south of the Headland. Approximately 71,500 feet of sand fencing would be installed and a variety of native vegetation species would be planted on approximately 8-foot centers.

The Chief's report recommends that, as part of the recommended plan, the Caminada Headland component be implemented under the existing authority. Based on October 2012 price levels, the estimated project first cost for the Caminada Headland component is about $227,500,000. In accordance with the cost sharing provisions in WRDA 1986, as amended, the Federal share would be about $147,900,000 (65 percent) and the non-Federal share would be about $79,600,000 (35 percent). The project first cost includes an estimated $640,000 for environmental monitoring and adaptive management. The State of Louisiana, acting as the non-Federal sponsor, is required to provide all LERRDs, the costs of which are estimated at $1,680,000.

The non-Federal sponsor is responsible for OMRR&R of the project, including renourishment. For the Caminada Headland component, OMRR&R is currently estimated at about $4,320,000 annually. Based on a 3.75 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the recommended plan are estimated to be $14,300,000, including OMRR&R.

Shell Island would be restored to its pre-Hurricane Bob (1979) single island configuration. About 5.6 mcy of sand and 23,800 feet of sand fencing would be placed to build approximately 317 acres of dunes. The proposed borrow source for Shell Island dune material is the Mississippi River, which is located about 11 miles north of the project site. Approximately 2.1 mcy of sediment would be placed to construct about 466 acres of marsh. The proposed borrow source for marsh material is an offshore site, south of the Empire jetties. A variety of native vegetation species would be planted on approximately 8-foot centers.

The Chief's report recommends that, while the Shell Island component is part of the recommended plan, it not be implemented without further authority. Based on October 2012 price levels, the estimated project first cost for the Shell Island work component is $207,200,000. In accordance with the cost sharing provisions in WRDA 1986, as amended, the Federal share of the project first cost would be about $134,700,000 (65 percent) and the non-Federal share would be about $72,500,000 (35 percent). The first cost includes an estimated $681,000 for environmental monitoring and adaptive management. The State of Louisiana, acting as the non-Federal sponsor, is required to provide all LERRDs, the costs of which are estimated at $2,042,000.

The non-Federal sponsor is responsible for OMRR&R of the project, including renourishment. For the Shell Island component, OMRR&R is currently estimated at about $1,960,000 annually. Based on a 3.75 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the recommended plan are estimated to be $12,200,000, including OMRR&R.

The Office of Management and Budget (OMB) advises that there is no objection to the submission of these reports to Congress. The Administration concluded that my recommendations for this project are consistent with the policy and programs of the President. OMB also advised that the project would need to compete with other proposed investments in future budgets. A copy of its letter is enclosed. I am providing a copy of the report and the OMB letter to the House Committee on Transportation and Infrastructure and the Senate Committee on Environment and Public Works. I am also sending the same documents to the President of the Senate.

Very truly yours,

Jo-Ellen Darcy

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

Enclosures

9 Enclosures

1. Report of the Chief of Engineers, Jun 22, 2012
2. NOAA letter Apr 24, 2012
3. HQUSACE Response to NOAA, Jun 29, 2012
4. State of Louisiana Letter, May 10, 2012
5. Choctaw Nation letter May 24, 2012
6. OMB Letter, Feb 12, 2013
7. Record of Decision
8. Final Report - Louisiana Coastal Area Barataria Basin Barrier Shoreline Project Final Integrated Construction Report and Final Environmental Impact Statement, March 2012 (DVD)
9. Report Abstract and Executive Summary for the Office of the Parliamentarian

DEPARTMENT OF THE ARMY
CHIEF OF ENGINEERS
2600 ARMY PENTAGON
WASHINGTON, DC 20310-2600

REPLY TO
ATTENTION OF

CECW-MVD (1105-2-10a)

22 JUN 2012

SUBJECT: Louisiana Coastal Area (LCA), Barataria Basin Barrier Shoreline Restoration Project, Lafourche, Jefferson, and Plaquemines Parishes, Louisiana

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on ecosystem restoration for Barataria Basin Barrier Shoreline (BBBS) in Lafourche, Jefferson, and Plaquemines Parishes, Louisiana. It is accompanied by the report of the New Orleans District Engineer and the Mississippi Valley Division Engineer. These reports are in final response to the authorization for BBBS contained in Section 7006(c)(1)(C) of the Water Resources Development Act of 2007 (WRDA 2007).

2. Section 7006(c)(1) of WRDA 2007 authorizes the Secretary to carry out five projects, including the BBBS project, substantially in accordance with the Report of the Chief of Engineers for ecosystem restoration for the Louisiana Coastal Area dated January 31, 2005. Section 7006(c)(3) states that before beginning construction of any project under Section 7006(c), the Secretary shall submit a report documenting any modifications to the project, including cost changes, to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environment and Public Works of the Senate. Section 7006(c)(4) states that notwithstanding Section 902 of the Water Resources Development Act of 1986, the cost of a project under Section 7006(c), including any modifications to the project, shall not exceed 150 percent of the cost of such project set forth in Section 7006(c)(1). Preconstruction engineering and design activities on the BBBS project will be continued under the authority provided by Section 7006(c)(1)(C). Construction of the recommended plan for BBBS will be undertaken under the Section 7006(c)(1)(C) authority as well, except for construction of the Shell Island component.

3. The Report of the Chief of Engineers for ecosystem restoration for the Louisiana Coastal Area, dated January 31, 2005, (hereinafter referred to as the LCA Chief's report), describes a plan to address the most critical restoration needs in coastal Louisiana. Congress authorized these projects for construction in WRDA 2007 Title VII. This report addresses BBBS, one of the 15 near-term ecosystem restoration features described in the LCA Chief's report.

4. In accordance with Section 7006(c)(1)(C), the reporting officers recommend that the Secretary carry out the Caminada Headland component of the recommended plan for BBBS under the existing authorization. The reporting officers also recommend that the Congress raise the total project cost for the recommended plan for BBBS. The recommended plan for BBBS is consistent

with the authorization in Section 7006(c)(1)(C) of WRDA 2007, but modification of that authorization is required because the total costs for the recommended plan for BBBS, including both the Caminada Headland component and Shell Island component, exceeds the authorized cost for the BBBS project as defined in Section 7006(c)(4) of WRDA 2007.

5. The BBBS is located approximately 55 miles south of New Orleans, Louisiana. It is a key component in regulating estuary hydrology and slowing the rate of wetland loss. Caminada Headland, forming the western portion of the barrier shoreline, has experienced some of the highest rates of shoreline retreat on the Gulf coast. Shell Island forms the eastern portion of the barrier and has disintegrated into several smaller islands and shoals and is gradually converting to a series of bays directly connected to the Gulf of Mexico. The two reaches were identified in the LCA Chief's Report as the most critical to maintaining Barataria shoreline integrity and protecting the interior coast from further degradation. The BBBS project described in the LCA Chief's report consisted of dredging and placing sediments to restore barrier dunes and marshes. At Caminada Headland, about 9-10 million cubic yards (mcy) of sand would be placed to create a dune approximately 6 feet high with a shoreward berm about 1000 feet wide and13 miles long. Approximately 6 mcy of material would be placed to create about 3,000 acres of marsh. The project would provide a net increase of 640 acres of dune/berm habitat and 1,780 acres of saline marsh habitat at Caminada Headland. Shell Island would be restored to a two-island configuration. At Shell Island (west) approximately 3.4 mcy of sand would be placed to create about 139 acres of dune and about 74 acres of marsh. Approximately 6.6 mcy of sand would be placed at Shell Island (east) to create about 223 acres of dune/berm and about 191 acres of marsh. The project would provide about 147 acres of shoreline habitat on Shell Island.

6. The reporting officers reviewed the BBBS project described in the LCA Chief's report, as well as the changed physical conditions of the shoreline. Since 2005 it has continued to degrade and has been heavily impacted by hurricanes and tropical storms. Based on this review the reporting officers developed the recommended plan presented in this report to respond to the changed conditions and to be consistent with the direction provided in WRDA 2007. As in the LCA Chief's Report, this recommended plan includes dune and marsh restoration at Caminada Headland and Shell Island, the barrier system's most critical components. The recommended plan is the National Ecosystem Restoration (NER) plan. It will restore the barrier system's geomorphic and hydrologic form. It will restore critical habitat for the threatened piping plover, as well as valuable stopover habitats for migratory birds and Essential Fish Habitats for a variety of fish and shellfish. It will protect the interior coast from further degradation, and the sediment input will supplement long shore sediment transport processes, increasing the restored area's sustainability.

7. The recommended plan consists of dredging and placing approximately 5.1 mcy of sand to restore and create about 880 acres of dune at Caminada Headland. Dune height would be + 7 feet North American Vertical Datum of 1988 (NAVD88) with a crown width of 290 feet and

slopes of 20 feet horizontal to 1 foot vertical. The proposed borrow source for Caminada dune material is Ship Shoal, located about 40 miles from the project site. Approximately 5.4 mcy of material would be placed landward of the dune to restore and create approximately 1,186 acres of marsh at an elevation of +2.0 feet NAVD88. The proposed borrow source for Caminada marsh material is located approximately 1.5 miles south of the Headland. Approximately 71,500 feet of sand fencing would be installed and a variety of native vegetation species would be planted on approximately 8 foot centers. Shell Island would be restored to its pre-Hurricane Bob (1979) single island configuration. About 5.6 mcy of sand and 23,800 feet of sand fencing would be placed to build approximately 317 acres of dunes to a height of +6 feet NAVD88 with a crown width of 189 feet and slopes of 45 feet horizontal to 1 foot vertical. The proposed borrow source for Shell Island dune material is the Mississippi River, about 11 miles north of the project site. Approximately 2.1 mcy of sediment would be placed to restore about 466 acres of marsh at an elevation of +2 feet NAVD88. The proposed borrow source for marsh material is an offshore site south of the Empire Jetties. A variety of native vegetation species would be planted on approximately 8 foot centers.

8. The recommended plan includes renourishment at staggered intervals to maintain the headland and island over time. As part of the non-Federal sponsor's Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) responsibilities, renourishment of the Caminada Headland would be implemented every 1.5 to 2 years in conjunction with Corps operation and maintenance dredging of the Bayou Lafourche, Louisiana (Belle Pass) navigation project. Shell Island would be renourished by the non-Federal sponsor 20 and 40 years after initial construction to the original construction template, as part of its OMRR&R responsibilities.

9. The recommended plan contains post-construction monitoring and adaptive management at an estimated cost of $1,300,000 to be conducted for a period of no more than ten years to ensure project performance. Monitoring may be cost-shared for a period of no more than ten years. The non-Federal sponsor is responsible for monitoring required beyond ten years. Because the recommended plan is an ecosystem restoration plan, it does not have any significant adverse effects, and no mitigation measures would be required.

10. The State of Louisiana is the non-Federal cost-sharing sponsor for all features and supports the recommended plan described herein. Based on October 2011 price levels, the estimated project first cost for the recommended plan is $428,000,000. In accordance with the cost sharing provisions in WRDA 1986, as amended by Section 210 of WRDA 1996 the Federal share of the total first cost would be about $278,000,000 (65 percent) and the non-Federal share would be about $150,000,000 (35 percent). The project first cost includes an estimated $1,300,000 for environmental monitoring and adaptive management. The State of Louisiana, acting as the non-Federal sponsor, is required to provide all lands, easements, relocations, right-of-ways and dredged or excavated material disposal areas (LERRDs), the costs of which are estimated at $3,660,000. Further, the non-Federal sponsor is responsible for OMRR&R of the project after

construction, including renourishment, currently estimated at about $6,180,000 annually. Based on a 4 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the recommended plan are estimated to be $27,000,000 including OMRR&R.

11. The reporting officers recommend that the Caminada Headland component of the NER plan be implemented under the existing authority provided in Section 7006(c)(1)(C) of WRDA 2007. The reporting officers also recommend that the Congress increase the authorized total project cost so that the entire recommended (NER) plan can be implemented. Modification of the authorization provided by Section 7006(c)(1)(C) is required because the cost of the recommended NER plan, including both the Caminada Headland and Shell Island components, exceeds the authorized cost limit as defined in Section 7006(c)(4). Costs to accomplish the original goals of the BBBS project have increased because the shoreline system has continued to degrade since the LCA Chief's report was completed. In addition, the cost of dredging and placing material, the largest component of this project, has increased because of increases in fuel and construction costs post-hurricane Katrina. The State of Louisiana, acting as the non-Federal sponsor, supports immediate implementation of the Caminada component.

12. Based on October 2011 price levels, the estimated first cost for the Caminada Headland component is $224,000,000. In accordance with the cost sharing provisions in WRDA 1986, as amended by Section 210 of WRDA 1996, the Federal share of the first cost would be about $146,000,000 (65 percent) and the non-Federal share would be about $78,000,000 (35 percent). The first cost includes an estimated $630,000 for environmental monitoring and adaptive management. The State of Louisiana, acting as the non-Federal sponsor, is required to provide all LERRDs, the costs of which are estimated at $1,650,000. Further, the non-Federal sponsor is responsible for OMRR&R of the project after construction, including renourishment, currently estimated at about $4,250,000 annually. Based on a 4 percent discount rate and a 50-year period of analysis, the total equivalent average annual costs of the recommended plan are estimated to be $14,600,000 including OMRR&R.

13. The reporting officers found the recommended plan and each of the components to be cost effective, technically sound, and environmentally and socially acceptable. The cost of the recommended aquatic ecosystem restoration features is justified by the decrease in shoreline erosion and loss of wetlands; the restored barrier system's regulation of salinity gradients and maintenance of the estuary critical to fish and wildlife, such as white and brown shrimp; the maintenance of geomorphic form that attenuates storm surge for interior wetlands and surrounding coastal communities, including Port Fourchon, major oil and gas infrastructure and the regional hurricane evacuation route for residents of southern Lafourche Parish; and the approximately 1719 AAHUs of beach/dune and marsh habitats provided 988 AAHUs on Caminada Headland and 731 AAHUs on Shell Island. The recommended plan conforms to essential elements of the U.S. Water Resources Council's Economic and Environmental Studies and complies with other administration and legislative policies and guidelines. The

recommended plan was developed in coordination and consultation with various Federal, State and local agencies using a systems approach in formulating ecosystem restoration solutions and in evaluating the impacts and benefits of those solutions. Study formulation looked at a wide range of structural and non-structural alternatives. Further refinement and additional analysis of the project will be performed during preconstruction engineering and design, and modifications will be made, as appropriate, prior to project implementation. Such analysis or modifications will continue to be coordinated with Federal, State, and local agencies and other parties.

14. In accordance with the Engineering Circular on review of decision documents, all technical, engineering and scientific work underwent an open, dynamic and rigorous review process to ensure technical quality. This included an independent Agency Technical Review (ATR), an Independent External Peer Review (IEPR), and a Corps Headquarters policy and legal review. All concerns of the ATR have been addressed and incorporated into the report. The IEPR was conducted by the Battelle Memorial Institute. IEPR of the draft report was completed on December 2, 2011. A total of 16 comments were generated. No comments were rated high significance, 15 were rated medium, and 1 was rated low significance. All comments from this review have been addressed and incorporated into the final project documents and recommendation as appropriate.

15. I concur in the findings, conclusions, and recommendation of the reporting officers. Accordingly, I recommend project implementation, in accordance with the reporting officers' recommendations with such modifications as in the discretion of the Chief of Engineers may be advisable. I further recommend, in accordance with the reporting officers recommendations, that the authorization be modified to raise the total project cost to allow for construction of the entire NER plan. My recommendations are subject to cost sharing, financing, and other applicable requirements of Federal and State laws and policies, including WRDA 1986, as amended by Section 210 of WRDA 1996. The State of Louisiana, acting as the non-Federal sponsor, would provide the non-Federal cost share and all lands, easements, relocations, right-of-ways and disposals. Further, the non-Federal sponsor would be responsible for all OMRR&R. This recommendation is subject to the non-Federal sponsor agreeing to comply with all applicable Federal laws and policies, including but not limited to its agreeing to:

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

(1) Provide the non-Federal share of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

(2) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material that

the Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project;

(3) Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of the total project costs allocated to the project;

b. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project;

c. Not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the study or project;

d. Not use the project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;

e. For as long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the project, or functional portion of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

g. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

h. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or

under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

i. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

j. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that would not cause liability to arise under CERCLA;

k. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce ecosystem restoration benefits, hinder operation and maintenance, or interfere with the project's proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

l. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as would properly reflect total costs of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

n. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.); and

o. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

16. The recommendations contained herein reflect the information available at this time and current departmental policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of the national civil works construction program or the perspective of higher levels within the executive branch. Consequently, the recommendations may be modified before they are transmitted to Congress for additional authorization and/or implementation funding. However, prior to transmittal to Congress, the State of Louisiana, interested Federal agencies, and other parties will be advised of any significant modifications in the recommendations and will be afforded an opportunity to comment further.

THOMAS P. BOSTICK
Lieutenant General, US Army
Commanding

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

April 24, 2012 F/SER46/PW:jk
225/389-0508

Mr. Theodore A. Brown, Chief
Planning and Policy Division
Directorate of Civil Works
Headquarters, U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, Virginia 22315-3860

Dear Mr. Brown:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Final Environmental Impact Statement (FEIS) and Final Integrated Construction Report titled "Louisiana Coastal Area (LCA) Louisiana – Barataria Basin Barrier Shoreline Restoration." These documents were transmitted for our review by your letter dated March 29, 2012.

The Army Corps of Engineers, New Orleans District (COE) evaluated various alternatives for restoration of the Caminada Headland in Lafourche Parish and Shell Island in Plaquemines Parish, Louisiana. The National Ecosystem Restoration (NER) Plan and Recommended Plan include the restoration of 1,197 acres of dune and supratidal habitats on Caminada Headland and Shell Island as well as an additional 1,652 acres of intertidal habitats, which is estimated to net approximately 1,684 total acres of habitats gained after the 50 year project life. The estimated fully funded cost of the Recommended Plan is $448,351,000. The Recommended Plan also utilizes approximately 650,000 cubic yards of sediment generated every 1.5 to 2 years during federal maintenance dredging of Bayou Lafourche to maintain the projects by placing the dredged material into the littoral drift near Bayou Moreau. This is the non-federal sponsor's operation and maintenance requirement and consists of paying the incremental cost over the federal standard for sediment disposal. The Recommended Plan also includes the renourishment of Shell Island at 20 year intervals. The NER Plan cannot be constructed within the maximum authorized project cost, therefore the Caminada Headland was selected as a subset for construction and would provide a net of 990 acres of total island-headland habitats.

By letter dated August 2, 2011, NMFS provided comments and recommendations for revisions to the Draft Environmental Impact Statement for this project. In addition, NMFS provided four EFH conservation recommendations designed to ensure impacts to EFH are minimized and adequately offset. Those EFH conservation recommendations stated:

The Empire borrow area is being used by the Pelican Island project presently being constructed under the auspices of the Coastal Wetlands Planning, Protection and Restoration Act. It is recommended the ROD commit to supplemental National Environmental Policy Act and EFH documents to assess potential adverse environmental impacts if other borrow sites are later determined during PED to be necessary for project construction.

In light of the documented adverse impacts of the Empire jetties on adjacent shoreline erosion, NMFS continues to question the overall need for the Empire jetties. Rather than remove the jetties, the COE proposes additional analyses of connecting the western jetty by extending the Shell Island restoration feature, despite the likelihood that doing so would induce accelerated erosion of the area proposed to be restored. NMFS understands the jetties are subject to a separate navigation authority; however, we believe the breadth of considered alternatives is lacking. We note that pursuant to Section 1502.14 (c) of National Environmental Policy Act, reasonable alternatives not within the jurisdiction of the lead agency should be included to provide a clear and comparative basis of choice. Therefore, NMFS advocates the COE examining the statutory authorities during the PED phase of project implementation to determine if it is possible to remove the jetties and extend the longevity of Shell Island

In our August 2, 2011, comment letter, NMFS described the procedures that should be followed to ensure fulfillment of coordination requirements pursuant to Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act and NMFS' implementing regulation at 50 CFR 600.920(k). Those procedures require the COE to provide a written response to our EFH conservation recommendations within 30 days of receipt. If the COE was unable to provide a substantive response within 30 days, the COE should have provided an interim response to NMFS, to be followed by the detailed response. To date, NMFS has not received an interim response and does not consider the submittal of the FEIS for our review to fulfill the detailed EFH response requirement. Based on the responses appended to the FEIS, gapping or degrading containment dikes is the one EFH conservation recommendation we find requiring further attention. As indicated above, NMFS recommends the ROD commit to the breaching of the containment dikes within three years following construction, if they are not naturally breached prior to that time. The COE should provide a detailed response to our EFH conservation recommendations at least 10 days prior to signing a ROD. That response should describe how each EFH conservation recommendation was addressed, and if not incorporated into project revisions, the response should provide justification for that decision.

NMFS appreciates the opportunity to review the FEIS. If you have questions regarding the above or attached comments, please contact Richard Hartman or Patrick Williams at 225-389-0508, for assistance.

Sincerely,

Virginia M. Fay

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

Planning and Policy Division

JUN 2 9 2012

Ms. Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division
National Marine Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

Dear Ms. Fay:

This letter is in response to your letter dated April 24, 2012, concerning the Final Environmental Impact Statement (FEIS) and Final Integrated Construction Report titled "Louisiana Coastal Area - Barataria Basin Barrier Shoreline Restoration" (LCA BBBS) and the proposed report of the Chief of Engineers.

Your letter reiterated four essential fish habitat (EFH) conservation recommendations submitted in a previous (August 2, 2011) letter. The previously submitted EFH conservation recommendations are:

1. During the Preliminary Engineering and Design phase of project implementation, means to minimize adverse impacts to existing intertidal habitats on both the Caminada Headland and Shell Island should be evaluated, in coordination with National Marine Fisheries Service (NMFS) and other interested natural resource agencies.

2. To ensure the development of functional habitat heterogeneity, project designs for the created marsh platform should include the creation of tidal creeks and ponds.

3. Containment dikes for the marsh platforms on both the Caminada Headland and Shell Island should be degraded or gapped in an acceptable manner to be developed through coordination with NMFS.

4. The sand fencing plan and species to be planted should be developed during the Preliminary Engineering and Design (PED) phase of project implementation, in coordination with NMFS and other natural resource agencies.

Your letter also included several new recommendations, including:

5. The ROD should stipulate that marsh platform containment dikes be gapped or degraded no more than three years after construction if containment dikes are not naturally breached in an amount deemed acceptable through coordination with NMFS. The manner of such gapping or degradation should be developed through coordination with NMFS during PED phase.

6. The need for additional EFH assessment, including impact analysis of a specific dump site, if hopper dredges would be used to dump sediment in the nearshore area for later mining and transport to the shoreline.

7. The need to commit in the ROD to supplemental National Environmental Policy Act (NEPA) and EFH assessments of potential adverse environmental impacts if borrow sites other than Empire are determined during PED to be necessary.

8. The recommendation to examine statutory authorities during the PED phase to determine if removal of the Empire jetties may be possible

9. The need to fulfill coordination requirements pursuant to Section 305(b)(4)(B) of the Magnuson-Stevenson Fishery Conservation and Management Act and NMFS' implementing regulation at 50 CFR 700.920(k) and provide a detailed response to your EFH conservation recommendations at least 10 days prior to signing a ROD.

Our responses to all NMFS recommendations are as follows:

1. The USACE concurs with conservation recommendation #1 as addressed in the Final EIS. During PED phase, additional means to minimize adverse impacts to existing intertidal habitats on both the Caminada Headland and Shell Island will be considered and coordinated with the NMFS and other natural resource agencies.

2. The USACE does not concur with conservation recommendation #2 that project design should include tidal creeks and ponds on restored Shell Island barrier island habitats or the Caminada Headland. As your letter acknowledges, including such design features into barrier islands and the beach/dune/supratidal/intertidal erosional zone of the Caminada Headland fronting the Gulf of Mexico would initiate and rapidly increase barrier habitat fragmentation to restored areas in this high energy Gulf of Mexico barrier system. Such features would naturally develop over time due to the different natural processes and sediment densities of the borrow material and differential settlement and consolidation of the borrow material over time.

3. The USACE concurs with conservation recommendation #3. Consistent with the USACE's experience with previous ecosystem restoration efforts, containment dikes are anticipated to degrade and gap naturally. However, we concur that, if they do not naturally degrade and gap in an amount deemed acceptable through coordination with the NMFS, containment dikes for the marsh platforms will be gapped or degraded no later than three years

after construction. The manner and process for doing so will be developed in coordination with the NMFS during PED.

4. The USACE concurs with conservation recommendation #4 as addressed in the Final EIS. During PED phase, refinement of the sand fencing plan and vegetative species to be planted will be coordinated with the NMFS and other natural resource agencies.

5. The USACE concurs with the need to develop plans for gapping and degradation of containment dikes in coordination with the NMFS, if determined to be necessary, as stated in conservation recommendation #5. We will coordinate with the NMFS to develop an acceptable plan as outlined in response #3 and will include the commitment in the ROD.

6. The USACE concurs with conservation recommendation #6 regarding the need for additional EFH assessment, including impact analysis of a specific dump site, if hopper dredges would be used to dump sediment in the nearshore area for later mining and transport to the shoreline. We will coordinate with NMFS to supplement the FEIS and EFH assessments, if it is determined during PED that a specific dump site will be necessary.

7. The USACE concurs with conservation recommendation #7 regarding the need for supplemental NEPA and EFH assessments of potential adverse environmental impacts if borrow sites other than Empire are determined during PED to be necessary. The commitment will be included in the ROD.

8. The USACE commits, as stated in conservation recommendation #8, to analyze further the potential impacts of the Empire jetties on Shell Island, including re-examining navigation statutory authorities outside the jurisdiction of the LCA BBBS restoration authorization, during the PED phase of project implementation to determine if it is possible to remove the jetties and extend the longevity of Shell Island. The USACE considered modifying the Empire jetties as described on page 3-5 of the integrated final report. In addition, an in-depth analysis was conducted on the impacts of the Empire jetties and is included in Appendix A, Annex 2 of the final integrated report.

9. The USACE concurs with the need to fulfill coordination requirements pursuant to Section 305(b)(4)(B) of the Magnuson-Stevenson Fishery Conservation and Management Act and NMFS implementing regulation at 50 CFR 700.920(k), and to provide a detailed response to your EFH conservation recommendations at least 10 days prior to signing a ROD, as stated in recommendation #9 above.

The USACE believes the responses above fulfill the coordination requirements. Thank you for your interest and input to review this Corps civil works study. We look forward to working with you in the future.

Sincerely,

Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works

State of Louisiana

BOBBY JINDAL
GOVERNOR

May 10, 2012

Mr. Theodore A. Brown, P.E.
Chief, Planning and Policy Division
Directorate of Civil Works
Headquarters
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

Dear Mr. Brown:

Please reference your letter requesting the position of the State of Louisiana regarding the proposed report of the Chief of Engineers and report of the district engineer on the Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline Restoration Project. The Coastal Protection and Restoration Authority (CPRA) is pleased to offer its continuing support of the LCA Barataria Basin Barrier Shoreline Restoration Project as authorized in the Water Resources Development Act of 2007 (WRDA 2007). This project is a critical part of the overall LCA Program and a vital component in rehabilitating the natural system of coastal Louisiana that serves to protect the economic and energy security of both the state and nation, the safety of more than 2 million Louisiana residents, the ecological balance of the Gulf region, and the survival of a unique culture. The appropriate agencies of the State have reviewed the report and its recommendations are generally consistent with State laws and policies and are in general agreement with the goals of CPRA as set forth in the agency's annual plan and 2012 Comprehensive Master Plan for a Sustainable Coast.

This letter, while not legally binding on the State as an obligation of future funds appropriated by the State Legislature, declares our full support for the LCA Barataria Basin Barrier Shoreline Restoration Project described in the proposed report of the Chief of Engineers and report of the district engineer, with cost sharing as required in WRDA 2007. Accordingly, the State acknowledges that the project requires the non-Federal sponsor to contribute 35% of the total project costs, including all lands, easements, rights-of-way, relocations, and any improvements on lands, easements, and rights-of-way required for disposal of dredged material. CPRA also acknowledges that it will be required to operate, maintain, rehabilitate, repair and replace the projects at the non-Federal sponsor's expense. The CPRA fully supports these projects and will make diligent efforts to secure all necessary funding, including asking the State Legislature for additional appropriations if necessary.

Nevertheless, the CPRA believes there is a need for further discussions and modifications related to the standard cost sharing requirements as described in the report and the United States Army Corps of Engineer's (USACE) position that section 7007 of WRDA 2007 does not authorize credit for work carried out after the date of execution of a project partnership agreement for LCA projects. Therefore, the CPRA reserves the right to and intends to continue to seek a correction

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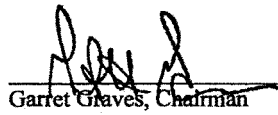
of the Corp's interpretation of Federal law that would allow in-kind contribution credit for work carried out after the date of a project partnership agreement, that would allow for such in-kind contributions credit to carry over between LCA Program components (i.e., "excess credit for work undertaken after signing of the project partnership agreement for one project may be carried over for credit to another project), and that would reduce the non-Federal cost share. Even so, while the CPRA is of the opinion that its view is consistent with the authority and Congressional intent under WRDA 2007, the CPRA fully intends to proceed with the project under the Corp's interpretation of current law and to meet all non-Federal financial and other obligations outlined by the USACE in this report until such time as the interpretation is corrected.

Similarly, renourishment of the recommended plan is currently included as an operations and maintenance responsibility of the non-Federal sponsor. The CPRA reserves the right to and intends to seek a modification to this responsibility. However, the CPRA fully intends to proceed with the project and obligations as written until such modification is approved.

The CPRA supports implementation of the Barataria Basin Barrier Shoreline Restoration Project and we look forward to working with the Corps to achieve this goal.

Respectfully,



Garret Graves, Chairman
Coastal Protection and Restoration Authority of Louisiana

Choctaw Nation of Oklahoma

P.O. Box 1210 • Durant, OK 74702-1210 • (580) 924-8280

Gregory E. Pyle
Chief

Gary Batton
Assistant Chief

May 24, 2012

Chief Joan M. Exnicios
Headquarters
U.S. Army Corps of Engineers
CECW-P (SA)
7701 Telegraph Road
Alexandria, VA 22315-3860

RE: Proposed Report of the Engineers and the report of the district Engineer on the Louisiana Coastal Area, Barataria Basin Barrier Shoreline Restoration Project, LaFouche and Jefferson Parishes, Louisiana.

Dear Chief Exnicios,

Thank you for your correspondence regarding Proposed Report of the Engineers and the report of the district Engineer on the Louisiana Coastal Area, Barataria Basin Barrier Shoreline Restoration Project, LaFouche and Jefferson Parishes, Louisiana. LaFouche and Jefferson Parishes and coastline are within the historic area of interest to the Choctaw Nation of Oklahoma. The Choctaw Nation of Oklahoma, concurs that work should proceed as planned. However, as the project is located in an area that is of general historic interest to the Tribe, we request that work be stopped and our office contacted immediately if any Native American cultural materials are encountered. This stipulation should be placed on the construction plans to insure contractors are aware of it. Please feel free to contact me with any further questions or concerns.

Sincerely,

Dr. Ian Thompson
Director, Historic Preservation Department
Tribal Archaeologist, NAGPRA Specialist, THPO
Choctaw Nation of Oklahoma
PO Drawer 1210
Durant, OK 74701

By: _____
Johnnie Jacobs
Section 106 Coordinator
jjacobs@choctawnation.com

Choctaws...growing with pride, hope and success!

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

February 12, 2013

The Honorable Jo-Ellen Darcy
Assistant Secretary of the Army (Civil Works)
108 Army Pentagon
Washington, DC 20310-0108

Dear Ms. Darcy:

As required by Executive Order 12322, the Office of Management and Budget completed its review of your recommendation for Barataria Basin Barrier Shoreline ecosystem restoration project, Louisiana Coastal Area (LCA), Louisiana. Based on our review, we conclude that your recommendation for authorization of construction of this project is consistent with the policy and programs of the President.

The Corps' construction report indicated that total first cost for the entire project (Caminada Headland and Shell Island) is in excess of the authorized level of appropriations provided in the Water Resources Development Act of 2007. An increase in the authorized level of appropriations is required.

The Office of Management and Budget does not object to you submitting this report to Congress. When you do so, please advise the Congress that the project would need to compete with other proposed investments in future budgets.

Sincerely,

John Pasquantino
Deputy Associate Director
Energy, Science, and Water

RECORD OF DECISION

LOUISIANA COASTAL AREA
BARATARIA BASIN BARRIER SHORELINE RESTORATION PROJECT
Lafourche, Jefferson and Plaquemines Parishes, Louisiana

The final integrated construction report and environmental impact statement (CR/EIS), dated March 2012, and the report of the Chief of Engineers, dated June 22, 2012, address the ecosystem restoration of the Louisiana Coastal Area, Barataria Basin Barrier Shoreline Restoration Project, Lafourche, Jefferson and Plaquemines Parishes, Louisiana. Based on these reports, the reviews of other Federal, State and local agencies, input from the public and the review by my staff, I find the plan recommended by the Chief of Engineers to be technically feasible, environmentally justified, cost effective, in accordance with environmental statutes and in the public interest. Thus, I approve the Barataria Basin Barrier Shoreline Restoration Project for construction.

The CR/EIS documents the evaluation of a number of structural alternatives to restore habitats on the Barataria Basin barrier islands that have been adversely affected by lack of sediment, storm-induced erosion and breaching, subsidence, sea level rise, and hydraulic modifications caused by navigation channels and oil exploration canals. The selected plan to restore the shoreline consists of Caminada Headland Alternative 5 in combination with Shell Island Alternative 5. The selected plan, which is also the environmentally preferable alternative, has the following major features:

- Construction of about 880 acres of dunes and 1,186 acres of marshes on the Caminada Headland from Belle Pass to Caminada Pass through the placement of about 10.5 million cubic yards of dredged material. Approximately 71,500 feet of sand fencing would be installed and a variety of native vegetation species would be planted. Renourishment would occur about every 1.5 to 2 years.

- Construction of about 317 acres of dunes and 466 acres of marshes on Shell Island through the placement of about 7.7 million cubic yards of dredged material which includes 10 years of advanced fill to restore it to a pre-Hurricane Bob (1979) single-island configuration. Approximately 71,500 feet of sand fencing would be installed and a variety of native vegetation species would be planted. Renourishment would occur about years 20 and 40.

- Cost shared monitoring and adaptive management plan for a period of up to 10 years to ensure the success of ecological outputs.

- Identification of borrow areas for initial construction and future re-nourishments of the Caminada Headland (Ship Shoal and Bayou Lafourche maintenance dredging material) and Shell Island (Mississippi River and the Empire deposit).

In addition to the no action plan, two alternatives were evaluated in detail in the feasibility report. The alternatives included: 1) Caminada Headland Alternative 5, and 2) a combination of Caminada Headland Alternative 5 and Shell Island Alternative 5. All

of the alternatives are fully described in the CR/EIS, which is incorporated herein by reference. The draft CR/EIS was circulated on June 24, 2011 for a 45-day public review. All comments were responded to in the final CR/EIS.

The recommended plan is the national ecosystem restoration plan. It would restore the geomorphic and hydrologic form of the barrier island system and provide critical habitat for the threatened piping plover. Additionally, it would restore valuable stopover habitats for migratory birds and help maintain the Barataria estuary, which contains significant fish and wildlife habitat. It would help reduce further degradation of the interior coastal wetlands. The sediment input would supplement long shore sediment transport processes and increase the sustainability of the restored areas. On an average annual basis, considering the initial construction, natural erosion and the renourishment cycles, sea level rise and subsidence, the net average annual benefits of the habitat created would be about 1,895 acres at the Caminada Headland and about 694 acres at Shell Island.

All practicable means to avoid or minimize adverse environmental impacts were included in the plan formulation and have been incorporated into the recommended plan. Post-construction monitoring and adaptive management costs for a period of no more than ten years are included in the project first cost to ensure project performance. The project does not have any significant adverse environmental effects. No compensatory mitigation measures would be needed. The Corps would continue coordination with the National Marine Fisheries Service on Essential Fish Habitat conservation recommendations during the preconstruction engineering and design and construction phases.

Technical, environmental, economic, and risk criteria used in the formulation of alternative plans were those specified in the Water Resource Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, Executive Orders, regulations and local government plans were considered in the evaluation of alternatives and the selection of the recommended plan. Based on review of these evaluations, I find that the public interest would best be served by implementing the recommended plan. This Record of Decision completes the National Environmental Policy Act process.

March 20, 2013
Date

Jo-Ellen Darcy
Assistant Secretary of the Army
(Civil Works)

US Army Corps of Engineers ®

LOUISIANA COASTAL AREA
BARATARIA BASIN BARRIER SHORELINE RESTORATION
FINAL INTEGRATED CONSTRUCTION REPORT
AND
FINAL ENVIRONMENTAL IMPACT STATEMENT

U.S. Army Corps of Engineers
Mississippi Valley Division
New Orleans District
March 2012

Integrated Construction Report and Final Environmental Impact Statement
for the
Barataria Basin Barrier Shoreline Restoration

LEAD AGENCY: U.S. Army Corps of Engineers – Mississippi Valley Division, New Orleans District

ABSTRACT: The U.S. Army Corps of Engineers, New Orleans District (CEMVN), proposes to restore approximately 2,849 acres of dune, supratidal, and intertidal habitat on the Caminada Headland in Lafourche and Jefferson Parishes and Shell Island in Plaquemines Parish. Without action, these critical geomorphic features that isolate the Barataria Basin estuaries from the Gulf of Mexico will continue to degrade, existing breaches will widen and new breaches will form, and portions of the project area will disappear in the near term. Three alternative plans, including the No Action plan, were developed and evaluated as the Final Array. A combination of Caminada Alternative 5 and Shell Island Alternative 5 was selected as the National Ecosystem Restoration (NER) Plan and Recommended Plan. The alternative increases the longevity of the geomorphologic form and function of the Caminada Headland and Shell Island by creating or restoring 1,197 acres of dune and supratidal habitat, and 1,652 acres of intertidal habitat immediately after construction.

The Recommended Plan will ensure the ability of the coastal landforms to provide geomorphic and hydrologic form and function, and provide habitat for essential fish and wildlife species. The fully funded cost of the Recommended Plan is approximately $448,351,000, without operations and maintenance. The estimated cost exceeds the WRDA 2007 authorization requiring additional authorization from Congress for implementation. The Recommended Plan will include operations and maintenance in the form of renourishment of the Caminada Headland and Shell Island, sustaining the benefits created by the project construction. Over each 10 year period, a minimum of 3.9 million cubic yards of material will be returned. Material from the Bayou Lafourche, Louisiana navigation project will be placed in the littoral drift south of Bayou Moreau where the long shore transport of material splits going east and west, allowing the longshore transport and wave action to move and place the sediment along the headland. The renourishment will benefit the Headland as longshore transport nourishes the beach and adds width to the shoreline. Shell Island will be restored to its pre-Hurricane Bob (1979) configuration and will include two renourishment cycles. Renourishment is an operations and maintenance cost that will be fully-funded by the non-federal sponsor. Near term restoration of the Caminada Headland and Shell Island is essential to prevent the need for significantly more difficult and costly restoration efforts in the future, or irretrievable loss of the ecosystem habitats.

Comments: Please send comments or questions on this Final Environmental Impact Statement (FEIS) to the U.S. Army Corps of Engineers, New Orleans District, Attention: William P. Klein, Jr., P.O. Box 60267, New Orleans, Louisiana 70160-0267. Telephone: (504) 862-2540; FAX: (504) 862-2088. **The official closing date for receipt of comments will be 30 days from the date on which the Notice of Availability of the Final EIS appeared in the Federal Register.**

Cover picture: Caminada Headland (East of Port Fourchon, LA). Picture provided by U.S. Army Corps of Engineers, New Orleans District (May 11, 2009).

EXECUTIVE SUMMARY

BACKGROUND

The Barataria Basin Barrier Shoreline Restoration Study (BBBS) was identified as a critical near-term restoration project in the *Louisiana Coastal Area, Louisiana Ecosystem Restoration Study Report* (LCA Report 2004). As a component of this report, the project was recommended for conditional authorization by the Chief of Engineers on January 31, 2005. The Assistant Secretary of the Army for Civil Works (ASA-CW), after obtaining the concurrence of the Office of Management and Budget, provided his report on the Louisiana Coastal Area to Congress on November 18, 2005. Title VII of the Water Resources Development Act of 2007, P.L. 110-114, Section 7006(c)(1)(C) authorizes construction of the Barataria Basin Barrier Shoreline Restoration project in accordance with the restoration plan in the Report of the Chief of Engineers dated January 2005, contingent on completion of a construction report documenting any modifications to the Chief's Report, approval of the Secretary of the Army, and submission to the House Transportation and Infrastructure Committee and Senate Environment and Public Works Committee. Section 7006(c)(4) of WRDA 2007 states that the cost of a project shall not exceed 150 % of the cost of such project set forth in Section 7006(c)(1) of WRDA 2007. The cost of the BBBS project set forth in Section 7006(c)(1)(C) of WRDA 2007 is $242,600,000. Therefore, as currently authorized, the Barataria Basin Barrier Shoreline alternatives are limited to a cost of $363,900,000.

The Barataria Basin barrier shoreline is a regional segment of the Gulf coast of Louisiana that is situated between the west bank of the Mississippi River at the active delta and the eastern shore of Terrebonne Bay. This restoration project would reconstruct coastal landforms of the barrier shoreline in the Barataria Basin to restore the barrier shoreline ecosystem and significantly reduce the loss of estuarine and freshwater wetlands. The Barataria Basin Barrier Shoreline is divided into six reaches. Initial study efforts considered shoreline restoration for five of these reaches in the Barataria Basin Barrier Shoreline. Several ecosystem restoration projects along the Barataria Basin Barrier Shoreline have been constructed, or are in the planning and construction phases under other authorities. The LCA Report identified restoration of the Caminada Headland and Shell Island Reaches as a critical near-term project for the Barataria Basin Barrier Shoreline.

The proposed action to be evaluated in this report is the restoration of the Caminada Headland and Shell Island through shoreline and marsh restoration. The purpose of the proposed action is to restore the geomorphic form and function of the barrier shoreline. Restoration of the shoreline and coastal marshes of Caminada Headland and Shell Island would restore critical habitat, form and function, and long-term sustainability of the barrier shoreline. The proposed action would help restore the diversity and sustainability of coastal habitats. These barrier landforms, along with their related hydrologic and biological processes, provide unique biologically diverse habitats that are crucial to the viability of migratory birds, commercial and recreational fisheries, and a great variety of terrestrial and aquatic species.

This document is an Integrated Construction Report and Environmental Impact Statement. The scope of this document is the evaluation of the restoration of the

Caminada Headland and Shell Island reaches within the Barataria Basin barrier shoreline. The report provides a description of the planning process used to identify the Recommended Plan; specifies implementation responsibilities and cost estimates; and presents a tentative recommendation for construction of the Barataria Basin Barrier Shoreline Restoration project. This report has been prepared in accordance with the National Environmental Policy Act (NEPA) and Engineering Regulation (ER) 1105-2-100. The requirements of Section 404(r) of Public Law 92-500, as amended, have been met. A PL 92-500, Section 404(b)(1) analysis has been completed. A Section 401 Water Quality Certification will be requested from the State of Louisiana.

PROJECT LOCATION

The project location for the BBBS study is divided into two reaches. (Figure ES-1) The Caminada Headland, forming the western portion of the Barataria Basin barrier system, has experienced some of the highest rates of shoreline retreat on the Louisiana or Gulf coast. The Caminada Headland is defined as the area south of Louisiana Highway 1 between Belle Pass and Caminada Pass. The headland is separated from East Timbalier Island to the west by Belle Pass and from Grand Isle to the east by Caminada Pass. Spits have formed at either end of the headland. The 13-mile long shoreline is narrow and has numerous storm overwashes.

Shell Island used to enclose both Bastian Bay and Shell Island Bay but has since disintegrated into several smaller islands and shoals. Currently, there are a few remaining islands and shoal remnants. The island now consists primarily of open water with little beach or saline marsh habitat. Due to the continuing and extensive land loss, Shell Island is gradually converting to a series of interconnecting bays directly connected to the Gulf of Mexico. The Shell Island Reach stretches approximately 2.5 miles, from Grand Bayou Pass to the Empire Waterway.

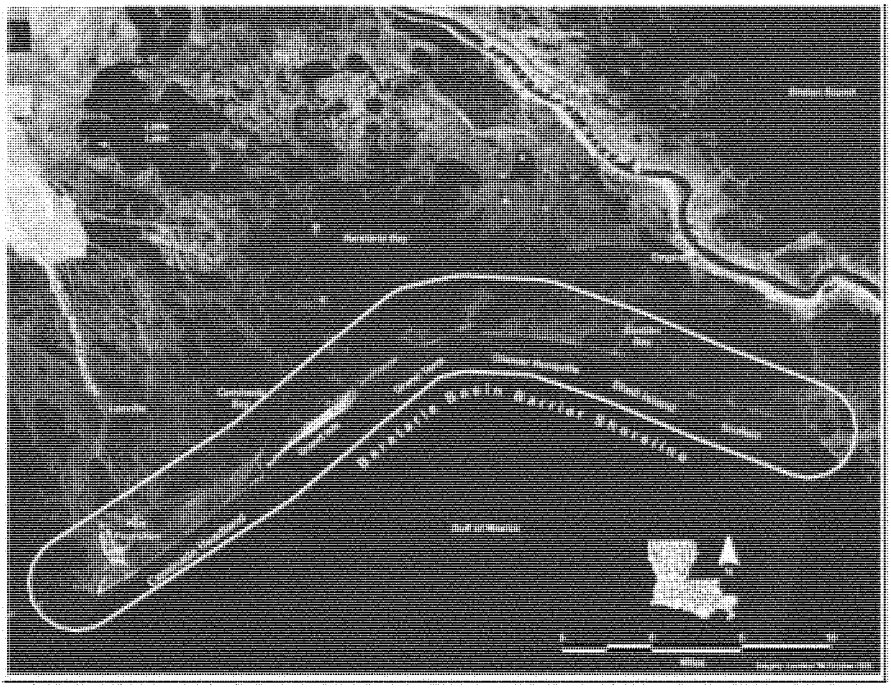


Figure ES-1 Barataria Basin Barrier Shoreline

PROJECT OBJECTIVES

The two reaches of the Barataria Basin Barrier Shoreline project area are almost entirely uninhabited, but they are essential ecosystems because they include wetland habitats and essential fish habitat with high fish and wildlife values. The barrier islands protect the interior coastal wetlands, which also have significant fish and wildlife value, as well as providing the foundation for economically valuable commercial and recreational fisheries. As Louisiana's barrier islands disappear and shorelines retreat, once protected inland bays experience substantially higher waves and storm surges, threatening the entire inland estuarine ecosystem. These ecosystems provide habitat for migratory birds, wildlife, finfish, shellfish, and other aquatic organisms including threatened or endangered species. The recovery and continued success of threatened and endangered species, such as piping plover, brown pelican, and several sea turtles, is significantly threatened by the continued land loss. The shoreline is also the first line of defense for protecting wetlands, inland bays, and mainland regions from the direct effects of high energy waves.

The Caminada Headland is the location of Port Fourchon through which approximately 18% of the nation's oil supply is transported, and is the land base for the Louisiana Offshore Oil Port (LOOP). The LOOP handles approximately 15% of the nation's foreign oil imports and is connected by pipelines to 50% of the United States refinery capacity. Also located on the headland, Louisiana Highway 1 is the only evacuation route for the residents of Grand Isle and Cheniere Caminada and for the workers that

support Port Fourchon and the near-by offshore oil industry. Abandoned beach ridges known as chenieres are covered with a rare maritime forest.

Shell Island was once a single island prior to Hurricane Bob in 1979, and provided protection to the interior estuaries habitats of marshes and bays from the intrusion of the Gulf of Mexico. Now a series of small islands and shoals, the Shell Island chain can no longer protect the back barrier estuarine environments from the high energy marine processes and associated salinities of the Gulf of Mexico. Changes in salinity gradient have reduced the productivity of this ecosystem and negatively impacted the wildlife species in the area. Shell Island Bay and adjacent Bastion Bay, which in the past have been productive oyster habitat and have supported important fisheries, are increasingly being impacted by the intrusion of salt water, resulting in a potential loss of these fisheries. The entire inland bay system is in danger of collapse, resulting in a large sound developing between Empire, Louisiana and the Gulf of Mexico. The restoration of these barrier shorelines will help to reduce the adverse impacts to these national assets.

Based on the function of these barrier islands and problems identified for the Caminada Headland and Shell Island during this study, the following planning objectives were developed to assist the development and evaluation of alternative plans.

- Restore the barrier structures to ensure their ability to provide geomorphic and hydrologic form and function

- Increase the acreage of shoreline, dune, and interior marsh habitat for essential fish and wildlife species, mimicking, as closely as possible, conditions which would occur in the area in the absence of human changes.

- Protect interior marsh and chenier ridge habitats for essential fish and wildlife species.

- Increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline, increasing the ability of the restored area to continue to function and provide habitat with minimum continuing intervention.

- Reduce land loss, preventing the dissolution of the Caminada Headland into separate barrier islands, and the disappearance of Shell Island.

Planning constraints relevant to the project include natural resources limitations; infrastructure and cultural resources that must be avoided or relocated; and avoiding adverse impacts to surrounding coastal areas and threatened and endangered species. Additionally, barrier shoreline systems are dynamic. Each hurricane and winter season will impact the shoreline to varying degrees. Often, breaches created during a hurricane are healed through the natural sand transport processes. Throughout the study, the team's analyses attempted to incorporate data resulting from these observed historic system responses.

PLAN FORMULATION

The Barataria Basin Barrier Shoreline Restoration study is an extension of previous planning and restoration efforts including the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA, PL-101-64, Title III) program, the *Coast 2050: Toward a Sustainable Coastal Louisiana* report, and the 2004 LCA Report. The LCA Report identified restoration of Caminada Headland and Shell Island Reaches as a critical near-term project for the Barataria Basin Barrier Shoreline.

Alternative plan formulation was performed in a two stage process: (1) the available ecosystem restoration measures were evaluated for capability to meet project objectives; and (2) alternative plans were formulated from the selected restoration measures. The plan formulation process included a number of detailed evaluations of potential scales and combinations of restoration measures, and an iterative refinement process for alternative development. Management measures, a feature or an activity that can be implemented at a specific geographic site to address one or more planning objectives, were presented. Structural and nonstructural management measures and various permutations of scales and locations were considered.

The management measures were evaluated to determine the capability of each towards the achievement of the planning objectives, their compatibility with project constraints, their engineering feasibility, and the possibility of consequential damages to areas surrounding the project area. Measures that warranted continued consideration were incorporated into alternative plans. The development of alternative plans for Caminada Headland focused on restoration of the shoreline and adjacent interior marshes that will help stabilize the restored shoreline. The development of alternatives for the Shell Island reach focused on reestablishing a barrier between a threatened estuarine ecosystem and the Gulf of Mexico by restoring the geomorphic structure and function of the barrier island. The management measures were combined to develop alternatives for the Caminada Headland and Shell Island. Engineering designs and preliminary costs were developed for each of these alternatives. The alternatives were evaluated based on their ability to meet project objectives and relative cost effectiveness while providing a variety and range of alternatives. The desired result was the most cost efficient alternatives for each reach that considered a broad range of restoration measures. The Wetland Valuation Assessment (WVA) benefit analysis was then completed on this intermediate array of alternatives.

Project alternatives were evaluated to determine the relative ecosystem benefits provided by each restoration approach. Benefits for ecosystem function have been determined for the alternatives using the WVA methodology. Cost-effectiveness and incremental cost analysis (CE/ICA) were performed by comparing the expected benefits of various restoration feature components over a series of target years during the period of analysis. The CE/ICA evaluated all possible combinations of the Caminada alternatives and Shell Island alternatives, including the no action alternative. These analyses resulted in the selection of Caminada Alternative 5 combined with Shell Island Alternative 5 as the National Ecosystem Restoration (NER) Plan and the Recommended Plan. The alternative would restore the barrier structures to ensure their ability to provide geomorphic and hydrologic form and function. The alternatives would restore the shoreline, dune, and interior marsh habitat for essential fish and wildlife by creating or restoring a total of 1,197 acres of beach/dune and 1,652 acres of marsh over the 50 year period of analysis, mimicking as closely as possible, conditions which would occur in the area in the absence of human changes. Caminada Headland Alternative 5 proposes a dune for the length of the shoreline from Belle Pass to Caminada pass. The marsh fill is

proposed on the landward side of the dune. Approximately 880 acres of beach/dune and 1,186 acres of marsh would be created or restored, resulting in a total of 2,066 acres. Shell Island 5 proposes a one-island configuration, closing Coupe Bob. The marsh and dune would be renourished to its original construction template in years 20 and 40. The initial construction will result in 317 acres of beach/dune and 466 acres of marsh, for a total of 783 acres.

The proposed plan will restore or create 2,849 acres. The plan will restore 1,816 acres of severely degraded barrier shorelines and create 1,033 acres of additional habitat. The estimated cost of the construction is $428,262,000 (October 2011.)

The alternative restores the shoreline, dune and interior marsh habitat for essential fish and wildlife by creating or restoring a total of 1,197 acres of beach/dune and 1,652 acres of marsh resulting in a total of 2,849 acres. The restoration of the shoreline and marsh will protect the interior marsh and chenier ridge habitats for essential fish and wildlife species by providing a buffer from the marine influences of the Gulf of Mexico. By transporting borrow material from the Mississippi River and Ship Shoal, the alternatives will increase sediment input to supplement the long shore sediment transport processes along the gulf shoreline. Finally, the alternatives will reduce land loss.

By utilizing the Mississippi River and Ship Shoal as the borrow sources for the beach/dune restoration, the project is providing new sediment to a sediment-starved ecosystem. The techniques chosen have been used in the restoration of other barrier islands in Louisiana and are proven to be effective. Infrastructure was avoided, requiring no relocations. Barrier shorelines are dynamic, and the alternatives were formulated to work with nature to restore the ecosystem.

The Recommended Plan will include Operations and Maintenance in the form of renourishment of the Caminada Headland and Shell Island. The USACE operations and maintenance dredging of the Bayou Lafourche, Louisiana (Belle Pass) navigation project yields on average approximately 650,000 cubic yards of material every 1.5 to 2 years. This material will be placed in the littoral drift south of Bayou Moreau where the long shore transport of material splits going east and west, allowing the long shore transport and wave action to move and place the sediment along the headland. Over each 10 year period, an estimated 3.9 million cubic yards of material will be returned to the headland which exceeds the amount of sediment lost from the headland through longshore transport. This renourishment is part of the non-Federal sponsor's operations and maintenance requirements. The non-Federal sponsor will pay the incremental cost of beneficially using this material over the federal standard. The renourishment will benefit the Headland both to the east and west of the nodal point as longshore transport nourishes the beach and adds width to the shoreline. The added width will afford protection to the uplands by attenuating wave run-up and thus reducing storm damage. Additionally, the transport of finer sediment into the dune system will bolster it and result in benefits to the flora and fauna species and habitats. Renourishment of Shell Island in years 20 and 40 will return the island to its post construction acreage. The average annual cost of the operations and maintenance is estimated to be $6,183,485 (October 2011). Monitoring and Adaptive Management will be performed on the project. The estimated cost of the Monitoring and Adaptive Management Plan is $1,299,000 (October 2011).

The LCA 2004 report states that, "The BBBS restoration feature addresses critical ecological needs and would sustain essential geomorphic features for the protection of Louisiana's coastal wetlands and coastal infrastructure...The design and operation of the feature would maintain the opportunity for, and support the development of large-scale,

long-range comprehensive coastal restoration." While the project will not stop the natural force of coastal erosion, the project will keep intact the geomorphic and hydrologic form and function of these barrier structures, allowing for the opportunity to develop large-scale and long range comprehensive coastal restoration.

PROJECT DESCRIPTION

Caminada Alternative 5 proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. Alternative 5 also proposes a landward beach and dune component in order to maximize acreage and longevity. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Approximately 880 acres of beach/dune and 1,186 acres of marsh would be restored or created, resulting in a total of 2,066 acres. The existing 1,431 acres (454 acres of beach/dune and 977acres of marsh), which are severely degraded, will be restored, and 635 acres (426 acres of beach/dune and 209 acres of marsh) will be created. For the dune area, the material would be pumped from the dredge to the beach. The material would then be worked on the beach by bulldozers and front-end loaders. For the marsh area, the material would be pumped from an offshore borrow site. The dune would serve as the southern dike for the marsh fill. Additional dikes would be constructed around the remaining perimeter. Placement operations would be completed in a manner that would minimize turbidity of the water at the dredge site and the discharge site. (Figure ES-2)

Approximately 71,500 feet of sand fencing would be installed. The sand fences would promote deposition of windblown sand, create dune features, reduce trampling of existing dunes by beach visitors, and protect vegetative plantings. Vegetative plantings would include a variety of native species.

The borrow area identified for the beach/dune restoration is Ship Shoal, a large submerged sand body in the Gulf of Mexico located offshore in south-central Louisiana approximately 40 miles from the project site. It is composed of well-graded quartz sand and is suitable for use in restoring the Caminada Headland since its grain size is similar to the sand found on the Headland. The borrow site for the marsh restoration is located approximately 1.5 miles south of the central portion of the Caminada Headland, and 4.7 miles southwest of Caminada Pass. The estimated cost of construction of the Caminada Headland is $223,526,000 (October 2011).

The Recommended Plan will include renourishment of the Caminada Headland which will be completed in conjunction with the Bayou Lafourche, Louisiana navigation project. Approximately 650,000 cubic yards of dredged material will be placed offshore in the littoral drift six times every 10 years. This renourishment is part of the non-Federal sponsor's operations and maintenance requirements. The non-Federal sponsor will pay the incremental cost of beneficially using this material over the federal standard. The estimated incremental cost of the renourishment is $7.35 million per event. Under the intermediate relative sea level rise (RSLR) scenario, the Target Year (TY) 50 acreage is estimated to be 2,064 acres; under the low (historic) RSLR scenario, the TY 50 acreage is estimated to be 2,122 acres.

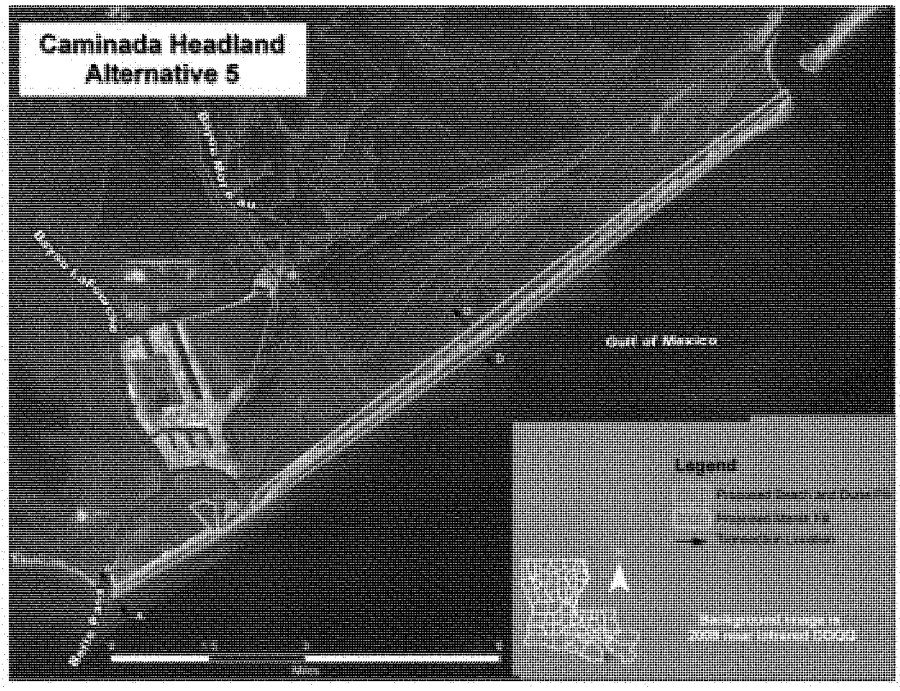


Figure ES-2 Caminada Headland

Under alternative 5, the Shell Island reach would be restored as one island. The island would include shoreface, dune, and marsh platform features. This alternative would restore Shell Island to a form similar to its pre-Hurricane Bob (1979) condition. (Figure ES-3.)

The landward edge of the dune of alternative 5 would be located seaward of the existing shoreline. The west end of the island would be terminated approximately 0.5 mile before Grand Bayou. The west end of alternative 5 is close to the western limit of Shell Island that was observed in 1973, prior to the opening of Coupe Bob. The proposed island follows the shortest and shallowest route across Coupe Bob. The east end of the island would then follow the remnants of Shell Island East with a concave shape towards land. The eastern end of the island would be located near the Empire Waterway. The constructed dune would have a uniform width of 189 feet along the length of the restored barrier island. The dunes will be constructed to a height of + 6 feet NAVD, and the marsh will be constructed to a height of + 2 feet NAVD. The plan would construct 317 acres of dune/beach and 466 acres of marsh. The existing 386 degraded acres (56 acres of beach/dune and 330 acres of marsh) will be restored while 397 acres will be created (261 acres of beach/dune and 136 acres of marsh.) The estimated cost of construction is $203,437,000 (October 2011).

Shell Island would be re-nourished 20 years and 40 years after initial construction to the original template of 317 beach/dune acres. The marsh fill would also be re-nourished to its original construction template at this time interval. The estimated cost of the

renourishment at year 20 is $63.3 million and $60.9 million in year 40 (October 2011 price levels). Under the intermediate RSLR scenario, the TY 50 acreage is estimated to be 855 acres; under the low (historic) RSLR scenario, the TY 50 acreage is estimated to be 919 acres.

The borrow source for the beach/dune would be a large sand deposit near Nairn in the Mississippi River between miles 32 and 34, approximately 11 miles north of the project area. The dredged material would be pumped from the Mississippi River via pipeline. The borrow source for the marsh restoration would be the Empire deposit, approximately 1.5 miles from the Empire Jetties.

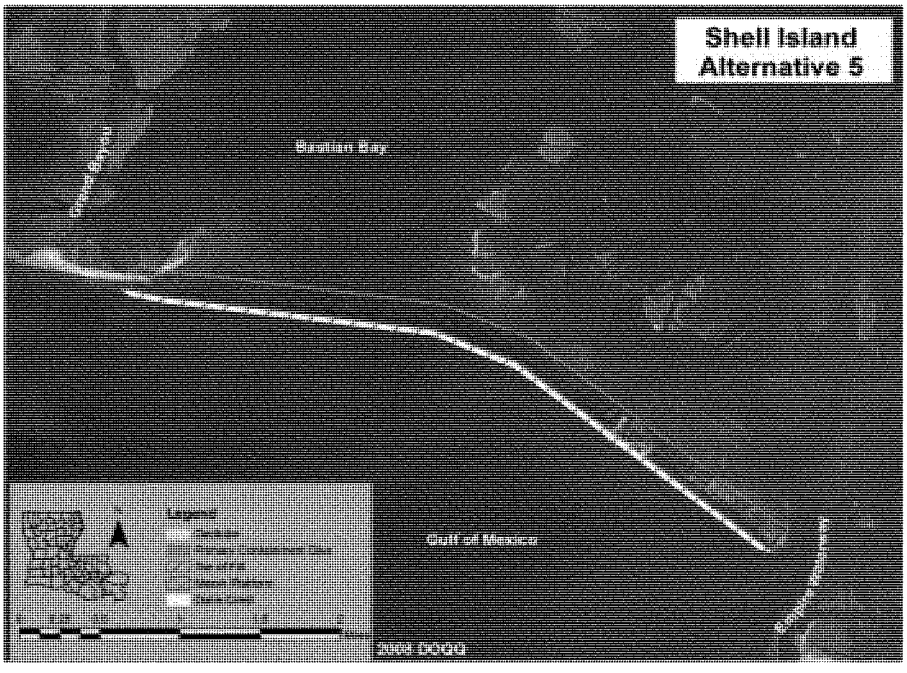


Figure ES-3 Shell Island

Title VII of the Water Resources Development Act of 2007, P.L. 110-114, Section 7006(c)(1)(C) authorizes construction of the Barataria Basin Barrier Shoreline Restoration project in accordance with the restoration plan in the Report of the Chief of Engineers dated January 2005. Section 7006(c)(4) of WRDA 2007 states that the cost of a project shall not exceed 150 % of the cost of such project set forth in Section 7006(c)(1) of WRDA 2007. (Table ES-1) identifies first costs of the Recommended Plan. The estimated cost exceeds the authorization. Additional authorization from Congress would be required to implement construction of this project.

Table ES-1 Recommended Plan Cost Apportionment

Project First Costs (Oct 2011)	$428,000,000
Federal Cost Share	$278,000,000
Non-Federal Cost Share	$150,000,000
Authorized Cost WRDA 7006(c)(1)(C)	$ 242,600,000
Cost plus 150% WRDA 7006(c)(4)	$363,900,000

SUMMARY OF AFFECTED ENVIRONMENT

The Affected Environment describes the climate, geology, and historic and existing conditions for significant environmental resources including: soils; offshore, nearshore, and riverine sand resources; barrier systems (including barrier shorelines, headlands, and islands); coastal processes and hydrology; salinity regimes, water quality; vegetation resources; wildlife resources (including birds, mammals, amphibians, and reptiles); fisheries; EFH; plankton; water bottoms and benthic resources; threatened and endangered species; historic and cultural resources; socioeconomic and human resources (population; infrastructure; employment and income; commercial fisheries; oyster leases; oil, gas, and minerals; pipelines; navigation; flood control; hurricane risk reduction levees; agriculture; forestry; and water supply); aesthetics (visual resources); recreation; and air quality. In addition, noise and hazardous, toxic, and radioactive waste (HTRW) are also considered. A resource is considered important if it is recognized by statutory authorities including laws, regulations, Executive Orders (EO), policies, rules, or guidance; if it is recognized as important by some segment of the general public; or if it is determined to be important based on technical or scientific criteria. The final programmatic EIS for the LCA Study (USACE 2004) presents detailed historic and existing information relevant to this current study. Consistent with 40 CFR Part 1502.21, that information is incorporated by reference.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

The Environmental Consequences chapter describes the potential environmental consequences of implementing the final array of alternative plans considered for restoration of the Caminada Headland and Shell Island. The environmental analysis compares the no action alternative (future without-project conditions) to the final array of two alternatives carried over for detailed analysis.

Alternative C5/S5 (NER/Recommended Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments would restore 2,849 acres.

Alternative C5: Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh would restore 2,066 acres.

Impact analysis described in this chapter is based on a combination of scientific and engineering analyses, professional judgment, and previously compiled information. The Recommended Plan (proposed action), was developed by considering the best combination of restoration alternatives for the Caminada Headland and Shell Island that would meet the study objectives. The environmental impact analysis includes comparison of the potential direct, indirect, and cumulative impacts. 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."

The long term impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. The impacts of the oil spill and the various actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco bags, rip-rap and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area. Potential impacts could include factors such as changes to existing conditions, as well as changes to future-without and future with project conditions.

PUBLIC INVOLVEMENT

The National Environmental Policy Act (NEPA) provides for an early and open public process for determining the scope of issues, resources, impacts, and alternatives addressed in the final environmental impact statement. A Notice of Intent (NOI) to prepare a Final EIS for the Louisiana Coastal Area (LCA) – Louisiana, Caminada Headland and Shell Island Restoration Feasibility Study (LCA Caminada-Shell Island Study) was published in the *Federal Register* (volume 70, number 96) on May 19, 2005. Scoping meetings were held on June 8, 2000; June 20, 2000; June 14, 2005; and June 16, 2005. Public meetings were held on July 26, 2011 in Plaquemines Parish and July 28, 2011 in Lafourche Parish, Louisiana. Meetings were held with stakeholders throughout the planning process.

AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

There is public support for the construction of structures to attempt to decrease erosion due to storm surge on the Caminada Headland near Port Fourchon. Placement of terminal groins would retain sediment on Caminada Headland while breakwaters would reduce the wave energy and reduce the amount of erosion. While the impact from breakwaters may appear to be positive as reduced erosion rates along portions of the shorelines could enhance project performance, these benefits could be offset by significant adverse impacts that could result from the interruption of longshore sediment transport. This interference with sediment transport processes could increase the rates of erosion and shoreline retreat to adjacent reaches of the barrier shoreline. The BBBS team deems that the most appropriate approach to restoration projects should be to mimic natural environmental processes and structures. Rock breakwaters do not mimic or reflect natural environmental features or processes in coastal Louisiana. Hard, immobile structures are fundamentally inconsistent with the soft and highly dynamic nature of the coastal system.

Fourchon Beach, located on the Caminada Headland at the terminus of Louisiana Highway 3090, is a local recreation spot. There have been differing opinions between the landowners and the public regarding access to the beach areas. While the shoreline and the beach area south of Bay Champagne are claimed as state lands by the State of Louisiana, access is available only by crossing private property. There has been considerable conflict between the landowners and the public over access to the beach, especially concerning vehicle access on the beach. While the landowners allow pedestrian access, pilings have been placed to prevent vehicle access. Consequently, beach goers are forced to recreate only in areas near the terminus of Highway 3090. To provide vehicle access to other areas of the beach, the South Lafourche Beach Development District (SLBDD) would like to build a road from Highway 3090 to the

beach area at Bay Champagne. The preferred location of the road would impact the marsh creation area planned between Bay Champagne and Highway 3090. The SLBDD also does not want marsh created in the Bay area, leaving this area available to beach visitors. There are very few beaches in Louisiana that can be accessed by vehicles, severely limiting the public's access to the seashore. However, vehicular traffic on the beach would be incompatible with the ecosystem goals and objectives of the BBBS project and the attainment of the project benefits. This conflict is a microcosm of the larger issue of whether private landowners should benefit from the use of public restoration funds, and whether, due to the use of public funds, the public should have access to restored lands.

There is also controversy resulting from the competing goals of the economic, hurricane and storm damage risk reduction, and restoration special interest groups. Some parties are primarily concerned with hurricane and storm damage risk reduction and shoreline erosion. Other groups are primarily interested in environmental restoration, especially restoration of the Caminada Headland beach, dune, and marsh ecosystems. Some interested parties are primarily concerned with the economic goals such as recreation and oil and gas interests in the Port Fourchon area. Consequently, the economic (e.g., recreation and oil and gas interest) and hurricane and flood damage risk reduction goals sometimes conflict with the ecosystem restoration goals of the LCA BBBS to restore the Caminada Headland barrier shoreline, dune, and marsh habitats and associated essential fish and wildlife species.

The long term impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area, including the BBBS project. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available. If at any time petroleum or crude oil is discovered on project lands, all efforts will be taken to seek clean up by the responsible parties, pursuant to the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.).

RECOMMENDATIONS

Description of the Recommended Plan

The Recommended Plan is a combination of Caminada Headland Alternative 5 and Shell Island Alternative 5. The initial construction of the barrier shorelines will restore or create 2,849 acres of beach, dune, and marsh habitats. The fully funded cost of the Recommended Plan is $448,351,000 (October 2011). The average annual cost of the Operations and Maintenance will be $6,183,485 with a present value of $132,834,761 (October 2011) price levels). The estimated cost exceeds the authorization. Additional authorization from Congress would be required to implement construction of this project.

Caminada Headland

Caminada Headland Alternative 5 proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. Alternative 5 also proposes a landward beach and dune component in order to maximize acreage and longevity. The landward and seaward slopes would be set 20 horizontal to 1 vertical. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Approximately 880 acres of beach/dune and 1,186 acres of marsh would be created or restored, resulting in a total of 2,066 acres. Fill quantities for the dune and marsh fills would be 5.1 million and 5.36 million cubic yards, respectively. Approximately 71,500 feet of sand fencing would be installed. Vegetative plantings would include a variety of native species. The recommended planting density is no greater than 8-foot centers.

The borrow area identified for the beach/dune restoration is Ship Shoal, a large submerged sand body in the Gulf of Mexico located offshore in south-central Louisiana. The sediment is to originate from South Pelto, Blocks 12 and 13, which is approximately 40 miles from the project site. The borrow site for the marsh restoration would be located approximately 1.5 miles south of the central portion of the Caminada Headland, and 4.7 miles southwest of Caminada Pass. The estimated cost of construction, including contingencies, supervision and administration, real estate, and preconstruction engineering and design (PED), is $223,526,000 (October 2011). The estimated duration of construction is 936 days. It is estimated that the duration of plantings would be 750 days over a 3-year period.

The Recommended Plan will include renourishment of the Caminada Headland in conjunction with USACE operations and maintenance dredging of the Bayou Lafourche, Louisiana (Belle Pass) navigation project which yields on average approximately 650,000 cubic yards of material every 1.5 to 2 years. This material will be placed in the littoral drift south of Bayou Moreau where the long shore transport of material splits going east and west, allowing the long shore transport and wave action to move and place the sediment along the headland. Over each 10 year period, an estimated 3.9 million cubic yards of material will be returned to the headland. This renourishment is part of the non-Federal sponsor's operations and maintenance requirements. The non-Federal sponsor will pay the incremental cost of beneficially using this material over the federal standard. The estimated incremental cost of the renourishment is $7.35 million per event. Caminada Headland Alternative 5 will create at year 50, an estimated 2,064 acres at intermediate RSLR or 2,122 acres at low (historic) RSLR will remain, protecting the more fragile cheniere and marsh habitats within the Caminada Headland.

Shell Island

Under alternative 5, the Shell Island reach would be restored as one island. This alternative would restore Shell Island to a form similar to its pre-Hurricane Bob (1979) condition. It is estimated that 5.6 million cubic yards of shoreline fill would be required to construct 317 acres of shoreline/dune area. The dunes will be built to a height of + 6 feet NAVD, and the marsh will be constructed to a height of + 2 feet NAVD. Approximately 2.1 million cubic yards of marsh fill would be required to construct 466 acres of marsh.

Shell Island would be re-nourished 20 years and 40 years after initial construction to the original construction template of 317 beach/dune acres. The marsh fill for alternative 5 would also be re-nourished to its original construction template at this time interval.

Approximately 1.5 million cubic yards of beach fill would be required for re-nourishment cycles in years 20 and 40. In year 20, approximately 907,200 cubic yards of marsh fill would be required and in year 40, 604,700 cubic yards would be required for re-nourishment. The renourishment costs at year 20 and year 40 are estimated to be $63.3 million and $60.9 million, respectively (October 2011 price levels). Under the intermediate RSLR scenario, the TY 50 acreage is estimated to be 855 acres; under the low (historic) RSLR scenario, the TY 50 acreage is estimated to be 919 acres.

Sand fencing and vegetative plantings would be similar to those described for the Caminada Headland alternative.

The borrow source for the dune/beach would be a large sand deposit near Nairn in the Mississippi River between mile markers 32 and 34, approximately 11 miles north of the project area. The dredged material would be pumped from the Mississippi River via pipeline. The borrow source for the marsh restoration would be the Empire deposit, approximately 1.5 miles from the Empire Jetties. The estimated construction cost, including contingencies, supervision and administration, real estate, and PED is $203,437,000 (October 2011). It is estimated that duration for construction would be 787 days. It is estimated that the duration for the plantings would be 360 days over a period of 3 years.

Recommended Component of Construction

Because the NER plan cannot be constructed within the maximum project cost as authorized by WRDA 2007, a subset of the NER, Caminada Headland Alternative 5, was selected as the recommended component of construction. The recommended component of construction represents an implementable and separable element of the NER plan, is cost effective and incrementally justified, and within the cost and scope of the current authorization.

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E- Public Comments and Responses

1.0 STUDY INFORMATION

This document is the integrated Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline Restoration (BBBS) Final Integrated Construction Report and Final Environmental Impact Statement (FEIS), hereafter referred to as the LCA BBBS Final Integrated Construction Report and FEIS. This report was prepared by the U.S. Army Corps of Engineers (USACE)–Mississippi Valley Division (MVD), New Orleans District (MVN), with input provided by the local sponsor, the Louisiana Coastal Protection and Restoration Authority (LaCPRA), and other Federal and State of Louisiana coastal resource agencies. The BBBS Project was identified as a critical near-term restoration project in the "November 2004 Louisiana Coastal Area, Louisiana Ecosystem Restoration Study Report," hereafter the 2004 LCA Report. This project was recommended for authorization by the Chief of Engineers on January 31, 2005. The Assistant Secretary of the Army for Civil Works (ASA(CW)), after obtaining the concurrence of the Office of Management and Budget, provided his report on the 2004 LCA Report to Congress on November 18, 2005. Title VII of the Water Resources Development Act (WRDA) of 2007, P.L. 110-114, Section 7006(c)(1)(C) authorizes construction of the BBBS Project. This report documents any modifications to the BBBS Study as stated in the report of the Chief of Engineers, dated January 31, 2005.

The Barataria Basin barrier shoreline is the regional segment of the gulf coast of Louisiana that is situated between the west bank of the Mississippi River at the active delta and the eastern shore of Terrebonne Bay. The proposed restoration project would reconstruct coastal landforms of the barrier shoreline in the Barataria Basin to restore the barrier shoreline ecosystem and significantly reduce the loss of estuarine and freshwater wetlands. The restored shoreline and protected wetlands would also help reduce the storm surge associated with tropical storms that may affect this portion of the Louisiana gulf coast.

The Barataria Basin barrier shoreline is divided into six reaches (Caminada Headland, Grand Isle, Grand Terre, Cheniere Ronquille, Shell Island, and Scofield) (**figure 1-1**). Grand Isle is an inhabited barrier island and is maintained under separate authorities, therefore, initial study efforts considered shoreline restoration for the other five reaches. Several ecosystem restoration projects along the Barataria Basin barrier shoreline have been constructed, or are in the planning and construction phase, under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) program (**table 1-1** provides a synopsis of CWPPRA projects). Because projects are already being planned or constructed in the Grand Terre (BA-30), Cheniere Ronquille (BA-38 and 35), and Scofield (BA-40) reaches and because Grand Isle is maintained under separate authorities, the 2004 LCA Report identified the restoration of the Caminada Headland and Shell Island reaches as a critical near-term project for the Barataria Basin barrier shoreline.

Less than 1 year after the completion of the 2004 LCA Report, Hurricane Katrina made its gulf coast landfall along the Barataria Basin barrier shoreline. This event caused shoreline erosion and breaching of the barrier shoreline. Additional storm surge from the passing of Hurricane Rita, a few weeks later, may also have contributed to the impacts observed since pre-storm conditions. The impacts of these events have been considered in the preparation of this study. In September 2008, this region was affected by Hurricanes Gustav and Ike. After consultation with both Federal and state agencies, and a re-evaluation of the engineering data, it was determined that the impacts of Hurricanes Gustav and Ike were within the planning parameters used to conduct the analyses. Barrier shorelines are by nature dynamic systems. Each hurricane season and winter storm season will create changes to the shoreline. Conditions will change, but the form and function of the shorelines will remain as addressed in the analysis.

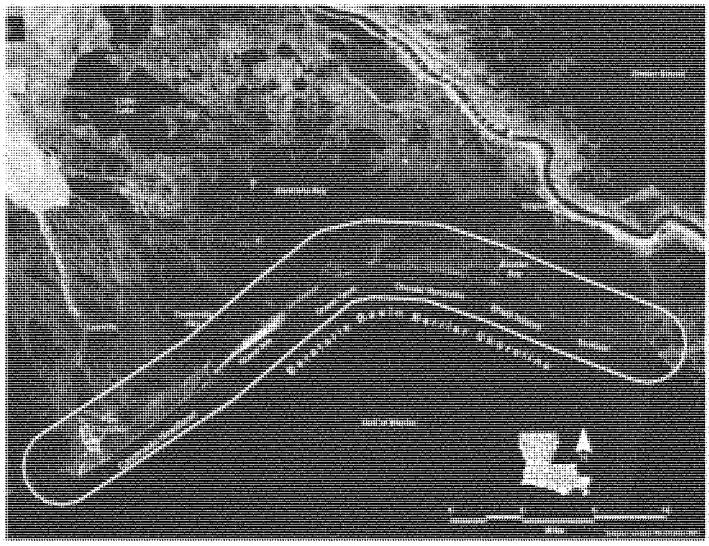


Figure 1-1. Barataria Basin Barrier Shoreline.

1.1 STUDY AUTHORITY

The BBBS Study was conducted under the authority provided to the USACE through resolutions adopted by the Committees on Public Works of the Senate and U.S. House of Representatives dated April 19, 1967 and October 19, 1967, respectively. These resolutions requested a review of prior USACE reports by the Chief of Engineers to determine the advisability of improvements or modifications to existing improvements in the coastal area of Louisiana, in the interest of hurricane risk reduction, prevention of saltwater intrusion, preservation of fish and wildlife, prevention of erosion, and related water resources purposes. 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."

Title VII of the WRDA of 2007, P.L. 110-114, Section 7006(c)(1)(C) authorizes construction of the Barataria Basin Barrier Shoreline Restoration project in accordance with the restoration plan in the Report of the Chief of Engineers dated January 31, 2005, contingent upon completion of a construction report documenting any modifications to the Chief's Report, approval of the Secretary of the Army, and submission to the House Transportation and Infrastructure Committee and Senate Environmental and Public Works Committee.

Section 7006(c)(1)(C) states:

> Initial projects. – In General – the Secretary is authorized to carry out the following projects substantially in accordance with the restoration plan:
> C. Barataria Basin barrier shoreline restoration at a total cost of $242,600,000.

Section 7006(c)(3) and Section 7006(c)(4) state:

> Construction reports – Before the Secretary may begin construction of any project under this subsection, the Secretary shall submit a report documenting any modifications to the project, including cost changes, to the Committee on Transportation and Infrastructure of the House of Representatives and the Committee on Environmental and Public Works of the Senate.
>
> Applicability of other provisions- Notwithstanding section 902 of the Water Resources Development Act of 1986 (33 U.S.C.2280), the cost of a project under this subsection, including any modifications to the project, shall not exceed 150 percent of the cost of such project set forth in paragraph 1.

1.2 STUDY PURPOSE AND SCOPE *(NEPA-Required)*

1.2.1 Study Purpose

The purpose of this study is to evaluate alternatives to restore the Barataria Basin barrier shoreline through shoreline and marsh restoration to ensure the continuing geomorphic and hydrologic form and function of the barrier structures. 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 process of the Mississippi River, contain an extraordinary diversity of habitats ranging from narrow natural levees and dunes to expanses of forested swamps and freshwater, intermediate, and brackish, and saline marshes. (**figure 1-2**).

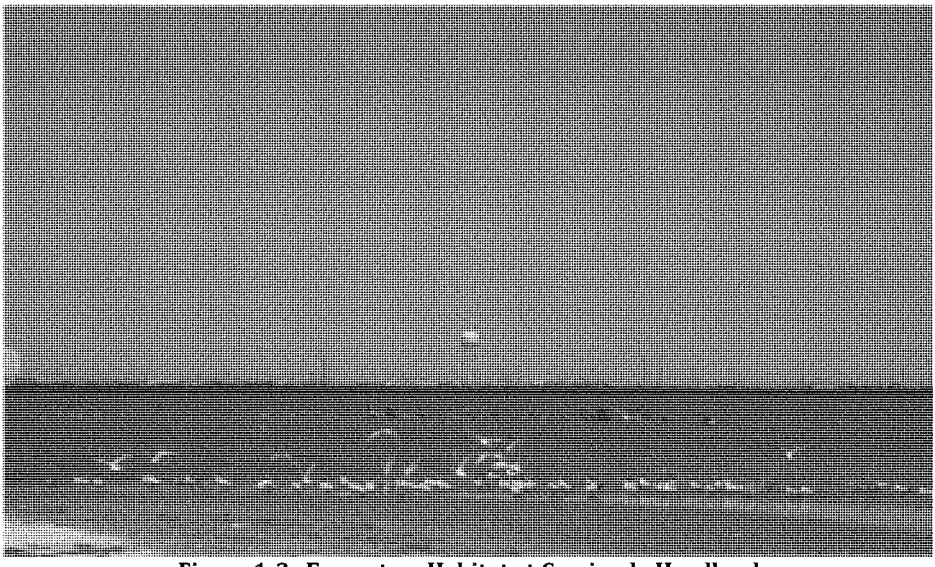


Figure 1-2. Ecosystem Habitat at Caminada Headland

Restoration of the shoreline and marsh platforms of Caminada Headland and Shell Island would restore the natural hydrologic function of the barrier island system. Restoration of these barrier shoreline landforms would decrease shoreline erosion and loss of interior wetlands in the Barataria Basin by reducing the extent and intensity of tidal, wave, and storm processes behind the shorelines. An incidental benefit of the proposed action would be reduction of storm surge that would result from restored shoreline integrity and protected wetlands. Coastal landforms and wetlands are one of the "first lines of defense" for storm surges and thereby reduce the impact of flooding and storm surges on infrastructure in the coastal region. Model results from the Louisiana Coastal Protection and Restoration Study (LaCPR, 2009) indicate that the barrier islands provide some level of protection as the first line of defense. Raising the barrier islands caused a decrease in the peak water level and wave energy landward of the barrier islands. The primary infrastructure that would be protected by this project include the only evacuation route for Caminada Headland and Grand Isle (Louisiana Highway 1), as well as Port Fourchon and related petroleum storage and transport facilities, including the onshore component of the Louisiana Offshore Oil Port (LOOP)—the Fourchon Booster Station, which supplies oil to the Clovelly Dome Storage Terminal. By supplying oil to Clovelly Dome and its interconnection to other pipelines, crude oil from LOOP can be pumped to nearly 50 percent of the nation's refining capacity. These major infrastructure facilities are located on the inland portion of the Caminada Headland (**figure 1-3**). Port Fourchon supports 75 percent of the deepwater oil and gas

production in the Gulf of Mexico as the point of departure for crew boats, equipment and supplies, rig components, and oilfield services.

Figure 1-3. Infrastructure at Caminada Headland

The proposed action is needed to reverse the current trend of degradation in the Caminada Headland and Shell Island reaches of the Barataria Basin barrier system. Restoration efforts would target ecologically distinct, critical, high priority areas that would increase sustainability with essential form and function of the natural barrier ecosystem.

1.2.2 Study Scope

1.2.2.1 Integrated Construction Report and EIS

This report is an integrated construction report and EIS. The scope of this document is the evaluation of the restoration of the Caminada Headland and Shell Island reaches within the Barataria Basin barrier shoreline.

This report provides a description of the planning process used to identify the Recommended Plan; identifies implementation responsibilities and cost estimates; and presents a recommendation for construction of the BBBS Project. This report has been prepared in

accordance with the National Environmental Policy Act of 1969 (NEPA) and Engineering Regulation (ER) 1105-2-100. The final report will be circulated for comment in accordance with NEPA review processes. The final report will be submitted to the ASA (CW).

This report consists of a main report and appendices. The main report provides an overview of the study effort and summarizes information found in the appendices. The appendices provide detailed supporting information for all of the investigations and tasks conducted for the study effort.

The study considers all reasonable alternatives including:

- Alternatives considered under previously initiated studies for restoration of the Caminada Headland and Shell Island reaches (prompted by, and including, the LCA Report 2004).
- Alternative borrow sources to be used in dune and marsh construction, including offshore, nearshore, riverine, and other sources.
- Alternatives of varying widths and configurations of barrier shorelines as well as varying heights of restored dunes.
- Consideration of marsh restoration as a platform for barrier shoreline rollover. Marsh platforms capture sand rollovers in response to storms, waves, and currents, allowing the barrier island landforms to migrate landward instead of the island losing the sediment.
- Recommendations from interested parties submitted during scoping and public meetings, and meetings with stakeholders.

1.2.2.2 National Environmental Policy Act Requirements

The NEPA of 1969, as amended, is the nation's charter for environmental protection. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Section 102(2) of NEPA contains action-forcing provisions to make sure that Federal agencies act according to the letter and spirit of NEPA, including a provision to prepare a detailed statement, called an Environmental Impact Statement (EIS), on the effects of a proposed Federal action. The Federal regulations for implementing the procedural provisions of NEPA were published by the Council on Environmental Quality (CEQ) in the Code of Federal Regulations (CFR) as 40 CFR Parts 1500-1508 (43 Federal Register 55978–56007, 29 November 1978).

This report documents the USACE study of shoreline and marsh restoration for the Caminada Headland and Shell Island reaches of the Barataria Basin in compliance with NEPA requirements. It employs three concepts established in the CEQ NEPA regulations (integration, tiering, and adoption) that are appropriate to the planning and design process for the BBBS Project.

Integration is based on the CEQ provision to combine documents, which states, *"any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork"* (40 CFR 1506.4). The USACE regulations permit an EIS ("environmental document") to be either a self-standing document combined with and bound within a feasibility report ("agency document"), or an integration of NEPA-required discussions in the text of the report. In view of the ecosystem restoration aspect of the BBBS Project, to reduce paperwork and redundancies, and consolidate documentation into one consistent report, the USACE elected to integrate discussions that normally would appear in an EIS into the Construction Report. Sections in this "integrated report" that include NEPA-

required discussions are marked "**(NEPA-Required)*" in both the table of contents and within the body of the document to assist readers in identifying such material.

Tiering was established by the CEQ to provide *"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) ... Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review"* (40 CFR 1508.28 and 1502.20). This integrated FEIS tiers from the Programmatic EIS (PEIS) developed for the LCA Report. The LCA Report PEIS evaluated the impacts of the overall program of restoring wetland loss in coastal Louisiana. The Record of Decision (ROD) for the LCA Report PEIS was signed on November 18, 2005.

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."* In an effort to reduce paperwork, integrate NEPA requirements with the other environmental review and consultation requirements, and combine environmental documents with other documents, this report utilizes the concept of adoption and incorporation by reference. 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.

Finally, the Corps has requested the following agencies to be cooperating agencies (as defined under 40 CFR 1501.6) for this study: Louisiana Department of Environmental Quality (LDEQ), LaCPRA, Louisiana Department of Wildlife and Fisheries (LDWF), Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), National Marine Fisheries Service (NMFS), National Resource Conservation Service (NRCS), United States Environmental Protection Agency (USEPA), United States Fish and Wildlife Service (USFWS,) and the United States Geological Survey (USGS).

1.3 LOCATION OF THE STUDY AREA

Coastal Louisiana is comprised of two wetland-dominated ecosystems: the Deltaic Plain and the Chenier Plain, both of which are influenced by the Mississippi River. The Deltaic Plain is a vast wetland area that extends from the eastern border of Louisiana to Freshwater Bayou, and 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 shorelines. The Barataria Basin is part of the Deltaic Plain.

The study area consists of the Barataria Basin, including the Barataria Basin barrier shoreline (**figure 1-4**). The barrier shoreline system in Barataria Basin begins about 45 miles northwest of the mouth of the Mississippi River and forms a concave arch with respect to the Gulf of Mexico at the southern end of the Barataria Basin. The study area is located in Lafourche, Jefferson, and Plaquemines Parishes, and includes the barrier shorelines, barrier islands, passes, and back barrier marshes from Belle Pass (the mouth of Bayou Lafourche) on the west to Sandy Point on the east.

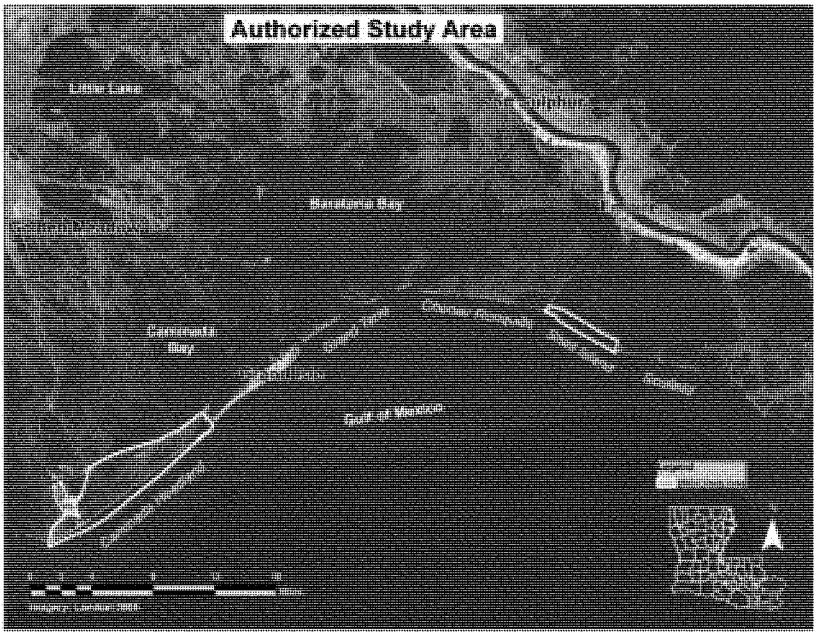


Figure 1-4. Barataria Basin Barrier Shoreline Study Area.

The project area includes the Caminada Headland and Shell Island reaches and the proposed borrow sites that could be used to provide sediment for the shoreline and marsh restoration (e.g., Ship Shoal, Sandy Point, Quatre Bayou, Bayou Lafourche, and Mississippi River) (see **figure 1-5**). The Caminada Headland consists of a sand dune, beach berm, barrier marshes, and chenier ridges interspersed with mangrove thickets, coastal dune shrub thickets, lagoons, and small bayous. Shell Island used to enclose both Bastian Bay and Shell Island Bay, but has since disintegrated into several smaller islands and shoals. Now there are few remaining islands and shoal remnants. This island consists primarily of open water with little beach or saline marsh habitat and with few shrubs or mangroves. Caminada Headland and Shell Island are discussed in further detail in the next two subsections.

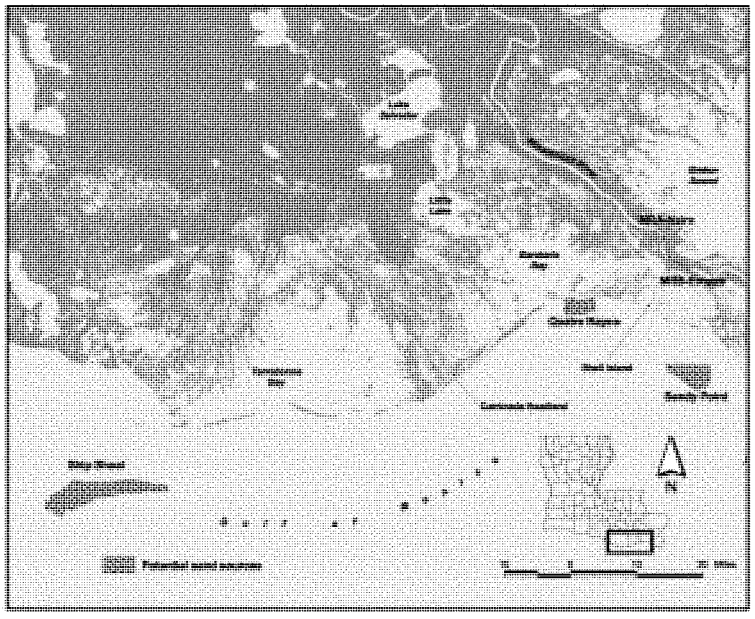


Figure 1-5. Potential Sand Sources.

1.3.1 Caminada Headland

The Caminada Headland is defined as the area south of Louisiana Highway 1 between Belle Pass and Caminada Pass (**figure 1-6**). The shoreline from Belle Pass to Highway 3090 is known as Fourchon Beach, and the shoreline at the eastern end of the headland is known as Elmer's Island. Spits have formed at either end of the headland. The 13-mile long shoreline is narrow and has numerous storm overwashes, particularly after Hurricanes Katrina and Rita (August and September 2005, respectively). Back-barrier lagoons include Bay Champagne, Caminada Bay, and several irregular shaped ponds. Numerous small bayous wind through the back barrier wetlands, and there are several man-made pipeline canals. The Chevron Pipeline Canal is parallel to the shore, only about 1,200 feet inland from the Gulf of Mexico, and runs nearly the entire length of the headland. There are also 12 privately constructed offshore breakwaters west of Bay Champagne (2004 LCA Report).

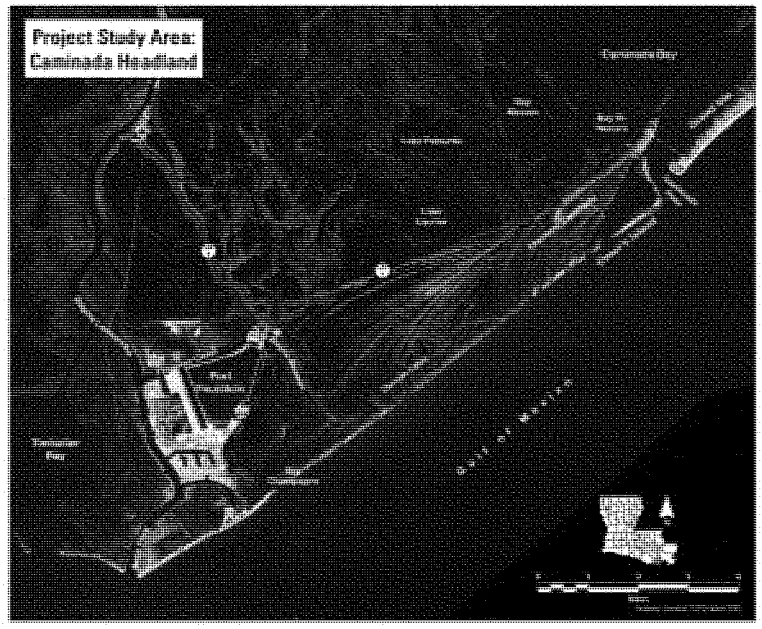


Figure 1-6. Project Area: Caminada Headland.

1.3.2 Shell Island

The Shell Island reach stretches approximately 2.5 miles, from Grand Bayou Pass to the Empire Waterway (**figure 1-7**). The Shell Island reach is currently highly fragmented into small, shallow shoals and islands, which represent only a fraction of the once continuous shoreline. The remaining shoals and islands have migrated northward into Bastian Bay.

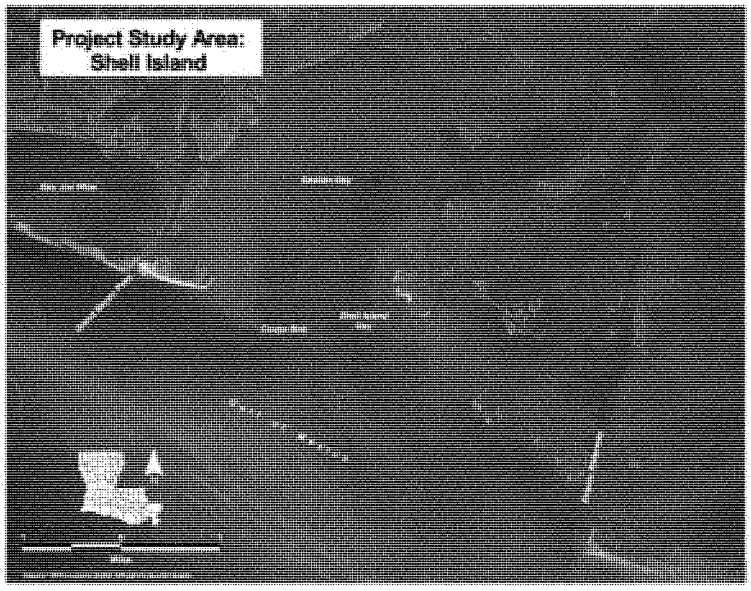


Figure 1-7. Project Area: Shell Island.

1.4 HISTORY OF THE INVESTIGATON

Loss of coastal wetlands in Louisiana has been occurring since the early 1900s. During the past 20 years to 30 years, individual studies and construction projects have provided localized remedies to this problem. In 1990, passage of CWPPRA (PL-101-646, Title III) provided authorization and funding for the Louisiana Coastal Wetlands Conservation and Restoration Task Force to begin actions to curtail wetland losses. The task force consists of five Federal agencies and the State of Louisiana (Federal agencies include USACE, U.S. Environmental Protection Agency [USEPA], U.S. Department of Interior [U.S. Fish and Wildlife Service (USFWS)], U.S. Department of Agriculture [Natural Resources Conservation Service (NRCS)], and U.S. Department of Commerce [National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS)]). CWPPRA is authorized until 2019. As of January 2012, 188 CWPPRA projects have been approved; 92 have been constructed, 10 are under construction, 33 have been de-authorized, 2 projects were transferred to other authorities, and the other projects are in the Engineering and Design phase (http://www.mvn.usace.army.mil/pd/cwppra_mission.htm).

After extensive studies and construction of a number of coastal restoration projects under CWPPRA, it was apparent that a systematic approach involving large projects working in conjunction with these smaller projects would be necessary to deal with the continuing loss of the coastal wetlands effectively. In 1998, the State of Louisiana and the five CWPPRA Federal agencies 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.

The Coast 2050 Plan was the basis for a USACE reconnaissance report that demonstrated a Federal interest in restoration of coastal Louisiana wetlands. As a result of the reconnaissance report, the USACE and the State of Louisiana developed the LCA Report, (November 2004). A programmatic EIS (PEIS) was prepared as part of the LCA Report. The Record of Decision (ROD) was signed on November 18, 2005.

The LCA Report has multiple components that help to address the critical water resource problems and opportunities in coastal Louisiana. As stated previously in section 1.0 of this report, the Caminada Headland and Shell Island reaches were not being addressed through other programs. Therefore, the LCA Report identified these two reaches of the BBBS Project as one of five near-term critical projects that could be implemented within 5 years based on proven restoration techniques. The critical near-term projects also address ecosystem losses that will result in rapidly increasing or irreversible impacts if existing trends continue unabated. Title VII of WRDA of 2007 authorizes construction for these five near-term projects.

1.5 PRIOR AND EXISTING PROJECTS

Existing water resources projects and on-going studies could affect and/or be affected by the implementation of the BBBS Project. There are three basic types of related water resources and flood control projects and studies to be considered in project planning and execution:

1. *Barrier Shoreline Stabilization and Restoration Projects:* Projects that help stabilize the coast and sustain barrier shoreline processes, by restoring geomorphic structure and hydrologic function to the Barataria Basin barrier segment of the coastline. Stabilization and restoration of breached and degraded segments of the coastline would contribute to the re-establishment of regional coastal processes that contribute to a sustainable barrier coastline. These projects include barrier shoreline restoration and immediate back barrier marsh restoration projects for coastal shorelines and barrier islands of the Barataria Basin barrier shoreline system.
2. *Interior Marsh Restoration Projects*: Projects located in landward portions of Barataria Basin that would be afforded additional protection with a restored barrier shoreline. By restoring the integrity and function of the barrier coastline, these related projects, along with the BBBS Project, will reduce the marine influence on interior marsh by reducing tidal prism, storm surges, wave energy and salt-water intrusion in estuaries and bays and associated wetlands. These projects include water and sediment diversions, salinity control features, and marsh restoration/nourishment projects located behind the barrier shoreline between Bayou Lafourche and the Mississippi River.
3. *Other Water Resource Projects:* Other types of projects that have affected the environment and influence natural processes must be considered in the assessment of alternatives and implementation of the Recommended Plan. These include water resources projects such as:
   - Authorized navigation channels and related structures, including jetties; and
   - Hurricane risk reduction levees and other flood control structures.

The following provides a description of existing water resources projects and previous and current studies that could affect and/or be affected by the implementation of the BBBS Project. Due to the large number of completed and planned projects in the coastal area, only the studies, reports, and projects that are most relevant to ecosystem restoration and storm surge reduction in relation to the BBBS Project are discussed below.

1.5.1 Barrier Shoreline Stabilization and Restoration Projects

The following projects are active and planned restoration features that address barrier shoreline restoration and stabilization for the Barataria Basin barrier shoreline. These projects help restore ecosystem functions by providing stabilization measures for headlands and islands, including immediate back barrier marshes. General locations of these projects are shown on **figure 1-8**.

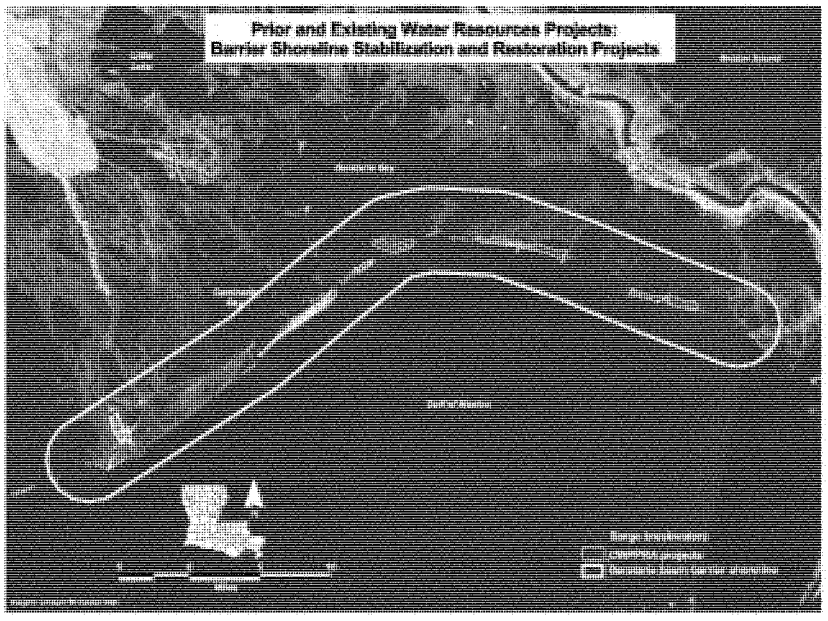


Figure 1-8. Barrier Shoreline Stabilization and Restoration Projects.

1.5.1.1 CWPPRA Shoreline Stabilization Projects

Several ecosystem restoration projects along the Barataria Basin barrier shoreline have been constructed, or are in the planning and construction phase, under the CWPPRA program, as discussed in section 1.0. **Table 1-1** provides a synopsis of CWPPRA projects located in the Barataria Basin.

Table 1-1. CWPPRA Shoreline Restoration and Stabilization Projects Related to the Barataria Basin Barrier Shoreline **Restoration Project**

Project Name	Type	Status	Location	Problem	Restoration strategy
East Grand Terre Island Restoration (BA-30)	Barrier Island Restoration	Construction Completed November 2010	At the mouth of Barataria Bay in Jefferson Parish. The islands are bordered by Barataria Bay to the north, Barataria Pass and Grand Isle to the west, Quatre Bayou Pass to the east, and the Gulf of Mexico to the south.	Shoreline erosion, the subsidence of back barrier marshes, and a lack of sand in an already sediment-deprived system have caused the breakup of Grand Terre into two islands.	Constructing 71 acres of dune and 82 acres of beach, as well as 432 acres of back-barrier marsh on East Grand Terre.
Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration (BA-38)	Barrier Island Restoration	Under construction	Two areas in the Plaquemines Barrier Island/Shoreline System. One is between Fontanelle Pass and Scofield Pass in the Barataria Basin. The second is between Pass La Mer and Chaland Pass, approximately 15 miles south of Diamond. Both segments are in south Plaquemines Parish.	Substantial land loss due to subsidence, sea-level rise, oil and gas activities, and marine and wind induced shoreline erosion.	(1) to prevent breaching of the barrier shoreline by increasing its width and average height, and (2) to protect and create dune, swale, and intertidal marsh habitats
West Belle Pass Headland Restoration (TE-23)	Dredging and shoreline protection	Completed in July 1998. Monitoring is underway, and operation and maintenance are scheduled.	Just west of Port Fourchon, in Lafourche Parish. It is bounded by Belle Pass to the east, the Gulf of Mexico shore to the south, and Timbalier Bay to the west.	Encroachment of Timbalier Bay into the marshes west of Belle Pass. Encroachment into the marshes on the west side of Bayou Lafourche, and wave action. Breaches were causing tidal scour in the interior marshes.	Dredging used to build marsh on the west side of Belle Pass. Additional material was placed on the shore for shoreline restoration.
West Belle Pass Barrier Headland Restoration (TE-52)	Barrier Headland and Marsh creation	Engineering and Design	Along the Chenier Caminada headland to the west of West Belle Pass, at the southeastern edge of Timbalier Bay in Lafourche Parish, Louisiana.	Shoreline erosion and substantial loss of headland. Severe impacts from Hurricanes Katrina and Rita removed emergent headlands and dunes west of the pass.	Rebuild approximately 9,300 ft. of beach and dune using nearly 2mcy of dredged sand and 150 acres of marsh habitat using nearly 1mcy of dredged material with native vegetative plantings to stabilize the rebuilt marsh and dune habitat.

Project Name	Type	Status	Location	Problem	Restoration strategy
Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration (BA-35)	Barrier Island restoration	Completed August 2009	Between Pass Chaland and Grand Bayou Pass in Plaquemines Parish, Louisiana.	Increased tidal prism storage (the total volume of salt water that moves in and out of a bay with the tide) and storm-related impacts have led to inlet and pass formation across the newly formed islands. The Bay Joe Wise shoreline rim has receded and decreased to a critical width that is susceptible to breaching.	The project's objectives are (1) preventing the breaching of the Bay Joe Wise shoreline by increasing barrier shoreline width; (2) increasing back-barrier, emergent marsh area by some 220 acres to maintain the barrier shoreline; and (3) creating emergent marsh suitable for tidal aquatic habitats.
Riverine Sand Mining/Scofield Island Restoration (BA-40)	Barrier Island restoration	Engineering and Design	Between Scofield Bayou and the point where Bay Coquette has merged with the Gulf of Mexico along the Plaquemines barrier shoreline in Plaquemines Parish.	A large shoreline breach developed early in 2003 after the passage of Hurricane Lily in October 2002. The gulfside erosion rate is approximately 13 feet per year. Wetlands, dune, and swale habitats within the project area have undergone substantial loss, causing landward transgression, and more recently, breaching and breakup.	Project strategies include the construction of 429 acres of dune area, and marsh platform. A double row of sand fencing will be installed along the 12,700-foot length of dune. A tidal pond will be constructed in the marsh platform, and containment dikes will be gapped as needed to ensure tidal exchange with the marsh platform. The dune and marsh platform will be planted with stabilizing vegetation.
Chenière Ronquille Barrier Island Restoration (BA-76)	Barrier Island restoration	Engineering and Design	In region 2, within the Barataria Basin portion of Plaquemines Parish, Louisiana.	Shoreline erosion, interior wetland loss, overwash and breakup. Erosion rate doubled from 1988 to 2006. Marshes eroding at -11.8ft/yr between 2003 to 2006 and converted to open water.	Tie into recently constructed projects east of the project area. Fill for beach and dune plus 20-years of advanced maintenance fill for beach, dune and marsh creation. Approximately 127 acres of beach/dune would be constructed and 259 acres of marsh would be created with dune plantings expected.

1.5.1.2 Other Shoreline Stabilization Projects

Additional shoreline stabilization projects have been constructed in the vicinity of the proposed BBBS Project as shown in **figure 1-9**.

1.5.1.2.1 Grand Isle

Grand Isle is located on the Gulf of Mexico in Jefferson Parish and is the only inhabited barrier island in coastal Louisiana. Flood damage reduction improvements on the island are subject to damage from erosion along its Gulf of Mexico shore and from the combined effects of winds and tides generated by hurricanes. Over the past 50 years, there have been a number of shoreline stabilization projects on Grand Isle, including jetties (East Jetty of 1958, West Jetty of 1971); dune/beach nourishment (1984, 1991, 2005); Town Rock Project (breakwater and groin system constructed in 1989); and detached breakwaters (1995 [USACE], 1999 [Louisiana Department of Transportation and Development (LaDOTD)]). While the intent of these projects is to stabilize and protect inhabited areas and related infrastructure of Grand Isle, these projects will also contribute to and benefit from shoreline stabilization and ecosystem restoration projects across the Barataria Basin barrier shoreline.

1.5.1.2.2 Fourchon Island

In order to protect a section of the Caminada Headland shoreline, the State of Louisiana, Port Fourchon, and private interests originally undertook a cooperative project to close old Pass Fourchon, relocate a shoreline road, and restore the dune ridge. Damages resulting from the 1985 hurricane season necessitated further state emergency work involving use of a hydraulic dredge to pump approximately 700,000 cubic yards of fill material into spoil-retention areas to restore the shoreline and dune ridge system. These improvements help stabilize the dune ridge system on the western portion of the Caminada Headland.

1.5.1.2.3 Offshore Barge Breakwaters

The Greater Lafourche Port Commission directed a cooperative effort that built a series of offshore breakwaters (off the southwestern segment of Caminada Headland) by sinking 12 old barges in 6 feet to 8 feet of water and filling them with stones. Sand accreted in the lee of the western barges; the others appear to have had no positive effect. There is an erosional shadow to the east of the barges where the shoreline has thinned and several overwash fans can be seen, including some on the shoreline in front of Bay Champagne (2004 LCA Report).

1.5.1.2.4 Bayou Lafourche, Louisiana

The Bayou Lafourche, Louisiana, project was authorized by the Rivers and Harbors Act of August 30, 1935, which provided for a 6-foot deep by 60-foot wide navigational channel from Larose to the Gulf of Mexico with a jettied entrance at Belle Pass. The Rivers and Harbors Act of July 14, 1960, provided for a 12-foot deep by 125-foot wide navigational channel to the 12-foot contour in the Gulf of Mexico. Construction of the Port Fourchon, Lafourche Parish, Louisiana project in southern Lafourche Parish, Louisiana, was authorized by Section 101(a)(16) of WRDA 1996, which provided for an inshore channel, with a depth of -24 feet Mean Low Gulf (MLG) over a bottom width of 300 feet, in Belle Pass and Bayou Lafourche extending from the Gulf of Mexico through the developed area of Port Fourchon (Mile 0.0 to Mile 3.4), and an entrance channel extending approximately 1.3 miles from the gulf shore to the -26 foot MLG contour with a depth of -26 feet MLG over a bottom width of 300 feet. The current maintenance

dredging is discussed in "Port Fourchon, Louisiana, Feasibility Report and Environmental Impact Statement", August 1994.

According to "Consistency Determination, FY09 Maintenance Dredging, Bayou Lafourche, Louisiana," in FY 09, the USACE anticipates the removal of approximately 560,000 cubic yards of material from between Mile 0.5 and Mile –1.8. The material removed would be deposited unconfined along the Gulf of Mexico shoreline adjacent to the jetties for beach nourishment purposes. Additionally, in late 2008, the Greater Lafourche Port Commission dredged Pass Fourchon, placing approximately 400,000 cubic yards of material unconfined on the beach on Fourchon Island. On average, the channel dredging yields approximately 650,000 cubic yards of material every 1.5 to 2 years.

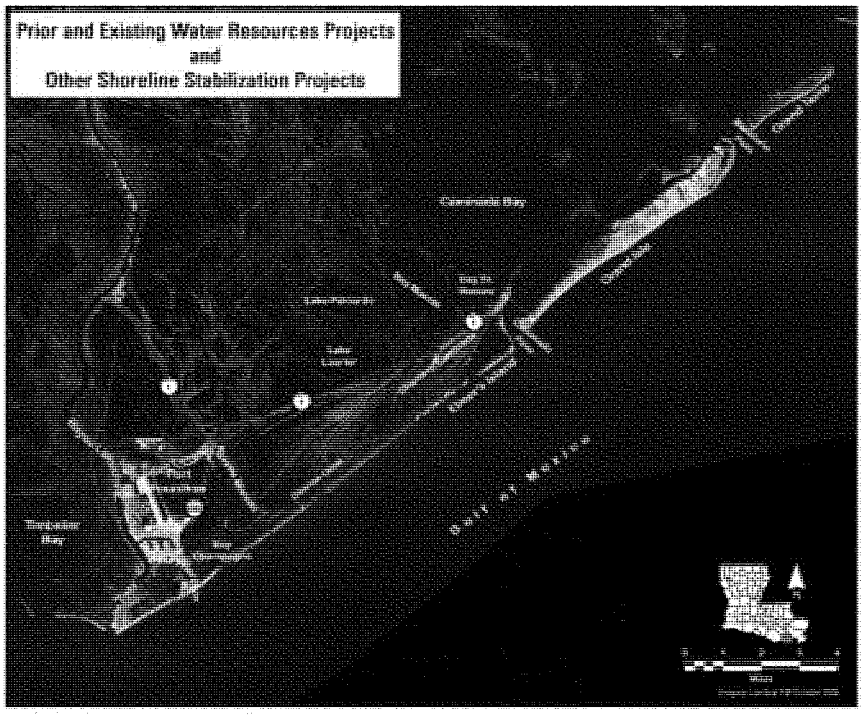


Figure 1-9. Other Shoreline Stabilization Projects

1.5.2 Interior Marsh Restoration Projects

The following projects are active and planned restoration features that address interior marsh of the Barataria Basin barrier shoreline. General locations of these projects are shown on **figure 1-10**.

1.5.2.1 CWPPRA Marsh Restoration Projects

In addition to the CWPPRA projects previously identified for barrier shoreline restoration, a number of projects in this program address wetland and marsh restoration for interior areas. **Table 1-2** provides a synopsis of CWPPRA projects for wetland and marsh restoration. These projects and the BBBS Project are mutually beneficial due to the overall reduction in tidal prism, which occurs by restoration of both the shoreline and the interior marsh.

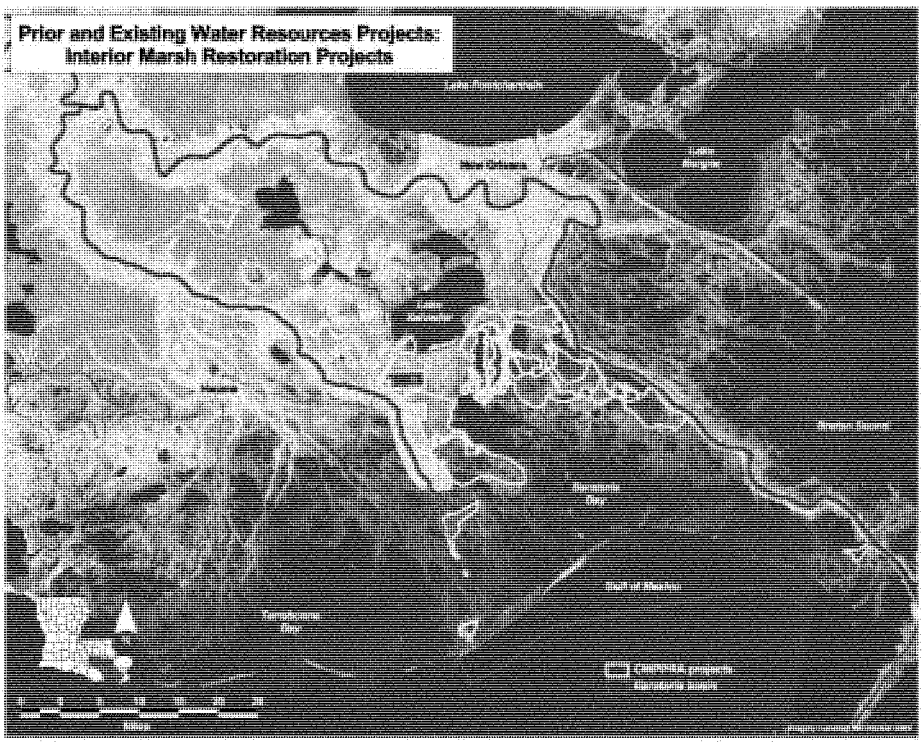


Figure 1-10. Interior Marsh Restoration Projects.

Table 1-2. CWPPRA Wetland/Marsh Restoration Projects Related to the Barataria Basin Shoreline Restoration

Project Name	Type	Status	Location	Problem	Restoration strategy
Barataria Bay Waterway Wetland Restoration (BA-19)	Marsh restoration	Completed December 1999	Queen Bess Island north of Grand Isle and east of the Barataria Bay Waterway in Jefferson Parish	Subsidence and erosion	Maintenance dredged sediments to create marsh to enlarge Queen Bess Island
Mississippi River Reintroduction Into Bayou Lafourche (BA-25b)	Freshwater diversion	Deauthroized	The intersection of Bayou Lafourche and the Mississippi River in Donaldsonville, Ascension Parish; marshes are south of Donaldsonville in the Fields and Long lakes, Grand Bayou, Bayou Terrebonne, Houma Navigation Canal, Delta Farms, and Bayous Perot and Rigolets areas	Dauming of Bayou Lafourche among other components has resulted in high rates of wetland loss in coastal Louisiana	Construction of a receiving intake structure; a pump/ siphon system; a discharge settling pond/sediment basin; modification of weir structures; bank stabilization; monitoring stations; and dredging
Little Lake Shoreline Protection/Dedicated Dredging near Round Lake (BA-37)	Marsh creation and estuary shoreline protection	Completed in March 2007	Between East and West Forks of Bayou L'Ours and the southern shoreline of Little Lake from Plum Point westward to Breton Canal	Lake shoreline erosion and rapid wetland loss of interior marshes	Lake shoreline protection and dedicated dredging to create marsh and nourish fragmented, subsiding marsh
Vegetative Plantings of a Dredged Material Disposal Site on Grand Terre Island (BA-28)	Vegetative planting	Completed in 2001	On west Grand Terre Island at the mouth of the Barataria Bay Waterway, east of Grand Isle in Jefferson Parish	Rapid erosion at both the shoreline front and back bay wetlands; breaks in the retention dikes	Stabilize the dredged material platform by vegetative planting; remove all cattle and goats from the island; and pnrchase grazing rights for the 20-year duration of the project

1.5.2.2 Other Marsh Restoration Projects

Other Federal and State of Louisiana coastal restoration efforts have resulted in the construction of 39 state projects and 30 Federal projects throughout coastal Louisiana, many of which have been constructed in the Barataria Basin. Significant contributions to the restoration of coastal wetlands have resulted from the North American Wetlands Conservation Act (NAWCA), administered by the USFWS, and the Barataria Terrebonne National Estuary Program (BTNEP). Established in 1990 as part of the USEPA National Estuary Program, BTNEP is a partnership for the study of natural and man-made causes of environmental degradation in the Barataria-Terrebonne watershed for protection of the watershed from further degradation. Projects implemented under this program primarily address public education and outreach, habitat restoration, invasive species management, and water quality enhancement within the basin.

Public and private parties have also participated in various coastal restoration projects. Examples of these 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, Ducks Unlimited, and the National Wildlife Federation. These efforts have included the NOAA Community-Based Restoration Program project completed by the Wisner Foundation and other parties.

1.5.3 Water Resources Projects

Under authorizations by Congress, the USACE operates and maintains a number of water resources projects within the Barataria Basin to facilitate navigation and flood control. This section provides brief descriptions of relevant water resources projects that are located within the Barataria Basin. These projects have altered natural sediment transport and water circulation patterns in the project area, and their impacts were considered in the development and evaluation of alternatives required to formulate the Recommended Plan for Caminada Headland and Shell Island. General locations of these projects are shown on **figure 1-11**.

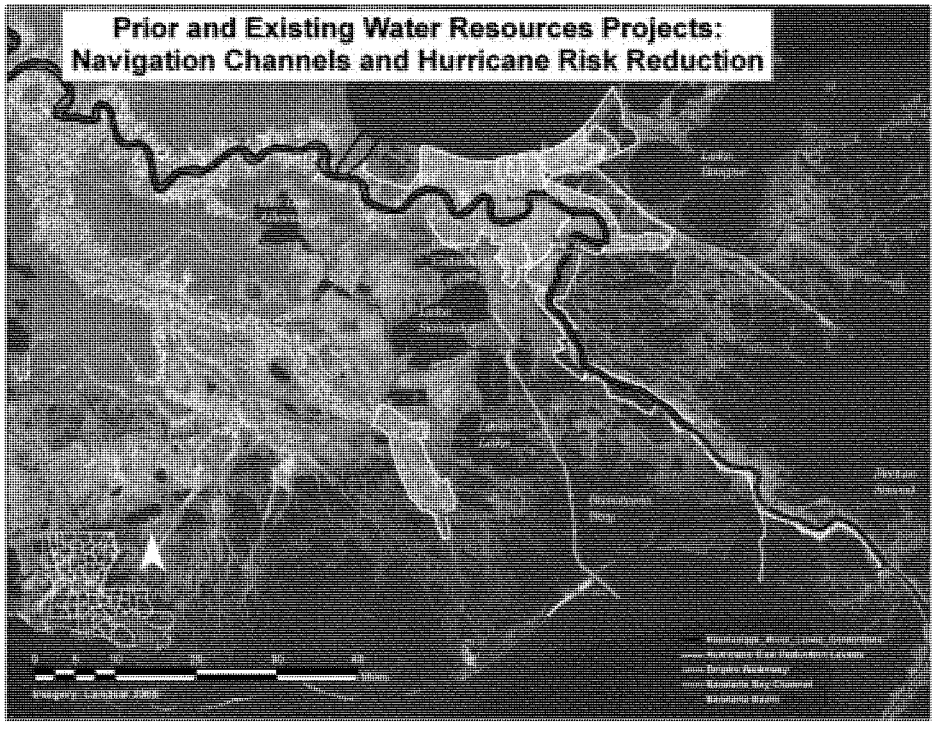


Figure 1-11. Navigation Channels and Hurricane Risk Reduction Projects.

1.5.3.1 Navigation Channels and Related Structures

1.5.3.1.1 Barataria Bay Waterway

Completed in 1967, the Barataria Bay Waterway is one of several navigation channels within the Barataria Basin whose presence has adversely impacted the interior and back barrier wetland marshes of the Barataria Basin. Degradation of the ecosystem has primarily occurred through an alteration of the natural hydrology and water circulation patterns in the vicinity of the project areas. For this specific project, the waterway has altered the natural hydrology in the vicinity of the project by acting as a conduit for the saline waters of the Gulf of Mexico to enter the interior freshwater and intermediate marshes within the basin. The Barataria Bay waterway bar channel is dredged every 3 years, and yields 600,000 CY of material. All of this material is beneficially used on the eastern side of Grand Terre Island.

1.5.3.1.2 Waterway from Empire to the Gulf of Mexico

Completed in 1950, this project consists of a 9-foot-deep by 80-foot-wide channel from Doullut Canal, near Empire, southward to the Gulf of Mexico. The navigation channel and its associated jetties have altered sediment transport processes, resulting in accelerated erosion and shoreline retreat west of the jetties at Empire. This, in conjunction with an already sediment starved system, results in an insufficient sediment supply to maintain the barrier island landforms along the Shell Island reach.

An in-depth analysis was conducted on the impacts of the Empire Jetties as part of this study. While the Empire Jetties have interrupted the littoral drift and the sediment supply to Shell Island, the formation of Coupe Bob in 1979 has had a much larger impact on Shell Island. Additionally, the downdrift effect of the Empire Jetties appears to be limited to 3,000 to 8,000 feet west of the jetties. Therefore, removing the jetties would have no impact on Shell Island West. A search for sand resources revealed that only the upper 2 to 3 miles of the Empire Waterway has been dredged, and the material is too silty for beach/dune creation on Shell Island. The remainder of the channel through the jetties has oyster leases located within the channel itself and is surrounded by existing oyster leases on either side. Consequently, the remainder of the waterway has not been dredged. Therefore, modifications to this project would not benefit the BBBS project

1.5.3.2 Hurricane Risk Reduction Projects and Studies

In addition to navigation projects, several ongoing and/or completed hurricane risk reduction projects are located within the Barataria Basin. These hurricane risk reduction projects are included in this report because geomorphic improvements to the Barataria Basin barrier shoreline and restoration of back barrier and interior marshes will provide lines of defense against tropical storm events. This additional risk reduction will work in conjunction with the hurricane risk reduction projects in the Barataria Basin to protect lives and property. In the aftermath of the 2005 hurricane season (coastal Louisiana was severely impacted by Hurricanes Katrina and Rita), hurricane vulnerabilities of the state are being reassessed.

1.5.3.2.1 Flood Control, Mississippi River and Tributaries, Donaldsonville, Louisiana, to the Gulf of Mexico Hurricane Protection Study

The Flood Control, Mississippi River and Tributaries, Donaldsonville, Louisiana, to the Gulf of Mexico Hurricane Protection Project study area is located between Bayou Lafourche and the Mississippi River. The purpose of the project is to provide flood risk reduction and hurricane risk reduction within the study area. The study will investigate possible solutions to improve interior drainage within the Lac des Allemands drainage basin and restoring and/or protecting the natural and human environment to create a sustainable ecosystem in the Lac des Allemands drainage basin. The study is currently in the feasibility study phase.

1.5.3.2.2 Larose to Golden Meadow, Louisiana, Hurricane Protection

The Larose to Golden Meadow, Louisiana, Hurricane Protection Project area is in southeast Louisiana along portions of the east and west banks of Bayou Lafourche. The purpose of the project is to provide risk reduction from storm surge. Funds to initiate construction were first appropriated in 1972. In 2005, the project was 97 percent

complete. As a result of Hurricanes Katrina and Rita, the design criteria are being re-evaluated, and will be incorporated into the project completion efforts.

1.5.3.2.3 New Orleans to Venice, Louisiana, Hurricane Protection

The New Orleans to Venice, Louisiana, Hurricane Protection Project includes flood risk reduction along portions of the east and west banks of the Mississippi River. The purpose of the project is to provide flood risk reduction from storm surge. The project was about 80 percent complete in August 2005. The project was severely affected by Hurricane Katrina, and the existing project structures and conditions are being comprehensively evaluated, including determination of corrected elevations due to subsidence. The ongoing assessment and re-evaluation will be incorporated into project completion and modification efforts.

1.5.3.2.4 West Bank and Vicinity, New Orleans, Louisiana, Hurricane Protection

The West Bank and Vicinity, New Orleans, Louisiana, Hurricane Protection Project area is located on the west bank of the Mississippi River. The purpose of the project is to provide hurricane risk reduction to residents from storm surges from Lakes Cataouatche and Salvador, and waterways leading to the Gulf of Mexico. Construction of the project was underway and estimated to be 40 percent complete when Hurricane Katrina made landfall. The project area was not affected by Hurricane Katrina as severely as areas to the south and on the East Bank. The existing project structures and conditions are being comprehensively evaluated, including determination of corrected elevations due to subsidence. The ongoing assessment and re-evaluation will be incorporated into project completion and modification efforts.

1.5.3.3 Deepwater Horizon Emergency Permit Requests

The USACE, New Orleans District Regulatory Branch has considered and responded to approximately 58 emergency permits related to the Deepwater Horizon oil spill and are described in detail in **Chapter 5, Table 5-1**. Of potential impacts to the BBBS are several permits that have constructed protective berms, Hesco baskets, rip-rap, bulkheads, and concrete fill to close gaps and washover areas along the Caminada Headland. In addition, the State of Louisiana is permitted to dredge and fill to construct a six sand berm reaches along the shoreline of the Chandeleur Islands/Breton National Wildlife Refuge westward to Baptiste Collette Bayou and along the seaward shoreline of Timbalier Island eastward to Sandy Pont. Material to construct the berms would be dredged from Ship Shoal, South Pelto, the Mississippi River Offshore Disposal Site, Pass a Loutre, St. Bernard Shoal and Hewes Point.

In November 2010, the State of Louisiana constructed a protective sand berm on the eastern portion of the Shell Island project area. The State placed approximately 1.3 million cubic yards of sand over 8,289 feet. The sand was placed to a height of 6 feet. This berm was specifically designed as a temporary buffer in order to stop the oil from entering the nearby marshes. The berm was not designed for sustainability purposes and consequentially, the berm may or may not exist today.

1.6 PLANNING PROCESS AND REPORT ORGANIZATION

In order to ensure that sound decisions are made with respect to development of alternative plans and ultimately plan selection, the planning 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 planning process and provides guidance for the systematic development of alternative plans that contribute to the nation's economy and/or ecosystem restoration. This chapter describes the planning process that was used and specifically outlines the problems that can be addressed by alternative plans.

1.6.1 The Six Step Planning Process

The USACE planning process involves six steps:

1. Identifying problems and opportunities
2. Inventorying and forecasting conditions
3. Formulating alternative plans
4. Evaluating alternative plans
5. Comparing alternative plans
6. Selecting a plan

The first step of the plan formulation process is the initial problem identification. Problem identification involves defining undesirable conditions that can be addressed through a water resources project. As part of this phase, opportunities are also identified. Opportunities are simply a favorable juncture of circumstances; a good chance for advancement or progress. Water resource projects often provide those chances.

As the problems and opportunities became well defined and gave way to planning objectives, the study team was better prepared to identify the data required to inventory relevant resources. This second step is a thorough inventory 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 inventory accounts for the level or amount of a particular resource that currently exists within the study, i.e., the "Existing Conditions." This step also involves forecasting to predict what change(s) will occur to resources throughout the period of analysis, assuming the proposed action is not taken to address the problems of marsh/land loss in Coastal Louisiana, i.e., the "Future Without Project Conditions."

The third step is to formulate alternative plans to meet one or more of the planning objectives and to avoid constraints. Alternative plans are formulated across a range of potential scales to demonstrate the relative effectiveness of various approaches at varying scales.

In the fourth step, alternative plans are 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 resources 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 impacts (either beneficial or adverse) of the alternatives.

The plan formulation process continues with the fifth step, comparison of alterative 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 step 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-step planning process, the Caminada Headland and Shell Island plans that best meet the planning objectives were developed.

1.6.2 Environmental Operating Principles

The USACE employs a set of environmental operating principles to govern all of the organization's missions and interactions. Viewed as a whole, these principles outline a path for conducting planning studies and implementing and operating constructed projects that recognizes the important link between environmental stewardship and sustainable economic productivity.

By implementing these principles, the USACE will continue its efforts to develop the scientific, economic and sociological measures to judge the effects of its projects on the environment and to seek better ways of achieving environmentally sustainable solutions. The principles are consistent with NEPA, the Army's Environmental Strategy with its four pillars of prevention, compliance, restoration and conservation, and other environmental statutes and Water Resources Development Acts that govern USACE activities. The Environmental Operating Principles (EOP) are:

1. Strive to achieve environmental sustainability. 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. 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. Seeks ways and means to assess and mitigate cumulative impacts to the environment; 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.

Guiding Principles as applied by the BBBS team:

1. In accordance with the Environmental Operating Principles, the team's primary focus was to achieve environmental stability to provide a healthy, diverse and sustainable ecosystem. Louisiana's coast is at a critical juncture. Only a concerted effort will stem the degradation, and thus alternatives must include features which can be implemented in the near term and provide some immediate benefits to the ecosystem.

2. Appreciation of the natural dynamism of coastal ecosystems must be integral to the planning and selection of preferred alternatives. Modeling analyses included tropical storms, wave effects, subsidence, and sea level rise to help predict the impacts of project features.

3. Features were included in the alternatives to allow for a balance between human use of these natural resources and the protection of the natural systems. The alternatives have been designed to restore the ecosystem, utilizing techniques that will allow the newly restored ecosystem to interact within its natural environment.

4. Limited sediment availability adversely affects the project area. Because sediment mining can contribute to ecosystem degradation in the source area, the alternatives maximize the use of sediments external to the coastal ecosystem in the Gulf of Mexico and in the Mississippi River.

5. Plans seek to achieve ecosystem sustainability and diversity while providing interchange and linkages among habitats. Care was taken to ensure the balance between dune and marsh habitats.

6. Restoration techniques and results from previous coastal restoration projects have been incorporated into the analysis of the Caminada Headland and Shell Island reaches.

7. The development of the plan has included many diverse individuals and groups. This group included landowners, environmental organizations, Federal resource agencies, interested citizens and state and local government agencies.

1.6.3 Corps of Engineers' Campaign Plan

USACE has developed a Campaign Plan to establish our command priorities, focus our transformation initiatives, measure and guide our progress, and adapt to the needs of the future. The goals of the Campaign Plan are 1) deliver USACE support to combat, stability and disaster operations through forward deployed and reachback capabilities, 2) deliver enduring and essential water resource solutions through collaboration with partners and stakeholders, 3) deliver innovative, resilient, sustainable solutions to the Armed Forces and the Nation, and 4) build and cultivate a competent, disciplined, and resilient team equipped to deliver high quality solutions.

The LCA BBBS Project was conceived as part of the restoration of the entire Barataria Basin barrier island system. These two project locations were chosen because the other reaches of the barrier island system were being studied or constructed under different authorities. Development of the alternatives was completed in concert with the various agencies responsible for the restoration of the other barrier islands. Analysis of the Caminada Headland and Shell Island alternatives incorporated an investigation of the alternatives' impacts on the surrounding environment. Alternatives that resulted in negative consequences to other barrier islands were discarded. The success of the restoration of the barrier island system is dependent upon each component within the system.

The study included an analysis of trends for such variables as sea-level rise, subsidence, and frequency of hurricanes to determine the impacts of these variables on the sustainability of the designs. Various management measures were analyzed to determine which measures best provided the desired results while minimizing the risk that project goals would not be achieved. Knowledge obtained from previous coastal restoration projects was incorporated in the study. In-depth technical review of the study results included Agency Technical Review and Independent External Peer Review. Additionally, input was received from various state and Federal agencies, private contractors, and local stakeholders. The state and Federal agencies were an integral part of the project study team.

The team provided effective and transparent communication with the public and state and Federal agencies. Several public meetings have been held, and local stakeholders have been kept apprised of project status. State and Federal agencies, as part of the study team, have been involved in the development of the alternatives, and knowledgeable of the impacts of each alternative.

The study has incorporated the most recent methodologies in its analysis of the alternatives. Information from completed restoration projects was included in the development and analysis of the project alternatives. The team has updated and adapted the study throughout the study period due to Hurricanes Katrina, Gustav, and Ike. The team collaborated with other government agencies, industry, and stakeholders to improve the project planning process.

1.6.4 Programmatic Planning, Development of Barataria Basin Barrier Shoreline Restoration Project as a Component of the LCA Program

The loss of wetlands and shoreline retreat has been identified as a systemic and regional change in the ecosystem of coastal Louisiana. The LCA Report was conducted to assess the problem of ecosystem change related to land loss throughout coastal Louisiana. The LCA Study identified specific planning objectives to help in the formulation and evaluation of alternative plans. These objectives included:

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.

Based on these planning objectives, the LCA Study developed specific projects and an implementation plan for these projects. The LCA Plan includes:

- 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.

The 2004 LCA Report identified the 'Barataria Basin Barrier Shoreline Restoration Project: Caminada Headland and Shell Island Reaches' as one of the specific restoration opportunities that can be implemented upon completion of a project-specific feasibility analysis. This project was recommended for implementation under the LCA Plan because the project can be implemented using available, proven restoration techniques, and it addresses ecosystem losses that would be irreversible or that would have significantly greater costs if ongoing degradation processes are allowed to continue. The 2004 LCA Report assessed the benefits and resource requirements, including the identification of available restoration techniques and a range of conceptual projects that were used to develop and evaluate specific project designs. The results of these programmatic study efforts have been incorporated into the project-specific problem definition and development of alternative plans for this study.

2.0 PROBLEMS, OPPORTUNITIES, AND NEEDS*(NEPA-REQUIRED)

2.1 NATIONAL OBJECTIVES

Ecosystem restoration is one of the primary missions of the USACE Civil Works program. The USACE's objective in ecosystem restoration planning is to contribute to national ecosystem restoration (NER). Contributions to NER (outputs) are increases in the net quantity and/or quality of desired ecosystem resources. Measurement of NER is based on changes in ecological resource quality as a function of improvement in habitat quality and/or quantity, and is expressed quantitatively in physical units or indexes. These net changes are measured in the planning area and in the rest of the Nation.

Louisiana contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss occurring in the Nation. The BBBS project area is an essential ecosystem since it includes wetland habitats, essential fish habitat, and has high fish and wildlife values. The barrier islands protect the interior coastal wetlands, which also have high fish and wildlife value as well as great economic value as commercial and recreational fisheries. These ecosystems provide habitat for migratory birds, wildlife, finfish, shellfish, and other aquatic organisms including threatened or endangered species. The Caminada Headland is the location of Port Fourchon, which handles approximately 18 percent of the Nation's oil supply and is the land base for the LOOP. The LOOP handles approximately 15 percent of the Nation's foreign oil imports and is connected to 50 percent of the United States' refinery capacity. The estuaries surrounding Shell Island are productive oyster habitat and have traditionally supported important fisheries. The restoration of these barrier shorelines would protect these national assets from further degradation.

2.2 PUBLIC CONCERNS

Public input was received during several scoping meetings as well as meetings with various stakeholders. Many people expressed that the timeline for the project needed to be advanced due to the urgency of the need in the project area. Others worried about access to and protection of the restored areas. The impact on landowners and users of the project areas was discussed as well as the impact on threatened and endangered species. Comments were received concerning construction methods and borrow sources. Affects to the tidal prism were also mentioned.

Details of the public comments about the project are in chapter 6 of this document.

2.3 PROBLEMS AND OPPORTUNITIES

The 2004 LCA Report discusses both natural and manmade actions that are causing adverse impacts on the Louisiana wetlands. The natural processes of subsidence, habitat switching, and erosion of wetlands, combined with 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 productive coastal ecosystem 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. The shorelines are starved for sediment and are retreating. Infrastructure constructed for access into the wetlands has modified the hydrology of the coastal area, thus facilitating and accelerating saltwater intrusion and conversion of wetlands to open water. 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.

The Barataria Basin barrier island system separates the Gulf of Mexico from the Barataria Basin estuary. The barrier islands influence the estuarine and freshwater wetland environment by helping to regulate salinity gradients important to estuarine and freshwater wetland species and by preventing open Gulf of Mexico wave energy from impacting and eroding interior marshes. As islands erode and are breached, marine forces begin to dominate the interior boundaries of the estuaries, thereby accelerating land loss and switching from freshwater and brackish habitats to more saline conditions. Much of the sediment that once maintained these barrier islands is lost from the system off the Mississippi pro-delta and continental shelf. Consequently, there is not an adequate amount of sand and other sediment in the system to maintain barrier islands naturally, thus requiring restoration efforts, such as the BBBS Project, to maintain this critical geomorphic feature in the Barataria Basin estuary. Without mechanical means of introducing sediments, barrier islands and their protected marshes become more vulnerable to the harmful effects of storms. The geomorphic structure of the barrier shoreline is impacted by a cycle of erosion and healing. The episodic nature of the coastal land mass changes is reflective of sharp decreases in land area caused by a tropical event followed by a period of healing as some of the materials washed away by the storm are returned to the land mass. However, human activities, such as: construction of navigation channels, oil and gas industry pipelines, breakwaters and jetties, and vehicular access to the beach, can significantly reduce or eliminate the ability of these natural processes to rebuild the barrier islands.

Many of the barrier shoreline areas in Barataria Basin have become nothing more than fragmented, low mounds of sand, easily washed over by minor storm events that provide poorer habitat than fully developed barrier islands. As the barrier shorelines become narrower and disintegrate, bays and wetlands behind them become more directly connected with the Gulf of Mexico. This exposes the more fragile landscape features to higher wave energy and higher salinity water.

In addition to its environmental benefits, a restored barrier island system serves as a valuable storm buffer protecting communities, industry, and associated infrastructure from storm surges. In the pilot study, "Coastal Land Loss and Wave-Surge Predictions During Hurricanes in Coastal Louisiana: Implications for Oil and Gas Industry" performed for Louisiana Department of Natural Resources (LDNR), USGS, and Minerals Management Service (MMS), recently reorganized as BOEMRE, the investigators used numerical hydrodynamics models to reveal how the loss of barrier islands and wetlands affects storm surge and wave energy along a portion of the south-central Louisiana coast. The study site location was Terrebonne Bay, which is fronted by Isles Dernieres and Timbalier Islands with an eastern boundary of Port Fourchon. The study states that, "Over the approximate 30 year period between 1990s and 2020, the model forecast results also indicate that a significant increase in surge and wave height will occur throughout much of the study site" (LDNR 2003). Based on this study, the increased surge and wave heights range from 10 feet to greater than 12 feet at the barrier islands and 6 feet throughout the marsh (see **figure 2-1** and **figure 2-2)**. The findings of this study concluded that "in the absence of large-scale barrier and marsh restoration, the current infrastructure will experience increasing surge levels and increasing wave energy as the coast erodes"(LDNR 2003). The study also states that "the data are conclusive in that they demonstrate the ability of barrier islands and coastal wetlands to mitigate surge and wave energy during tropical cyclones with a frequency of occurrence indicative of historical storms impacting the Louisiana coast" (LDNR 2003). These findings demonstrate the importance of maintaining barrier islands as a vital component of Louisiana's coastal system. These findings were reaffirmed by modeling performed during the LaCPR study (LaCPR, 2009). Barrier islands were shown to decrease wave energy landward of

the island during tropical events. When the barrier islands were degraded in the models, the modeled wave heights increased, thus heightening the potential for overtopping levees and inundation of protected areas.

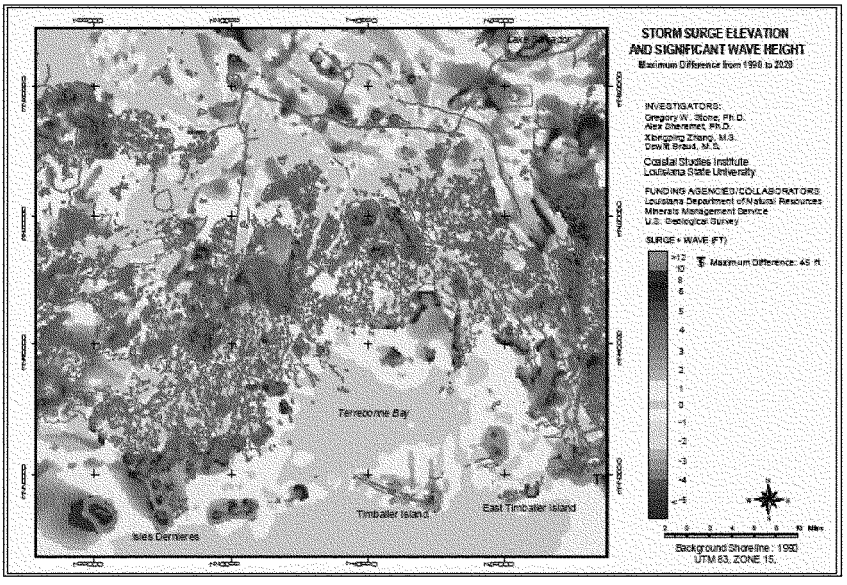


Figure 2-1: Difference in Maximum Storm Surge and Maximum Wave Height between 1990s and 2020 scenarios (LDNR 2003).

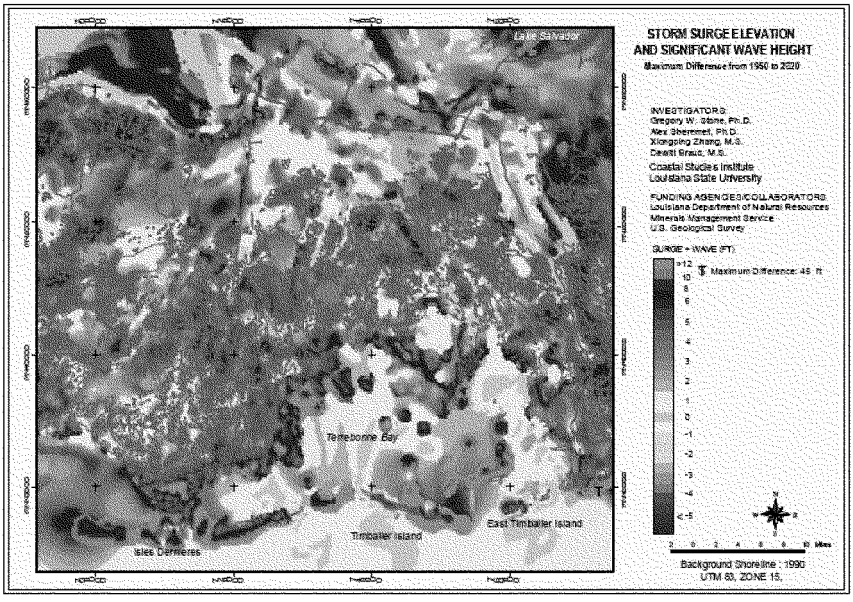


Figure 2-2: Difference in Maximum Storm Surge and Maximum Wave Height between 1950s and 2020 scenarios (LDNR 2003).

The problems in the BBBS project area are:

- Land loss due to erosion threatens the geomorphic structure and hydrologic function of barrier shoreline systems
- Loss of barrier island/headland ecosystem habitat
- Wetlands are impacted by increased salinity, tidal flux, wave action and storm impacts.
- Longshore sediment is significantly reduced, limiting the ecosystem's ability to be self-sustaining.

The 2004 LCA Report lists the following opportunities for ecosystem restoration:

- Freshwater reintroductions and outfall management
- Barrier island restoration through placement of sand from offshore sources or the Mississippi River
- Hydrologic modification
- Use of sediment material from dedicated dredging or maintenance dredging to create a marsh platform

Opportunities for the BBBS project include:

- Barrier island restoration through placement of sand from offshore sources or the Mississippi River to help sustain geomorphic structures that protect the ecology of estuarine bays and marshes by reducing gulf influences.
- The use of sediment material from dedicated dredging to construct a marsh platform which can create a large amount of coastal habitat quickly.
- The beneficial use of dredged material from the Bayou Lafourche, Louisiana navigation project.

2.3.1 Caminada Headland

Historically, the Caminada Headland has suffered loss of wetland habitat and diminished function within the gulf shoreline (**figure 2-3**). It is likely that without restoration efforts, such as the BBBS project, the observed average coastal erosion rate at the Caminada Headland of 45 feet per year will continue for the foreseeable future (LCA Report 2004). The shoreline has thinned and the dune has been breached by overwash from storm surges at several locations along the Caminada Headland shoreline, including multiple shoreline breaches during the 2002 to 2003 hurricane season, and the landfall of Hurricanes Katrina and Rita in 2005. Some of the breaches had begun to heal due to natural sand transport processes, but additional erosion was caused by Hurricanes Gustav and Ike in 2008. In a continuation of the erosion/healing cycle, the beach has begun to rebuild and a breach caused by Hurricane Katrina that opened Bay Champagne to the Gulf of Mexico has closed. However, due to limited sediment, the closure is easily breached during high water events.

Ongoing shoreline erosion and wetlands loss threatens the function of the Caminada Headland as a major geomorphic structural element of the regional coastline that prevents the coalescence of Terrebonne Bay and Barataria Bay. Any connection between these water bodies would result in a larger area of open water. The increased expanse of open water would have a larger fetch, resulting in increased wave energy and erosion along the bay shorelines. These processes will accelerate the loss of marsh, cheniere, and estuary habitats as the embayment increases in size. Fragmentation would occur when erosion has permanently breached the shoreline, producing detached islands from segments of the barrier shoreline and associated marsh that were formerly part of the headland. Without stabilization of this shoreline reach, permanent fragmentation of the headland is likely to occur.

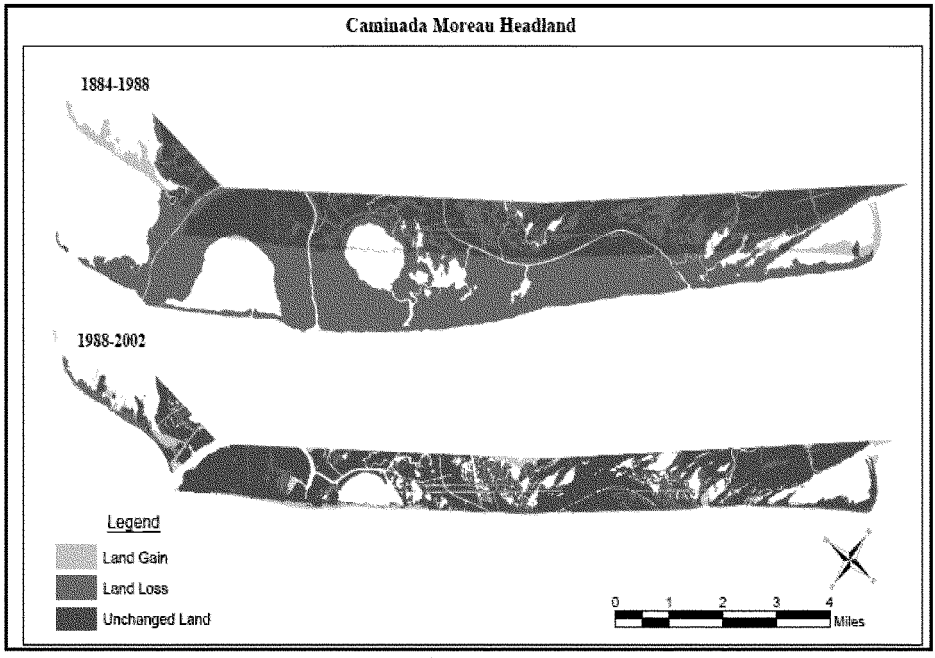


Figure 2-3. Caminada Headland Erosion History 1884–2002.

On the western end of the headland, erosion associated with Hurricane Katrina caused a connection between Bay Champagne and the Gulf of Mexico, resulting in a significant discontinuity of the shoreface and dune landforms. Breaches in the barrier shoreline will subject the interior and back barrier marsh and chenier ridges to degradation by wave action and salt-water intrusion. Based on observed rates of shoreline erosion and conversion of marsh to open water at Caminada Headland, the segment of the barrier shoreline from the western shore of Bay Champagne to the remnant Bayou Moreau ridge will eventually be detached from the headland. This permanent fragmentation would change the western portion of the headland into an island separated from the headland.

On the eastern end of the headland, erosion associated with Hurricane Katrina caused several breaches along the shoreline, including two significant breaches at the spit along the eastern end of the Caminada Headland shoreline segment (also known as Elmer's Island or Cheniere Caminada). This breach has been partially closed by ongoing sediment transport since the storm, but currents in the breach may result in the permanent separation of the spit from the headland without intervention. This will likely lead to a reconfiguration of Caminada Pass that would cause significant instability on the eastern end of the Caminada Headland and on the western end of Grand Isle, including the western end of the Louisiana Highway 1 Bridge between Caminada Headland and Grand Isle.

Degradation and fragmentation of Caminada Headland will also decrease the quantity of sand available for transport by longshore transport processes, thus increasing the instability of other

shoreline reaches east and west of the headland. The resulting decrease in sediment supply will exacerbate loss of downdrift shoreline reaches, further breaching and degrading nearby reaches of the barrier shoreline system. **Figure 2-4**, **figure 2-5**, and **figure 2-6** show aerial views of Caminada Headland in 1998, 2004, and after Hurricane Katrina (December 2005). The following images show erosion between 1998 and 2004, and the last image shows erosion associated with Hurricane Katrina, reflected in the multiple breaches visible in the headland shoreline. Several of these breaches have either completely or partially closed. However, due to the limited sediment in the system, the closure of the breaches is tenuous.

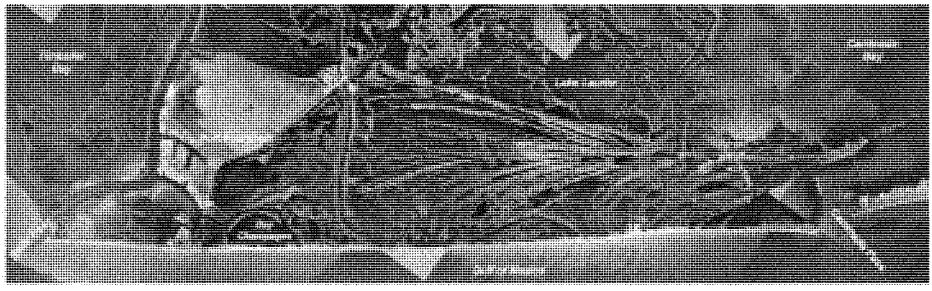


Figure 2-4. Aerial Views of Caminada Headland, 1998

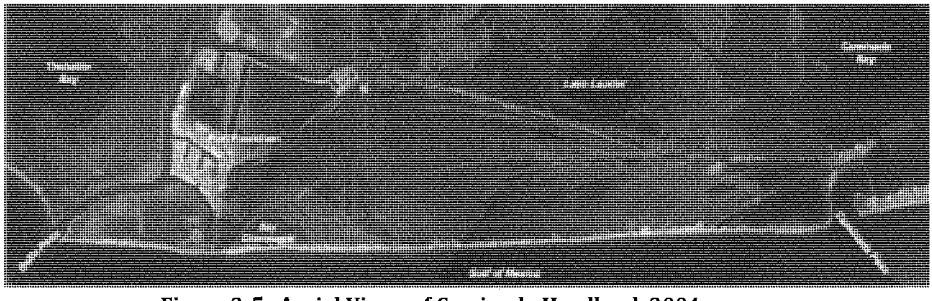


Figure 2-5. Aerial Views of Caminada Headland, 2004

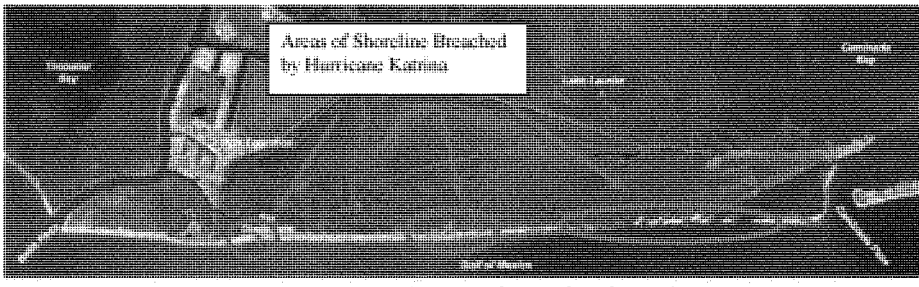


Figure 2-6. Aerial Views of Caminada Headland, 2005.

A USGS-led interagency team developed a land loss model of the Caminada headland for the 2004 LCA Report (USGS, 2004). The model simulated land loss over a 50-year period, from 2000 to 2050. The model predicted a land loss of 3,750 acres from the headland and a decrease of 14,780 acres from landward areas protected by the headland between Bayou Lafourche and Caminada Bay that extends inland approximately 12 miles. These additional losses of landforms and habitats will occur as fragmentation and retreat of the barrier shoreline expose back-barrier habitats to the increased wave energy and salinity of the Gulf of Mexico.

2.3.2 Shell Island

Coastal erosion along Shell Island has resulted in nearly complete loss of the barrier shoreline along this coastal segment. The long-term erosion rate for this reach is 38.5 feet per year with a range of 8.0 feet to 101.5 feet per year (**figure 2-7**). Historically, the Shell Island reach migrated landward and merged with the small barrier island at Grand Bayou Pass. By 1956, jetties had been constructed along Empire Waterway, and Shell Island migrated further landward and attached to the new Empire jetties. An erosional shadow developed downdrift (to the west) from the western Empire Pass jetty. The erosional shadow began affecting Shell Island because western longshore transport along this segment of the barrier shoreline system was disrupted. The erosion rates along Shell Island accelerated from 8 feet per year to 79.5 feet per year, causing Shell Island to rapidly narrow. In 1979, Hurricane Bob breached Shell Island, thus forming Coupe Bob. After the shoreline was breached, erosion rates accelerated further to 101.5 feet per year, exposing Shell Island Bay to marine processes. This pattern of barrier island degradation continued with the enlargement of Coupe Bob and by 2003, Bastion Bay was also exposed to the forces of the open Gulf of Mexico. Loss of the Shell Island reach has contributed to changes in the hydrologic patterns, allowing more saline waters to enter the estuary. The increased salinity of the estuary has also compressed the salinity gradient, decreasing the species diversity associated with transitional environments. Numerous studies have shown that elevated salinity can negatively affect all wetland species (Chabreck and Linscombe, 1982; McKee and Mendelssohn, 1989). These changes in salinity gradient have reduced the productivity of this ecosystem and negatively impacted the wildlife species that depend on this habitat. Increased wave energy also increases the rate of erosion along the exposed bay shoreline. **Figure 2-8**, **figure 2-9**, and **figure 2-10** show aerial views of Shell Island in 1998, 2004, and after Hurricane Katrina (December 2005). These images show a natural progression of erosion between 1998 and 2004, and erosion associated with a significant storm event between 2004 and 2005.

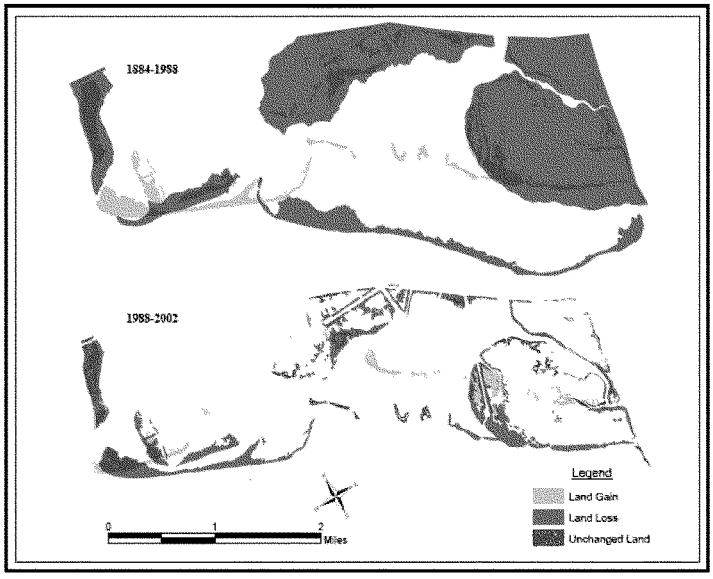


Figure 2-7. Shell Island Erosion History 1884–2002.

Figure 2-8. Aerial view of Shell Island, 1998.

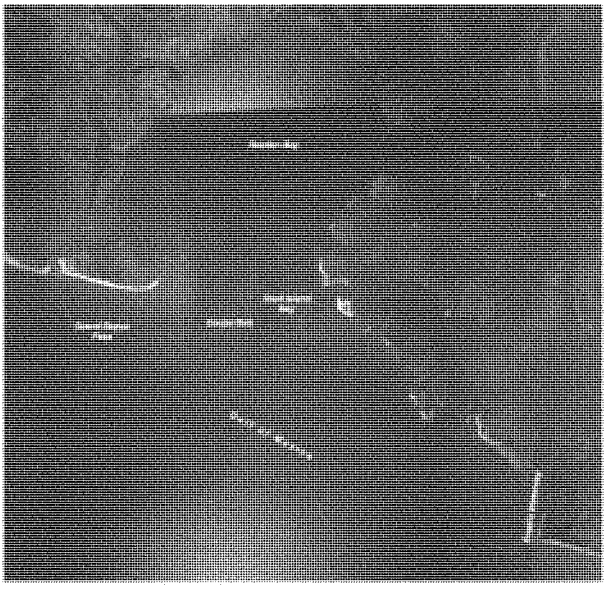


Figure 2-9. Aerial view of Shell Island, 2004.

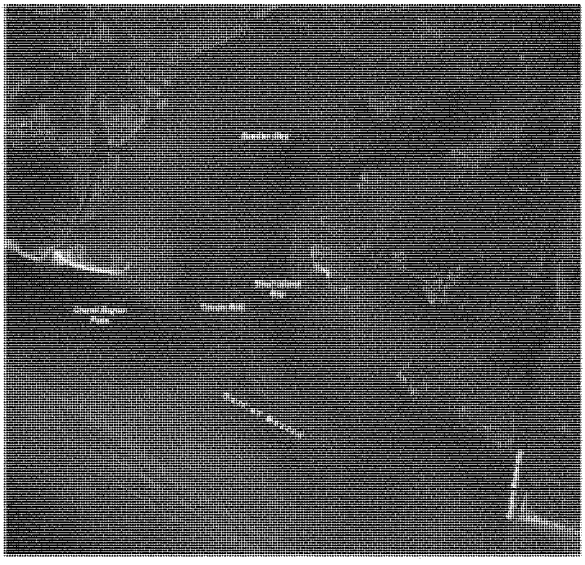


Figure 2-10. Aerial view of Shell Island, 2005.

2.4 NEEDS

The critical needs listed in the 2004 LCA Report are:

- Prevent future land loss where predicted to occur.
- Restore fundamentally impaired or mimic deltaic processes through river reintroduction.
- Restore or preserve endangered critical geomorphic structures.
- Protect vital local, regional, and national socioeconomic resources.

Critical needs in the study area are a subset of the critical needs identified in the 2004 LCA Report and include:

- Preservation of critical and essential geomorphic structures (beach, dune, ridge, and marsh) of the Barataria barrier system.
- Future land loss, habitat loss, and fragmentation of the land features will result in diminishing habitats for threatened and endangered species.
- Vital local, regional, and national socio-economic resources are in danger of being lost.
- The back barrier estuarine environments are being adversely impacted by the high energy marine processes and associated salinity of the Gulf of Mexico.
- Near-term restoration should be synergistic with future restoration by maintaining or restoring the integrity of Louisiana's coastline, upon which all future coastal restoration is dependent.
- Restoration features should be designed that support the development of large-scale, long-range, comprehensive coastal restoration.

2.4.1 Caminada Headland

The Caminada Headland is the central geomorphic feature in the Bayou Lafourche barrier system (Ritchie 1995) and it has suffered the highest land loss rates in this barrier system. The geomorphic elements comprising the Caminada Headland include barrier shorelines, dunes, washovers, inlets, salt and mud flats, chenier ridges, brackish and saline marsh, and bays of variable salinity. These geomorphic elements provide critical and essential habitat to a variety of terrestrial and aquatic plant and animal species.

The extensive and continuing land loss throughout the Caminada Headland has resulted in significant adverse impacts to many of the plants and animals that utilize this area. Recovery of endangered and threatened species, such as the piping plover and several sea turtles, is significantly threatened by the continued land loss, especially the critical wintering habitat of the piping plover. The continued loss of valuable stopover habitat for neotropical migratory birds further threatens these species who also are being stressed by loss of wintering habitat in the tropics and loss of nesting habitat in North America. The Caminada Headland is considered by the NMFS, as essential fish habitat, or EFH, (personal communication NMFS 2005). Continued

land loss and habitat degradation will likely result in significant adverse impacts to commercial and recreational fisheries.

Continued land loss, habitat degradation, and fragmentation of the Caminada Headland further threatens several uncommon habitats in the region, including the only chenier ridges in the Deltaic Plain, the largest black mangrove thickets in the state, and the majority of the coastal dune shrub thickets in the basin. The continued loss of these habitats would likely reduce the numbers and diversity of the birds and terrestrial wildlife that depend on these resources.

Continued land loss and fragmentation of the Caminada Headland also adversely impacts several important socio-economic sectors such as: Port Fourchon, the largest base for offshore oil and gas operations in coastal Louisiana and the largest coastal fishing port; major oil and gas infrastructure, such as regional transportation and storage facilities, the LOOP, and the Mars pipeline; and the regional hurricane evacuation route serving residents of southern Lafourche Parish, the community of Grand Isle and approximately 6,000 workers stationed at offshore facilities in the central Gulf of Mexico. Continued erosion and potential splintering of the headland will impact the investment in infrastructure located at Port Fourchon by increasing its vulnerability to storm surges. Maintenance requirements would increase to protect oil and gas pipelines, and Louisiana Highway 1.

2.4.2 Shell Island

Shell Island, one of the most fragmented areas along the Louisiana barrier shoreline, has suffered the highest land loss rates in the Plaquemines barrier system (Ritchie 1990). Shell Island forms the demarcation between the predominantly marine influences of the Gulf of Mexico and the fresher influences from the upper reaches of the eastern Barataria estuary. As such, Shell Island is a critically important geomorphic feature of the Barataria estuary that, until recently, protected the back-barrier estuarine environments from the high energy marine processes and associated salinities of the Gulf of Mexico. However, due to continuing and extensive land loss, Shell Island is gradually converting to a series of interconnecting bays (Bastian Bay and Shell Island Bay) directly connected to the Gulf of Mexico.

The NMFS considers the Shell Island area as EFH (personal communication NMFS 2005), especially important for nursery habitat. However, salinities in the Shell Island area, as well as the interior Bastian Bay and Shell Island Bay, are generally the same as the adjacent Gulf of Mexico. The lack of a dynamic salinity gradient, which typically characterizes a functioning estuary, has negatively impacted the productivity of the fish and wildlife that depend on this habitat.

Barrier islands perform some level of protection from storm surge, however, the extensive land loss at Shell Island has significantly reduced the critical first line of defense function of this barrier system. As recently as the 1970s, Shell Island functioned as an important buffer against the daily high-energy forces of the Gulf of Mexico. The significant degradation and fragmentation of the Shell Island system, combined with the loss of wetlands located directly inland of Shell Island, has further compounded the potential for catastrophic damage. Without the barrier islands and interior wetlands, there is an almost unimpeded path for storms to directly impact the Barataria Basin.

The need for restoration of Shell Island is especially time sensitive. The high rate of land loss at Shell Island has eroded the barrier system to the point where the remaining geomorphic barrier features are now just below the water's surface. However, these critical geomorphic features still function as a skeletal framework upon which to build a viable barrier system, if completed in the

very near term. Failure to restore the Shell Island barrier system in the immediate near term would result in the loss of this critical geomorphic skeletal framework, which, in turn, would preclude any future attempts at restoring this barrier system

2.5 PLANNING OBJECTIVES

For the 2004 LCA Study, two tiers of planning objectives were established – hydrogeomorphic and ecosystem objectives. The hydrogeomorphic objectives were:

- Establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing.
- Increase sediment input from sources outside estuarine basins, and manage existing wetlands and rebuild marsh substrate.
- Maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function.

The ecosystem objectives were:

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

The BBBS study objectives are a localized and project specific delineation of the LCA objectives. The Barataria Basin barrier shoreline is a unique ecosystem that helps to maintain the integrity of the gulf shoreline and protects the interior coast from further degradation. Aside from supporting coastal habitats, the coastal barrier chains in Louisiana are the first line of defense for protecting wetlands, inland bays, and mainland regions from direct effects of wind, waves, and storms. The barrier systems serve multiple defensive purposes to:

- Reduce coastal flooding during periods of storm surge
- Prevent direct ocean wave attack which accelerates rates of erosion and degradation of marshes and other wetlands; and
- Help maintain gradients between saline and freshwater, thereby preserving estuarine systems

Based on the function of these barrier islands and problems identified for the Caminada Headland and Shell Island during this study, the following planning objectives were developed to assist the development and evaluation of alternative plans.

- Restore the barrier structures to ensure their ability to provide geomorphic and hydrologic form and function
- Increase the acreage of shoreline, dune, and interior marsh habitat for essential fish and wildlife species, mimicking, as closely as possible, conditions which would occur in the area in the absence of human changes.
- Protect interior marsh and chenier ridge habitats for essential fish and wildlife species.

- Increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline, increasing the ability of the restored area to continue to function and provide habitat with minimum continuing intervention.

- Reduce land loss, preventing the dissolution of the Caminada Headland into separate barrier islands, and the disappearance of Shell Island.

2.6 PLANNING CONSTRAINTS

Planning constraints are restrictions that limit the planning process. Some general types of constraints that need to be considered are resource constraints and legal and policy constraints. Constraints that are relevant to the study include:

- Natural resources limitations. The limited availability of natural resources such as suitable sand materials is a critical constraint. The sediment particle size used for construction should be similar to the native sand in the project area. The coarser sand required for beach and dune construction is located in a limited number of sites in the Gulf of Mexico and the Mississippi River. The presence of pipelines and cultural artifacts further decreases the available sand.

- Avoid adverse impacts to surrounding coastal areas and threatened and endangered species. Alternatives developed should not adversely impact the surrounding ecosystems. Additionally, these plans should not adversely impact threatened and endangered species such as the piping plover.

- Avoid impacts to infrastructure and cultural resources. On the Caminada Headland, pipeline canals, roads, and oil and gas infrastructure impact the development and evaluation of alternatives. Highway 3090 bisects the project area, and active pipeline canals run the length of most of the headland. Within the Ship Shoal borrow site, areas near pipelines and cultural resources may not be utilized. The project site is also near Port Fourchon, an important commercial site for the oil and gas industry, and includes Fourchon Beach, a beach area visited by local residents. Relocations of the oil and gas infrastructure near Port Fourchon would have national impacts because Port Fourchon is linked to 50% of the refining capacity of the nation. Alternative plans must take into consideration impacts to commercial and recreational activities in the area.

3.0 ALTERNATIVES *(NEPA-REQUIRED)

3.1 PLAN FORMULATION RATIONALE

In this chapter, plan formulation is presented as a two-stage process: (1) the available ecosystem restoration measures are evaluated for capability to meet project objectives and avoid constraints; and (2) alternative plans are formulated from the selected restoration measures. As the plan formulation process is iterative and comprehensive, a complete discussion of the process is beyond the scope of this chapter. The plan formulation process includes a number of detailed evaluations of potential scales and combinations of restoration measures, and an iterative refinement process for alternative development. This section of the report presents a streamlined overview of the plan formulation process for the BBBS Study. Specifically, management measures are presented, screening criteria are discussed, and alternative plans are presented. The alternative plans identified through the plan formulation process are then evaluated for ecosystem benefits, cost-effectiveness, and environmental impacts to ensure that the preferred plan best meets the project objectives.

For this study, the objectives address the project goals to restore the geomorphic structure and ecosystem function of the barrier shoreline reaches. In addition to the objectives relating to the restoration of the geomorphic structure, increasing sediment into the sediment starved ecosystem and the reduction of land loss are important considerations for developing and evaluating the various alternatives. Planning constraints relevant to the project include natural resources limitations, impacts to infrastructure and cultural resources that must be avoided, and avoiding adverse impacts to surrounding coastal areas and threatened and endangered species. Solutions that address these objectives and avoid the planning constraints were incorporated into the alternative plans assembled from one or more of the available management measures for ecosystem restoration of barrier shorelines.

3.1.1 PRIOR PLAN FORMULATION AND SCREENING

In 1990, passage of CWPPRA (PL-101-646, Title III) provided authorization and funding for the Louisiana Coastal Wetlands Conservation and Restoration Task Force to begin actions to curtail wetland losses. After extensive studies and construction of a number of coastal restoration projects under CWPPRA, it was apparent that a systematic approach involving large projects working in conjunction with these smaller projects would be necessary to deal with the continuing loss of the coastal wetlands effectively. In 1998, the State of Louisiana and the five CWPPRA Federal agencies 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.

The Coast 2050 Plan was the basis for a USACE reconnaissance report that demonstrated a Federal interest in restoration of coastal Louisiana wetlands. In 2000, the BBBS Study was initiated to study the entire barrier shoreline of the Barataria Basin. This study was paused in 2002 to allow integration of its alternatives into the "November 2004 LCA, Louisiana Ecosystem Restoration Study" (2004 LCA Study). The goal of this study was to fully explore large-scale, comprehensive restoration approaches for coastal Louisiana.

Restoration strategies presented in the Coast 2050 Plan and the LCA 905(b) reconnaissance report formed the basis for the detailed effort under the 2004 LCA Study. During the development of the 2004 LCA Study, the project team used an iterative decision making process

to identify and evaluate the merits of multiple 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 Barataria Basin barrier shoreline was considered critical due to the greatly degraded state of this shoreline and its key role in defining, protecting, and preserving larger inland wetland area and bay systems. The 2004 LCA Study further identified that the Caminada Headland and Shell Island reaches were not being address through other programs. If this fragile area is not addressed quickly, restoration would be far more difficult and costly. This critical relationship to overall system function and structure, coupled with an advanced level of project development resulted in the identification of these specific reaches of the Barataria Basin barrier shoreline as critical features. As a result, the 2004 LCA Report identified these two reaches of the BBBS Project as one of five near-term critical projects that could be implemented within the near-term based on proven restoration techniques. A PEIS was prepared as part of the 2004 LCA report. The Record of Decision (ROD) was signed on 18 November 2005. The 2004 LCA report has multiple components that help to address the critical water resource problems and opportunities in coastal Louisiana.

In the final 2004 LCA report, the BBBS Project was identified as the reconstruction of critical coastal landforms at Caminada Headland and Shell Island to provide proven, near-term restoration benefits and to prevent larger scale, potentially irreversible ecosystem impacts. Because the 2004 LCA report addressed ecosystem restoration for entire coastal Louisiana on a regional and programmatic basis, it was recognized that additional detail on formulation and evaluation of alternatives would be needed for project implementation. Consequently, the BBBS Study was re-initiated in 2005 to provide detail to the plan formulation and evaluation, identify a selected plan, and fulfill NEPA and related regulatory requirements.

3.2 MANAGEMENT MEASURES AND PRELIMINARY PLANS

For the reinitiated BBBS Study, project alternatives have been developed from an array of potential restoration measures for the identified critical reaches. A management measure is a feature or an activity that can be implemented at a specific geographic site to address one or more planning objectives. Structural and nonstructural management measures and various permutations of scales and locations have been considered. Generally, the measures became more specific and better defined as the planning of this project progressed.

As part of the plan formulation, a Value Engineering (VE) study was conducted to identify potential modifications of restoration measures and plan configurations that could improve the performance and cost effectiveness of the preliminary alternatives. The results of the VE study for this project were fully considered and were used to refine the alternative plans.

In order to consider a reasonable range of alternatives for Caminada Headland and Shell Island, a wide range of management measures were first identified and screened. This section presents a discussion of the management measures that were considered. Management measures that could reasonably achieve the planning objectives have been maintained for consideration and incorporated into alternative plans.

The management measures were divided into two general categories: (1) shoreline restoration and protection, and (2) marsh restoration. It should be noted that shoreline restoration at Caminada Headland and Shell Island is needed to stabilize these geomorphic features and reduce the rapid rate of shoreline erosion. Marsh restoration alone does not provide the coastal area protection against everyday wave action or storm events. Therefore, shoreline restoration is

necessary in conjunction with marsh restoration for optimal shoreline protection and ecosystem restoration.

3.2.1 Shoreline Restoration and Protection Measures

Shoreline restoration and protection at Caminada Headland and Shell Island are needed to protect the marsh habitats which, when exposed to open marine influences, have been impacted by very high erosion rates The management measures to restore the shoreline include features to initially restore the landform and integrity of the shoreline. Other management measures were also considered that reduce the energy of wave actions on the shoreline. However, these measures were eliminated from the plan formulation process because of the high level of uncertainty with respect to feature performance, including potential instability and increased erosion that these features may induce along adjacent shoreline reaches. Wave energy reduction measures considered, but eliminated from plan formulation, include inverted breakwaters and nearshore wave attenuation systems.

Restored barrier shorelines can achieve the project objectives by restoring the geomorphic structure and ecosystem functions of the original shoreline landforms prior to coastal erosion. The geomorphic structure of intact barrier shorelines serves numerous systemic functions. Continuous nearshore and shoreface landforms dissipate wave energy and protect estuary marsh shorelines from erosion. Barrier shorelines confine tidal exchange to inlets and passes, limiting the tidal prism and back-barrier salinity gradients, which impact estuary hydrodynamics, water quality, and associated marsh wetlands. Beach and nearshore sand geomorphic structures are also self-sustaining, with maintenance being driven by longshore transport. Sand beaches also provide habitat for shore birds and nesting grounds for sea turtles. These habitat functions are not available along hardened or mud-dominated shorelines.

Dune ridges reduce tidal overwash and storm surges, thus protecting estuary and marsh environments from disruptive currents and higher salinity conditions. Dunes also provide shelter and resting areas for birds and animals. Additionally, dunes reduce the landward transport of salt spray and reduce the energy of on-shore winds, thereby shielding terrestrial vegetation.

Sand Shoreline Restoration – This measure consists of construction of a sand shoreline and dune system using external sediment sources (e.g., Ship Shoal or the Mississippi River). Sediment of suitable grain size and physical properties is dredged from offshore or river locations and transported to the restoration feature location. The materials are then placed along the shoreline reach to restore the shoreface and dune profile of the barrier shoreline as specified in the topographic profile developed for the restoration feature. Containment structures may be used to control placement of sediment. This measure would recreate the shoreline and dune system and restore the form and function of the shoreline. Restoring the shoreline through placement of sand would help mitigate storm damage to natural and man-made components in the study area. However, a sand shoreline would continue to erode if other measures, such as periodic re-nourishment, are not implemented, or until longer term projects reestablish sediment supply for this region of the gulf shoreline. To manage the increasing demand for sediment sources, USACE has initiated the Regional Sediment Management Program.

Dune Vegetative Plantings – This feature is associated with the sand shoreline restoration measure. Vegetation is a natural means of shore and dune stabilization that is effective when used under the proper circumstances. Vegetation is relatively economical and does not detract from, but can benefit, environmental quality. On open seacoasts, vegetation is primarily used to enlarge and stabilize dunes. A number of shoreline grasses and other plants tolerant of a dune

environment can be used to create, enlarge, or stabilize dunes. Frequently used species are sea oats (*Uniola paniculata*) and the panic grasses (*Panicum amarum* and *Panicum amarulum*). All of these plants can be propagated by planting suitable stock and are effective in trapping and holding windblown sand. A number of herbaceous and woody plants are also effective in dune areas. Dune vegetation is capable of growing up through the accumulating dune sand, and it can repair itself if damaged, provided the damage is not too extensive and the vegetation was well established prior to being damaged. New plantings would require periodic fertilization the first year or two and watering the first few months for the young plants to become well established.

Sand Fencing – This measure consists of installation of sand fencing along the dune ridge landward of the shoreline. Sand fences would help stabilize the dunes and assist in the formation of new dunes. They would be less expensive than constructing more dunes by mechanical means. Additionally, sand fencing would provide protection for the newly created dunes from beach goers on the Caminada Headlands by discouraging access.

Feeder Shorelines – Sometimes shoreline nourishment projects include the creation of a feeder shoreline, in which fill material is introduced at the updrift end of the area intended to receive the fill. Then longshore transport distributes the fill to the rest of the project area. Feeder shorelines work best in areas that serve as a source of littoral material for downdrift shorelines, in areas that are presently experiencing a deficit in the supply of littoral material and have unusually high loss rates, and in areas where the net longshore transport direction is predictable and the net transport rate is "strong" (i.e., longshore sand transport in one direction greatly exceeds the transport in the other direction). Candidate sites for feeder shorelines include areas immediately downdrift from inlets or other man-made structures that form a littoral barrier or in areas that have been identified as erosional "hot spots." As the feeder material spreads under the influence of waves, the orientation of the feeder shoreline approaches that of the adjacent shoreline, resulting in longshore transport out of the feeder area equal to the transport along the adjacent area. Eventually, the orientation in the feeder shoreline area would return to its original configuration. Protection provided by feeder shorelines would not have the same degree of alongshore uniformity as that provided by placing fill in a prescribed manner throughout the project area. In general, both Caminada Headland and Shell Island have fairly uniform loss rates and inconsistent longshore transport direction. Therefore, this management measure was eliminated from further consideration as a construction measure.

Rock Shoreline – This measure consists of the construction of a rock shoreline (segmented, continuous, and/or submerged). This measure would stabilize the shoreline and significantly reduce shoreline erosion for the protected area. However, a rock shoreline would adversely impact threatened and endangered species such as the piping plover and the Kemp Ridley's sea turtle by eliminating nesting and feeding areas. Further, the rock shoreline would interrupt the natural longshore sediment transport system and would impact adjacent shoreline reaches not protected by hard stabilization. Use of rock shorelines was unsuccessful on both Wine and East Timbalier Islands in nearby Terrebonne basin with rocks either sinking below the surface of the water or the island moving away from the rocks. During Hurricane Gustav, in areas on the Caminada Headland where revetments exist, large gouges in the beach formed that healed only when additional sand was added to the area. In areas without revetments, the beach rolled back and much of the sand was retained on the Headland. For these reasons, a rock shoreline was eliminated from further consideration.

Groins and Breakwaters – This measure consists of the construction of hard structures (such as rock or the sinking of old ships) perpendicular (groins) or parallel (breakwaters) to the shoreline. This measure would protect a portion of the shoreline by reducing wave energy and/or capturing sediment that would otherwise be lost through offshore transport and deposition. Placement of

groins would retain sediment on Caminada Headland and Shell Island while breakwaters would reduce the wave energy and reduce the amount of erosion. While the impact from breakwaters may appear to be positive as reduced erosion rates along portions of the shorelines would enhance project performance and potentially increase the interval between re-nourishment events, these benefits would be offset by significant adverse impacts that would result from the interruption of longshore sediment transport. This interference with sediment transport processes would increase the rates of erosion and shoreline retreat to adjacent reaches of the barrier shoreline. The breakwaters near Port Fourchon appear to provide some protection, but at the cost of an erosional shadow that contributed to the creation of a breach at Bay Champagne. Once breaches have occurred and marsh is exposed, erosion rates increase. During storms, hardened structures have been tossed aside, providing no protection or causing a scouring affect behind any remaining structures.

In general, restoration projects should be designed to mimic natural environmental processes and structures. (See the USEPA's Principles for the Ecological Restoration of Aquatic Resources: www.epa.gov/owow/wetlands/restore/principles.html .) A guiding principle of the 2004 LCA study is that alternatives should mimic natural processes and rely on natural cycles and processes for their operation and maintenance. Rock breakwaters do not mimic or reflect natural environmental features or processes in coastal Louisiana. Hard, immobile structures are fundamentally inconsistent with the soft and highly dynamic nature of the coastal system. This inconsistency is the basis for a number of concerns with the use of armoring and rock breakwaters, including the potential for unintended adverse environmental impacts such as changing long-shore sediment transport at the expense of adjacent or downdrift areas, lost restoration opportunities, maintenance requirements, and uncertainties with respect to the long-term viability of rock projects. If focus is placed on hard protection, it is potentially diverted from other types of coastal restoration projects. In the case of barrier island and barrier shoreline projects, efforts placed on hard protection result in less attention on the placement of external sediment. Sediment deprivation is a root cause of coastal decline in the Barataria Basin. Additionally, the effects of subsidence and sea-level rise, combined with the dynamic nature of barrier islands and shorelines bring into question the long-term viability of rock breakwaters and similar hard and stationary structures in the deltaic plain. The life expectancy of hard structures would be shortened as the shoreline continues to migrate landward and subside. In many cases, hardened structures have not been successful in the soft, fluid environment of coastal Louisiana.

Because of the predicted adverse impacts associated with the placement of these hardened structures along the barrier shorelines, additional costs, and reduced environmental benefits, breakwaters and groins were eliminated from further consideration.

Modify Belle Pass Jetties – The Belle Pass jetties protect the Bayou Lafourche Navigation Channel. This feature includes removal of the Belle Pass jetties, or modification of the jetties by reducing their length or putting in gaps. This feature is intended to restore the longshore transport of sediments, thereby creating a new source of material for downstream barrier shoreline, but the jetty positively impacts Caminada Headland as the existing jetty serves as a terminal groin and collects longshore sediments that would otherwise be lost to the headland. Further, removal or modification of the Belle Pass jetties would adversely impact the Bayou Lafourche Navigation Channel, which would require additional maintenance dredging, greatly increasing the costs of maintaining the navigation channel. For these reasons, modifications to Belle Pass jetties were eliminated from further consideration.

Modify Empire Jetties – This feature consists of the modification of the Empire jetties to restore longshore transport of sediments to renourish the Barataria Basin barrier shoreline. The Empire jetties presently protect the Empire waterway navigation channel. Modification of the

Empire jetties to restore the longshore transport of sediments would result in the channel filling in, thus necessitating dredging for continued use. Additionally, an in-depth analysis was conducted on the impacts of the Empire Jetties and is included in Appendix A, Annex 2. While the Empire Jetties have interrupted the littoral drift and the sediment supply to Shell Island, the formation of Coupe Bob in 1979 has had a much greater impact on Shell Island. Following the formation of Coupe Bob, Shell Island East underwent a shoreline retreat and reorientation to a southeast-northwest alignment that has resulted in disintegration of the island. Only a few scattered sections of Shell Island East remain. The shoreline retreat rate increased to 89 feet per year on the east side of Shell Island. Shell Island West continued to undergo retreat due to rollover and migration to the west. The Empire jetties are responsible for a shoreline recession of approximately 10 feet per year along only a portion of Shell Island. The downward drift of the Empire Jetties appears to be limited to 3,000 to 8,000 feet west of the jetties, and would therefore have no effect on Shell Island West. Further, the limited longshore transport of sand in this barrier shoreline system makes this feature an inefficient means to restore the shoreline. For these reasons, modifications to the Empire jetties were eliminated from further consideration.

Sand Bypass System – This feature consists of the construction of a permanent sand bypass system at the Empire jetties to protect and restore Shell Island. A sand bypass system captures sand that accumulates at the jetty to replace sand on the eroded shoreline downstream of the jetty. This feature provides for the operation of a permanent sand bypassing system. Sand that arrives at the permanent system at Pelican Island would be trapped and pumped to Shell Island. The schematic layout of a typical sand bypass system is shown on **figure 3-1**. However, the limited longshore transport of sand in this barrier shoreline system makes this feature an ineffective means to restore the shoreline. Therefore, this feature was eliminated from further consideration.

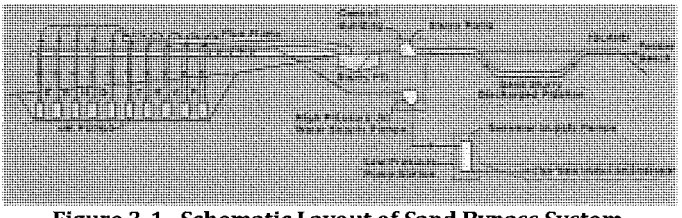


Figure 3-1. Schematic Layout of Sand Bypass System.

Dune Fields – This measure consists of the construction of a series of dunes behind the primary dune to shore up the Caminada Headland. For Shell Island, a dune field would provide a rollover platform. However, in order to create this dune field, potential marsh habitat would be sacrificed. When restoring barrier islands, a wide marsh is generally created behind the dune to add stability to the shoreline. At Caminada Headland, there is not enough space to create a dune field and a sufficient supporting marsh due to the presence of the pipeline canal north of the headland. At Shell Island, the depth of open water that would have to be filled in would require sediment volumes that are not feasible for the project based on resource availability and cost considerations.

3.2.2 Marsh Restoration Measures

Marsh restoration, in combination with the shoreline restoration and protection, would help maintain the diversity of coastal habitats such as beaches, dunes, saline marshes, and bays of variable salinity. These landforms, along with their related hydrologic and biological processes,

provide unique habitats that are crucial to the viability of migratory birds, commercial and recreational fisheries, and a great variety of terrestrial and aquatic species. Marsh platforms landward of barrier shorelines provide a foundation for rollover of the dune ridge and beach shoreface, allowing the barrier shoreline landforms to migrate landward in response to storms, waves, and currents. The migrating shorelines continue to provide benefits even though some wetland loss occurs during the rollover process.

Marsh restoration could be implemented without restoration of the associated barrier shoreline providing habitat and ecosystem benefits. However, marshes exposed to open marine wave energy and tidal currents have been impacted by very high rates of shoreline erosion. In addition, marsh features without associated barrier shoreline would not provide benefits related to limiting influence of tides and waves on interior marshes and would not reduce storm surges. Furthermore, specific beach habitats and ecosystem functions would not be provided in a marsh-only restoration alternative.

Restore/Nourish Interior Marsh – This measure consists of using offshore sediment sources to restore/ nourish the marsh behind the dune. These measures would restore critical habitat, restore form and function and long-term stability of the barrier shoreline, and would help mitigate storm damage (to natural and man-made components) if constructed in combination with the shoreline restoration measure.

Vegetative Plantings – This measure consists of planting habitat-specific vegetation (e.g., sea oats, smooth cordgrass, and wax myrtle). The vegetation would stabilize the newly created landforms, thereby reducing potential erosion and contributing to the stability and longevity of restored shoreline features. Vegetation would also contribute to the ecosystem function of barrier shoreline and associated marsh platform features, providing habitat diversity for birds and other wildlife, reducing the risk of establishment of invasive species, and supporting the beneficial cycling of nutrients and pedogenic activity (e.g., burrowing organisms, soil microbes).

Plug or Fill Pipeline Canal – This management measure consists of the plugging and filling of pipeline canals within the marshes. These canals have altered the natural hydrology and may promote the acceleration of the loss of marsh. This management measure would help restore natural hydrology of transected marshes, reducing salt water encroachment, and canal bank erosion. Many of these pipeline canals are actively used by commercial navigation to access active oil and gas facilities, and plugging or filling these canals would require negotiation and compensation to existing property owners and holders of valid existing rights to access their facilities. The canals are outside the footprint of the planned restoration measures, and canal plugging or filling could be implemented independently of shoreline ecosystem restoration. Coordinating future actions to address the canals with landowners and navigation users would allow this measure to be implemented as production facilities are taken out of service, thus providing for restoration benefits while avoiding or reducing economic impacts.

Terraces – The construction of terraces in Bay Champagne and Caminada Bay in the Caminada Headland reach, or Bastion Bay and Shell Island Bay in the Shell Island reach could be used to reduce fetch in open water areas, create marsh habitat, promote submerged aquatic vegetation growth, and create island habitat. However, upon investigation, the amount of open fetch in the bays is not a primary factor contributing to erosion of the marsh associated with the barrier shoreline features. Therefore, terraces do not directly contribute to the project objective of restoring and protecting the barrier shoreline or increasing sediment input to supplement long shore transport processes. This measure was eliminated from further consideration.

Chenier Ridge Restoration – This measure includes creating marsh cells adjacent to existing ridges, rebuilding subsided ridges, replanting ridges with woody species, and creating marsh between the ridges. Due to the extent of uncertainties associated with this measure, it has been recommended as a demonstration project for the Science and Technology (S&T) Program. In addition, the opportunity for chenier ridge restoration is preserved for later implementation by proceeding with beach/dune and marsh platform restoration while uncertainties are resolved through the demonstration project.

3.2.3 Screening/Evaluation of Management Measures

The management measures were evaluated (screened) to determine the capability of each to contribute to project objectives and the compatibility of the measures with project constraints. The management measures considered and the rationale for screening based on the measure's ability to meet objectives, solve problems, and avoid constraints is listed in **table 3-1**.

Table 3-1. Screening Results for Restoration Management Measures

Management Measures	Warrants Further Evaluation	Eliminated	Discussion
Shoreline Restoration and Protection Measures			
Sand Shoreline Restoration	✓		Addresses the problem of lack of sediment and meets objectives by increasing acreage of shoreline and dunes, increasing sediment input/restores barrier structures/reduces land loss, and protecting interior marsh and chenier habitats
Rock Shoreline		X	Contributes to the problem by producing systemic disruption throughout barrier shoreline. Does not avoid adverse impacts to surrounding coastal areas.
Groins and Breakwaters		X	Contributes to the problem by producing systemic disruption throughout barrier shoreline. Does not avoid adverse impacts to surrounding coastal areas.
Modify Belle Pass Jetties		X	Does not meet objectives to restore barrier structures or increase sediment input.
Modify Empire Jetties		X	Contributes to the problem by producing systemic disruption throughout barrier shoreline. Does not avoid adverse impacts to surrounding coastal areas.
Sand Bypass System		X	Measure is ineffective due to natural resource limitations.
Feeder Shorelines		X	Measure is ineffective due to natural resource limitations.
Sand Fencing	✓		Meets objective by helping to restore barrier structures and retaining sediment.

Management Measures	Warrants Further Evaluation	Eliminated	Discussion
Dune Fields		X	Does not meet objectives to increase acreage of marsh habitat or protect interior marsh and chenier habitats.
Dune Vegetative Plantings	✓		Meets objectives by helping to restore barrier structures and retaining sediment.
Marsh Restoration Measures			
Restore/Nourish Interior Marsh	✓		Meets objectives by restoring barrier structures, increasing acreage of marsh habitat, protecting interior marsh and chenier habitats, increasing sediment input, and reducing land loss.
Marsh Vegetative Plantings	✓		Meets objective by helping to restore barrier structures, protecting interior marsh and chenier habitats, and retaining sediment.
Plug or Fill Pipeline Canals		X	Does not avoid infrastructure. Does not meet objectives of restoring barrier structures, increasing acreage of marsh habitat, or increasing sediment input.
Terraces		X	Does not meet objectives of restoring barrier structures or increasing sediment input.
Chenier Ridge Restoration		X	Measure is recommended for S&T Program due to areas of uncertainty with measure

3.3 PRELIMINARY ARRAY OF ALTERNATIVES

The plan formulation process includes development of a reasonable range of alternative plans to address the specific problems, needs, and objectives of the study described in chapter 2. This section discusses the development of alternative plans incorporating restoration measures that warranted further consideration. The predicted impacts of these alternative plans are estimated and the alternative plans are compared to the no action alternative.

Management measures that warranted continued consideration and used in the formulation of alternative plans included:

1. Sand Shoreline Restoration
2. Restoration of Interior Marsh
3. Dune Vegetative Plantings
4. Marsh Vegetative Plantings

5. Sand Fencing

The development of alternative plans for the Caminada Headland reach focused on restoration of the shoreline and adjacent interior marshes that would help stabilize the restored shoreline.

The development of alternatives for the Shell Island reach focused on reestablishing a barrier between a threatened estuarine ecosystem and the Gulf of Mexico by restoring the geomorphic structure and function of this barrier island. The Shell Island alternative plans were developed to restore the natural sustainability of the barrier shoreline system, while protecting the quality and quantity of habitats along this shoreline reach and adjacent back-barrier marshes.

3.3.1 Description of the Alternative Plans

This section summarizes the alternative plans. For more details on each alternative, refer to the Engineering Appendix (appendix A). Excluding the no action alternative, 10 preliminary alternatives were developed for the Caminada Headlands and 8 preliminary alternatives were developed for Shell Island. Engineering analyses and costs were developed for each of these alternatives. The Caminada Headland construction costs listed in appendix A, annex 1 were deflated in accordance with ER 1105-2-100 for the plan formulation evaluations.

3.3.1.1 Caminada Headland

Eleven project alternatives (including the no action alternative) for Caminada Headland were formulated for further evaluation. The alternatives consist of various cross-section profiles for shoreline restoration, as well as restoration of the marsh. The plan alternatives for Caminada Headland include:

- No Action
- Alternative 1: Base Marsh Only
- Alternative 2: Low and Wide Dune with Base Marsh
- Alternative 3: High and Narrow Dune with Base Marsh
- Alternative 4: Landward Dune with Base Marsh
- Alternative 5: Preferred Dune with Expanded Marsh
- Alternative 6: Preferred Dune with Expanded Marsh and One Re-nourishment
- Alternative 7: Preferred Dune with Expanded Marsh and Two Re-nourishments
- Alternative 8: Optimized Project with Base Marsh and Four Re-nourishments
- Alternative 9: Optimized Project with Expanded Marsh and Four Re-nourishments
- Alternative 10: Optimized Project with Expanded Marsh, Four Re-nourishments, and Full Storm Protection

The Caminada alternatives were developed sequentially with alternatives 1 through 4 designed first, and output from their analyses used to develop alternatives 5 through 10. For the preferred dune design fill, a dune height of + 7 feet was proposed. Modeling results show that an 8 foot dune provided greater storm risk reduction, but is higher than the existing dunes. The higher dunes restrict overwash, which blocks the supply of sand required to help the back barrier marshes keep up with relative sea level rise. Consequently, a 7-foot dune height was selected as

a compromise between the competing interests of maintaining the ecology of the interior wetlands, minimizing collateral damage that would occur on both ends of the Caminada Headland as a result of the damming effect of a higher than neighboring dune height, and affording a higher level of protection to infrastructure. This 7-foot dune height was incorporated into alternatives 5 through 10. Their design fill template is consistent with Alternative 4 in that the majority of the template is sited landward over existing elevations, maximizing acreage and longevity. However, alternatives 5-10 create a greater number of acres with their designs due to the increased marsh template. The optimized design attempts to maintain the existing habitat and offer storm risk reduction for 50 years. Per the 2004 LCA report, to ameliorate the immediate or subsequent impact of storm events, the alternatives should include designs of barrier islands of sufficient height and width to minimize the risk of breaching. Various renourishment intervals were evaluated to determine the most cost effective operations and maintenance schedule.

The range of dimensions for the dune and supratidal features were defined through analysis of existing profile data and historical data extracted from the literature sources referenced herein. Mendelssohn (1982) reported that Louisiana barrier shorelines have poorly-developed dunes because of the limited volume of aeolian sand and the high frequency of storm overwash, stating that "Most of Louisiana's barrier islands and beaches have only one primary dune line which is relatively low in profile and only moderately vegetated." Ritchie and Penland (1989) studied coastal erosion and washover along the Caminada Headland and reached a number of relevant conclusions. The coastline is dominated by storm events, the vast majority being winter cold-fronts that elevate water level up to 3 feet on a cycle of 10 to 30 per year and produce waves as high as 9 feet. Tropical storms occur less frequently (~4 to 5 year interval) but elevate sea level from 6 feet to over 20 feet. While the coastal sediment is fine grained sand that can be readily formed into dunes by aeolian transport, the high frequency of overwash events prevents formation and stabilization of high dunes.

The average healthy marsh elevation is defined as typically within +/- 0.1 feet of MHW and is the target elevation for the marsh platform. MHW for the Project area is approximately 1.6 feet NAVD88 and was defined as the design criteria for the marsh platform elevation. Marsh fill compaction (a combination of foundation settlement and fill consolidation) was compensated for in the design.

With the exception of Caminada Alternative 1, (marsh only), and Alternative 4, (which does not include beach fill near Highway 3090, behind the breakwaters) the Caminada Alternatives include restoration of the entire 13 mile coastline. Much of the Caminada Headland from Belle Pass to the east for 7 miles, and from Bayou Thunder Von Tranc to the eastern point of the Caminada Headland, including Elmer's Island has been designated as critical habitat for the piping plover by USFWS. The shoreline also protects a rare maritime forest, important to neotropical migratory birds. The headland's nearshore zone is considered an essential fish habitat by NMFS. Restoring the entire shoreline and dune along the headland is critical to the survivability of these important ecological habitats and to prevent the dissolution of the headland into separate islands. If only a portion of the headland were to be restored, breaching would occur on the unrestored portion of the headland. Once this has occurred, erosion rates will increase, thus impacting the environmental resources and reducing the longevity of the restored portion. Consequently it was considered necessary to meet project goals to restore the dune/beach on the entire headland. Four different configurations of marsh were evaluated for the Caminada alternatives. Various configurations and designs were considered during the analysis to select the most efficient and effective design.

The proposed source of borrow sand for all action alternatives at Caminada Headland is Ship Shoal, a sand body in the Gulf of Mexico located approximately 40 miles southwest of Belle Pass. Ship Shoal is approximately 31 miles long and 7 miles wide, lying in a water depth of 9 feet to 30 feet. It is the remaining seaward shoal from one of the older abandoned Mississippi River deltas. Ship Shoal is composed of well-graded quartz sand and is ideal for use in restoring the Caminada Headland since its grain size is slightly larger than the sand found at the headland. Coarser grain sand is more resistant to erosion. Ship Shoal is the nearest, accessible sand source that contains material of a similar or coarser grain size to the sand found on the Caminada Headland. Some alternatives also include periodic re-nourishment of the shoreline and marsh and consist of restoring post-construction conditions. The borrow source for the marsh restoration is located offshore of the Caminada Headland.

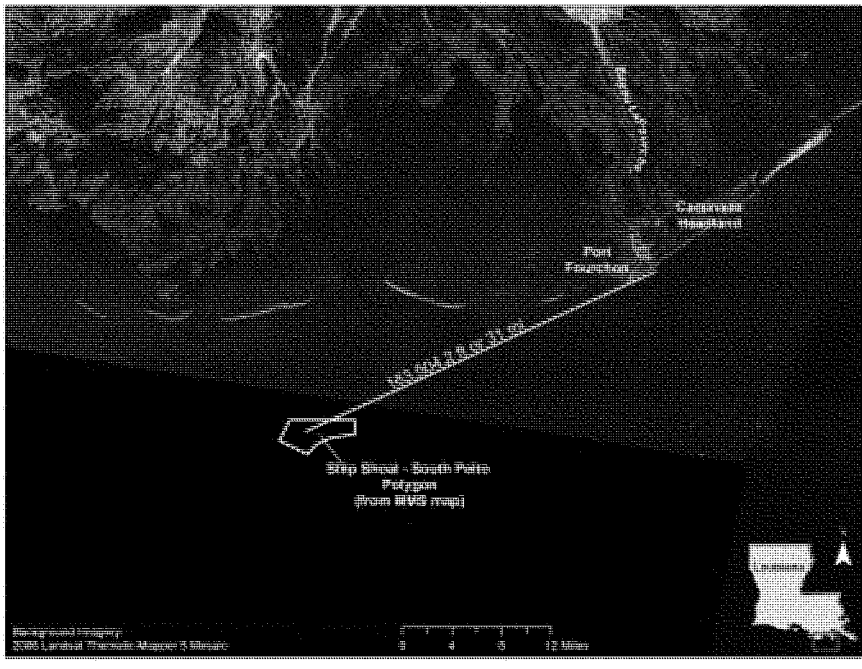


Figure 3-2 Borrow sources for the Caminada Headland

An in-depth description of each alternative including evaluations is located in chapter 6 of the "Barataria Barrier Shoreline Restoration Feasibility Study, Caminada Headland, Lafourche Parish, Louisiana" in appendix A. A summary description of the preliminary alternatives is provided below.

3.3.1.1.1 No Action Alternative

Under the no action alternative for the Caminada Headland, no shoreline restoration would occur. The project area consists of approximately 454 acres of beach and dune with an average dune elevation of +3.5 to 4 feet NAVD88 and 977 acres of marsh with an average elevation of +0.94 feet NAVD88. The headland would likely permanently fragment within the next 5 years to 20 years and migrate landward as a detached chain of three or more barrier islands. If this occurs, some of the last remaining stopover areas for neotropical migrants would be lost as the maritime forests are degraded. As the headland fragments into islands, it would provide less protection to marshes to the north, resulting in increased salinity and wave energy conditions in the estuarine environments. As a result, salinities would increase in lakes and bays to the north, and some critical habitat for the threatened piping plover would be lost. With loss of the beach and marsh areas, the only chenier ridges in the Barataria Basin, which have the largest black mangrove thickets in the state, would be endangered, and the loss of these habitats would dramatically decrease habitat diversity in this basin. Only 34 acres would remain in the project area.

3.3.1.1.2 Alternative 1: Marsh only

Alternative 1 would create 1,186 acres of saline marsh extending west through Bay Champagne to the eastern edge of the project boundary near Caminada Pass and 75 additional acres to the west of the oil and gas facility on the western end of the headland. Alternative 1 proposes this marsh fill on the landward side of the dune at an elevation of +2.0 feet NAVD88. Fill quantities for marsh would be 5.36 million cubic yards.

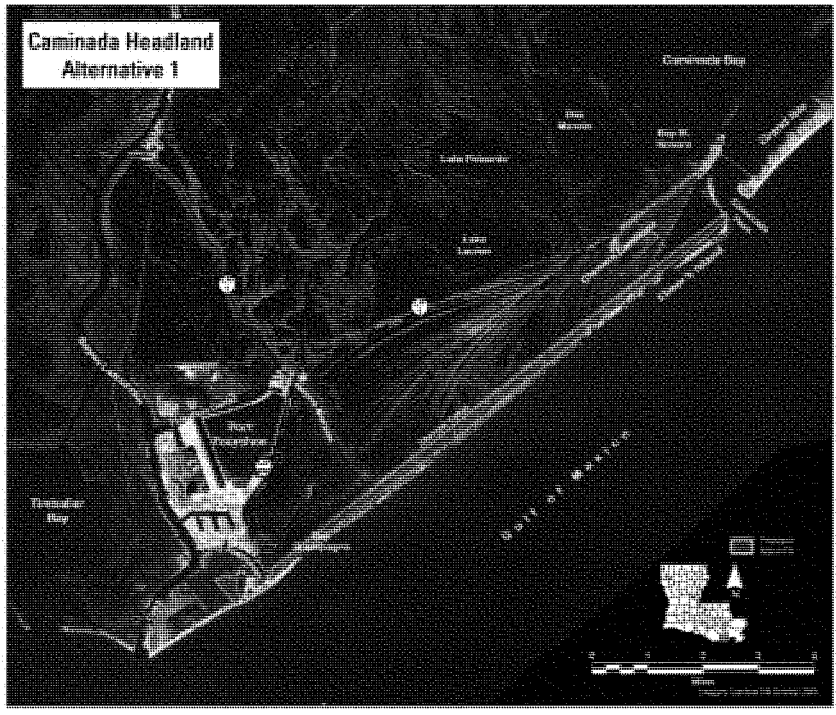


Figure 3-3 Caminada Headland: Alternative 1 Plan View

3.3.1.1.3 Alternative 2: Low and Wide Dune with Base Marsh

Alternative 2 proposes a dune with a width of 200 feet. This dune would be centered over the existing dune and would slope down to a construction berm that is extended seaward. The proposed dune height of +6 feet NAVD88 would be slightly higher than the existing dune elevation of +4 feet NAVD88. The landward, seaward, and dune to berm slopes would be 20 horizontal to 1 vertical. The beach fill alternative would have a 75 feet wide seaward berm at an elevation of +4.5 feet NAVD88 and a marsh fill alternative is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. This alternative would create 936 acres of saline marsh and 879 acres of beach/dune. Fill quantities for the dune and marsh fills would be 5.7 million and 3.8 million cubic yards, respectively.

Figure 3-4. Caminada Headland: Alternatives 2 and 3 Plan View

3.3.1.1.4 Alternative 3: High and Narrow Dune with Base Marsh

Alternative 3 proposes a dune higher and narrower than alternative 2. The alternative 3 dune height was set at +8 feet NAVD88 and with the exception of the fill tapers, contains a 125 foot dune width. This dune would be centered over the existing dune and slope down to a construction berm that was extended seaward. The landward, seaward, and dune to berm slopes would all be set to 20 horizontal to 1 vertical. With the exception of the fill tapers, the beach fill alternative would have a 75 feet wide seaward construction berm at an elevation of +4.5 feet NAVD88 and marsh fill would be proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. The proposed marsh fill for alternative 3 would be the same as the marsh fill for alternative 2, creating 936 acres of saline marsh. There would be 939 acres of beach/dune created. Fill quantities for the dune and marsh fills would be 5.7 million and 3.8 million cubic yards respectively.

3.3.1.1.5 Alternative 4: Landward Dune with Base Marsh

Alternative 4 proposes a dune height of +7 feet NAVD88. The modeling analyses demonstrate that the higher dune proposed in alternative 3 at +8 feet NAVD88 would offer more storm surge dissipation than the lower dune proposed in alternative 2 at +6 feet NAVD88. Although the higher dune offers more storm protection, there may be ecological concerns with constructing a dune that is too much higher than the headland's existing dune elevations. To balance storm protection benefits with ecological concerns, alternative 4 dune height is proposed at +7 feet NAVD88.

Alternative 4 also proposes a landward beach and dune component compared to the seaward beach component as in alternatives 2 and 3, which eroded completely during the analysis of storm impacts. Because the fill would be sited landward over existing higher elevations, the dune could be extended over the majority of the beach fill. The width of the landward alternative would be limited from Belle Pass to the western edge of the existing breakwater field by environmental habitats and oilfield canals to the north of the barrier shoreline. In this area, the width would be 340 feet. No sand would be placed in the landward alternative behind the breakwaters due to the proximity of oil and gas facilities and Highway 3090. From the eastern end of the breakwater field to Caminada Pass, the fill would taper northward to a maximum width of 465 feet. The landward and seaward slopes would be set to 20 horizontal and 1 vertical. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Approximately 955 acres of beach/dune and 667 acres of marsh would be created. Fill quantities for the dune and marsh fills would be 6.0 million and 2.6 million cubic yards, respectively.

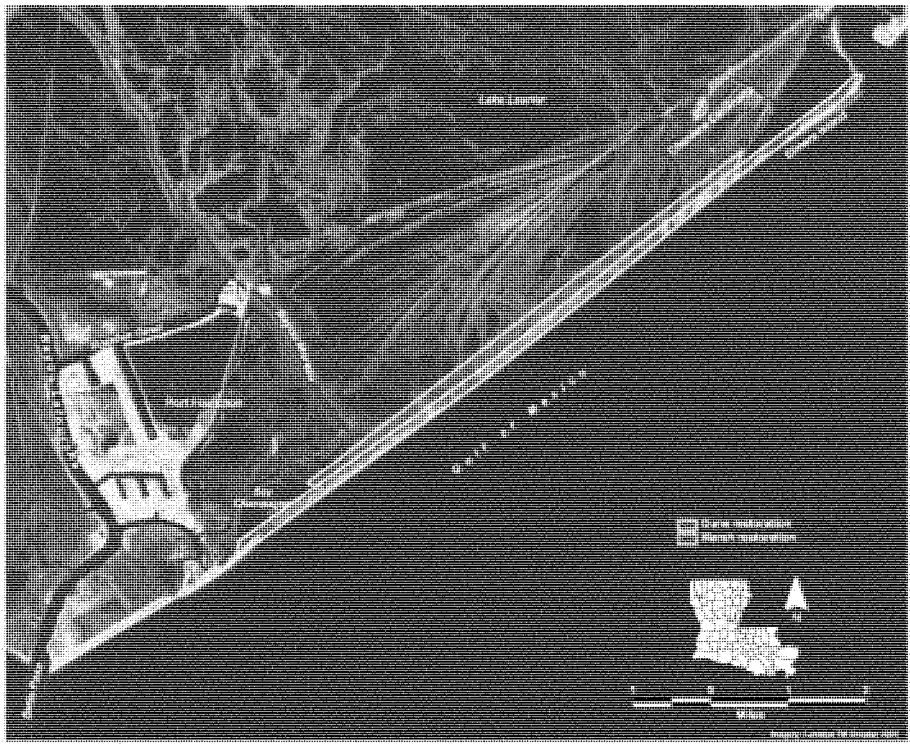


Figure 3-5. Caminada Headland: Alternative 4 Plan View

3.3.1.1.6 Alternative 5: Preferred Dune with Expanded Marsh

Alternative 5 proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. Alternative 5 also proposes a landward beach and dune component. The landward and seaward slopes would be set 20 horizontal to 1 vertical. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Fill quantities for the dune and marsh fills would be 5.1 million and 5.36 million cubic yards, respectively. Alternative 5 would construct 880 acres of dune/beach and 1,186 acres of saline marsh. Alternative 5 is most similar to the 2004 LCA plan. **Figure 3-6** shows the plan view of alternative 5, alternative 6, and alternative 7.

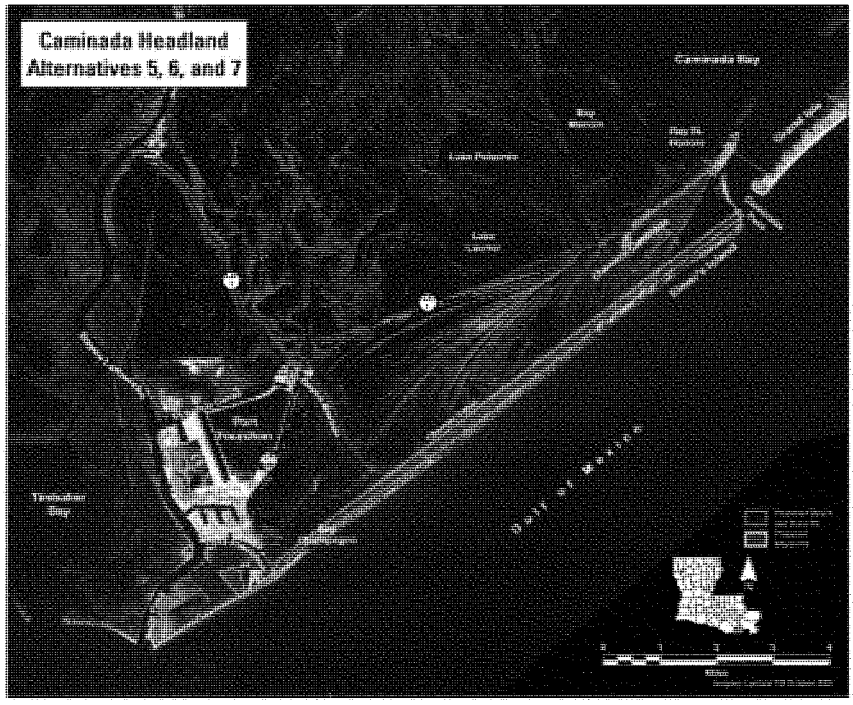


Figure 3-6. Caminada Headland: Alternatives 5, 6, and 7 Plan View.

3.3.1.1.7 Alternative 6: Preferred Dune with Expanded Marsh and 1 Re-nourishment

Alternative 6 expands on alternative 5 by adding one re-nourishment event at year 25. Alternative 6 proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. Alternative 6 also proposes a landward beach and dune component. The landward and seaward slopes would be set 20 horizontal to 1 vertical. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Initial fill quantities for the dune and marsh fills would be 5.1 million and 5.36 million cubic yards, respectively. Acres created by the initial construction would be equal to the acres created by alternative 5 with 880 acres of dune/beach and 1,186 acres of saline marsh.

3.3.1.1.8 Alternative 7: Preferred Dune with Expanded Marsh and 2 Re-nourishments

Alternative 7 expands on alternative 5 and alternative 6 by adding two re-nourishment events at years 20 and 40. Alternative 7 proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. Alternative 7 also proposes a landward beach and dune component. The landward and seaward slopes would be set 20 horizontal to 1 vertical. The marsh fill is proposed on the

landward side of the dune at an elevation of +2.0 feet NAVD88. Initial fill quantities for the dune and marsh fills a would be 5.1 million and 5.36 million cubic yards, respectively. Acres created by the initial construction would be equal to the acres created by alternative 5 and alternative 6 with 880 acres of dune/beach and 1,186 acres of saline marsh.

3.3.1.1.9 Alternative 8: Optimized Project with Base Marsh and 4 Re-nourishments

Alternative 8, alternative 9, and alternative10 were developed to optimize the function of the barrier shoreline over the 50-year evaluation period. The conceptual design for the dune/beach restoration feature for these alternatives includes two components: design fill and advanced fill. For the design fill, a dune elevation of +7.0 feet NAVD88 was selected to balance the increased longevity of the shoreline feature offered by a higher dune elevation with concerns that dune elevations significantly higher than existing topography may have undesirable ecological effects. For all three alternatives, the dune width on the western end of the project would be 210 feet, while the dune width from Bay Champagne to Elmer's Island would be 290 feet. The design fill template would include the landward alignment of the dune ridge over existing higher elevations, thus maximizing the constructed acreage of the dune/beach feature and its longevity with respect to erosion and storm washover processes. Design fill volumes for the beach/dune feature were based on a range of predicted re-nourishment intervals that would be needed to preserve the shoreline over the evaluation period to offset the estimated shoreline sediment losses of 383,000 cubic yards per year. Required design fill volumes were calculated for nourishment intervals of 5, 10, 15, and 25 years. Advanced fill quantities were then added to these volumes for additional shoreline protection and feature longevity. Advanced fill quantities were determined to account for initial losses due to shoreline equilibration and additional shoreline sediment losses expected for recurrent storm events that would be expected to occur between re-nourishment events. Based on a mass balance analysis of equilibration and storm sediment transport, it was determined that an average of 65 feet of shoreline retreat would occur from cross-shore transport during the equilibration process. Storm modeling results yielded a predicted shoreline loss of approximately 80 feet for the design storm event. Further details of this analysis are included in the Engineering Appendix (appendix A).

Alternative 8 also includes marsh fill on the landward side of the dune at an elevation of + 2.0 feet. In the north-south direction, the marsh platform would extend from the landward edge of the dune ridge at this elevation to the south bank of the Chevron Canal. The marsh platform would extend from the eastern shore of Bay Champagne eastward to the existing shoreline of the back barrier lagoon adjacent to Elmer's Island. Initial fill quantities for the beach/dune and marsh fills under alternative 8 would be 5.1 million and 3.3 million cubic yards, respectively. The beach and dune fill for alternative 8 would not include advanced fill for the design storm. Alternative 8 would be re-nourished in year 25. Alternative 8 would create 880 acres of beach/dune and 824 acres of saline marsh.

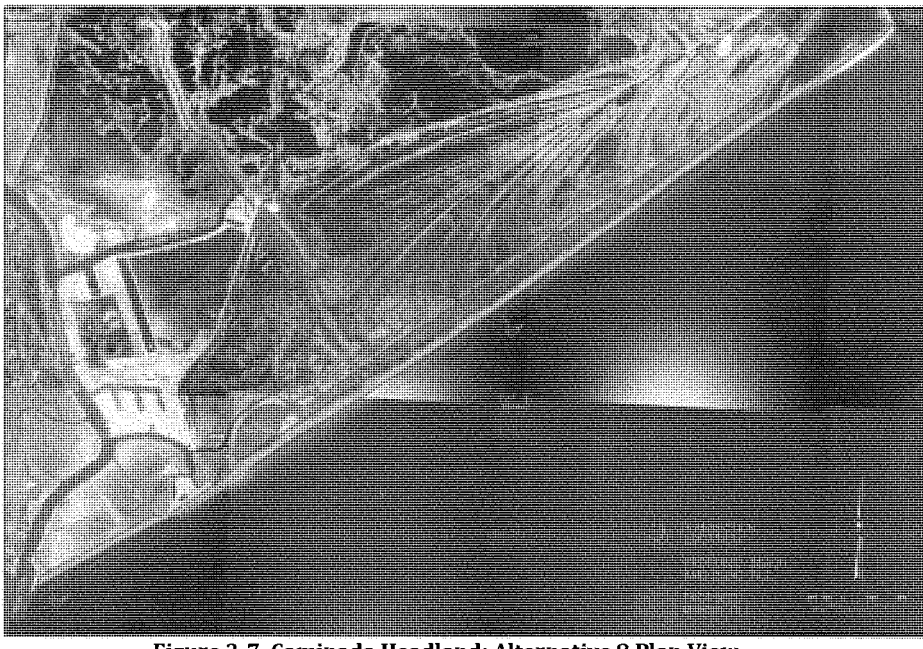


Figure 3-7. Caminada Headland: Alternative 8 Plan View.

3.3.1.1.10 Alternative 9: Optimized Project with Expanded Marsh and 4 Re-nourishments

Alternative 9 includes the optimization process applied for alternative 8 for the configuration and re-nourishment interval and volumes for the beach/dune restoration feature. The beach/dune features of this alternative are similar to alternative 8. In order to assess the benefits of different platform marsh configurations in the restoration of Caminada Headland, alternative 9 includes an expanded marsh platform that would be constructed landward of the barrier shoreline. For alternative 9, the marsh platform fill would extend along the landward edge of the dune ridge from a point near the terminus of Louisiana Highway 3090 eastward through Bay Champagne to the eastern edge of the project boundary where a small spit forms the western edge of Caminada Pass. Additional marsh would also be restored in an area between two existing canals west of the petroleum storage facility, immediately landward of the existing dune ridge. Initial fill quantities for the beach/dune and marsh features for alternative 9 would be 5.1 million and 5.36 million cubic yards, respectively. Alternative 9 would create 880 acres of beach/dune and 1,186 acres of marsh. The beach/dune area would be re-nourished every 10 years while the marsh area would be re-nourished in years 20 and 40. Plan view for alternative 9 is shown on **figure 3-8**.

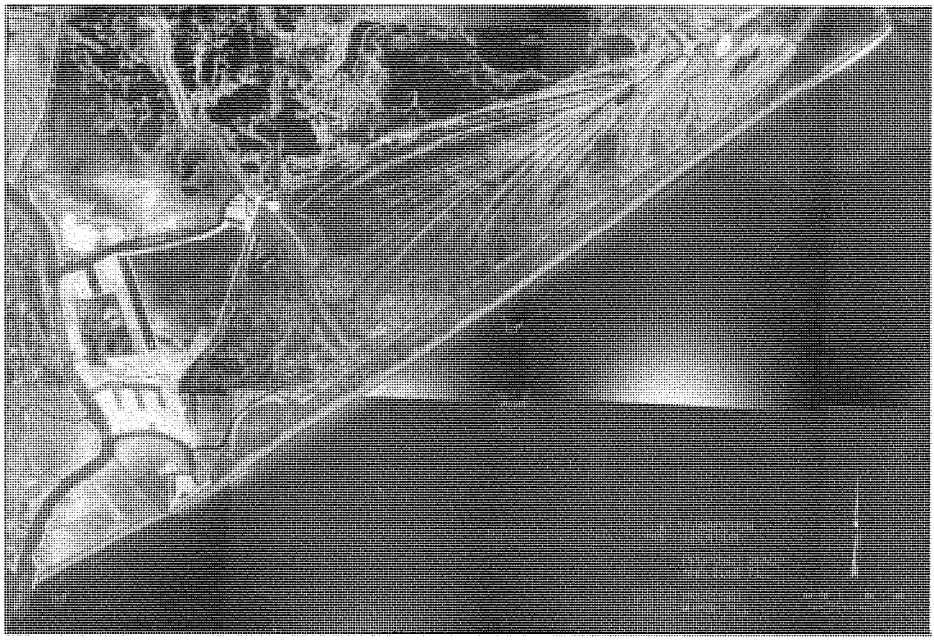


Figure 3-8. Caminada Headland: Alternative 9 Plan View.

3.3.1.1.11 Alternative 10: Optimized Project with Expanded Marsh, 4 Re-nourishments and Full Storm Protection

The marsh fill area for alternative 10 is equivalent to the marsh fill in alternatives 1, 5, 6, 7, and 9, extending east through Bay Champagne and to the eastern edge of the project boundary near Caminada Pass. There is also additional marsh in an area to the west of the oil and gas facility on the western end of the headland resulting in a total of 1,186 acres of saline marsh. Alternative 10 includes the advanced fill, which includes the anticipated loss determined by the storm modeling results, which yielded a predicted shoreline loss of approximately 80 feet for the design storm event. Advanced fill quantities were added to design fill volumes to provide additional gulfward protection. Because the advanced fill would be placed in the gulfward direction, where bottom elevations are deeper, the advanced fill elevation would be set at +4.5 feet NAVD88. The alternative would create 980 acres of beach/dune. Initial fill quantities for the dune and marsh fills would be 6.3 million and 5.36 million cubic yards, respectively. The beach/dune area would be re-nourished every 10 years while the marsh area would be re-nourished in years 20 and 40.

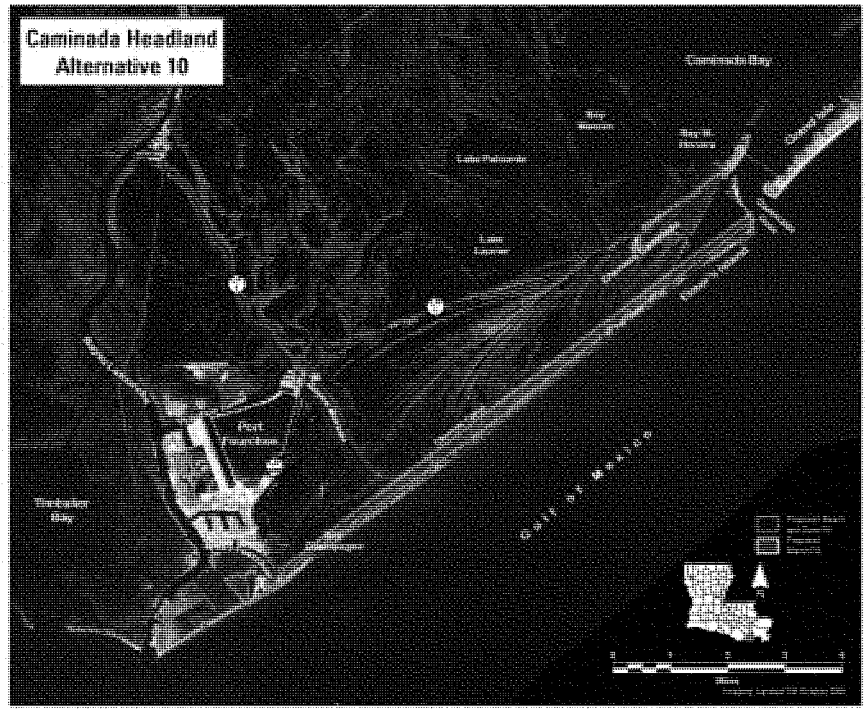


Figure 3-9 Caminada Headland: Alternative 10 Plan View

Table 3-2 displays the preliminary construction costs of each alternative.

Table 3-2 Construction Costs (October 2007 Price Level)

Alternative	Construction Costs
1	$48,988,000
2	$198,631,700
3	$198,631,700
4	$197,951,000
5	$195,541,000
6	$580,738,000
7	$814,044,500
8	$972,609,200
9	$998,124,300
10	$1,175,720,700

3.3.1.2 Shell Island

Nine project alternatives (including the no action alternative) were formulated for Shell Island for further evaluation. Alternative plans for Shell Island evaluated in this study include:

- No Action
- Alternative 1: Two Islands with no Re-nourishment
- Alternative 2: Two Islands with Re-nourishment
- Alternative 3: Single Island with no Re-nourishment
- Alternative 4: Single Island with 10 year Advanced Fill, and One Re-nourishment
- Alternative 5: Single Island with 10 year Advanced Fill, and Two Re-nourishments
- Alternative 6: Single Island with 10 year Advanced Fill, and Four Re-nourishments
- Alternative 7: Single Island with 20 year Advanced Fill, and Two Re-nourishments
- Alternative 8: Single Island with 25 year Advanced Fill, and One Re-nourishment

The action alternatives were formulated to re-establish a barrier between a threatened estuarine ecosystem and the Gulf of Mexico by restoring the geomorphic structure and function of this barrier island. By restoring the geomorphic function of Shell Island, the action alternatives would promote the reestablishment of longshore sediment transport along the gulf shoreline,

which, in turn, would support shorelines and shoreline habitats west of the Empire Waterway. These alternative plans were configured to reduce the existing marine influence that has encroached into the marsh environment located behind the former site of Shell Island. Further, the alternatives were formulated to increase the potential to diminish storm surges and thereby reduce erosion and storm related impacts. The modeling of the alternatives had been completed prior to the 2008 hurricane season. However, initial investigations after Hurricanes Gustav and Ike show little impact to the Shell Island reach.

The description of the criteria used to develop the Shell Island plan is described in Appendix A, Annex 2. Both one island and two island configurations were evaluated. The Shell Island design was chosen for several reasons. The beach portion of the islands would be built in front of the existing island so that the marsh component of the erosive face, with its fine sediments, would not be exposed during profile retreat. The marsh restoration footprint was then located to minimize the thickness of marsh fill, limiting settlement. The two island design location is based on the existing location of the island remnants so that the seaward construction slope intercepts the existing beach face, reducing the volume of beach fill required to construct the project. SBEACH and GENESIS models as well as observations of past coastal restoration projects were used to determine the optimal design with respect to overwash and orientation of the shoreline. The width of the single island alternatives was based on the minimum width required to prevent breaching over the 50-year project evaluation period. The single island alternative was also oriented so as to minimize construction volume. The elevation for Shell Island was primarily driven through environmental concerns that historical elevations of Louisiana's barrier islands are typically less than 6-8 feet. Therefore, an ecosystem restoration project should employ a similar elevation to the natural system. Dune widths were based on cross-shore modeling to determine the design width, following National Research Council design guidance. Advanced fill volume was then added in front of the design template and an economic analysis performed to determine the optimum renourishment interval.

The proposed source of borrow sand for the Shell Island shoreline/dune fill is the Mississippi River located at Nairn. The Nairn deposit is 2 miles to 4 miles upriver from Empire between Mile Marker (MM) 32 and MM 34, and about 11 miles from the center of Shell Island. The deposit is located in a river meander where greater sediment thickness may be anticipated due to the presence of relict (vertically stacked) sand bars. The borrow site for the marsh restoration is located offshore, near the southern end of the Empire Waterway.

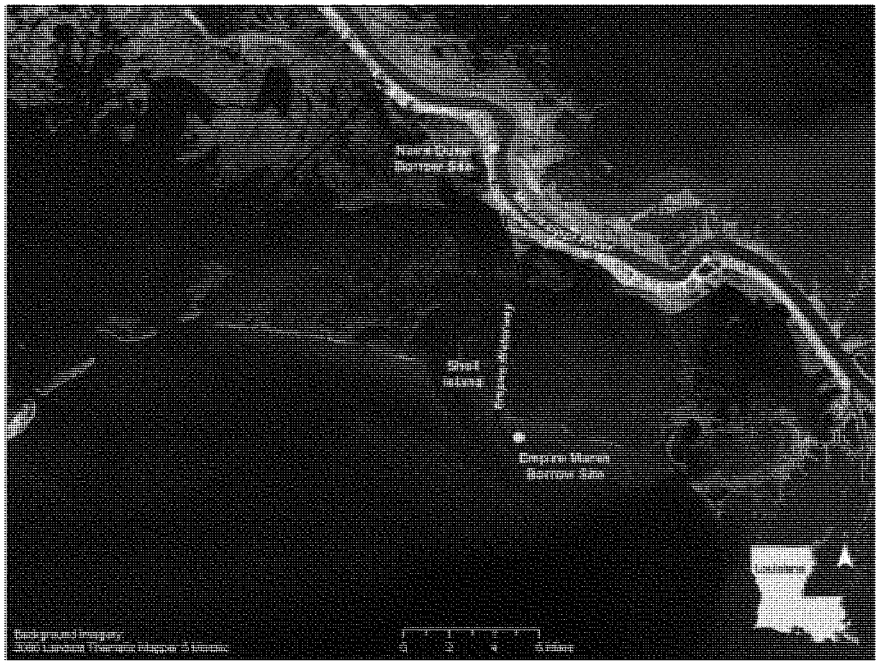


Figure 3-10 Borrow Sites for Shell Island

An in-depth description of each alternative including evaluations is located in chapters 4 and 5 of the "Barataria Basin Barrier Shoreline Restoration Feasibility Report, Appendix C, Shell Island, Plaquemines Parish, Louisiana" in appendix A. A summary description of the preliminary alternatives is provided below.

3.3.1.2.1 No Action Alternative

The Shell Island reach stretches approximately 4.5 miles from Grand Bayou Pass to the Empire Waterway. Shell Island is currently highly fragmented into small, shallow shoals and islands. Shell Island East is a series of small islands and shoals measuring approximately 294 acres. There is no measurable land greater than +2 feet NAVD88. Shell Island West measures 92 acres and contains no dunes greater than +5 feet NAVD88. Shell Island West is a mixture of beach, low dunes, and marsh.

Under the no action alternative for Shell Island, no shoreline restoration construction would occur. All 386 acres of Shell Island would disappear. Continued degradation of the barrier island chain in the Shell Island reach jeopardizes the remaining framework of the barrier shoreline and interior bays north of the Shell Island reach. Shell Island Bay is increasingly connected to the adjacent Bastian Bay. Another storm event like Hurricane Katrina (2005) may

cause widespread fundamental changes in the hydrodynamics and ecological function of the interior bay system. Complete opening of the bays would nearly double the volume of open water and fetch within these bays, decreasing their ecologic value. Only a few marsh islands and small ridges along the northern boundary of Bastian Bay separate it from the much larger Adams Bay. Coalescence of these bays would continue and accelerate without this project and a large sound would develop between Empire and the Gulf of Mexico. Development of such a sound would have a profound impact on configuration of the coast in this region. Ecologic changes would occur and storm surges would increase, thereby requiring greater levels of flood and wave damage reduction for infrastructure and populated areas. Although there is no infrastructure immediately adjacent to Shell Island, the Barataria Basin barrier shoreline as a whole (including the Shell Island reach) provides systemic storm surge diminishment and protection to infrastructure. Under the no action alternative, storm surge effects would continue to increase and expand. **Figure 3-11** displays the waterways surrounding Shell Island.

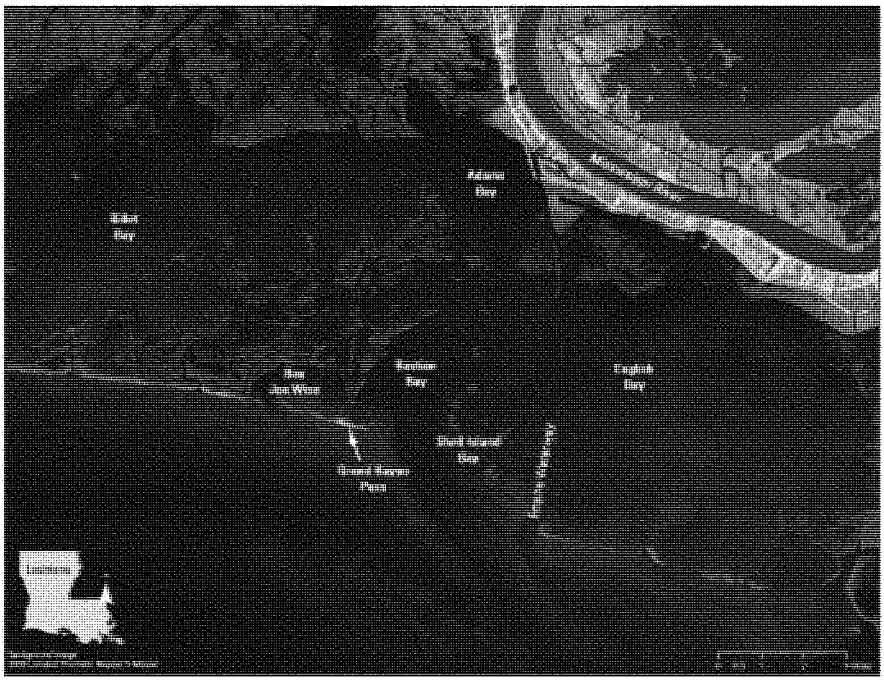


Figure 3-11 Waterways surrounding Shell Island

3.3.1.2.2 Alternative 1: Two Islands with No Re-nourishment

Under alternative 1, the Shell Island reach would be restored as two islands (Shell Island East and Shell Island West) (**figure 3-12**). Each island would include shoreface, dune ridge, and marsh platform features. Periodic re-nourishment would not be included in this alternative. The

general alignment and configuration of this alternative is based on the restoration feature identified in the 2004 LCA Report, adapted for current conditions and constraints. Based on cross-shore transport modeling using the SBEACH program, it was determined that the minimum dimensions for the shoreline profile must include a dune elevation of at least +5.75 feet and a dune width of at least 100 feet. This profile configuration was determined to provide effective barrier island function for the shoreline reach throughout a 50-year evaluation period, assuming that a 50-year storm event would occur during the evaluation period, and a 20-year storm event would occur at the end of the evaluation period.

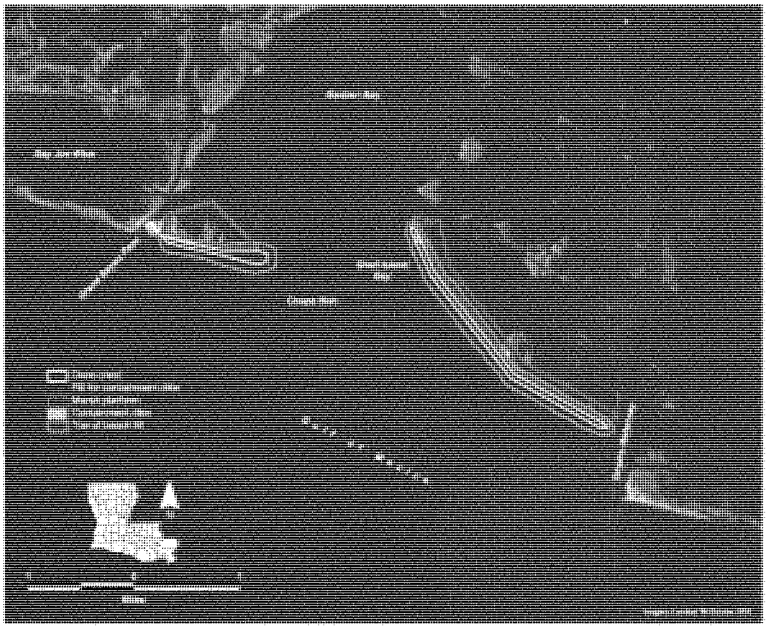


Figure 3-12 Plan View of Shell Island Alternative 1.

Under alternative 1, Shell Island East would be constructed with a dune width of approximately 281 feet. The width would be uniform along the restored shoreline, which would be 15,400 feet in length. The landward edge of the dune for Shell Island East for alternative 1 would be located along the approximate mean high water line of the remaining islands. With this alignment, the majority of the sand fill would be placed in front of the existing remnant islands. This alignment would ensure that the entire active profile height of the shoreface, beach, and dune ridge would be armored with sand. By preventing the exposure of the mixed sediment of the existing island to wave and storm processes, the rate of shoreline retreat rates would be reduced significantly from current trends. Shell Island East would be constructed with 232 acres of dune/berm and 206 acres of marsh. The dunes would be built to a height of +6 feet NAVD88.

On Shell Island West, the proposed shoreline restoration would extend partially into Coupe Bob, thus extending the length of the barrier shoreline provided by the existing islands. The width of

the dune would be 250 feet with a height of 6 feet NAVD88. Shell Island West would be constructed with 100 acres of dune/berm and 145 acres of marsh.

The marsh on Shell Island East would have a typical width of 525 feet, widening along the northernmost 2,400 feet of the island to just over 1,200 feet wide. The marsh on Shell Island West would follow the outline of the restoration feature described in the 2004 LCA Report, which has a triangular shape. The marsh platform at Shell Island West would extend along approximately 4,500 feet of shoreline, with a maximum width of approximately 2,300 feet.

While the optimum upper elevation of the marsh surface is +2.0 feet, which is the upper elevation of the bay intertidal range, the post-construction marsh volumes are calculated based on the post-construction elevation of +2.5-feet. Settlement of the marsh material would lower the marsh elevation to the bay intertidal range within 1 year.

This alternative is most similar to the 2004 LCA plan. The 2004 LCA plan would create 139 acres of dune and 74 acres of marsh on Shell Island West and 223 acres of dune and 191 acres of marsh on Shell Island East. Compared to the 2004 plan, alternative creates 30 less acres of beach/dune, but creates 86 more acres of marsh.

3.3.1.2.3 Alternative 2: Two Islands with Re-nourishment

Alternative 2 also includes two islands (Shell Island East and Shell Island West), with a re-nourishment component (**figure 3-13**). Alternative 2 is similar to alternative 1 except that the dune would be 82 feet wider, or 332 feet, along Shell Island West, which would increase the shoreline/dune acreage to 339 acres of shoreline/dune. The dune height would be +6 feet NAVD88. Another difference from alternative 1 is that the constructed marsh elevation would be +2.0 feet NAVD88. Alternative 2 incorporates a re-nourishment cycle every 10 years for the shoreline fill and every 20 years for the marsh fill. Re-nourishment of the project would extend the project life. While it is anticipated that the islands would be intertidal by year 48 if restored using alternative 1, the re-nourishment included in alternative 2 would enable long term viability, keeping the two islands intact for the full 50-year period of analysis. The beach/dune would be re-nourished every 10 years, while the marsh would be re-nourished every 20 years. In years 10 and 20, 1.6 million cubic yards of beach fill would be required. In year 30, 1.1 million cubic yards would be required, and in year 40 623,000 cubic yards would be required. For the marsh, 699,900 cubic yards and 451,400 cubic yards would be required for years 20 and 40 respectively.

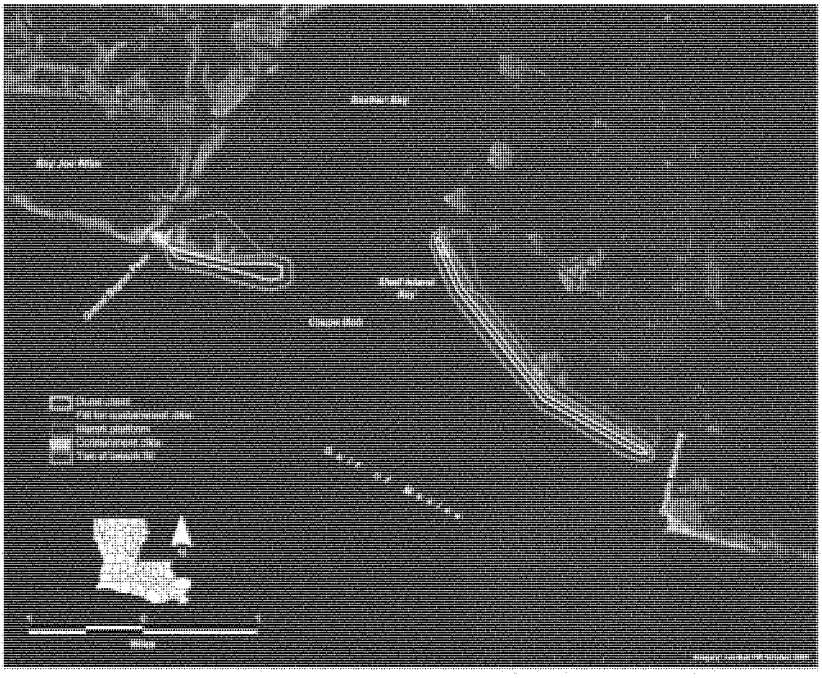


Figure 3-13. Plan View of Shell Island: Alternative 2.

3.3.1.2.4 Alternative 3: Single Island with10 year Advanced Fill, and no Re-nourishment

Under alternative 3, the Shell Island Reach would be restored as one island with no re-nourishment component (**figure 3-14**). This alternative would restore Shell Island to a form similar to its pre-Hurricane Bob (1979) condition.

The landward edge of the dune of alternative 3 would be located seaward of the existing shoreline, similar to alternatives 1 and 2. However, the west end of the alternative 3 single island would be terminated approximately 0.5 mile before Grand Bayou and 1,650 feet east of the western limits of the restored shorelines of alternatives 1 and 2. It is anticipated that the closure of Coupe Bob would return the tidal prism to its pre-1979 path—flowing through Grand Bayou, with Grand Bayou increasing in size in response to the altered tidal flow pattern. The west end of alternative 3 is close to the western limit of Shell Island that was observed in 1973, prior to the opening of Coupe Bob. The proposed island follows the shortest and shallowest route across Coupe Bob. The east end of the island would then follow the remnants of Shell Island East, but has a concave shape towards land, rather than the convex shape of alternatives 1 and 2. This would be required to maintain a smooth shoreline. The eastern end of the island would be located in the same location as the eastern end of the restored shoreline for alternatives 1 and 2. The constructed dune would have a uniform width of 189 feet along the length of the restored barrier island. The 189-foot dune width would be based on the projected requirements to sustain

an effective barrier shoreline over an interval of 10 years. The dunes will be constructed to a height of + 6 feet NAVD88.

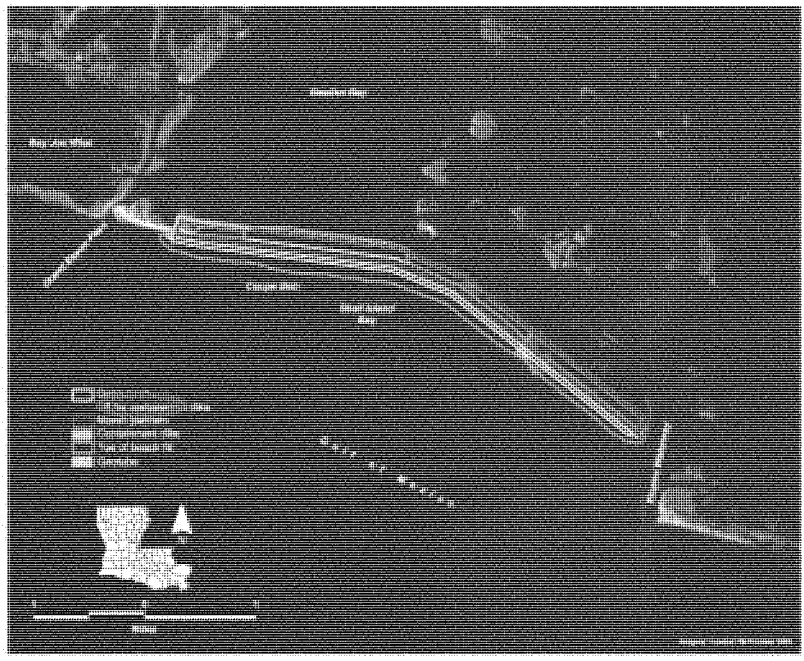


Figure 3-14. Plan View of Shell Island Alternatives 3, 4, 5, and 6.

Louisiana barrier islands have typical widths in the region of 1,000 feet to 1,500 feet wide from the gulf shoreline to the bayward limit of the marsh. A uniform marsh width of 735 feet was chosen to construct an island that is approximately 1,240 feet wide following equilibration of the shoreline fill. The fill source for dike construction was located within the marsh fill footprint where the existing bathymetry is relatively shallow (less than -2.0 feet). The marsh will be constructed to a height of + 2 feet NAVD88.

However, in deeper water (bathymetry below -3.0 feet), it is not feasible to construct the marsh section with only marsh sediments, as the marsh would settle too rapidly and nonuniformly to perform its intended purpose effectively. Instead it is recommended to construct a sand base across Coupe Bob, at -3.0 feet, using shoreline fill material. The marsh can then be constructed on top of this base, which would reduce settlement of the marsh material. A second option is to install a geotextile tube for containment of the marsh fill where the -3 feet NAVD88 sand base is constructed. The geotextile tube could be filled with sand from the sand base. This option was used for the development of alternatives 3 through 6.

It is estimated that 5.6 million cubic yards of shoreline fill would be required to construct 317 acres of shoreline/dune area (area above +2 feet, NAVD88). Approximately 2.1 million cubic yards of marsh fill would be required to construct 466 acres of marsh.

3.3.1.2.5 Alternative 4: Single Island with 10 year Advanced Fill, and 1 Re-nourishment

Alternative 4 has the identical construction template as alternative 3. It would initially be constructed with 10 years of advanced nourishment, similar to alternative 3, but would be re-nourished 25 years after initial construction to the original template of 317 beach/dune acres. The marsh fill for alternative 4 would also be re-nourished at this time interval. Approximately 1.9 million cubic yards of beach fill and 1.1 million cubic yards of marsh fill would be required for the year 25 re-nourishment cycle.

3.3.1.2.6 Alternative 5: Single Island with 10 year Advanced Fill, and 2 Re-nourishments

Alternative 5 has the identical construction template as alternative 3. It would initially be constructed with 10 years of advanced nourishment, similar to alternative 3, but would be re-nourished 20 years and 40 years after initial construction to the original template of 317 beach/dune acres. The marsh fill for alternative 5 would also be re-nourished to its original construction template at this time interval. Approximately 1.5 million cubic yards of beach fill would be required for re-nourishment cycles in years 20 and 40. In year 20, approximately 907,200 cubic yards of marsh fill would be required and in year 40, 604,700 cubic yards would be required for re-nourishment.

3.3.1.2.7 Alternative 6: Single Island with 10 year Advanced Fill, and 4 Re-nourishments

Alternative 6 has the identical construction template as alternative 3. It would initially be constructed with 10 years of advanced nourishment, similar to alternative 3, but the dune area would be re-nourished every 10 years after initial construction to the original template of 317 acres. The marsh fill for alternative 6 would also be re-nourished to its original construction template at 20 years and 40 years after construction. Approximately 756,000 cubic yards of beach fill would be required for re-nourishment cycles in years 10, 20, 30, and 40. In year 20, approximately 907,200 cubic yards of marsh fill would be required and in year 40, approximately 604,700 cubic yards would be required for marsh re-nourishment.

3.3.1.2.8 Alternative 7: Single Island with 20 year Advanced Fill, and 2 Re-nourishments

Alternative 7 is also a single island design with the same marsh fill and containment dike as alternatives 3 through 6. However, the beach fill for alternative 7 has 20 years of advanced nourishment, requiring a uniform construction dune width of 280 feet. The beach fill and marsh fill for alternative 7 would be re-nourished every 20 years after initial construction. It is estimated that 6.4 million cubic yards of beach fill would be required to construct 361 acres of beach/dune area. Approximately 2.1 million cubic yards of marsh fill would be required to construct 466 acres of marsh. Approximately 1.6 million cubic yards of beach fill would be required for re-nourishment cycles in years 20 and 40. In year 20, approximately 907,200 cubic yards of marsh fill would be required and in year 40, approximately 604,700 cubic yards would be required for marsh re-nourishment.

Figure 3-15 Plan View of Shell Island Alternative 7

3.3.1.2.9 Alternative 8: Single Island with 25 year Advanced Fill, and 1 Re-nourishment

Alternative 8 employs the same one island design as alternatives 3 through 7, but would have a construction berm width of 343 feet, to account for 25 years of advanced nourishment. The beach and marsh fill for alternative 8 would have one re-nourishment event 25 years after the initial construction.

It is estimated that 6.9 million cubic yards of beach fill would be required to construct 395 acres of beach/dune area. Approximately 2.1 million cubic yards of marsh fill would be required to construct 466 acres of marsh. Approximately 2 million cubic yards of beach fill and 1.1 million cubic yards would be required for re-nourishment cycles in year 25.

Figure 3-16 Plan View of Shell Island Alternative 8

Table 3-3 displays the preliminary construction costs per alternative.

Table 3-3 Construction Costs (2007 Price Level)

Alternative	Construction Cost
1	$127.091,500
2	$313,375,500
3	$166,019,500
4	$234,652,700
5	$280,331,800
6	$306,631,400
7	$284,444,000
8	$269,005,000

3.3.1.3 Restoration Features Common to Action Alternatives

In addition to the specifics discussed previously, all of the alternative plans for the Caminada Headland and Shell Island reaches include various scales of dune and marsh planting, as well as sand fencing as separable elements to be incorporated into the alternative plans.

3.3.1.3.1 Dune and Marsh Plantings

Dune plantings would promote the growth of dunes by holding blowing sand. In the marsh, the plants' roots would stabilize soils quickly to help consolidate the marsh creation areas. Plantings would also accelerate the restoration of the habitats. The types of plants used for dune and marsh planting should offer some degree of diversity, including woody vegetation (e.g., mangroves, wax myrtle, maritime live oaks) and grasses. Dune plants would consist of a variety of dune species, including bitter panicum (*Panicum amarum* var amarum "Fourchon"), sea oats (*Uniola paniculata* "Caminada"), marshhay cordgrass (*Spartina patens* "Gulf Coast"), and gulf cordgrass (*Spartina spartinae*). Marsh plants would consist of mainly smooth cordgrass (*Spartina alterniflora* "Vermilion") and black mangrove (*Avicennia germinans* "Pelican"). Other plants that should be considered to add diversity include seacoast bluestem (*Schizachyrium maritimum*), seashore dropseed (*Sporobolous virginicus*), and salt grass (*Distichlis spicata*). At the end of the proposed construction, key species would be planted and grasses would be seeded. A more detailed description of the vegetative plantings is located in section 3.5.3.3.

3.3.1.3.2 Sand Fencing

Construction of sand fencing would promote the growth of the dunes by holding blowing sand. One shore-parallel fence would be installed, approximately 50 feet north of the southern toe of the dune, to continue the capture of transported sand until the surface is vegetated. The sand fence would extend along the total length of the constructed dune. Sand fences would be installed in sequences/phases. The installation should start from the southern side of the dune so as to build dune towards the Gulf of Mexico and proceed north. Additional rows of sand fencing may be added once the existing sand fence is full (i.e., sand is stacked up to the top of the fence).

3.4 PROJECT AREA LAND LOSS TRENDS

In 2000, the BBBS Project was initiated to study the entire barrier shoreline of the Barataria Basin. This study was stopped in 2002 to focus on the comprehensive 2004 LCA Study. The BBBS Project was re-started in 2005, at the completion of the 2004 LCA Study, which identified specific elements of the Barataria Basin barrier shoreline as critical near term projects. A baseline of 2007 was chosen for the project alternatives based on the study status. Engineering analysis was completed by mid 2005. However, Hurricane Katrina caused serious impacts in the study area and delays to the study, requiring adjustments to the 2005 modeling results. Post 2005 priorities and the 2008 hurricanes further delayed the completion of the study. Completed engineering analyses and modeling utilized to determine acreages for the WVA analysis were based on the 2007 baseline. Construction costs were also based on 2007 costs. Therefore, the costs and benefits utilized for the incremental cost analysis are based in 2007. However, construction is now anticipated in 2013.

A sensitivity analysis was performed on the impacts of shifting the construction start to 2013. The benefits created by the alternatives would remain unchanged since the footprint of the alternatives is located on top of the existing land. The benefits estimated for the no action plan would be overestimated compared to 2013 since it is assumed that the downward land area trend would continue. Since the with-project benefits would remain the same, but the no action benefits would be assumed to decrease, the result would be an increase in net benefits. Additionally, there may be additional costs due to the possibility of the need for increased quantities of fill. However, the changes between the alternatives are linear and would not impact the selection of the recommended plan. The possibility for increase in material quantities and costs has been included in the risk analysis and incorporated into the Mii analysis and construction costs.

The USGS prepared a land/water comparison from 1956 until October 2006. The analysis shows that barrier island loss is episodic, with losses after significant events such as a hurricane, followed by a period of natural healing of the loss. The analyses also show a slow decline in the land masses. No data is available between 1956 and 1978, so while the following graphs show either no decline or a linear decline, the intervening years would probably show more variance, similar to the later periods, during which data was collected more frequently.

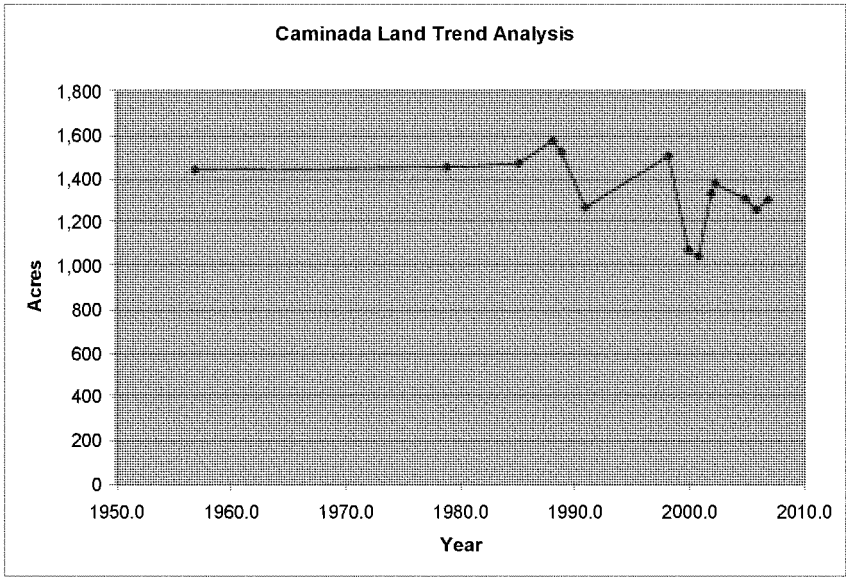


Figure 3-17 Caminada Land Trend Analysis 1956 to 2006

As more data sets are taken in the later years, the episodic nature of the coastal land mass changes becomes more evident. Generally, the sharp decrease in land area caused by a tropical event is followed by a period of healing as some of the materials washed away by the storm are returned to the land mass. Additionally, washover from the beach is transferred to the marsh area, increasing the amount of land vs. water in the back barrier marsh. In 2005, the Caminada Headland was impacted by Hurricane Katrina, but data collected in October 2006 demonstrates that the headland had begun to heal some of the breaches caused by the hurricane and recover land mass.

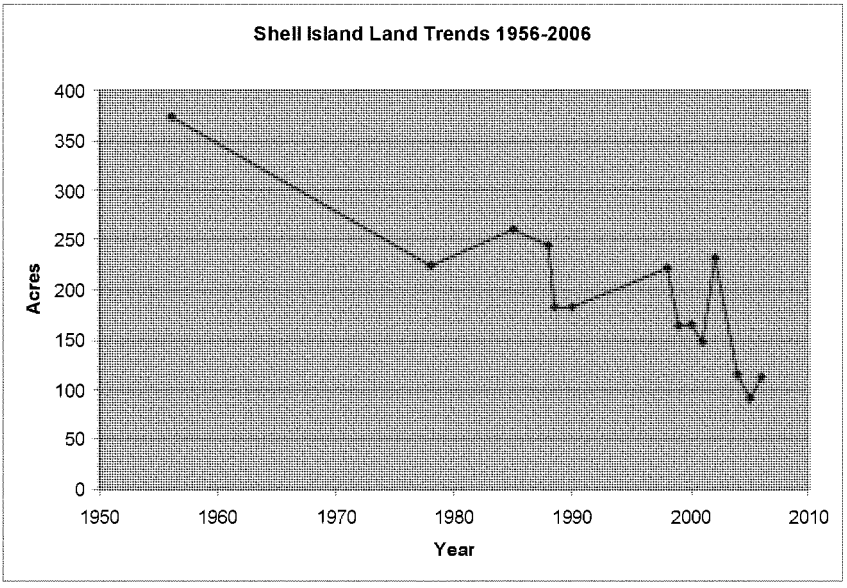


Figure 3-18 Shell Island Land Loss Trend 1956 to 2006

Shell Island displays a much more accelerated land loss rate than the Caminada Headland. Shell Island was impacted by the construction of the Empire Waterway jetties beginning in 1950. However, the impact of the formation of Coupe Bob by Hurricane Bob in 1979 has had an even greater impact on shoreline erosion. Hurricane Bob breached the center of the island, and shoreline recession rates of 160 feet and 230 feet per year were measured adjacent to the breach. Following the formation of Coupe Bob, Shell Island East underwent a shoreline retreat and reorientation to a southeast-northwest alignment that has resulted in disintegration of the island. Only a few scattered sections of Shell Island East remain today. Shell Island West continues to undergo retreat due to rollover and migration to the west. Coupe Bob has captured much of the tidal prism in the basin, and Grand Bayou Pass has shoaled and is completely closed.

A land loss trend analysis from 1985 to 2006 was performed by the USGS for the project areas. **Figure 3-19** and **figure 3-20** were prepared by the USGS for the BBBS Project based on the selected alternatives. Tides and weather patterns can impact the results of the analysis, which resulted in excluded data points. For example, pictures taken at high tide at Shell Island would decrease the acreage of land. A strong north wind blowing water into the back barrier marsh at Caminada would increase the water to land ratio, making it appear that there is less land than actually existed.

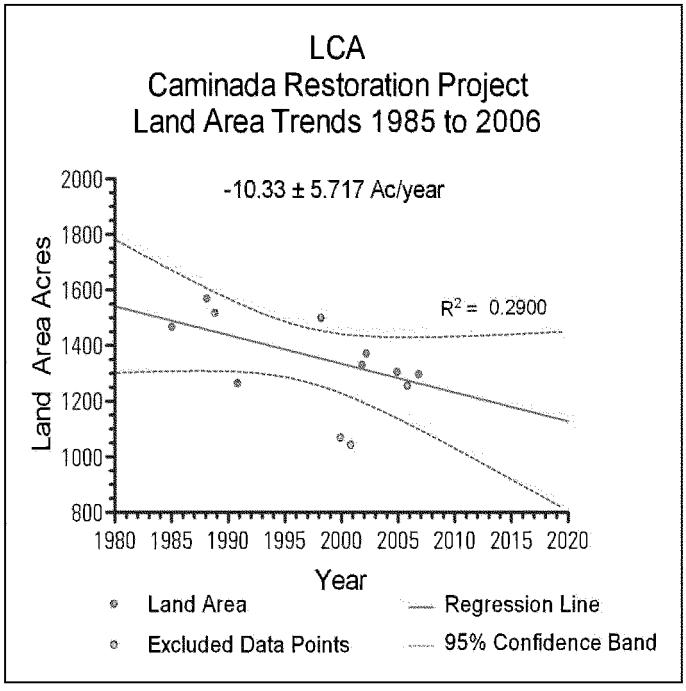


Figure 3-19 Caminada Land Trend Analysis 1985 – 2006

The USGS plotted data points and performed a regression analysis on the sample data. **Figure 3-19** displays the regression trend line and the 95 percent confidence interval. Based on figure 3-18, the Caminada Headland land acreage is above the trend line in October 2006, the last data set available. While the 2008 hurricanes impacted the Caminada Headland, the land loss is part of the episodic loss experienced by the coastal landforms. The loss caused by the 2008 hurricanes would have to exceed 400 acres for the land mass to be outside of the 95 percent confidence band, resulting in a 20 percent loss of land mass in the project area. Aerial photography taken immediately after the hurricane, while the water levels were above normal, shows that the damage caused by the hurricane was not that excessive. Additionally, it is expected that the trend of erosion and then repair will continue over the next few years. Therefore, it is assumed that the 2007 based analysis is sufficient to quantify the costs and benefits for the Caminada Headland.

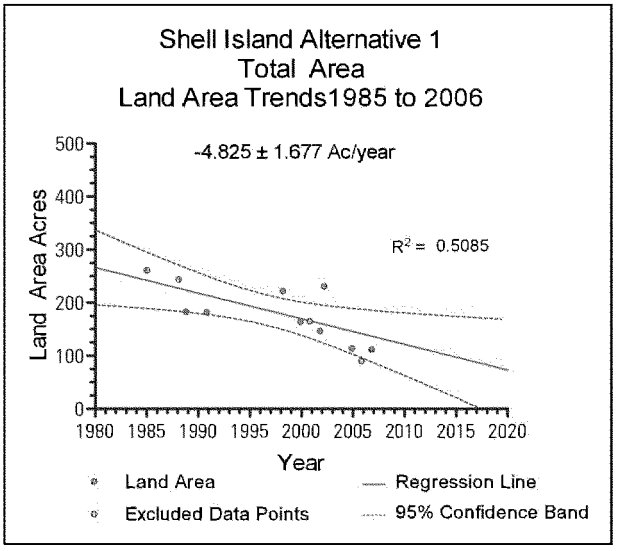


Figure 3-20 Shell Island Alternative 1 Land Trend Analysis 1985-2006

While Shell Island acreage is currently below the trend line, **figure 3-20** shows that the land loss has stabilized over the last few years. The impact from storms does not pose a significant erosion problem at this location. Modeling suggests that once the island is overtopped, the impact of an increased storm event does not increase significantly because the majority of the wave energy passes over the island. Observations following the passage of Hurricane Katrina in 2005 appeared to confirm the validity of the modeling. Hurricanes Gustav and Ike did not greatly impact Shell Island. It is anticipated that the acreage at Shell Island is within the 95 percent confidence band. Therefore, the 2007 based analysis is sufficient to quantify the costs and benefits associated with the Shell Island alternatives. Due to the need for timely action to preserve these landforms, the project delivery team has opted to continue with the study and quantify the potential changes between 2007 and 2013 within the Cost Risk Analysis.

3.5 INTERMEDIATE ARRAY OF ALTERNATIVES

Engineering and cost analyses were completed on the Caminada and Shell Island alternatives. The Project Delivery Team, as well as representatives from the non-Federal sponsor (LaCPRA), USEPA, USFWS, NFMS, and NRCS, evaluated and selected criteria to reduce the number of alternatives for further analysis to a manageable number. The alternatives were evaluated based on their ability to meet project objectives and cost effectiveness while providing a full spectrum of alternatives. The desired result was the most cost efficient alternatives that considered a broad range of restoration measures. Acres were utilized as a surrogate for the Wetland Valuation Assessment (WVA) outputs. Acres are the major input of the WVA evaluation. The WVA benefit analysis would then be completed on this intermediate array of alternatives.

3.5.1 Caminada Headland Analysis

A comparison of the present value of the costs over the 50-year period of analysis to the average acres over 50 years for each alternative, when displayed graphically, results in four groupings. **Figure 3-21** compares the costs of the alternatives to the acres created. Projects below the trend line are more cost efficient than those above the trend line. Of the alternatives, 1 alternative is a marsh only alternative. The other alternatives consist of both a marsh creation and a shoreline restoration component.

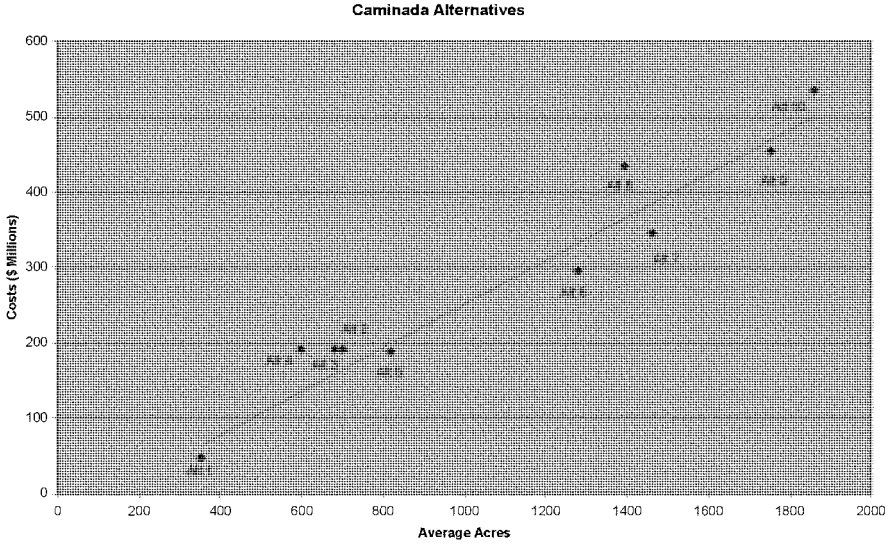


Figure 3-21 Cost Effectiveness of Caminada Alternatives

The first grouping contains only alternative 1 which is a marsh only alternative. The shoreline in the Caminada area is severely degraded. The marsh only alternative would do little to restore or preserve critical and essential geomorphic structures, which is an important objective of this study. Therefore, alternative 1 was eliminated.

The next grouping includes alternatives 2, 3, 4, and 5. All four alternatives cost approximately the same, but alternative 5 is the most effective. Therefore, alternative 5 was selected, and alternatives 2, 3, and 4 were eliminated.

The third grouping consists of alternatives 6, 7, and 8. Alternatives 6 and 7 are below the trend line, while alternative 8 is above the trend line. The alternatives are similar in effectiveness, but alternative 8 is much less efficient. Therefore, alternative 8 was eliminated.

The final grouping is alternatives 9 and 10. Alternative 9 is below the trend line while alternative 10 is above the trend line. Both are similar in effectiveness, but alternative 10 is less efficient. Therefore, alternative 10 was eliminated.

Based on cost efficiency, alternatives 5, 6, 7, and 9 were selected for further analysis. The team analyzed the alternatives to ensure that the chosen alternatives covered the full spectrum of alternatives as required by NEPA. Alternatives 5, 6, 7, and 9 have similar footprints. The main difference between the alternatives is the number of re-nourishments that are proposed. Alternative 5 includes the initial construction footprint. Alternative 6 has one renourishment cycle at year 25. Alternative 7 has 2 renourishment cycles at years 20 and 40. Alternative 9 has 4 renourishment cycles at years 10, 20, 30, and 40 for the beach/dunes and 2 renourishment cycles at years 20 and 40 for the marsh.

3.5.2 Shell Island Analysis

In order to provide a range that covers the full spectrum of alternatives, it is important to include both one and two island alternatives as well as alternatives with no renourishment and with some renourishment. Alternatives 1 and 2 are two island alternatives, while alternatives 3 through 8 are one island alternatives. Alternatives 1 and 3 have no renourishment, while the other alternatives have some form of renourishment. **Figure 3-22** compares the costs of each alternative to the acres created. Alternatives 1 and 2 were both included so that a comparison could be made between the two island alternative with renourishment and without renourishment. Alternative 3 was selected to include a one island alternative with no renourishment. While alternative 3 appears to be less efficient than other alternatives, it was kept in the array for comparative purposes. Alternatives 1 and 3 both have no renourishment, but have very different project footprints. Alternatives 3 through 8 are all one island alternatives. Thus by keeping alternative 3 in the array, both the cost effectiveness and efficiency of the one island vs. the two island, and the various renourishment proposals can be further compared.

Alternatives 4 through 8 are one island alternatives with varying degrees of renourishment. Alternative 5 was selected to remain as this alternative was the most cost efficient of the one island alternatives. Alternatives 2, 4, and 5 all cost approximately the same amount, but alternative 5 is more effective. Alternatives 6 and 8 are equally or less effective than alternative 5, but less efficient. Alternative 7 creates more acres and costs more than alternative 5, but the average cost per acre for alternative 7 is greater than alternative 5, making alternative 5 the more cost effective choice. Therefore, the alternatives selected for further study are alternatives 1, 2, 3, and 5.

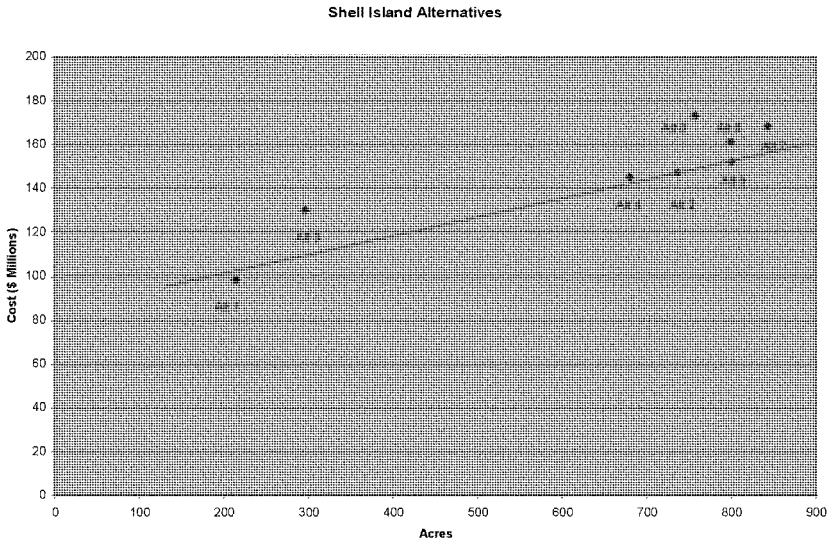


Figure 3-22 Cost Effectiveness of Shell Island Alternatives

3.5.3 Cost Estimates

Data for initial construction/implementation, and periodically recurring costs for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) have been developed through engineering design and cost estimation. These costs were then refined through a present worth calculation to assist in the economic evaluation and cost effectiveness evaluations of alternative plans. Cost estimates were developed for each alternative based on the alternative descriptions and construction methods discussed in the Engineering Appendix (appendix A.)

3.5.3.1 Shoreline Restoration

The design of the shoreline and dune fill addresses gulf-front erosion and closes existing breaches. The dune platform shall be planted with appropriate vegetation. Various fill templates were developed and evaluated during the modeling tasks to determine the optimum project performance in terms of habitat creation and storm damage reduction. For the Caminada Headland, the borrow source would be Ship Shoal, approximately 40 miles from the project area. The amount of material that would be required varies depending upon the design of the alternative and the number of proposed renourishment cycles. For Shell Island, the borrow source would be the Mississippi River near Nairn, Louisiana. The sediment would be pumped through a pipeline from the river across land owned by Plaquemines Parish, and then follow the alignment of the Empire Waterway to Shell Island. The pipeline would be approximately 19 miles in length. The amount of material that would be required varies depending upon the design of the alternative and the number of proposed renourishment cycles.

3.5.3.2 Marsh Restoration

The design of a marsh platform for the Caminada Headland is contiguous with the Chevron Pipeline Canal on its northern boundary and the shoreline and dune fill component along its southern boundary. The marsh fill would only be implemented along a portion of the headland. The various marsh creation footprints were evaluated. The design elevation of the marsh to achieve the tidal zone design objective is 2.0 feet NAVD88. Quantity estimates of dredged material required to construct the marsh platform vary depending on whether or not the shoreline and dune component is located seaward or landward of the existing dune. The borrow source for the marsh material is located offshore near the central portion of the headland. For Shell Island, the elevation of the marsh would be 2.0 feet NAVD88 except for alternative 1 in which the elevation would be 2.5 feet NAVD88. The higher elevation is designed to provide the greatest time period that the marsh is intertidal defined as between 0.0 feet and 2.0 feet NAVD88. The borrow material would be taken from the Empire borrow area, about 3.5 miles from the center of Shell Island. The marsh platform would be planted with appropriate vegetation as described below.

3.5.3.3 Vegetation Plantings

For each alternative, the length of the dune platform was estimated. The number of plants was estimated based on planting row spacing and distances. Marsh restoration would include both open water and planted areas. The vegetative plantings plan and cost estimates were developed by NMFS and NRCS, who have expertise and experience with plantings in coastal Louisiana, with input from the USACE environmental team.

Dune and Supratidal Platform:

Seeding of the dune platform (aerial or ground application) could be considered depending on the time of the year construction would be completed. Rye grass seed could be considered if construction would be completed in the summer or fall to be used as a ground cover during the winter months. Bermuda grass seed has been dispersed on the barrier island dune platforms in the past as well, but with strong objection by some Federal and State of Louisiana wildlife agencies as it is non-native.

Herbaceous dune and supratidal plants would consist of a variety of dune species including bitter panicum (*Panicum amarum* var *amarum* 'Fourchon'), sea oats (*Uniola paniculata* 'Caminada'), marshhay cordgrass (*Spartina patens* 'Gulf Coast'), and gulf cordgrass (*Spartina spartinae*). Plants would be grown mainly in 4-inch containers (sea oats in a slightly larger container.) The aforementioned recommendations are general recommendations. Species recommendations may change due to soil properties and conditions, elevation after final construction, salinity, available soil moisture, and other site conditions. Other plants that could be considered to add diversity (other than the plants mentioned) are seacoast bluestem (*Schizachyrium maritimum*), seashore dropseed (*Sporobolous virginicus*), and salt grass (*Distichlis spicata*).

Woody species that would be considered for planting on the dune and supratidal swale areas include, but are not limited to matrimony vine, wax myrtle, iva, baccharis, and hercules club.

It has been suggested that more woody vegetation be included on the Caminada Headland than Shell Island. Planting of woody species should be delayed until Target Year (TY) 3 to allow for stabilization and leaching of salt from deposited material.

Plants on the dune, supratidal, and marsh platforms would be installed in variable density patterns based on site conditions. For quantity and cost estimating purposes, it was assumed that plants would be installed on 8-foot centers throughout 100 percent of appropriate dune and supratidal acreage at the certain target years. For estimating purposes, woody vegetation also was assumed to be planted on 8-foot centers throughout 15 percent of the dune, swale, and marsh acreage.

Marsh Platform:

Herbaceous marsh plants would consist of mainly smooth cordgrass (*Spartina alterniflora* 'Vermilion'). A smaller planting of black mangrove (*Avicennia germinans* 'Pelican') may be incorporated to add a larger seed bank for black mangroves. Plants would mainly consist of vegetative plug material or 4-inch containers (smooth cordgrass), or tube-tainers (mangroves). The planting density was assumed to be 8-foot center applied to 100 percent of the marsh acres.

3.5.3.4 Summary of Initial Costs

Total costs for these alternatives are summarized in the Engineering Appendix (appendix A). A design report was written for each of the reaches. The Caminada Headland costs are summarized in "Barataria Barrier Shoreline Restoration Feasibility Study, Caminada Headland, Lafourche Parish, Louisiana, Chapter C-9" (annex 1). The Shell Island costs are summarized in "Barataria Basin Barrier Shoreline Restoration Feasibility Report, Shell Island, Plaquemines Parish, Louisiana", Chapter 7 (annex 2).

3.5.3.5 OMRR&R Cost Estimate

Annual operation and maintenance costs were estimated for the construction features of the Recommended Plan. The operation and maintenance costs were determined by extrapolation from operational cost histories, by using industry standard cost data and by using data from past and projected future cost trends. Estimated maintenance costs for the sand fencing were extrapolated from Louisiana OCPR's maintenance records from CWPPRA barrier island projects.

After completion of construction, the State of Louisiana would assume all operation and maintenance responsibilities associated with this project. The non-Federal sponsor will be responsible for the cost of renourishment as described in Section 3.8.11. Land rights would be acquired that would protect the project area from human influences such as construction of habitable dwellings, vehicular access, excavation or disposal. The non-Federal sponsor would be responsible for operating the project to maintain the integrity of the restored features by enforcing the protective restrictions on the land and preventing any foreseeable, non-nature induced alteration. The non-Federal sponsor would be responsible for the maintenance, repair, and rehabilitation of the sand fencing. The non-Federal sponsor would be required to monitor the project area to ensure that no unauthorized disposal or excavation occurred on the project site, and no habitable structures were constructed.

3.5.3.6 Average Annual Costs

For economic evaluation of alternative plans on a comparable basis, the implementation costs and the reoccurring costs were further refined through present worth calculations, use of appropriate price levels, and consideration of the timing of project expenditures.

Costs represent the difference between conditions without any plan (the without project condition) and conditions with an alternative plan. Costs of a plan represent the value of goods and services required to implement, operate, and maintain the plan. In this analysis, since there were no costs identified in the without project condition, the with-project costs of an alternative plan represents the value of goods and services required to implement, operate, and maintain the plan.

The projected timing of costs incurred over the implementation of a plan is important. Construction costs incurred in different years of a project cannot simply be added if meaningful and direct comparisons of the costs of the different alternatives are to be made. The cost time streams of each alternative are mathematically translated into a present worth value. This present worth value, calculated for this study to a base year of 2013, can then be directly and meaningfully compared between the plans being considered in this study. An annual value, equivalent to the present worth, can also be computed for the 50-year period of analysis. This average annual value represents an equivalent way of expressing the costs of a plan. The various costs estimated to be incurred over time to put each plan into place and operating have been computed and expressed as both a present worth value and an average annual equivalent value. USACE Engineering Regulation 1105-2-100 requires that average annual equivalent costs be used for cost-effectiveness and incremental cost analyses (CE/ICA).

3.6 COMPARISION OF ALTERNATIVES

Project alternatives have been evaluated to determine the relative ecosystem benefits projected for each restoration approach. A cost-effectiveness analysis and incremental cost analysis were performed by comparing the expected benefits of various restoration feature components over a series of target years during the period of evaluation. Benefits for ecosystem function have been determined for the alternatives using the Wetland Value Assessment (WVA) methodology, described below.

The WVA for the Caminada Headland was calculated assuming renourishment of 2 mcy of maintenance dredged material from Bayou Lafourche over a ten year period (see Tables 5-4). This calculation is similar to the benefit determination used in the 2004 LCA Ecosystem Restoration Study (USACE 2004). However, recent Corps policy on sustainability (CECW-MVD Memo dated October 7, 2011, Policy Guidance Request for Addressing Sustainability of Ecosystem Restoration Projects in Louisiana) required additional analysis and modeling. In order for this project to comply with these policies and be sustainable, additional dredged material from the Bayou Lafourche navigation project would be needed for renourishment of the Caminada Headland.

On average, approximately 650,000 cy of material is dredged from the Belle Pass reach of Bayou Lafourche approximately every 1.5 to 2 years, and would result in an estimated renourishment of the Caminada Headland of 3.9 mcy every ten years, slightly more than the 3.8 mcy lost over the ten year time period. Overall project costs were determined utilizing the costs associated with 3.9 mcy for renourishment; while the stated benefits (as described in Table 5-4) utilized 2 mcy for renourishment. The changes resulted in a more conservative calculation of benefits. Utilizing 3.9 mcy for renourishment on the Caminada Headland, whose WVA results are undetermined, are estimated to increase the project benefits, thus meeting the sustainability requirements of Corps policy.

Consequently, the acres and AAHUs developed under the WVA utilizing 2 mcy for renourishment (see Tables 5-2, 5-4; and reported throughout Chapter 5) under-report the total benefits in acres that would accrue utilizing the 3.9 mcy of renourishment. Hence, the net acres reported throughout this chapter, Chapter 3, and the abstract vary from the net acres reported in Chapter 5. This increase in material would not impact the selection of the National Environmental Restoration (NER) or recommended plan.

For example, the total net acres for the Caminada Headland reported in Table 5-4 (990 net acres) were determined utilizing 2 mcy of renourishment material in contrast to net acres for the Caminada Headland presented in Table 3-9 (High RSLR: 1,736; BBBS RSLR: 1,929; Intermediate RSLR: 2,064; and Low RSLR: 2,122). Similarly total project net acres (both Caminada Headland and Shell Island) calculated using 2 mcy renourishment is 1,684 net acres in contrast to 2,728 total net acres calculated using 3.9 mcy renourishment.

3.6.1 Benefits Analysis

The WVA was chosen as the most appropriate ecological model to assess ecosystem restoration benefits for the project based on a number of factors. It is a quantitative, habitat-based assessment methodology developed to prioritize Louisiana coastal restoration projects submitted for funding under CWPPRA. The WVA quantifies changes in fish and wildlife habitat quality and quantity that are expected to result from a proposed project. The results of the WVA, measured in Average Annual Habitat Units (AAHUs), can be combined with cost data to provide a measure of effectiveness of a proposed project in terms of annualized cost per AAHU gain. Habitat Units (HU) represent a numerical combination of quality and quantity existing at any given point in time. The HUs resulting from the future without and future with project scenarios are annualized and averaged over the period of analysis to determine AAHUs. The difference in AAHUs between the two scenarios represents the net benefits attributable to the project in terms of habitat quality and quantity. The WVA methodology provides an estimate of the number of acres benefited by the project and the net acres of habitat protected or restored. WVA was developed specifically to apply to habitat types present along the Louisiana coast. The types of variables measured by the WVA community models are sensitive to the types of changes that are intended outcomes for barrier shoreline and marsh restoration. Specifically, these are potential changes in salinity, stress and death of marsh vegetation, and further loss or degradation of already stressed coastal marshes. The variables measured by WVA are also recognized scientifically and technically as important in characterizing overall habitat quality. Variables utilized in the WVA were selected from existing, widely accepted Habitat Evaluation Procedures (HEP) models. The variables were constituted such that data were easily estimated or collected from existing data sources.

Specific community models used to evaluate the ecosystem benefits of the project alternatives include the Barrier Island Community Model, the Barrier Headland Community Model, and the Coastal Marsh Community Model. WVA models employ a community approach which assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality similar to those developed under HEP. HEP is widely used by the USFWS and other Federal and state agencies in evaluating the impacts of development projects on fish and wildlife resources. However, the HEP generally uses a species-oriented approach, whereas the WVA utilizes a community

approach. The WVA models have been developed for determining the suitability of coastal wetlands in providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. The results of the WVA analysis are located in appendix D.

The Barrier Headland Model was developed to determine the wetland benefits of headland restoration projects. The Barrier Island Model was developed to evaluate traditional barrier island habitat along the Louisiana coast; those containing emergent habitat surrounded by open water. The Barrier Headland Model should be applied to shoreline areas along the coast which consist of beach, dune, and supratidal habitat and which naturally decrease in elevation to an intertidal marsh. By nature, barrier headlands are contiguous with the mainland marsh and have not yet detached and begun formation of a barrier island. Conversely, the Barrier Island Model is applied to detached headlands which have formed barrier islands and are gulfward of bay or lake systems. This model has been designed to function at a community level and therefore attempts to define an optimal combination of habitat conditions for all fish and wildlife species utilizing barrier headlands.

The Coastal Marsh Community Model is one of three emergent marsh community models (including fresh/intermediate, brackish, and saline models). The emergent marsh community models were developed to determine the suitability of emergent marsh and open water habitats in the Louisiana coastal zone. These models were designed to function at a community level and attempt to define an optimal combination of habitat conditions for all fish and wildlife species utilizing coastal marsh ecosystems. Variables for the emergent marsh models were selected through a two-part procedure. The first part includes wildlife habitat in coastal marsh ecosystems. The second part involves a listing of environmental variables thought to be important in characterizing fish and involved reviewing variables used in species-specific habitat suitability index models published by the USFWS.

Model certification of the Barrier Headland and Barrier Island WVA models was approved for certification by the US Army Corps of Engineers, HQ Model Certification Team on November 8, 2011 per EC 1105-2-407. The Coastal Marsh Community Model was approved by the USACE HQ Model Certification Team on February 28, 2012. As part of the certification process, a sensitivity analysis of the BBBS WVA analysis was performed by the Engineer Research and Development Center (ERDC) Environmental Laboratory (EL). The WVA models were relatively insensitive to manipulation of the WVA variables 1 through 3 suitability curves. The sensitivity analysis concluded that suggested changes of WVA variables 1 through 3 suitability curves had no impacts on project selection.

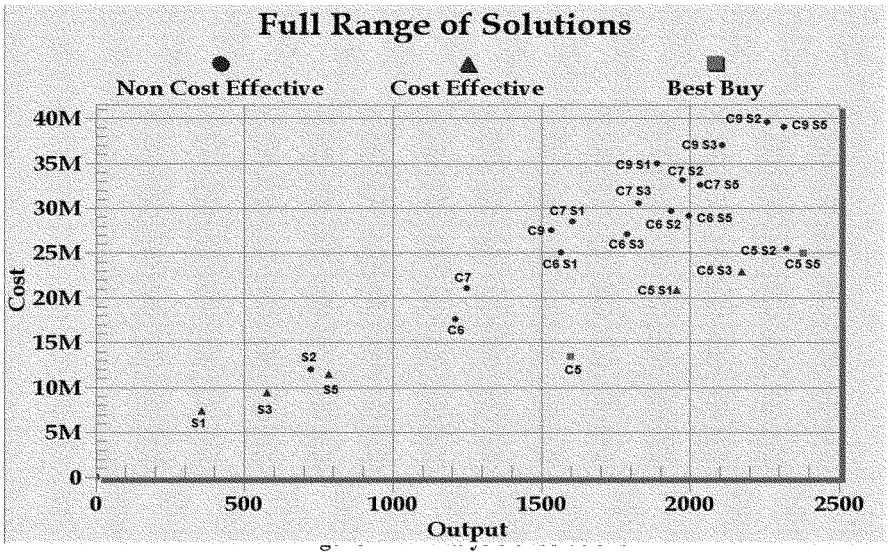
3.6.2 Cost Effectiveness and Incremental Cost Analyses

Cost Effectiveness and Incremental Cost Analyses (CE/ICA) are applied to evaluate alternative plans and identify a National Ecosystem Restoration (NER) plan. The planning process ensures the NER plan meets the planning objectives and constraints and reasonably maximizes environmental benefits while meeting tests of completeness, acceptability, efficiency, and effectiveness. The NER plan is usually based on the array of best buy plans identified during the cost effectiveness and incremental cost analysis.

The CE/ICA analysis is based on and follows guidance from the USACE Institute for Water Resources publication, "Evaluation of Environmental Investment Procedures Manual, Interim: Cost Effectiveness and Incremental Analyses," May 1995, IWR Report #95-R-1. The costs are converted to average annual costs, as described previously, and include pre-construction engineering and design (PED) and construction costs, interest during construction, as well as

operations and maintenance costs after construction. The benefits were derived from the WVA and are also in the form of average annual outputs. The benefits calculations utilized in the CE/ICA factor in the opportunity cost of lost benefits by not restoring the opposing reach. The various alternatives in the intermediate array were analyzed individually and in combinations of one Caminada Headland and one Shell Island alternative.

Figure 3-23 displays the intermediate array of alternatives and all possible combinations of those alternatives.



3.6.2.1 Cost Effectiveness

Table 3-4 displays the cost effective solutions. Cost effectiveness analysis ensures that the least cost solution is identified for each possible level of environmental output. The outputs represent the incremental outputs over the combined no action plans for each of the restoration alternatives. A description of the cost effectiveness analysis is included in the Economic Appendix (appendix B.)

Table 3-4. Cost Effective Alternatives

Name of Solution	Description	Outputs (AAHU)	Average Annual Costs ($)
No Action	No Action	0	0
S1	Two Islands with No Renourishment	355.9	7,400,433
S3	Single Island with 10 Year Advanced Fill and No Renourishment	575.9	9,476,986
S5	Single Island with 10 Year Advanced Fill and 2 Renourishments	783.6	11,506,705
C5	Landward/Seaward Combination with Additional Marsh and Renourishment	1598.9	13,459,269
C5/S1	C5 plus S1	1954.8	20,859,702
C5/S3	C5 plus S3	2174.8	22,936,255
C5/S5	C5 plus S5	2382.5	24,965,974

Notes:
(1) 2010 Price Levels
(2) 4 1/8 Interest Rate
(3) AAHU - Average Annual Habitat Units

3.6.2.2 Incremental Cost Analysis

The cost effectiveness and incremental cost analyses process is an iterative process. For the incremental cost analysis, the cost effective alternative plans were sorted in order of increasing output. Next, the plan with the lowest average annual cost per AAHU beyond the no action plan was identified and selected as the first "Best Buy" plan. The process continues, searching for the greatest increases in output for the least increases in cost. The best buy plans are those cost effective plans that are most efficient in production. The best buy plans provide the greatest increase in output for the least increase in cost. The alternatives were analyzed in all possible combinations. A description of the incremental cost analysis is located in the Economic Appendix (appendix B.) **Table 3-5** displays the best buys which are both cost effective and incrementally justified.

Table 3-5. Cost Effective and Incrementally Justified Alternatives

Name of Solution	Output (AAHU)	Avg. Ann. Costs ($)	Additional Output (AAHU)	Additional Costs ($)	Incremental Costs ($ per AAHU)
No Action	0	0	--	--	--
C5	1598.9	13,459,269	1598.9	13,459,269	8,418
C5/S5	2382.5	24,965,974	783.6	11,506,705	14,684

Notes:
(1) 2010 Price Levels
(2) 4 1/8 Interest Rate
(3) AAHU - Average Annual Habitat Units

Figure 3-24 displays the best buys and the relationship between the increasing financial investments required for increasing environmental outputs. The incremental costs of the plans are compared to the average annual environmental benefits created by each best buy plan.

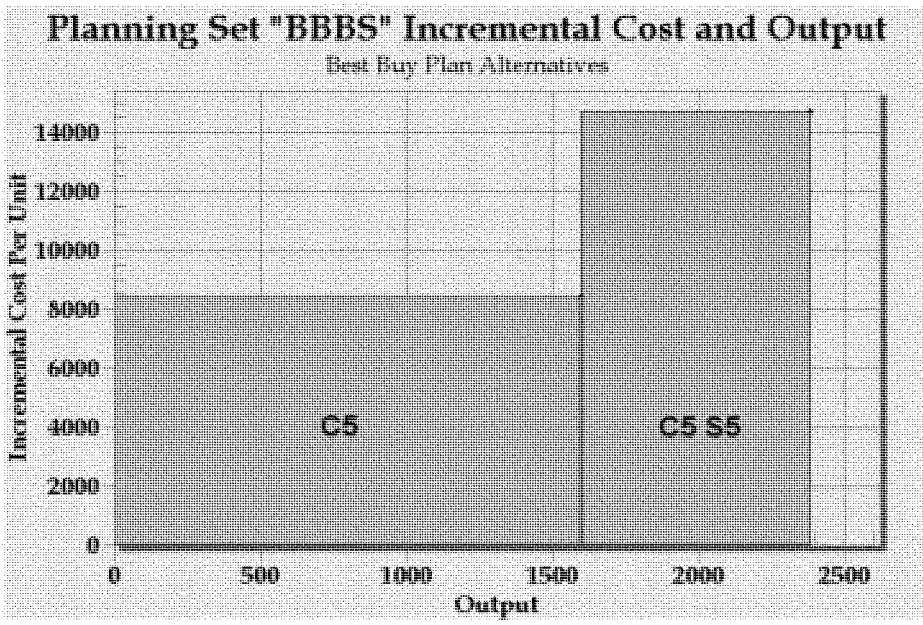


Figure 3-24 Best Buy Incremental Analysis

3.7 FINAL ARRAY OF ALTERNATIVES

The team narrowed the alternative selection to those alternatives that were considered to be best buys. After the previously listed economic evaluations and a discussion of the goals and objectives of the project, the team selected the following alternatives for detailed analysis:

- No Action Plan
- Caminada Headland Alternative 5
- Combination of Caminada Headland 5 and Shell Island 5

3.7.1 No Action Plan

Under the no action alternative, no shoreline restoration would occur. The Caminada Headland and Shell Island reaches function as a part of the Barataria Basin barrier shoreline system. By

allowing the continued degradation of the shoreline habitat in these areas, the entire barrier shoreline ecosystem would be weakened. In the study area, 3,750 acres from the Caminada Headland and 14,780 acres from north of the headland, and all 386 acres of Shell Island would be lost over the next 50 years. The continued land loss, increased numbers of tidal inlets, disruption of the tidal prism, and conversion of marsh to open water would alter the salinity regimes, thus impacting the Barataria estuary and resulting in the loss of important, critical and essential fish and wildlife habitats used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; reduction in productivity; degradation and loss of essential fish habitat (EFH), especially marsh-edge habitat and transitional habitat between estuarine and marine environments; and increased inter- and intra-specific competition between resident and migratory fish and wildlife species for decreasing coastal wetland resources. Critical wintering habitat for the threatened piping plover would be degraded and eventually lost. Important migratory stopover habitat for neotropic birds would be degraded and eventually lost. Those terrestrial and aquatic species that are linked in the barrier food chain would be indirectly affected; population reductions and shifts in predator/prey relationships would lead to localized decline in fishery productivity and reduced recreational opportunities for fishing, hunting, and/or wildlife observation. Impacts to fish populations would result from the continued loss and/or degradation of EFH, shoreline erosion, subsidence, and overall barrier habitat loss. The no action alternative (future without project conditions) is the base conditions to which the final array of alternatives is compared.

Under the no action alternative, coastal processes and hydrology resources would be impacted by the extensive barrier headland and barrier island losses resulting in changes to existing flow patterns and changes in the tidal prism. Sediment supply into the area would continue to decrease. The study area does not presently support groundwater extraction, which would continue into the foreseeable future. Water quality would likely remain similar to existing conditions.

The study area is remote and uninhabited by man. Other than oil and gas pipelines, there is no infrastructure in the study area, which would likely continue into the future. There are no agriculture or forestry resources within the study area and would likely be no such resources into the future. Employment and income, primarily associated with commercial and recreational fisheries, would likely experience local decreases due to fishery habitat degradation and loss. There would likely be fewer viable oyster leases due to barrier habitat loss and associated increased salinities making the area unsuitable for oyster production. There are no flood control or hurricane risk reduction levees or other structures within the study area and none in the foreseeable future. Aesthetically, viewscapes of existing fragmented headlands and barrier islands and open water would change to viewscapes of wide expanses of open gulf waters. The continued loss of barrier habitats would continue to threaten the integrity of any historic or cultural resources; reduce recreational opportunities and commercial fishery success; and may contribute to greater costs to maintain oil and gas pipelines. Institutional regulation of air quality would continue; however, increased human populations and industries throughout southeastern Louisiana and nation-wide would likely result in decreased air quality.

Coastal landforms and wetlands are one of the "first lines of defense" for storm surges and thereby reduce the impact of flooding and storm surges on infrastructure in the coastal region. Under the no action alternative, the incidental benefits of enhanced storm surge reduction to infrastructure (e.g., Port Fourchon, LOOP, Louisiana Highway 1, and the communities along the Mississippi River such as Empire) would not be realized.

The Caminada Headland would likely permanently fragment within the next 5 years to 20 years and migrate landward as a detached chain of three or more barrier islands. If this occurs, some

of the last remaining stopover areas for neotropical migrants would be lost as the maritime forests are degraded. As the headland fragments into islands, it would provide less protection to marshes to the north, resulting in increased salinity and wave energy conditions in the estuarine environments. As a result, salinities would increase in lakes and bays to the north, and some critical habitat for the threatened piping plover would be lost.

The loss of the only chenier ridges in the Barataria Basin, the largest black mangrove thickets in the state, and the coastal dune shrub thickets would dramatically decrease habitat diversity in this basin. This would reduce the numbers and diversity of the birds and mammals that presently utilize these areas.

On Shell Island, continued degradation of the barrier island chain in the Shell Island reach would jeopardize the remaining framework of the barrier shoreline and interior bays north of the Shell Island reach. Complete opening of the bays would nearly double the volume of open water and fetch within these bays, thereby decreasing their ecologic value. Only a few marsh islands and small ridges along the northern boundary of Bastian Bay separate it from the much larger Adams Bay. Coalescence of these bays would continue and accelerate without this project and a large sound would develop between Empire and the Gulf of Mexico. This sound would have a profound impact on configuration of the coast in this region. Ecologic changes would occur and storm surges would increase requiring greater levels of flood and wave protection for infrastructure and populated areas.

3.7.2 Comparison of Alternative Plans

Management measures were combined into alternatives for the Caminada Headland and Shell Island. These alternatives were further narrowed to an intermediate array of alternatives. The Caminada Headland Alternative 5 includes an initial construction with periodic renourishment accomplished in conjunction with the beneficial use of dredged material from the Bayou Lafourche, Louisiana navigation project. The Shell Island alternative includes the one island configurations with two renourishment cycles. Maps showing the final array alternatives are shown in **figure 3-25** and **figure 3-26.**

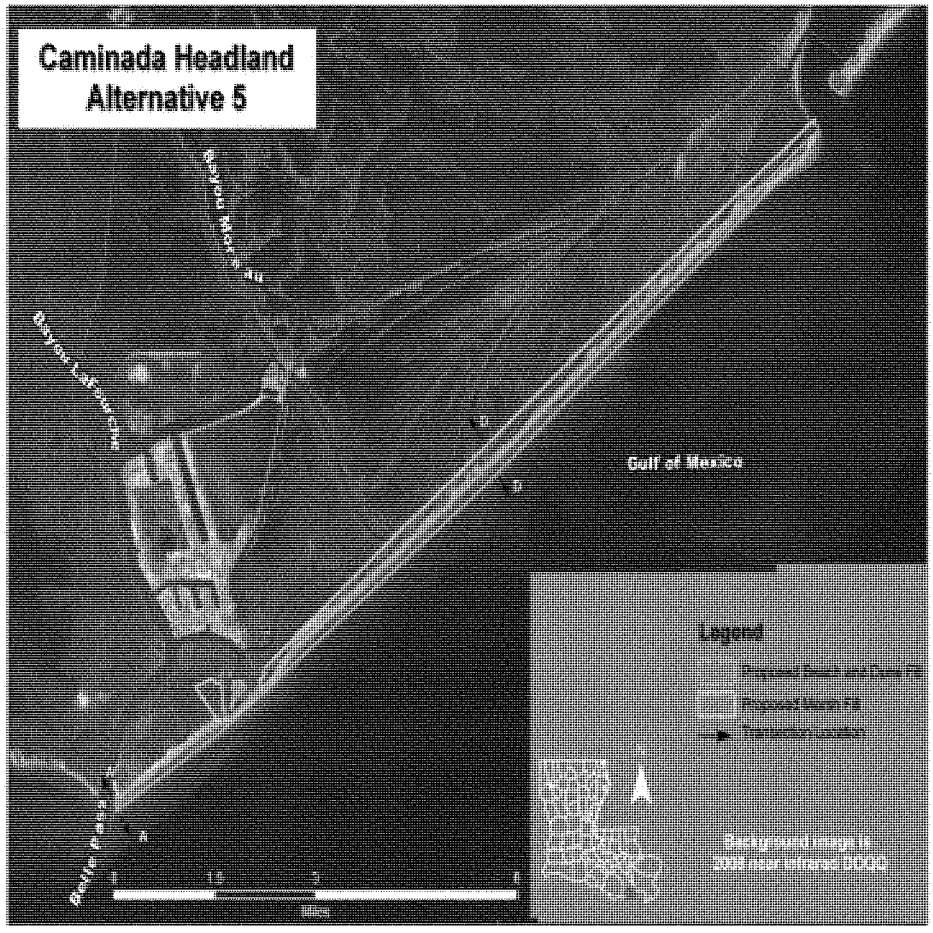


Figure 3-25 Caminada Headland Alternative 5

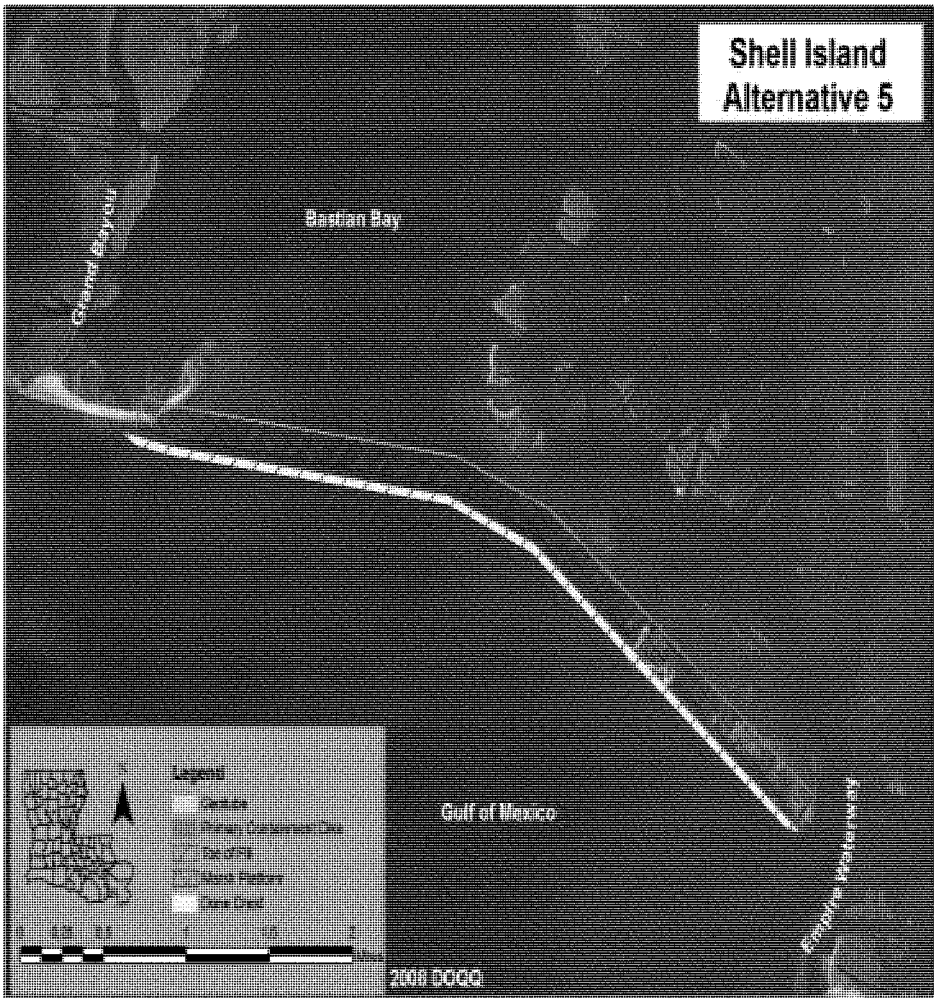


Figure 3-26 Shell Island Alternative 5

Table 3-6 and **table 3-7** give a brief description of the final array of alternatives.

Table 3-6 Final Array acreage

Alternative	Caminada Dune Acres	Caminada Marsh Acres	Shell Island Dune Acres	Shell Island Marsh Acres	Total Acres
C5	880	1186	N/A	N/A	2066
C5/S5	880	1186	317	466	2849

Table 3-7 Final array borrow requirements

Alternative	Borrow Volume Caminada Dune (CY)	Borrow Volume Caminada Marsh (CY)	Borrow Volume Shell Island Dune (CY)	Borrow Volume Shell Island Marsh (CY)
C5	24,600,000	5,360,000	N/A	N/A
C5/S5	24,600,000	5,360,000	8,635,700	3,650,400

Table 3-11 compares the impacts on significant resources of the final array and the no action alternative.

3.8 PLAN SELECTION

3.8.1 NER Plan

Caminada Alternative 5 combined with Shell Island Alternative 5 is cost effective and incrementally justified per the IWR analysis. This alternative combination fulfills the planning objectives stated in section 2.5 of this report. The alternative would restore the barrier structures to ensure their ability to provide geomorphic and hydrologic form and function. The alternatives would restore the shoreline, dune, and interior marsh habitat for essential fish and wildlife by creating/restoring a total of 1,197 acres of beach/dune and 1,652 acres of marsh over the 50 year period of analysis, mimicking as closely as possible, conditions which would occur in the area in the absence of human changes. Caminada Headland Alternative 5 proposes a 7-foot dune for the length of the shoreline from Belle Pass to Caminada pass. The marsh fill of +2 feet is proposed on the landward side of the dune. Approximately 880 acres of beach/dune and 1,186 acres of marsh would be created and/or restored, resulting in a total of 2,066 acres. The Caminada Headland reach will include renourishment in conjunction with the dredging of the navigation channel at Belle Pass (Bayou Lafourche, Louisiana navigation project.) An estimated 3.9 million cubic yards of material will be placed in the littoral zone over each ten year period. Shell Island 5 proposes a one-island configuration, closing Coupe Bob. The marsh and dune would be restored to its original construction template in years 20 and 40. The initial construction will result in 317 acres of beach/dune and 466 acres of marsh. The estimated cost of the construction

is $428,262,000 (October 2011) and the estimated present value of operations and maintenance is $132,834,761 (October 2011).

The restoration of the shoreline and marsh would protect the interior marsh and chenier ridge habitats for essential fish and wildlife species by providing a buffer from the marine influences of the Gulf of Mexico. By transporting borrow material from the Mississippi River and Ship Shoal, the alternatives would increase sediment input to supplement the long shore sediment transport processes along the gulf shoreline, increasing the ability of the restored area to continue to function and provide habitat with minimum continuing intervention. Finally, the alternative would reduce land loss and result in storm damage reduction.

The alternative works within the planning constraints. By utilizing the Mississippi River and Ship Shoal as the borrow sources for the beach/dune restoration, the project would provide new sediment to a sediment-starved ecosystem. The techniques chosen have been used in the restoration of other barrier islands in Louisiana and are proven to be effective. Infrastructure was avoided, requiring no relocations. Barrier shorelines are dynamic, and the alternatives were formulated to work with nature to restore the ecosystem.

The NER was selected from the most efficient alternatives as identified by the IWR analysis. **Figure 3-28** identifies the most efficient alternatives.

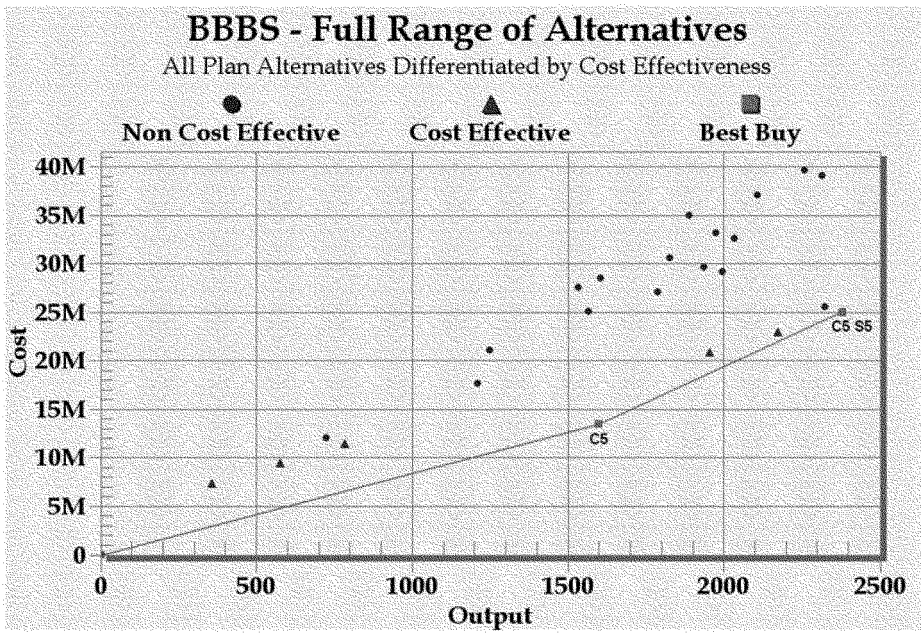


Figure 3-28 Incremental Comparison of Best Buy Plans

The first best buy presented in the IWR analysis is the Caminada Headland Alternative 5. ER 1105-2-100 states that, "Selecting the NER plan requires careful consideration of the plan that meets planning objectives and constraints and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses, significance of outputs, acceptability, completeness, efficiency, and effectiveness." As stated previously, the 2004 LCA Report identified restoration of Caminada Headland and Shell Island reaches as a critical near-term project because these two reaches were portions of the Barataria Basin barrier shoreline that were not being addressed. The barrier islands protect the interior coastal wetlands and provide habitat for migratory birds, wildlife, finfish, shellfish, and other aquatic animals including threatened and endangered species. The shoreline is the first line of defense for protecting wetland, inland bays and mainland regions from the direct effects of wind, waves, and storms. The barrier islands chain functions as a system. These two reaches will work in concert with restoration efforts under other authorities to increase sustainability of the essential form and function of the natural barrier ecosystem. Consequently, it is important that both reaches are addressed in the selected restoration plan. Without a fully functioning barrier system and interior wetlands, the estuarial ecosystem will be destroyed.

Without the restoration of both reaches, the systemic weakening of the Barataria barrier island system would continue. Near-term restoration of the Caminada Headland and Shell Island is essential to prevent the need for significantly more difficult and costly restoration efforts in the future, or the irretrievable loss of some islands. The Caminada Headland has experienced some of the highest rates of shoreline retreat on the gulf coast. Shell Island is one of the most fragmented areas of the Louisiana barrier shoreline. Shell Island is a critical element for defining the marine influences of the Gulf of Mexico and the fresher influences of the eastern Barataria estuary. Due to continuing and extensive land loss, Shell Island is gradually converting to a series of interconnecting bays directly connected to the Gulf of Mexico. Additionally, the need for restoration of Shell Island is especially time sensitive. The critical geomorphic features still function as a skeletal framework upon which to build a viable barrier system if completed in the near term. Failure to restore Shell Island in the near term would result in the loss of this critical geomorphic skeletal framework, which may preclude any future attempts at restoring this barrier system. Without the restoration of Shell Island, the 2004 LCA project goal of preventing the intrusion of the Gulf of Mexico into the interior bays and marshes in Plaquemines Parish would not be met. Therefore, Caminada Alternative 5 as a stand-alone alternative was not selected as the NER plan.

The next best buy plan, Caminada Alternative 5 and Shell Island 5, fulfills the objectives of this study and the 2004 LCA report to establish dynamic salinity gradients that reflect natural cycles of freshwater availability and marine forcing and increasing sediment input from sources outside estuarine basins. Additionally, this plan satisfies the 2004 objective to maintain or establish natural landscape features and hydrologic processes that are critical to sustainable ecosystems structure and function. The plan fulfills 3 of the 4 critical needs criteria listed in the 2004 report which are: prevents future land loss where predicted to occur, restores or preserves endangered critical geomorphic structures, and protects vital socioeconomic resources. The plan meets the two overall goals of the Barataria Basin Barrier Shoreline restoration project as defined in Section 4.2.3.2.3 of the 2004 LCA report. The overall goal for the Caminada Headland 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 overall goal of the Shell Island reach is to prevent the intrusion of the Gulf of Mexico into 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.

The 2004 LCA plan proposed the creation of dune and beach from material dredged from Ship Shoal along 13 miles of shore on the Caminada Headland. The plan included creation of marsh behind the dunes, and vegetative plantings. The plan also recommended periodic renourishment every 10 years which would be part of the local sponsor's operations and maintenance responsibilities. The plan was estimated to create 732 AAHUs. The Shell Island reach would consist of beach, dune, and marsh creation with the creation of two islands and 322 AAHUs, resulting in an estimated total of 1,054 AAHUs.

The NER plan would create 1,718.9 AAHUs. On the Caminada Headland, the design of the NER plan is similar to the 2004 LCA plan and will create 988.3 AAHUs. Shell Island would be restored as one island with periodic renourishment in years 20 and 40, which varies from the two islands, no renourishment design of the 2004 LCA plan. Approximately 730.6 AAHUs will be created on Shell Island.

The NER plan is cost effective and incrementally justified. It fulfills the planning objectives and works within the planning constraints. The project is sustainable, maintaining or increasing construction acreage through the use of renourishment. Therefore, the NER was chosen as the Recommended Plan.

3.8.2 Description of Recommended Plan

3.8.2.1 Caminada Headland

Caminada Headland Alternative 5 proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. Alternative 5 also proposes a landward beach and dune component. The landward and seaward slopes would be set 20 horizontal to 1 vertical. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Approximately 880 acres of beach/dune and 1,186 acres of marsh would be created/restored, resulting in a total of 2,066 acres. Fill quantities for the dune and marsh fills would be 5.1 million and 5.36 million cubic yards, respectively. For the dune area, the material would be pumped from the dredge to the beach. The material would then be worked on the beach by bulldozers and front-end loaders. Points of direct access to the project area are Louisiana Highway 3090 and a beach road at Elmer's Island on the eastern end. For the marsh area, the material would be pumped from the offshore borrow site. The dune would serve as the southern dike for the marsh fill. Additional dikes would be constructed around the remaining perimeter. These operations would be completed in a manner that would minimize turbidity of the water at the dredge site and the discharge site. **Figure 3-6** shows the plan view of alternative 5.

Approximately 71,500 feet of sand fencing would be installed. The sand fences would be porous barriers that would reduce wind speed along the coast such that sand being transported by the wind accumulates on the downwind side of the fence. The sand fences would promote deposition of windblown sand, create dune features, reduce trampling of existing dunes by beach visitors, and protect vegetative plantings. Vegetative plantings would include a variety of native species. The recommended planting density is no greater than 8-foot centers.

The borrow area identified for the beach/dune restoration is Ship Shoal, a large submerged sand body in the Gulf of Mexico located offshore in south-central Louisiana. The shoal is about 31 miles long and 7 miles wide, lying in water depths of 9 feet to 30 feet. Preliminary studies have shown it is the remaining seaward shoal from one of the older, abandoned Mississippi River deltas. It is composed of well-graded quartz sand and is suitable for use in restoring the Caminada Headland since its grain size is similar to the sand found on the headland. The

sediment is to originate from Ship Shoal South Pelto, Blocks 12 and 13, which is approximately 40 miles from the project site. Blocks 12 and 13 contain an estimated 28.3 million cubic yards of sediment to be used in the construction of barrier islands. Ship Shoal Blocks 88 and 89 contain approximately 50 million cubic yards of available sandy material. The LCA Terrebonne Basin Barrier Shoreline Restoration project will require an estimated 37.4 million cubic yards for construction of the NER plan. Consequently, there is sufficient sediment for both restoration projects. The borrow site for the marsh restoration would be located approximately 1.5 miles south of the central portion of the Caminada Headland, and 4.7 miles southwest of Caminada Pass. The estimated cost of construction, including contingencies, supervision and administration, real estate, and preconstruction engineering and design (PED), is $223,526,000 (October 2011). The estimated duration of construction is 936 days. It is estimated that the duration of plantings would be 750 days over a 3-year period.

A complete construction design description is located in appendix A, annex 1.

The Recommended Plan will include renourishment of the Caminada Headland per the 2004 LCA report which included near-shore recovery of 2 million cubic yards of sand every 10 years. USACE operations and maintenance dredging of the Bayou Lafourche, Louisiana (Belle Pass) navigation project yields, on average, approximately 650,000 cubic yards of material every 1.5 to 2 years. This material will be placed in the littoral drift south of Bayou Moreau where the long shore transport of material splits going east and west. The material will be placed, allowing the long shore transport and wave action to move and place the sediment along the headland. Over each 10 year period, an estimated 3.9 million cubic yards of material will be returned to the headland, exceeding the estimated loss of 3.79 million cubic yards every ten years. The marsh is continually renourished through overwash as the cross shore sediment transport moves sand from the beach to the marsh. By adding sediment to the beach, the marsh is also sustained. The non-Federal sponsor will pay the incremental cost of beneficially using this material over the federal standard which is estimated to be $7.35 million per event (October 2011). Additional description of the O&M plan is included in section 3.8.11. Caminada Alternative 5 will create 988.3 AAHUS.

The renouishment will create a feeder beach, where material is introduced in the littoral zone and distributed by the longshore current, near the nodal point of the Caminada Headland. The nodal point is a "hot spot" due to bifurcation of the sediment transport, thus it breaches more frequently than other locations on the Headland. By placing the material at the nodal point, the entire Headland will benefit by reducing breaching. At TY50, it is estimated that under the intermediate relative sea level rise (RSLR) scenario, 2,064 acres will remain, and under the low (historic) RSLR scenario, 2,122 acres will remain.

3.8.2.2 Shell Island

Under alternative 5, the Shell Island reach would be restored as one island. The island would include shoreface, dune, and marsh platform features. This alternative would restore Shell Island to a form similar to its pre-Hurricane Bob (1979) condition. **Figure 3-14** shows a plan view of alternative 5.

The landward edge of the dune of alternative 5 would be located seaward of the existing shoreline. The west end of the alternative 5 single island would be terminated approximately 0.5 mile before Grand Bayou. It is anticipated that the closure of Coupe Bob would return the tidal prism to its pre-1979 path—flowing through Grand Bayou, with Grand Bayou increasing in size in response to the altered tidal flow pattern. The west end of alternative 5 is close to the western

limit of Shell Island that was observed in 1973, prior to the opening of Coupe Bob. The proposed island follows the shortest and shallowest route across Coupe Bob. The east end of the island would then follow the remnants of Shell Island East, but has a concave shape towards land. This would be required to maintain a smooth shoreline. The eastern end of the island would be located near the Empire Waterway. The constructed dune would have a uniform width of 189 feet along the length of the restored barrier island. The dunes would be built to a height of + 6 feet NAVD88.

Louisiana barrier islands have typical widths in the region of 1,000 feet to 1,500 feet wide from the gulf shoreline to the bayward limit of the marsh. A uniform marsh width of 735 feet was chosen to construct an island that is approximately 1,240 feet wide following equilibration of the shoreline fill. The fill source for dike construction was located within the marsh fill footprint where the existing bathymetry is relatively shallow (less than -2.0 feet). The marsh will be constructed to an elevation of + 2 feet NAVD88.

However, in deeper water (bathymetry below -3.0 feet), it is not feasible to construct the marsh section with only marsh sediments, as the marsh would settle too rapidly and nonuniformly to perform its intended purpose effectively. Instead it is recommended to construct a sand base across Coupe Bob, at -3.0 feet, using shoreline fill material. The marsh can then be constructed on top of this base, which would reduce settlement of the marsh material. A second option is to install a geotextile tube for containment of the marsh fill where the -3 feet NAVD88 sand base is constructed. The geotextile tube could be filled with sand from the sand base. This option was used for the development of alternative 5.

It is estimated that 5.6 million cubic yards of shoreline fill would be required to construct 317 acres of shoreline/dune area (area above +2 feet, NAVD88). Approximately 2.1 million cubic yards of marsh fill would be required to construct 466 acres of marsh.

Shell Island would be renourished 20 years and 40 years after initial construction to the original template of 317 beach/dune acres. The marsh fill for alternative 5 would also be renourished to its original construction template at this time interval. Approximately 1.5 million cubic yards of beach fill would be required for renourishment cycles in years 20 and 40. In year 20, approximately 907,200 cubic yards of marsh fill would be required and in year 40, 604,700 cubic yards would be required for renourishment. The renourishment in year 20 is estimated to cost $63.3 million and the renourishment is year 40 is estimated to cost $60.9 million (October 2011 price levels). Under the intermediate relative sea level rise, the TY 50 acreage is estimated to be 855 acres; under the low (historic) relative sea level rise scenario, the TY 50 acreage is estimated to be 919 acres.

The borrow source for the dune/beach would be a large sand deposit near Nairn in the Mississippi River between river mile markers 32 and 34, approximately 11 miles north of the project area. The borrow site is located in a river meander where greater sediment thickness is anticipated due to the presence of relict (vertically stacked) sand bars. USACE boring data indicates sand thickness of at least 70 feet. Based on samples obtained from vibracores, the sand grain size is comparable to the sand at the project site. The dredged material would be pumped from the Mississippi River via pipeline. The Scofield Island Restoration Project will also utilize sediment from the Mississippi River. The two neighboring river sites have an estimated quantity of 9.6 million cubic yards. The Scofield construction will require 2.1 million cubic yards of material, leaving 7.5 million cubic yards for Shell Island, not including any future infilling. The remaining material exceeds the sediment requirement for Shell Island construction. The borrow source for the marsh restoration would be the Empire deposit, approximately 1.5 miles from the Empire Jetties. Water depths in the borrow area are from 16 feet to 20 feet. The borrow area

occupies about 207 acres and total mixed sediment volumes range from 5.5 million to 6.6 million cubic yards for 15 foot and 20 foot cut depths, respectively. The sedimentary characteristics indicate a silt content of about 40 percent, a clay content of about 22 percent and sand content of about 38 percent. The estimated construction cost, including contingencies, supervision and administration, real estate, and PED is $203,437,000 (October 2011). It is estimated that duration for construction would be 787 days. It is estimated that the duration for the plantings would be 360 days over a period of 3 years. Complete design details are located in appendix A, annex 2. **Figure 3-29** displays the project areas and the borrow sources.

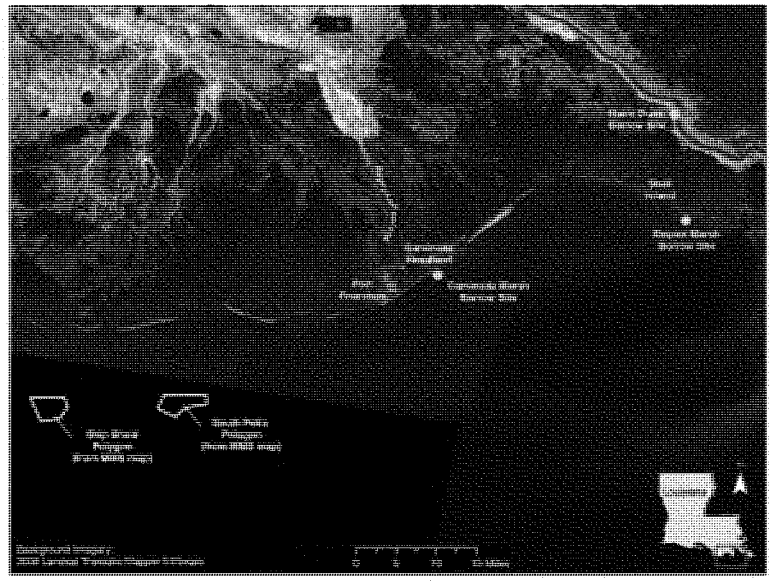


Figure 3-29 Project area and borrow sources

Because the NER plan cannot be constructed within the maximum project cost as authorized by WRDA 2007, a subset of the NER, Caminada Headland Alternative 5, was selected as the recommended component of construction. The recommended component of construction represents an implementable and separable element of the NER plan, is cost effective and incrementally justified, and within the cost and scope of the current authorization.

3.8.3 System Benefits to the Barataria Basin

The LCA critical near-term features of the 2004 LCA report 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. The main goal of the Barataria Basin Barrier Shoreline Restoration project, in both the 2004 LCA and the 2012 BBBS reports, is to maintain the geomorphic and hydrologic form and function of the barrier structures. Near term restoration of the Caminada Headland and Shell Island is essential to prevent the need for significantly more difficult and costly restoration efforts in the future, or irretrievable loss of these ecosystem habitats. The critical geomorphic features still function as a framework upon which to build a viable barrier system if completed in the near term. As indicated in the 2004 LCA report, the design and operation of the BBBS feature would maintain the opportunity for, and support the development of large-scale, long range comprehensive coastal restoration. The project is synergistic with future restoration by maintaining or restoring the integrity of Louisiana's coastline, upon which all future restoration is dependent. BBBS will work in concert with other LCA features such as the Beneficial Use of Dredged Material (BUDMAT) program and Medium Diversion with dedicated dredging at Myrtle Grove, in addition to future projects developed under the Louisiana Coastal Comprehensive Plan and the LCA Mississippi River Hydrodynamic and Delta Management Study to improve the sustainability of the Barataria Basin. The construction of diversions will help to restore some of the sediment that is now deposited off the continental shelf due to the channelization of the Mississippi River. This material will filter through the estuaries to the barrier islands bolstering their form and function as barrier structures. Should this additional material prove sufficient, renourishment may become unnecessary. The barrier islands provide a geomorphic barrier, separating the Gulf of Mexico from the interior estuaries and helping to regulate salinity gradients important to the estuarine and freshwater wetland species. The diversions and marsh creation projects will help to restore the estuaries, while the barrier islands will protect the fragile inland marshes, decreasing land loss and habitat switching to more saline conditions.

The Recommended Plan meets both 2004 LCA and 2012 BBBS planning objectives. The Recommended Plan will restore the barrier structures to ensure their ability to provide geomorphic and hydrologic form and function. Shoreline, dune, and interior marsh habitat for essential fish and wildlife species will be restored, mimicking as closely as possible, conditions which occur naturally in the area. The alternatives were designed to work with the natural, fluid, soft environment of coastal Louisiana. The project will protect interior marsh and chenier ridges. The increased sediment input will supplement long shore sediment transport processes, increasing the ability of the restored area to continue to function and provide habitat. Without this project, the Caminada Headland will disintegrate into 3 barrier islands, and Shell Island will completely disappear.

The 2004 LCA Report developed 3 hydrogeomorphic objectives. These objectives, listed in Section 3.2.2 (MR 3-11), include maintaining salinity gradients, increasing sediment input from sources outside the estuarine basins, and maintaining or establishing natural landscape features and hydrologic processes that are critical to sustainable ecosystem structure and function. The Recommended Plan provides this geomorphic form and function by separating the Gulf of Mexico from the interior estuaries and helping to regulate salinity gradients important to the range of estuarine and freshwater wetland species. The geomorphic structures prevent open Gulf of Mexico wave energy from impacting the interior estuary and provide hydrodynamic stability to the system.

Loss of these functions would have impacts beyond the project footprint. Modeling conducted, which excluded the BBBS project in its future projections, estimated that by 2060, 75% of the land between the Caminada Headland and the Larose to Golden Meadow Hurricane Risk Reduction levees would be lost. The barrier islands in Plaquemines Parish, including Shell Island, will have disappeared as well as the marshes between the islands and the Mississippi River levees. Salinity modeling reflecting a without project condition demonstrates the function

of the barrier islands in separating the marine from the estuarine environments. On the eastern side of the basin near Shell Island, in areas where the barrier islands are severely eroded, the salinity fields grow proportionally larger. With the Recommended Plan, at year 50 and under the intermediate relative sea level rise scenario, Shell Island is estimated to be 855 acres, over double the current acreage, providing the geomorphic barrier to the wave energy and salinity intrusion of the Gulf of Mexico. On the Caminada Headland, the beneficial use of the dredged material from the Bayou Lafourche navigation channel will sustain the headland, retaining the acres constructed by the project. Sediment that is transported east of the Caminada Headland, while lost to the headland, benefits Grand Isle. Similarly, the additional sediment placed at Shell Island will increase the amount of sediment within the longshore transport, benefitting neighboring islands. Without this plan, it is estimated that 3,750 acres from the Caminada Headland and 14,870 acres from north of the headland, and all 386 acres of Shell Island would be lost over the next 50 years.

This plan, by increasing the sediment input into a sediment starved system, would let the ecosystem "self-regulate," letting natural shoreline processes take over. Per ER 1105-2-100 Section E-30, "The objective of Civil Works ecosystem restoration is to restore degraded significant ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. However, partial restoration may be possible, with significant and valuable improvement made to degraded ecological resources." The Caminada Headland and Shell Island provide important geomorphic, hydrologic, and habitat functions in the Barataria basin.

Modeling results have shown that barrier islands decreased wave energy landward of the island during tropical events. When the barrier islands were degraded in the models, the modeled wave heights increased, thus heightening the potential for overtopping levees and inundation of protected areas. Sustaining the geomorphic form of the barrier islands will provide storm surge protection for the interior wetlands and the surrounding coastal communities. The feeder beach constructed during the operations and maintenance of the Caminada Headland, as modeled by CEC (Coastal Engineering Consultants, Inc., Memorandum, July 30, 2010) provides a benefit for storm damage reduction in addition to the benefits created by the initial construction of the barrier shorelines by decreasing the amount of shoreline change and the volume of sand lost as a result of tropical storms.

The Recommended Plan will prevent the fragmentation of the Caminada Headland and greatly ameliorate impacts on several important socio-economic sectors such as: Port Fourchon, the largest base for offshore oil and gas operations in coastal Louisiana and the largest coastal fishing port; major oil and gas infrastructure, such as regional transportation and storage facilities, the LOOP, and the Mars pipeline; and the regional hurricane evacuation route serving residents of southern Lafourche Parish, the community of Grand Isle and approximately 6,000 workers stationed at offshore facilities in the central Gulf of Mexico. By decreasing the rate of erosion and preventing the splintering of the headland, the investment in infrastructure located at Port Fourchon will be less vulnerable to storm surges. Oil and gas pipelines and Louisiana Highway 1 maintenance requirements will lessen compared to the future without project conditions.

3.8.4 Significance of Ecosystem Benefits

The significance of the ecosystem outputs plays an important role in ecosystem restoration evaluation per section E-37 of ER 1105-2-100. Information on the significance of ecosystem outputs helps to determine whether the proposed environmental investment is worth the cost and

whether a particular alternative should be recommended. The significance of restoration outputs are characterized in terms of institutional, public, and technical importance.

Institutional Recognition:

Institutional recognition refers to the importance of an environmental resource as acknowledged in laws, executive orders, rules and regulations, and treaties. Federal and Louisiana authorities and executive orders relevant to the BBBS project are listed in **Tables 7-1 and 7-2.**

The outputs are institutionally recognized. NMFS has declared both project areas essential fish habitats (EFH) per the Magnuson-Stevens Fishery Conservation and Management Act of 1996. Much of the Caminada Headland has been designated by USFWS as critical habitat for the piping plover, a species protected by the Endangered Species Act of 1973. The project will preserve and protect these important habitats. The importance of the coastal zones was codified in the Coastal Zone Management Act of 1972. A Consistency Determination has been completed and is included in Appendix D. Executive Order 13186, Migratory Bird Habitat Protection, requires the evaluation of effects of projects on migratory birds. The Recommended Plan will preserve valuable migratory bird habitat. The Council on Environmental Quality's (CEQ) March 2010 *Roadmap for Restoring Ecosystem Resiliency and Sustainability* lists the BBBS project as a necessary component of coastal restoration in Louisiana. Louisiana Highway 1 has been designated by the United States Congress as a "high priority corridor." This project is listed in the Louisiana State Master Plan, and is designated as a critical near term feature in the 2004 LCA Ecosystem Restoration Study.

Public Recognition:

There is public support in Louisiana for this project, with specific emphasis on beginning construction as soon as possible. Fourchon Beach is one of the few beaches that is publically accessible by car. The area is utilized for camping, fishing, and holiday celebrations. Commercial and recreational fishing are culturally significant to many south Louisiana residents. The wetlands protected by the barrier structures are nurseries for many fish species. The wetlands and wildlife in the project area draw birders, hunters, fisherman, boaters and other outdoor enthusiasts.

Several national and regional organizations have campaigned to save the Louisiana wetlands, and the BBBS project area is considered of great importance to these groups. Organizations such as America's Wetland Foundation, Coalition to Restore Coastal Louisiana, Restore or Retreat, National Wildlife Federation, and the National Audubon Society consider saving the Louisiana wetlands a top priority.

Technical Recognition:

Technical recognition refers to the importance of an environmental resource as based on scientific or technical knowledge or judgment of critical resource characteristics. Examples of technical significance are:

- Scarcity: Louisiana's coastline represents 90% of the wetlands in the contiguous United States and is currently disappearing at an alarming rate. This unique and scarce habitat has high fish and wildlife values. The Recommended Plan will create valuable wetland habitats as well as reduce impacts from marine forces and increase the longevity of the inland marsh habitats. The project will also restore and protect barrier island and headland habitats, coastal barrier vegetation, important estuarine/marine transition habitat

and other EFH, and critical piping plover habitat. There are only a few hectares of black mangrove in Louisiana, including the study area. This plant species is important because the root system helps prevent soil erosion and land loss and for nesting habitat.

- Representativeness: The project footprint is uninhabited. The Recommended Plan will restore the headland and island using sediment and native plantings that exemplify the natural habitat. The use of compatible sediments as shoreline protection provides considerable environmental benefit. Subtropical sandy beaches support a broad range of organisms and the varied plants that stabilize the berm and dune and shelter its inhabitants. Of particular importance is the berm nesting activity of sea turtles, the berm and dune nesting activities of several species of shorebirds, and the foraging activities of both shorebirds and transient migratory neotropical birds. The nearshore and surf zones are prime foraging areas for pelicans, skimmers, terns, and gulls. A restored and periodically renourished beach berm and dune system affords more protection than one that continues to erode.

- Status and Trends: The project areas are declining and imperiled. Over the last 100 years, the Caminada Headland has experienced an average shoreline erosion rate of 45 feet per year (USACE 2004). Shell Island has experienced an average erosion rate of -89 feet per year between1988 - 2004. While the project cannot stop the natural processes of sea level rise, subsidence, and storm caused erosion, the project can greatly slow down the disappearance of these landforms by increasing the amount of sediment in the coastal system. Additionally, utilization of 3.9 million cubic yards of material dredged from Belle Pass as renourishment every 10 years will replace sediment lost from the headland. Shell Island has almost completely disappeared. Construction of the Shell Island plan will restore the historical footprint of the barrier island. Renourishment in years 20 and 40 will extend the longevity of the island well beyond the 50 year period of analysis.

- Connectivity: The Caminada Headland is the largest expanse of critical piping plover habitat in southeast Louisiana. With the loss of the headland, only small, geographically dispersed areas will remain for the threatened piping plover. The barrier shorelines are also valuable stopover habitats for migratory birds. The construction of Shell Island will result in additional habitat for the piping plover and migratory birds in an area that is greatly eroded. The Louisiana coast is where the Central and Mississippi flyways meet. It provides a place for neotropical migratory songbirds to rest and feed before or after crossing the Gulf of Mexico, and it is a winter home to 70 percent of the waterfowl that migrate across these flyways such as the gadwall, green-winged teal, northern shoveler, and snow goose. The Louisiana estuaries and wetlands are nurseries for young fish and shellfish.

- Limiting Habitat: Much of the Caminada Headland is designated critical habitat for the piping plover. NMFS has designated both Shell Island and the Caminada Headland as important transitional estuarine/marine habitats and valuable EFH. The proposed action would provide important transitional estuarine/marine habitats and valuable EFH for foraging, breeding, spawning and cover for a variety of larval, juvenile and adult fish and shellfish such as the white and brown shrimp. It also limits inter/intra-specific competition between resident and migratory fish and mammal species with limited coastal vegetation resources.

- Biodiversity: In the Shell Island area, the compressed salinity gradient has decreased the species diversity. This lack of dynamic salinity gradient has negatively impacted the productivity of the fish and wildlife. The proposed action would restore biodiversity

including important transitional estuarine/marine habitats and valuable EFH for foraging, breeding, spawning and cover for a variety of larval, juvenile and adult fish and shellfish such as the white and brown shrimp. On the Caminada Headland, the diversity of birds and terrestrial wildlife is dependent upon the chenier ridges and the mangrove thickets which are protected by the Recommended Plan.

The Recommended Plan meets the four evaluation criteria specified in the P&G.

- Acceptability: The plan is implementable from a technical, environmental, economic, political, legal, institutional, and social perspective. The Recommended Plan is acceptable to the State and the Federal Agencies. The Recommended Plan was selected by an interagency and interdisciplinary team. There is broad based public support for the plan. The agencies' and public's greatest concern is beginning construction as soon as possible.
- Completeness: The plan provides and accounts for all necessary investments and actions to ensure the realization of the planned restoration outputs specified in the Recommended Plan. The plan prevents the disappearance of Shell Island and the dissolution of the Caminada Headland as stated in the project objectives. Consequently, the project improves the potential for long term survival of the coastal systems. The project restores or creates 2,849 acres, all of which are maintained through OMRR&R. The Caminada Headland maintains its beach and dune footprint through the input of 3.9 million cubic yards of material over a 10 year period. The marsh is maintained through cross shore transport of materials from the beach to the back barrier marsh. Shell Island will be returned to its construction template in years 20 and 40.
- Efficient: The Recommended Plan was identified as a cost effective and incrementally justified best buy by the IWR analysis.
- Effectiveness: The Recommended Plan makes a significant contribution to addressing the specific restoration problems. Increasing sediment in the coastal system will improve the self-sustainability of the coastal system. The plan will prevent the loss of Shell Island and the break–up of the Caminada Headland, reducing the land loss and providing essential habitat for wildlife. By maintaining the geomorphic and hydrologic form and function of a barrier system, salinity impacts on the wetland interiors will be lessened. In addition, the Recommended Plan will reduce the impacts of increased wave action, tidal flux, and resulting habitat switching and estuarine shoreline loss and marsh fragmentation in areas landward of the barrier shoreline.

The 2004 LCA report states that, "The BBBS restoration feature addresses critical ecological needs and would sustain essential geomorphic features for the protection of Louisiana's coastal wetlands and coastal infrastructure...The design and operation of the feature would maintain the opportunity for, and support the development of large-scale, long-range comprehensive coastal restoration." While the project will not stop the natural force of coastal erosion, the project will keep intact the geomorphic and hydrologic form and function of these barrier structures, allowing for the opportunity to develop large-scale and long range comprehensive coastal restoration. Renourishment will replace sediment lost from the Caminada Headland, significantly reducing the estimated rate of erosion. The creation of the feeder beach with the dredged materials will benefit the Headland both to the east and west as longshore transport nourishes the beach and adds width to the shoreline. The added width will afford protection to the uplands by attenuating wave run-up and thus reducing storm damage. In addition transport of the finer sediment into the dune system will bolster it, resulting in benefits to the flora and

fauna species and habitats. Shell Island will be restored to its pre-1979 configuration. The two renourishment cycles will result in an island at TY50 that is greater than double its current size.

3.8.5 Comparison of the Recommended Plan to LCA 2004 Plan

The 2004 LCA report identified the Barataria Basin Barrier Shoreline restoration study as a critical near-term restoration project. According to the 2004 LCA report, the BBBS restoration feature is to address the critical ecological needs and sustain essential geomorphic features for the protection of Louisiana's coastal wetlands and coastal infrastructure. The overall goal is to maintain the headland reach and prevent intrusion of the Gulf of Mexico into the interior bays and marshes (LCA Study, 2004, Attachment 5). The project would also help restore natural sand transport along the coast, supporting the adjacent regional shorelines and various shoreline habitats.

The 2004 LCA plan proposed the creation of dune and beach from material dredged from Ship Shoal along 13 miles of shore on the Caminada Headland. The plan included creation of marsh behind the dunes, and vegetative plantings. The plan also recommended periodic renourishment every 10 years which would be part of the local sponsor's operations and maintenance responsibilities. The estimated annual cost of the operations and maintenance was $500,000.

The Recommended Plan will create a total of 1,718.9 AAHUs in excess to the future without project. A total of 730.6 AAHUs, in excess of the FWOP, will be created on Shell Island and 988.3 AAHUs will be created on Caminada Headland. The 2004 LCA report envisioned one renourishment episode every 10 years, while the Recommended Plan will place 650,000 cubic yards of material 6 times within a 10 year period for a total of 3.9 million cubic yards of material every 10 years. The 2004 LCA recommended plan for Shell Island was a two island plan with no renourishment. The Recommended Plan includes the construction of one island with two renourishment cycles in years 20 and 40. The average annual cost of the O&M is $6,183,485 (October 2011).

Near term restoration of the Caminada Headland and Shell Island is essential to prevent the need for significantly more difficult and costly restoration efforts in the future, or irretrievable loss of these ecosystem habitats. The critical geomorphic features will continue to function as a framework upon which to build a viable barrier system if completed in the near term.

3.8.6 Locally Preferred Plan

The State of Louisiana is in agreement that the preferred plan is the combination of Caminada alternative 5 and Shell Island alternative 5.

3.8.7 Compensatory Mitigation Measures

No compensatory mitigation would be required for this project. As an ecosystem restoration project, the alternatives were designed to avoid environmental impacts.

3.8.8 Design, Environmental, and Construction Considerations

Project construction would require the hydraulic placement of beach and marsh fill within the project area. For both reaches, inclement weather, especially tropical storms, may impact the

construction schedule. High seas may impact offshore dredging. Waves and winds from storm events may also move debris, cultural artifacts, and pipelines on the gulf floor. If during dredging, an artifact is inadvertently discovered, there could be impacts to the schedule and cost of the project. Additionally, dredge availability may impact the schedule and cost of the project.

For the Caminada Headland reach, access is available via Louisiana Highway 3090 on the western side of the headland, and a beach road on Elmer's Island on the eastern end of the headland. Material for the dunes would be pumped from Ship Shoal using a hopper dredge. Environmental laws protecting sea turtles could possibly require the cessation of work for a limited time if the allowable number of sea turtles killed is exceeded during dredging. In order to minimize the impact on piping plover, the beach would be constructed in sections to allow the birds to move to areas that are not currently under construction. The required grading equipment would be transported via local roads. The dune would serve as the southern dike for the marsh fill, with a system of dikes constructed around the remaining perimeter for containment of the fill material. These operations would be completed in a manner that would minimize turbidity of the water at the dredge site and at the discharge sites. Discharge and dewatering from the fill sites would be directed towards the Gulf of Mexico. Materials for the marsh containment dikes would come from the interior of the fill site. Consequently, the dredged areas would be filled with materials once the marsh site is completed.

For Shell Island, construction of the beach and marsh fill would require the use of heavy machinery to manage the pipeline and construction containment dikes. The contractor would be required to construct dikes to control the placement of marsh fill. The bayward side of the beach fill would act as a dike to control fill on the south side of the marsh. The material used to construct the dikes would be taken from within the footprint of the marsh fill. Construction of the marsh in deep water (bathymetry below -3 feet, NAVD88), will require a sand base using beach fill material. The marsh will then be constructed on top of this base, which will reduce settlement of the marsh material. A geotube will be placed in the 9,000 foot section of Coupe Bob. The geotextile tube will be filled using material from the sand base but from within the marsh footprint. To transport sand from the Mississippi River to Shell Island would require a pumping distance of approximately 19 miles. The pipe would have to cross several obstacles including the Mississippi River levee, Highway 11, Highway 23, and the Empire Waterway. The pipe would be submerged to prevent blocking navigational access. Actual closure construction methods would be decided by the contractor but it is assumed that the contractor will stockpile extra material on each side of the final closure section of the inlet. Sheet pile about 100 to 200 feet in length would be placed on each side of this final opening to allow the sand material to be piled up higher than would be possible without it. When the tide range is the lowest, the dredged material will be pushed into the breach.

3.8.9 Real Estate Requirements

A Real Estate Plan has been completed and is included as appendix C. The estimated Real Estate cost is $3.7 million (October 2011).

3.8.10 Land Acquisition

The Caminada Headland would be fronted by a sand dune, in order to better protect and promote the development of the wetlands behind it. The dune restoration and creation area will cover approximately 880 acres and marsh creation and restoration area covers 1,186 acres of marsh.

The Shell Island reach would employ the same method utilized for the Caminada Headland, with a sand dune facing the gulf to protect and better ensure the growth of the newly created marsh in the rear. Shell Island is currently divided into two islands. The project will restore Shell Island to its pre-1979 configuration. As with the Caminada Headland, the dune restoration and creation area covers 317 acres and the marsh area would encumber 466 acres.

In addition, due to the need to move dredge material from the Mississippi River to Shell Island, a standard Utility And/Or Pipeline Easement would be required. This easement would cover approximately 174 total acres, 155 of which are classified as water and the remaining 19 are either marsh or mixed use land.

The proposed source of borrow sand for the Caminada Headland is Ship Shoal, a sand body in the gulf located approximately 40 miles southwest of Belle Pass.

The proposed source of borrow sand for the Shell Island shoreline/dune fill is the Mississippi River, near Nairn. The Nairn deposit is located 2 miles to 4 miles upriver from Empire between Mile Marker (MM) 32 and MM 34, and about 11 miles from the center of Shell Island.

A Real Estate Plan (REP) has been prepared and is attached as Appendix C. The REP provides a description of estates to be acquired for project features. The REP recommends acquiring Fee, Excluding Minerals for the marsh and dune creation project features, adding that it is the opinion of the Non-Federal Sponsor and CEMVD that construction of this project can be accomplished through the acquisition of easements rather than fee, and at the time of this report, a Request to Deviate from Fee Acquisition and Request for Approval of Non-Standard Estates has been submitted and is under review. CEMVD has proposed acquisition of the following non-standard estates: Wetland Creation and Restoration Easement and Perpetual Dune Restoration and Creation Easement.

However, regardless of which estate is acquired, the primary acquisition goal is to protect the project features. Any activity that is allowed must be consistent with project authorization and function. The possibility for public access to the project site will depend upon which real estate interest is acquired and will be dictated by State and Federal laws as they relate to ecosystem restoration projects.

The non-Federal sponsor, through its Office of Coastal Protection and Restoration (OCPR) would acquire all land rights.

3.8.10.1 Relocation Assistance

Construction of the Recommended Plan would not cause displacement of persons or habitable or commercial structures.

3.8.11 Operations and Maintenance

Based on the sediment budget prepared for the Caminada Headland, the loss of sediment from the headland, which is derived from the total gulf shoreline erosion loss minus the total overwash accumulation, is estimated to be 379,000 cubic yards per year. The overwash is captured in the back barrier marsh north of the dunes. Operations and maintenance of the headland will include renourishment beneficially used in conjunction with the USACE operations and maintenance dredging of the bar channel of Bayou Lafourche, Louisiana (Belle Pass) navigation project. Dredging of the pass yields on average approximately 650,000 gross cubic yards of material every 1.5 to 2 years. This material will be placed in the littoral drift south of Bayou Moreau where the sediment budget indicates that the long shore transport of material splits going east and west. The material will be placed unconfined between 100 and 300 feet offshore from the mean high water (MHW) mark, allowing the long shore transport and wave action to move and place the sediment along the headland. The material will be pumped offshore of the nodal point directly impacting approximately 67 acres of water bottom. The Caminada Headland is a high energy wave environment that is very dynamic. The material will be stacked no higher than + 6 feet MLG, but will be quickly reworked by the wind and waves. The pumping of the material will take approximately 54 days, with placement and removal of the pipeline taking a total of approximately 98 days. The pipe will be placed offshore. The material will be dredged from a federal navigation channel which previously received NEPA clearance for the maintenance dredging of the Bayou Lafourche channel. Approximately 124.2 acres will be directly impacted by the dredging. Over each 10 year period, an estimated 3.9 million cubic yards of material from six dredging cycles (650,000 cubic yards per cycle) will be returned to the headland. Unless the shoreline is in danger of breaching, timing of the renourishment will be dependent upon the maintenance dredging requirements of the Bayou Lafourche, Louisiana navigation project. Historically, maintenance dredging has begun as early as March and ended as late as November. This renourishment is part of the non-Federal sponsor's operations and maintenance requirements.

The purpose of the O&M is to sustain the constructed footprint and protect the headland north of the project footprint. The O&M is driven by the need to ensure continuity of the shoreface, and is not determined by the dredging cycle. The beach and dunes protect the more fragile marsh habitats from the direct wave action of the marine environment. Once the shoreline has been breached, erosion rates increase. Because a major objective of this study is to protect the interior marsh and chenier habitats of the headland, continuity of the shoreface to protect these fragile habitats is essential. The need for O&M will be determined by the need to balance the sediment budget, breaches or imminent breaches in the shoreline, and erosion of the beach that threatens the dunes.

O&M should be performed in conjunction with the maintenance dredging to ensure that the sediment budget remains balanced. The headland loses approximately 379,000 cy annually. Placement of the material from the maintenance dredging should over time equal the amount of material lost to the headland. Should the maintenance dredging not provide sufficient material, the non-Federal sponsor will be required to provide another source of comparable material. However, the beach should not be allowed to erode to within one year of estimated erosion of the dunes. The long term average erosion rate is 45 feet per year. Consequently, when the distance between the dunes and the MLG waterline decreases to 50 feet, O&M would be required. Material will be placed at the nodal zone for headland-wide erosion. Should the shoreline breach or a particular area of the shoreline be in danger of breaching, sediment would be placed near the breach to supplement the existing sediment. O&M determinations would be made through use

of LIDAR, surveys, aerial photography, or site inspections. Site inspections would be conducted by an interagency team containing at minimum USACE and CPRA team members.

Any changes to the approved OMRR&R plan must receive environmental clearances, including consultation with the appropriate agencies for compliance with the Endangered Species Act (ESA.) Additionally, because the Belle Pass jetties provide the important function of acting as a terminal groin and trapping sediment, prior to any navigation dredging event, the stability of the jetties will be inspected. If USACE, New Orleans District Operations Division determines that stabilization of the jetties is necessary, sufficient material will be placed to support the jetties. The restored marsh is protected from the south by the beach and dunes. The marsh is protected from the north by the marsh and cheniers of the headland. The marsh is renourished by the cross shore sediment transfer from the beach and dunes. An estimated 547,000 cy of material is captured in the marsh through overwash. Consequently, by continually renourishing the beach and dune, the marsh also receives renourishment.

The non-Federal sponsor will pay the incremental cost of beneficially using navigation maintenance material over the federal standard. For the Bayou Lafourche navigation channel, the federal standard, which is the least costly, environmentally acceptable plan for disposal of the dredged material, is to pump the material to the beach adjacent to the channel a minimum of 1,000 feet away from the jetties for an average pump distance of 4,000 feet. The material utilized for O&M will be placed approximately 5 miles from the navigation channel. The total estimated cost for dredging and placement of the 650,000 cy is $13,270,000 with $5,920,000 being the estimated cost for the federal standard and $7,350,000 the estimated incremental cost attributable to the BBBS project (October 2011 price levels).

Shell Island will be renourished 20 and 40 years after initial construction. The marsh is impacted by northerly winds that erode the marsh from the bay side of the island. The marsh is renourished back to an elevation of +2.0 feet NAVD88. The volume of marsh fill required for the first renourishment is approximately 907,200 cubic yards while the volume for the second renourishment is 643,600 cubic yards. The volume of beach fill required for each of the beach renourishment cycles is approximately 1,512,000 cubic yards of sediment. The O&M borrow sources are the same as the construction borrow sources. The non-Federal sponsor is responsible for the O&M of Shell Island. The estimated cost of the Shell Island renourishment is $63.3 million in TY 20 and $60.9 million in TY 40 (October 2011 price levels).

Research on Louisiana barrier islands determined that islands are in danger of breaching when they reach approximately 300 feet in width. Modeling of Shell Island estimates that the island would breach in year 30. Renourishment episodes are estimated for years 20 and 40. However, should the island narrow to approximately 300 feet in width prior to year 20, O&M should be scheduled.

O&M would also include repair and/or maintenance of sand fencing. The maintenance estimate for sand fencing includes complete replacement in year 5 with 20 percent replacement every 5 years until the end of the period of analysis. In addition to this task, the non-Federal sponsor would monitor the project area and enforce the restrictions of the easements through yearly inspections of the project area. Sufficient land rights will be obtained to perform operations and maintenance in perpetuity. The present value of the operations and maintenance costs including renourishment is $132,834,761 with an average annual cost of $6,183,485 (October 2011 price levels).

3.8.12 Monitoring Plan and Adaptive Management

Monitoring would be necessary to determine if the predicted performance is being achieved and to provide feedback for future projects. Construction is estimated to require 2 - 3 years. As part of the construction phase of the project, the active profile would be surveyed at completion of construction activities to document completion of construction. Post-construction monitoring of the Caminada Headland would be coordinated with Bayou Lafourche operation and maintenance activities, and would be carried out to support adaptive management of the project. In addition, the project monitoring for both the Caminada Headland and Shell Island would incorporate available monitoring data on the project features gathered by ongoing regional monitoring programs. Monitoring data for the project area is collected by the U.S. Geological Survey's National Assessment of Coastal Change Hazards Program, which monitors shoreline change over time and assesses shoreline impacts of hurricanes and other extreme storm events. Monitoring of the shoreline configurations and landforms in the project areas would be done with remote-sensing techniques such as aerial photography, surveys, and satellite imagery. All data acquired for project monitoring would be applied to subsequent barrier island projects. In addition to shoreline landform monitoring, vegetation plantings should be monitored for a period of 5 years post construction to document the establishment of effective vegetative cover for shoreline stabilization. During annual site visits, USACE will conduct endangered species monitoring. Additionally, USACE will conduct a baseline piping plover survey within the migrating and wintering season immediately prior to initial construction in order to determine the piping plover's preferred habitat use within the action area. The annual site visits will also be used to determine the need for renourishment, location of sand placement and condition of sand fencing.

Because the sand budget for shorelines along the central Gulf Coast is a relatively small fraction of available sediment, the challenge for Louisiana barrier island and shoreline management is to maximize the volume of sand retained in the beach environment and to minimize sand dispersal into the surrounding mud environments. This must be accomplished in a context of a highly dynamic system in which both fair weather and storm conditions may continuously or sporadically alter the movement of sand.

For initial construction, the Recommended Plan would place external sediment into a sediment starved system and then let the natural shoreline processes shape these materials. The Recommended Plan has designed the restored areas to sufficient height and width to minimize the risk of breaching. Additionally, Operations and Maintenance plans include beneficial use of dredged material from Belle Pass for periodic renourishment of the Caminada Headland shoreline reach at an average frequency of six times per decade. Shell Island would be rebuilt to its post construction design at years 20 and 40. Operations and Maintenance will also include the repair and replacement of the sand fencing due to both normal wear and tear and storm damage.

An adaptive management approach will be used to carry out the renourishment activities for Operation and Maintenance of the Caminada Headland shoreline reach. Historical records indicate that maintenance dredging is carried out on an average frequency of one dredging event every 1.5 to 2 years. Prior to each dredging event, shoreline conditions will be assessed to determine the best strategy for placement of material for maintenance of the Caminada Headland shoreline reach. The adaptive management strategy will use the following steps for determining how the Operations and Maintenance beneficial use will be carried out:

1. Existing monitoring information will be evaluated to determine whether the data are sufficient for supporting the adaptive management of the project maintenance renourishment. Project-specific data will be acquired as needed. It is anticipated that the monitoring will provide for survey data collection for three events over the operational period of the project, based on the frequency of past dredging operations, availability of data from other programs, and rate of change expected along the shoreline reach.

2. For maintenance events where material will be placed for renourishment of the Caminada Headland shoreline reach, shoreline imagery will be evaluated to determine the renourishment approach. Annual site visits will evaluate the need for renourishment in addition to the surveys and aerial photography. The following basic approaches will be used, based on shoreline conditions:

a. When monitoring data indicate that the shoreline is relatively intact, with no breaches created by storm surge or wave action, the dredged material from Belle Pass will be placed beneficially at the nodal point located at approximately the midpoint of the shoreline reach. Placement of material at this location sustains the project by building out the shoreline at the nodal point, which is an area of more rapid shoreline erosion, and by feeding material along the entire reach through existing longshore transport patterns.

b. When monitoring data indicate that the shoreline reach has been breached or severely damaged by overwash or other erosion, dredged material will be beneficially placed to repair breaches and other highly eroded areas of the shoreline reach. The material will be placed 100 to 300 feet offshore, similar to the placement at the nodal point. If the volume of material available is greater than the quantity required to address breaches and erosional hot spots, then the remaining material will be placed at the nodal point of the shoreline reach.

c. During O&M events for the Bayou Lafourche navigation channel, material has been placed on either side of the jetties for support. The integrity of the Belle Pass jetties is essential to the effectiveness of the BBBS project. The jetties act as a terminal groin, protecting the project benefits by preventing the loss of sediment from the headland. Should it appear that the stability of the jetties is in question, some of the material would be used to stabilize the landward connection of the jetties and beachhead.

For Shell Island, monitoring results may determine that the timing of the renourishment cycles and the amount of material required to restore the construction template be adjusted. Analyses may also help to optimize the configuration for the renourishment design. Additionally, the need for renourishment will be re-evaluated as longer term strategies are implemented such as LCA Medium Diversion at Myrtle Grove and any projects resulting from the LCA Mississippi River Hydrodynamic and Delta Management Study.

According to the CECW-PB Memo dated 31 August 2009:

Monitoring is identified as supporting information needs that will help further understand and corroborate project effects and includes the systemic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits.

A monitoring design was established to determine if the desired outcome or risk endpoint is met. Upon completion of the BBBS project, monitoring for ecological success and adaptive management will be initiated and will continue until such time as the Secretary of the Army determines that the success criteria has been met, as defined by the project-specific objectives. This monitoring plan includes the monitoring actions to evaluate success and to determine adaptive management needs. Although the law allows for a ten-year cost-shared monitoring plan, ten years of monitoring may not be required. Once ecological success has been achieved, which may occur in less than ten years post-construction, no further monitoring will be performed. If success cannot be determined within that ten-year period of monitoring, any additional monitoring will be a non-Federal responsibility. This plan estimated monitoring costs for a period of ten years because that is the maximum allowed federal contribution to monitoring. As soon as ecological success is achieved, monitoring will cease.

The following discussion outlines key components of a monitoring plan that will support the BBBS project Adaptive Management Program. The plan identifies performance measures along with desired outcomes (i.e. targets) and monitoring designs in relation to specific project goals and objectives. Performance is measured against the predicted benefits generated by the project as quantified by the WVA and project modeling. A performance measure includes specific feature(s) to be monitored to determine project performance. If applicable, a risk endpoint would be identified. Risk endpoints measure undesirable outcomes of a management or restoration action.

Objective 1: Restore the barrier structures to ensure their ability to provide geomorphic and hydrologic form and function.

Performance Measure 1: Aerial extent.

Desired Outcome: Maintain an aerial extent that matches the predicted aerial extent of the species specific landscape features (surface area of barrier island habitats) at a particular point in time as estimated by project modeling. For the Caminada Headland, renouishment in conjunction with the maintenance dredging of Belle Pass will stabilize the size of the project area. Over each 10 year period, desired acreage would be within 15% of the constructed area of 2,066 acres. Shell Island will be renourished in years 20 and 40. The desired acreage would be within 15% of the following values TY 10 – 650 acres; TY 15 – 617 acres; TY 25 – 688 acres; TY 30 – 648 acres; TY 35 – 615 acres; and TY 45 – 688 acres.

Monitoring Design: Aerial photography will be used to assess the barrier headland/island's dimensions over time. One pre-construction and three post-construction surveys will be obtained.

Objective 2: Restore and improve various barrier headland/island habitats that provide essential habitats for fish, migratory birds, and other terrestrial and aquatic species, mimicking, as closely as possible, conditions which occur naturally in the area.

Performance Measure 2: Habitat composition.

Desired Outcome: Provide a distribution of acreage between habitat types that matches the predicted acreages of the barrier island habitats at a particular point in time. Successful barrier islands in Louisiana require beach, dunes, and marsh. The acres would be equal to or greater than those predicted at varying target years in the WVA for the dune, supratidal, and marsh habitats. For the Caminada Headland, renouishment in conjunction with the maintenance dredging of Belle Pass will stabilize the size of the project area. Over each 10 year period, desired acreage for beach/dunes will be within 15 % of 880 acres. Desired acreage for marsh

will be within 15 % of 1,186 acres. For Shell Island, The desired acreage would be within 15% of the following values TY 10 – 257 acres of beach and dune and 393 acres of marsh; TY 15 – 235 acres of beach and dune and 382 acres of marsh; TY 25 – 278 acres of beach and dune and 410 acres of marsh; TY 30 – 256 acres of beach and dune and 392 acres of marsh; TY 35 – 234 acres of beach and dune and 381 acres of marsh; and TY 45 – 278 acres of beach and dune and 410 acres of marsh.

Monitoring Design: Habitats will be classified using aerial photography to assess trends in conversion of beach and marsh to open water. One pre-construction and three post-construction acquisitions will be obtained. Site visits will monitor plantings and check accuracy of aerial photography assessments.

Objective 3: Increase sediment input to supplement long-shore sediment transport processes along the gulf shoreline by mechanically introducing compatible sediment, and increasing the ability of the restored area to continue to function and provide habitat with minimum continuing intervention.

Performance Measure 3: Island elevation changes.

Desired Outcome: Maintain elevation profile that matches the predicted profiles of the associated barrier island landscape features at a particular point in time. Desired elevations would match the elevation classifications of the WVA: dunes greater than or equal to +5 feet NAVD88 and marshes between 0 feet NAVD88 and +2 NAVD88.

Monitoring Design: Topographic surveys will be used to determine the cross shore profile and volumes of the barrier islands in order to characterize the changes that are occurring in the sediment budget and barrier platform stability over time. One pre-construction and three post-construction acquisitions will be obtained.

Costs for implementing the Monitoring and Adaptive Management Plans

To be conservative, the costs assume the maximum allowable cost shared time of 10 years. Should ecological success be determined in less than 10 years, no further monitoring will be performed and costs will be less than estimated.

Annual site visits are planned. The site visits will take two days (one for each reach) and require two additional days per site to evaluate and document the results of the investigation. Site visits to Shell Island will require the rental of a boat, estimated at a cost of $1,600 per trip. In addition to the annual site visits, aerial photography will be used to assess the barrier shorelines' dimensions and habitat distribution. Evaluations of the aerial photography will take place every three years at a cost of $25,000 each. Additionally, one pre-construction evaluation will be completed.

One pre-construction and three post-construction surveys will be obtained at a cost of $150,000 per cycle. Evaluation of the surveys and documentation of the findings will cost an estimated $20,000 per cycle or $80,000. **Table 3-8** provides a detailed description of the costs.

Table 3-8 Ten Year Cost Description (October 2011)

Activity	Purpose	Description	Unit Cost	Ten Year Cost
Site Visits	Monitor plantings. Evaluate habitat composition. Monitor for ESA compliance	Annual visits. 2 days for visits. 4 days for documentation	$19,000	$190,000
Boat Rental	Access to Shell Island		$1,600	$16,000
Aerial Photography Evaluations	Evaluate aerial extent and habitat composition	Evaluate aerial photography to assess island dimensions and classify habitats	$25,000	$100,000
Surveys	Evaluate aerial extent, habitat composition, and island elevations	One pre-construction and three post-construction surveys	$150,000	$600,000
Survey Evaluations	Evaluate aerial extent, habitat composition, and island elevations	5 days for evaluation of each reach	$20,000	$80,000
Cost				$986,000
Monitoring & Adaptive Management Cost w/ Contingencies				$1,299,000

The project will be adaptively managed by altering the required operations and maintenance based on the renourishment needs for the barrier shorelines. The O&M is the responsibility of the nonfederal sponsor. The need for renourishment will be impacted by the number and intensity of storms and the impact of future projects such as the LCA Medium Diversion at Myrtle Grove and any other coastal restoration projects. Monitoring results will determine the need for varying

the O&M. The nonfederal sponsor, as part of its O&M responsibilities, will be responsible for the increase or decrease in O&M costs.

Adaptive management triggers reflect aerial extent (acres), habitat composition (acres), and island elevation (elevation profile of habitat type.) For the Caminada Headland, timing of the renourishment will be dependent upon the maintenance dredging requirements of the Bayou Lafourche, Louisiana navigation project unless the monitoring reveals a more immediate need. O&M requirements will be determined by the need to balance the sediment budget, breaches or imminent breaches in the shoreline, or erosion of the beach that threatens the dunes. If acres are not achieved, O&M cycles would be adjusted to ensure that target acres are met, similar to the O&M triggers discussed in section 3.8.11. For island elevation, O&M would be adjusted to include the use of construction techniques such as the construction of dunes to target height or addition of material to the marshes (marsh renourishment.) For the Caminada Headland, when the distance between the dunes and the water decreases to 50 feet, O&M would be required. For Shell Island, the monitoring results may indicate the need to change the timing or quantities estimated for the renourishment. The timing of the O&M can be either pushed up or moved back dependent upon the achievement of the desired outcomes. Should the island narrow to approximately 300 feet in width prior to year 20, O&M would be scheduled.

Monitoring results from aerial photography, surveys, or site visits, will also determine the placement of the material on the Caminada Headland. Should the placement of the dredged material be within the federal standard, there will be no incremental cost to the nonfederal sponsor. If the material is placed outside of the federal standard, but west of the nodal point, the cost of the O&M will decrease. However, should monitoring determine that the material should be placed east of the nodal point, the nonfederal sponsor will be responsible for the additional cost. If more material is required than is provided by the maintenance dredging, it is the nonfederal sponsor's responsibility to locate additional sand sources.

Ecological Success

Close out of the monitoring would occur when it is determined that the project has been successful. Success would be considered to have been achieved when project objectives have been met or when it is clear that they will be met based upon the trend for the site conditions and processes. Project success would be based upon the following:

- Reduction in land loss in the project areas
- Decline in current trend in conversion of beach and marsh to open water
- Increase in elevation

These criteria will be compared to the performance measures and the desired outcomes to ensure that the project is achieving the stated objectives. Once it is determined that the project is performing as expected, ecological success may be determined.

3.9 RISK AND UNCERTAINTY ANALYSIS

Risks and uncertainties related to the formulation, selection and implementation of the Recommended Plan have been considered in this study. Uncertainties in the analysis of the alternatives are associated with the precision of the information on ecosystem processes and the methods used to assess performance of alternatives. Physical processes associated with the evolution of coastal landforms are generally very complex. While the underlying principles controlling these processes are well understood, reliable simulation of such processes and their interactions (wind and wave processes, ocean currents, tides, sediment transport, storms) may require very large amounts of data. In order to analyze the alternatives at an appropriate level of detail and reliability for selection of the Recommended Plan, a number of simplifying assumptions and approaches were used to evaluate the restoration feature performance for the alternatives. These uncertainties, assumptions and limitations on reliability of the analyses are provided in the Engineering Appendix. Where uncertainties are present regarding the particular values to use for certain processes or conditions in the study, generally, a mid-range value was selected. A value assignment may be selected that is not at or near the midpoint of a range of estimates where the value can be justified based on the best professional judgment of the PDT members, or where there is a particular rationale for the value selected, such as the need for a conservative safety factor in selection of an estimate. A formal cost risk analysis was completed in accordance with ER 1110-2-1302.

An assessment of sea level rise was included in plan formulation, alternatives analysis, and the report per the Corps' guidance in place at the time the alternatives were formulated and evaluated. The evaluation of eustatic sea level rise and local subsidence is documented in the Engineering Appendix. The comparison of the rate of sea level change utilized in the Feasibility Study to the requirements of EC 1165-2-212 indicates that the sea level change projection used in this study lies between the intermediate and high trend lines identified in the EC. The subsidence rate of 0.0292 ft/yr utilized in the Feasibility Study, is higher than the rate observed at the Grand Isle CO-OPS gage, which is .0247 ft/yr. The eustatic sea level rise rate utilized in the Feasibility Study is 0.013 ft/yr, and is higher than the global eustatic rate of .0056/yr in the EC. The low, intermediate, and high rates of relative sea level rise (RSLR) are 0.0304 ft/yr, 0.0382 ft/yr, and 0.0640 ft/yr, respectively, using the USACE guidance. A RSLR rate of 0.043 ft/yr was applied in the BBBS alternative analysis.

An analysis was conducted on the effect of the various sea level rise rates on projected shoreline retreat at the project locations. The results showed that RSLR is the cause of approximately 1/3 of the total projected shoreline loss under future without project conditions. The variation between shoreline loss projections obtained using the high and low values provided in the EC is approximately 25% of the total shoreline retreat. Given that a RSLR value between the intermediate and high value was used in the analysis for this study, the projected shoreline change in the study is about 10% lower than the projected outcome based on the highest rate of change identified in the EC. While RSLR impacts shoreline recession, the conservative assumptions applied in the analysis performed for this study provides a result within the upper portion of the range of outcomes that would be generated following the EC methodology. Acreage and AAHUs would be slightly lower for the study area under the highest rate of sea level change scenario identified in the EC. Consequently the alternatives analysis and resulting benefits utilized in the Feasibility Study are sufficiently conservative for completion of this study and identification of the recommended plan. The risk that the Recommended Plan will not achieve the estimated benefits is minimal. Should the RSLR coincide with the low or intermediate rates as calculated per EC 1165-2-212, output will be greater than anticipated.

However, should the RSLR equal the high sea level rise trend, the project will produce less benefits than anticipated as shown in **Table 3-9**.

Table 3-9 Comparison of RSLR outputs at TY 50

	High RSLR=0.064 ft/yr	BBBS (Alternative Analysis) RSLR=0.043 ft/yr	Intermediate (BBBS Recommended Plan) RSLR=0.0382 ft/yr	Low (Historic) RSLR=0.0304 ft/yr
Caminada Headland Acres	1,736	1,929	2,064	2,122
Shell Island Acres	719	799	855	919

Renourishment through O&M will decrease the risks due to RSLR. Should RSLR be greater than estimated, the material utilized for O&M could be increased. Additionally, the risk of not achieving the benefits stated is minimal. For the Caminada Headland reach, the estimated acres equal or exceed the construction template at year 50 for the intermediate and historic RSLR scenarios, and exceed the existing conditions at all sea level rise rates. For Shell Island, the estimated acres exceed the construction template for all but the high sea level rise rates, and exceed the existing conditions for all RSLR scenarios. **Figure 3-30** displays the sea level rise rates calculated per the EC and the sea level rise utilized in plan formulation for BBBS.

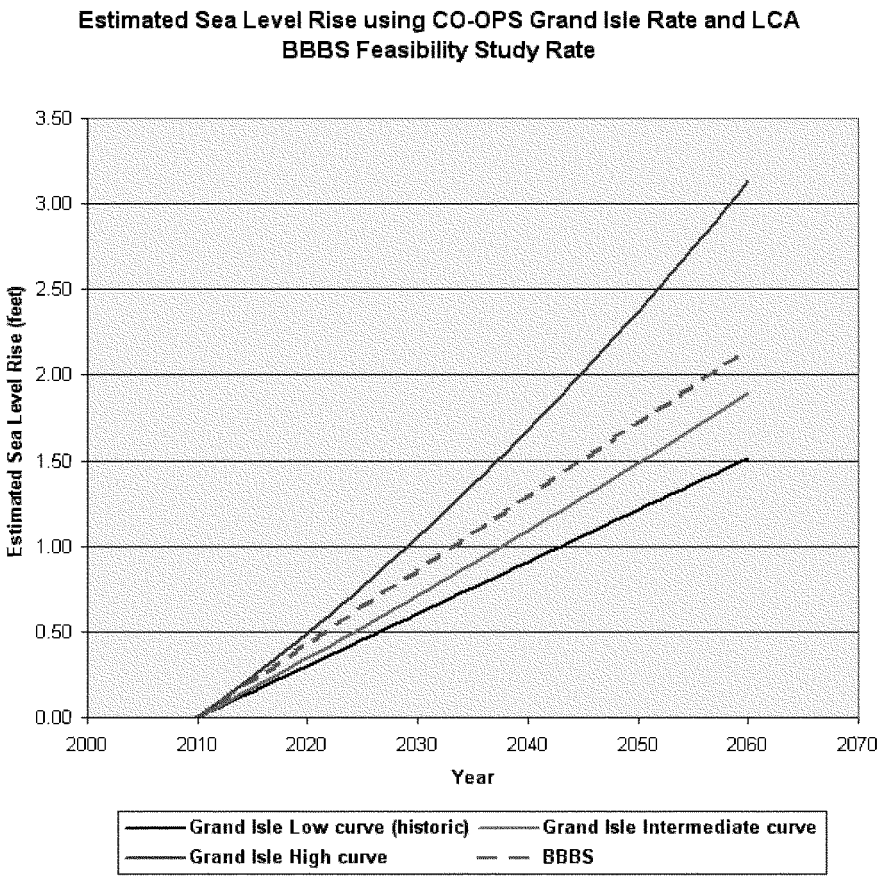


Figure 3-30 Comparison of sea level rise rates

Extreme Weather Events

Risks associated with the project alternatives are primarily related to the possibility of extreme weather events during the project period of performance. If powerful tropical weather systems pass over the project area more frequently, the overall performance and benefits of the restoration features may be greatly reduced, or even eliminated, by such events. The assumptions are based on historical observations of the frequency of repeat events that are considered likely to occur during the period of analysis. While a project could be designed to provide benefits after impacts of a major storm event or multiple events, this approach would

require costs and resource commitments that would be unnecessary under conditions that are more likely to occur during the period of analysis.

Near the completion of the study, the study area was impacted by Hurricanes Ike and Gustav. Storms are included in the erosion used in the analyses. By using a long-term record of erosion caused by both storm and normal events, the effects of such storms are incorporated, which reduces the uncertainty in the determination of project benefits.

The planned renourishment for the Caminada Headland is dependent upon the maintenance schedule of the Bayou Lafourche navigation channel. While on average, the channel is dredged every 1.5 years and produces 650,000 cubic yards of material, storm events impact the frequency of the channel dredging. Should the coast experience a period of no storms, the channel may not need to be dredged as often as anticipated. However, if the coast does experience a period of few storms, the headland will not experience as high a rate of erosion as estimated.

Timing of Occurrence

Uncertainty concerning the prediction of project benefits can be attributed to the uncertainty in the occurrence (timing) of significant storm events. A qualitative analysis of the plausible outcomes on benefit acres and resultant AAHUs from severe storms impacting the barrier shorelines in earlier years than those modeled within the Wetland Value Assessment (Environmental Work Group, 2002) for the period of analysis is presented below.

System-wide

Shifting the time frame of severe storm impacts to an earlier year will apply to both the Future With Project (FWP) and Future Without Project (FWOP) scenarios. For the FWOP, a major storm event can eliminate what limited dune or supratidal acres are present, thus reducing the acres through conversion to supratidal, intertidal or open water acres by a combination of overwash and breach formation. Opening of breaches into interior marsh areas facilitates more intertidal conversion to open water through marsh deterioration from salinity stress. The same salinity stress effects the woody vegetation, another contributor to desirable WVA acreage values. This will result in a reduction of benefit acres and the respective AAHUs.

For the FWP, a major storm event can reduce dune acres, while concurrently increasing the supratidal acres of the barrier shorelines by washover of the dune sediment. Since the dune and supratidal habitats are equally weighted in the WVA for both the Barrier Island and Barrier Headland Models, conversion from one habitat zone to another would not necessarily alter the benefit acres or the respective AAHUs.

Due to the degraded state of these barrier shorelines, one plausible outcome of a major storm impacting the system earlier than predicted in the WVA Model is the net AAHU's will actually increase, resulting in an increase in benefits, as the FWOP benefits will reduce more rapidly than the FWP benefits.

Another scenario is there would be a reduction in the quantity of all of the habitat zones (e.g. loss of acres from the project boundary or conversion to open water) resulting in less project benefits than anticipated. As previously stated, the risk of not achieving the benefits stated is minimal as O&M is planned through renourishment and can be altered through the Adaptive Management Plan.

Shell Island

The Barrier Island WVA Model places the greatest weighting factor on the intertidal habitat compared to the dune and supratidal habitats, which are weighted equally. For the FWP, a major storm event may reduce the quantity of dune or supratidal habitat with a resultant increase in the intertidal habitat. While the total benefit acres may not change, the AAHUs could increase due to the weighting factor applied to the intertidal habitat. Conversely, the percent vegetative cover parameters in the WVA for the dune and supratidal may decrease, thus reducing the AAHUs.

Caminada Headland

The Barrier Headland WVA Model weights the dune and supratidal acres equally. The intertidal habitat is addressed through the Emergent Marsh Model. Thus emergent marsh is weighted equal to dune and supratidal habitat. For the FWP, a major storm event may reduce the quantity of dune or supratidal habitat with a resultant increase in the intertidal habitat. While the total benefit acres may not change, the AAHUs could increase due to increased quality and possibly quantity of marsh. Conversely, the percent vegetative cover parameters in the WVA for the dune and supratidal zone may decrease, thus reducing the AAHUs.

Model parameters

The numerical models (SBEACH and GENESIS) applied in development of the design sections and performance prediction of the various alternatives, while appearing to provide a specific response, are only representations of a complex system. While the analysis is enhanced by the models, application of the models can introduce error into the overall analysis. Calibration and verification efforts are employed so that the models more closely replicate observed changes or at least provide insight into the limitations of the model. Models are still limited by basic, underlying assumptions.

Some of the simplifying assumptions include the model parameters, for which a sensitivity discussion is included in Appendix A. Another area that adds uncertainty is that a limited number of profile lines are modeled. It is assumed that two or three cross-sections are representative of a much longer shoreline, whereas the natural system is not that uniform. The models also use available historic data to extrapolate future storm conditions and frequency. The size and frequency of storms included in the model are based on statistical analysis but do not account for meteorological changes, such El Nino and La Nina effects, that can increase or decrease storminess over a period of several years. For example, the project areas were subjected to Hurricanes Gustav and Ike within several weeks of each other but were spared from tropical storm impacts for several years thereafter. Neither do the models account for the potential of increased storminess due to climate change. The storm record for storms is constantly being updated and a large storm such as Hurricane Katrina or Ike can alter the expected return period for other storms.

Borrow sites have been designated in the report. Enough sediment sources have been identified for currently authorized projects in Louisiana. However, required borrow material from the identified sites cannot be reserved for this project. The Bureau of Ocean Energy, Management, Regulation, and Enforcement (BOEMRE) issues leases for Ship Shoal on a first come basis and there is no way to know whether or not another project will use the identified source before this project receives construction funding. Should another source be required, additional investigations will be required.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time even though, the relief well process was successfully completed on September 19, 2010 and the federal government declared the well "effectively dead". The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area, including the BBBS project. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available. If at any time petroleum or crude oil is discovered on project lands, all efforts will be taken to seek clean up by the responsible parties, pursuant to the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.).

3.10 IMPLEMENTATION REQUIREMENTS

3.10.1 Schedule

A Project Management Plan has been prepared for the Recommended Plan to identify specific tasks to be accomplished during the preconstruction engineering and design phase and to identify construction activities for the construction phase.

The PMP includes the following milestones:

- Availability of the Draft PIR/EIS — June 2011
- PED Start — June 2012
- Chief of Engineers Report — June 2012
- Construction of Caminada Headland — October 2013

3.10.2 Division of Implementation Responsibilities

3.10.2.1 Preconstruction Engineering and Design

Detailed design of the BBBS Project will be shared between LaCPRA and the USACE. All detailed design will be in accordance with USACE's regulations and standards.

3.10.2.2 Construction and LERRDs

Activities within the Construction Phase would be in accordance with the USACE's regulations and standards. Crediting for work performed by LaCPRA would be subject to project authorization and adherence to USACE design standards and regulations. Lands, easements, right-of-ways, relocations and disposal (LERRDs) would be the responsibility of the LaCPRA.

3.10.2.3 Operations and Maintenance

All future OMRR&R for the restoration project would be accomplished by the non-Federal sponsor at 100 percent non-Federal cost. Operations and Maintenance of structures would be required. The non-Federal sponsor would repair and/or replace the sand fencing, as required. Additionally, the non-Federal sponsor would monitor the project area and enforce the easement restrictions. All costs associated with the renourishment of the Caminada Headland and Shell Island are the responsibility of the non-Federal sponsor. For the Caminada Headland, the non-Federal sponsor will be responsible for the incremental cost over the federal standard for the beneficial use of the dredged material removed during the maintenance of the Bayou Lafourche navigation channel. The non-Federal sponsor will provide the cost share in a timely manner that does not delay scheduled channel maintenance.

3.10.3 Cost Sharing

The State of Louisiana, acting through the Coastal Protection and Restoration Authority of Louisiana (CPRA), will be the non-Federal sponsor for the LCA Barataria Basin Barrier Shoreline project. The cost-share during the feasibility phase was 50% Federal and 50% non-Federal. Following the feasibility phase, the cost share for the planning, design and construction of the project will be 65% Federal and 35% non-Federal. The CPRA must provide all lands, easements, rights-of-way, utility or public facility relocations, and disposal areas (LERRDs) required for the project. Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) of the project would be a 100% CPRA responsibility. The O&M costs are estimated to have a present value of $132,834,761 with an average annual cost of $6,183,485 (October 2011 price levels). The cost apportionment for the first costs is presented in **Table 3-10.**

Table 3-10. Cost Apportionment of First Costs: Recommended Plan
(October 2011 Price Level)

Item	Total	Federal	Non-Federal
PED	$6,800,000	$4,420,000	$2,380,000
Construction	$409,000,000	$268,255,000	$140,745,000
Lands, Easements, Rights of way	$3,700,000	$0	$3,700,000
Monitoring & Adaptive Management	$1,299,000	$844,350	$454,650
Total First Costs(R)	$428,262,000	$278,370,300	$149,891,700

The estimated fully funded construction cost of the BBBS project is $448,351,000 (October 2011).

The State of Louisiana is in full support of the LCA Barataria Basin Barrier Shoreline Restoration project at the current cost share ratio of 65 percent Federal, 35 percent non-Federal, with operations, maintenance, repair, replacement and rehabilitation being a 100 percent non-Federal responsibility, as required in WRDA 2007. Additionally, project monitoring and any Adaptive Management deemed necessary will be cost shared at 65/35 for the first ten years of the project life.

Under current law, authority for the non-Federal sponsor to receive credit for construction activities is limited. Section 7007(a) of WRDA 2007 authorizes the Secretary to credit, "toward the non-Federal share of the cost of a study or project under this title the cost of work carried out in the coastal Louisiana ecosystem by the non-Federal interest for the project before the date of the execution of the partnership agreement for the study or project." In addition, section 7007(a) incorporates the requirement of section 221 of the Flood Control Act of 1970, as amended, (42 U.S.C. 1962d-5b) that the Government and non-Federal sponsor must enter into a separate agreement for any work that will be carried out prior to execution of the partnership agreement. In other words, work undertaken by the non-Federal sponsor prior to (but not after) execution of the project partnership agreement (PPA) is eligible for credit subject to execution of a separate agreement covering such work before it is undertaken. For design work that the non-Federal sponsor proposes to undertake, the Design Agreement will serve as the required separate agreement. For construction work that the non-Federal sponsor proposes to undertake, an In-Kind Memorandum of Understanding will be required. Opportunities to enter into an In-Kind MOU for construction activities will depend on the schedule for entering into the PPA for a project.

Section 7007(d) provides that credit afforded under section 7007 that is in "excess" of the non-Federal cost share for a study or project authorized in Title VII of the Water Resources Development Act of 2007 may be applied toward the non-Federal cost share of any other study or project under that title. "Excess" credit will be applied only toward another study or project involving the same sponsor. In addition, "excess" credit will be applied within project phases (i.e., study to study, design to design, and construction to construction). At this time, it is anticipated that that there are limited opportunities for the application of "excess credit" from other Title VII projects toward these projects.

3.10.4 Environmental Commitments

The USACE, its non-Federal sponsor, the LaCPRA, and contractors commit to avoiding, minimizing, or mitigating for adverse effects during construction activities by taking the following actions:

1. Employ best management practices with regard to erosion and turbidity control. Prior to construction, the construction team should examine all areas of proposed erosion/turbidity control in the field, and make adjustments to the plan specified in the plan control device as warranted by actual field conditions at the time of construction.

2. The contract specifications will prohibit the contractor from dumping oil, fuel, or hazardous wastes in the work area and will require that the contractor adopt safe and sanitary measures for the disposal of solid wastes. The contractor will be required to prepare a spill prevention plan.

3. Demolition debris would be transported to a landfill or otherwise disposed of in accordance with Federal, State of Louisiana, and local requirements. Concrete or paving materials would be disposed of in accordance with Federal, State of Louisiana, and local requirements.

4. Inform contractor personnel of the potential presence of threatened and endangered species in the project area, the need for precautionary measures and the Endangered Species Act prohibition on taking listed species.

5. The following special measures will be incorporated during project construction to minimize effects to any listed species that may be present. a) Due to the length of the project development, implementation and construction processes, and because the USFWS requires annual update of listed species information, the USACE will re-initiate consultation with the USFWS on an annual basis until construction begins, or at any time if there are changes in the scope or location of the proposed action that would produce project effects not considered in the Biological Assessment. b) To minimize disturbance to colonial nesting seabirds which have historically nested on the remnant Shell Islands, all activity occurring within 650 feet of a rookery containing nesting gulls, terns and/or black skimmers should be restricted to the non-nesting period (i.e., September 16 through April 1, depending on species present). c) The Shell Island project area should be surveyed for nesting shorebirds prior to construction to avoid disturbance to those species. In addition, on-site contract personnel shall be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

6. Both the LaCPRA and the USFWS have been consulted for recommendations on avoidance of impacts to federally listed and state listed species. Both the LaCPRA and USFWS will be consulted in the event that colonial or solitary wading bird nests are observed within the construction footprint.

7. The USACE agrees to maintain an open and cooperative informal consultation process with the USFWS throughout the design, construction, and operation of this restoration project.

8. To protect cultural resources, conditions stipulated by the SHPO will be followed. Language will be included in construction contract specifications outlining the steps to be taken in the event that undiscovered historical properties or unmarked human burials are encountered. An informational training session, developed by a professional archaeologist, will be conducted for the contractor's personnel to explain what kinds of archaeological/cultural materials might be encountered during construction of the impoundment, and the steps to be taken in the event these materials are encountered. A professional archaeologist will conduct periodic monitoring of the project area during ground disturbing activities to determine if activities are impacting unanticipated cultural resources.

9. The USACE agrees to carefully mark and stake the boundaries of the project footprint on both the Caminada Headland and Shell Island and ensure that those markers are maintained for the duration of project construction activities. Should the project extend outside of those boundary markers, the USACE would reinitiate ESA section 7 consultation as soon as possible.

10. The USACE agrees to conduct a baseline piping plover survey within the migrating and wintering season immediately prior to initial construction in order to determine the piping plover's preferred habitat use within the action area. Such information could then be used as an aid to determine whether specific project actions require slight modifications in order to minimize the effects of the take for future migrating and wintering seasons. For example, initial bird surveys may aid in locating and marking appropriate ingress and egress routes for ORVs

and other work-related equipment, as well as equipment staging areas, in order to reduce disturbance to foraging and roosting birds to the maximum extent practicable.

11. The USACE agrees to conduct a simple diversity and abundance survey of the intertidal benthic prey species community within the migrating and wintering season immediately prior to initial construction (preferably at the same time as the plover distribution surveys) in order to establish a baseline of benthic prey species diversity and abundance. Again, such information could then be used as an aid to determine whether specific project actions require slight modifications in order to minimize the effects of the take for future migrating and wintering seasons. For example, initial surveys could locate areas of abundant benthic prey where birds may tend to congregate for foraging, and those areas could be flagged for avoidance by regular personnel traffic to reduce disturbance to foraging plovers.

12. The USACE agrees to conduct piping plover monitoring surveys during the migrating and wintering seasons throughout the initial project construction and three consecutive years following completion of initial construction in order to determine whether ingress and egress routes are working or whether they need to be adjusted.

13. The USACE agrees to determine the length of time needed for recovery of suitable foraging habitat for migrating and wintering plovers. Monitoring surveys of the intertidal benthic prey species community would be conducted each year following completion of initial construction for three consecutive years. Such information could then be used as an aid to determine whether specific project actions require slight modifications in order to minimize the effects of the take for future project renourishment and/or maintenance events.

14. The USACE agrees to notify the Service in writing at least six months prior to mobilization, when renourishment events (i.e., renourishment of the subtidal feeder bar and of Shell Island) would occur within the action area so that the Corps and the Service can coordinate and exchange updated information to ensure that reinitiation of consultation is not necessary.

15. The USACE will continue coordination with the LDWF and its designated POC's Julia Lightner and Vaughn McDonald, as well as securing a Special Use Permit for work on the LDWF Elmer's Island Wildlife Refuge.

16. The USACE will provide a written response regarding the proposed EFH conservation recommendations in a manner to ensure that it is received by NMFS at least 10 days prior to the final approval of the action.

3.10.5 Financial Requirements

It is expected that the CPRA will have the capacity to provide the required local cooperation for the first component of construction. A project schedule and cost estimate will be provided to the CPRA so that it may develop a financing plan. A standard cost share percentage of 65% Federal and 35% non-Federal would be applied to the total first cost of the project, including the value of PED costs construction features. A self-certification of financial capability for decision documents is included in this section.

Section 7007(b) of WRDA 2007 provides that "The non-Federal interest may use, and the Secretary shall accept, funds provided by a Federal agency under any other Federal program, to satisfy, in whole or part, the non-Federal share of the cost of the study or project if the Federal

agency that provides the funds determines that the funds are authorized to carry out the study or project." If the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), formerly the Mineral Management Services (MMS), determines in writing that funds it provides to the non-Federal sponsor under the Energy Policy Act of 2005 (Coastal Impact Assistance Program - CIAP) and the Gulf of Mexico Energy Security Act of 2006 (GOMESA) are authorized to be used to carry out LCA projects, the non-Federal sponsor can use those funds toward satisfying its local cooperation for the project, including the non-Federal sponsor's acquisition of Lands, Easements, Relocations, Right-of-ways and Disposals (LERRD) required for the project.

By letters dated July 2, 2009 and December 18, 2009, a process was established for the BOEMRE to provide its written determination regarding the acceptability of the use of CIAP funds for LCA studies, projects, and programs. That process provides that the BOEMRE's written determination for a specific study, project, or program will take the form of the grant award document for that activity. An updated written determination by the federal CIAP managing agency that states that CIAP funds are authorized to be used to carry out the project will be required prior to the approval of a Project Partnership Agreement for execution.

NON-FEDERAL SPONSOR'S
SELF -CERTIFICATION OF FINANCIAL CAPABILITY
FOR DECISION DOCUMENTS
FOR THE LOUISIANA COASTAL AREA BARATARIA BASIN
SHORELINE RESTORATION PROJECT

I, Garret Graves, do hereby certify that I am the Chairman of the Coastal Protection and Restoration Authority of Louisiana (the "Non-Federal Sponsor"); that I am aware of the financial obligations of the Non-Federal Sponsor for the Louisiana Coastal Area Barataria Basin Barrier Shoreline Restoration Project; and that the Non-Federal Sponsor will have the financial capability to satisfy the Non-Federal Sponsor's obligations for the Louisiana Coastal Area Barataria Basin Barrier Shoreline Restoration Project. I understand that the Government's acceptance of this self-certification shall not be construed as obligating either the Government or the Non-Federal Sponsor to implement a project.

IN WITNESS WHEREOF, I have made and executed this certification this 12th day of January, 2012.

BY: _____

TITLE: CPRA Chairman

DATE: 01/12/12

3.10.6 Items of Local Cooperation

The recommendation contained herein reflects the information available at this time, 2011 price levels, and current Departmental policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program or the perspective of higher levels of review within the Executive Branch. Consequently, the recommendation may be modified before they are transmitted to Congress for authorization and/or implementation funding. However, prior to transmittal to Congress, the State of Louisiana, interested Federal agencies, and other parties will be advised of any significant modifications in the recommendations and will be afforded an opportunity to comment further.

WRDA 1996. The State of Louisiana, acting as the non-Federal sponsor, would provide the non-Federal cost share and all lands, easements, relocations, right-of-ways and disposals. Further, the non-Federal sponsor would be responsible for all OMRR&R. This recommendation is subject to the non-Federal sponsor agreeing to comply with all applicable Federal laws and policies, including but not limited to its agreeing to:

a. Provide a minimum of 35 percent of total project costs as further specified below:

1. Enter into an agreement which provides, prior to execution of the project partnership agreement, 25 percent of design costs;

2. Provide, during the first year of construction, any additional funds needed to cover the non-Federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material, perform or ensure the performance of all relocations, and construct improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material that the Government determines to be necessary for the construction, operation, maintenance, repair, replacement, and rehabilitation of the project;

4 Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of the total project costs allocated to the project;

b. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1percent of the total amount authorized to be appropriated for the project;

c. Not use funds provided by a Federal agency under any other Federal program, to satisfy, in whole or in part, the non-Federal share of the cost of the project unless the Federal agency that provides the funds determines that the funds are authorized to be used to carry out the study or project;

d. Not use project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;

e. For as long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the project, or functional portion of the project, including mitigation, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in

accordance with applicable Federal and state laws and regulations and any specific directions prescribed by the Federal Government;

f. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

g. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

h. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

i. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

j. Agree that, as between the Federal Government and the non-Federal sponsor, the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that would not cause liability to arise under CERCLA;

k. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce ecosystem restoration benefits, hinder operation and maintenance, or interfere with the project's proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

l. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as would properly reflect total costs of construction of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

n. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements, including but not limited to 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c et seq.); and

o. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

3.10.7 Views of non-Federal Sponsor

The State of Louisiana fully supports the project. The state recognizes the USACE's position that section 7007 does not authorize credit for work carried out after the date of a partnership agreement. However, the state disagrees with the USACE position and intends to continue to seek a change in law that would allow in-kind contribution credit for work carried out after the date of a Project Partnership Agreement and that would allow for such in-kind contributions credit to carry over between LCA Program components (i.e., "excess" credit for work undertaken after signing of the project partnership agreement for one project may be carried over for credit to another project). The state also disagrees with the USACE's requirement that this critical near-term project be sustained in perpetuity as part of the non-Federal sponsor's O&M responsibilities and intends to seek U.S. Army/Corps of Engineers policy changes or the enactment of Federal law that would additionally address this issue. Nevertheless, while the state is of the opinion that its views are consistent with the authority and Congressional intent under WRDA 2007, the state fully intends to proceed with the project under the Corps' interpretation of current law and to meet all non-Federal financial and other obligations outlined by the USACE in this report until such time as the law is changed.

A letter of intent has been provided by the non-Federal sponsor.

State of Louisiana

BOBBY JINDAL
GOVERNOR

January 6, 2012

Colonel Edward R. Fleming
New Orleans District
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, LA 70160-0267

Dear Col. Fleming:

The State of Louisiana is pleased to offer its continuing support of the Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline (BBBS) project as authorized in the Water Resources Development Act of 2007 (WRDA 2007). This project is a critical part of the overall LCA Program and a vital component in rehabilitating the natural system of coastal Louisiana that serves to protect the economic and energy security of both the state and nation, the safety of more than 2 million Louisiana residents, the ecological balance of the Gulf region, and the survival of a unique culture.

This letter, while not legally binding on the State as an obligation of future funds appropriated by the State Legislature, declares our full support for the LCA BBBS project as described in the final BBBS report dated January 2012, with cost sharing as required in WRDA 2007. Accordingly, the State acknowledges that the project requires the non-Federal sponsor to contribute 35% of the total project costs, including all lands, easements, rights-of-way, relocations, work in kind and any improvements on lands, easements, and rights-of-way required for disposal of dredged material. The State also acknowledges that it will be required to perform all activities necessary to operate, maintain, rehabilitate, repair and replace the project at the State's expense, including the performance of renourishment for the project features as described in the decision document.

The State of Louisiana fully supports this project, and the Coastal Protection and Restoration Authority will make diligent efforts to secure all necessary funding, including asking the State legislature for additional appropriations if necessary. Nevertheless, as we have previously stated the Coastal Protection and Restoration Authority and the State of Louisiana reserve the right to seek U.S. Army/Corps of Engineers policy changes or the enactment of Federal law to reduce the non-Federal cost share and address the current requirement that critical near-term restoration projects, such as the BBBS project, be sustainable as standalone features in perpetuity.

The State of Louisiana and the Coastal Protection and Restoration Authority whole-heartedly endorse this and other Corps' efforts to restore Louisiana's coastal ecosystem, and we look forward to working with the Corps on the implementation of this important project.

Respectfully,

Garret Graves, Chair
Coastal Protection and Restoration Authority

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Table 3-11. Comparison of Final Array of Alternatives to the No Action Alternative (Future Without Project Conditions) Among Significant Resources.

SIGNIFICANT RESOURCE	No Action Alternative (FWOP)	C5/S5(Recommended Plan /NER)	C5
Soils	Loss of 3,750 acres of soil resources (Scatlake) from Caminada Headland and 386 acres (Felicity) from Shell Island over 50-year period of analysis.	Restore net total of 1,684 acres of soils over 50-year period of analysis	Restore net total of 990 acres of soils over 50-year period of analysis
Offshore, Nearshore, and Riverine Sand Resources	Offshore sand shoals (Ship Shoal) and nearshore sand bodies likely to remain target for oil and gas exploration and extraction activities. Riverine sand resources continue to be used for construction of civil works and other projects; soil conservation practices upriver continue resulting in decrease of available sediments to replenish riverine sediment borrow sites.	Removal 10,500,000 CY of borrow from Ship Shoal and Caminada Headland nearshore borrow sites. Removal 6,006,500 CY from Mississippi River and Empire borrow sites. Removal of 10,000,000 CY from the Bayou Lafourche bar channel for renourishment of Caminada Headland.	Removal 10,500,000 CY of borrow from Ship Shoal and Caminada Headland nearshore borrow sites.
Barrier Systems: Barrier Shorelines, Headlands, and Islands	Continued fragmentation and loss of Caminada Headland and Shell Island further accelerates interior coastal wetland loss and conversion of interior wetlands to open water. Loss of Shell Island results in coalescence of Bastian and Shell Island Bays directly connecting to the Gulf of Mexico.	Restoration of Caminada Headland and Shell Island and other Louisiana barrier shorelines may also receive indirect benefits from the introduction of sand via littoral drift from the restored barrier system.	Restoration of Caminada Headland and other Louisiana barrier shorelines may also receive indirect benefits from the introduction of sand via littoral drift from the restored barrier system.
Coastal Processes	As barrier land loss continues, hydrologic connections between the gulf and interior areas increase and exacerbate interior land loss and conversion of habitat types. Continued loss of barrier systems result in reduction and eventual loss of the natural protective storm buffering of these barrier systems	Barrier system restoration, combined with interior marsh creation and restoration measures and renourishment of the Caminada Headland, 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 Caminada Headland would be similar to the Recommended Plan /NER plan but without the restoration of Shell Island which, over time, would be lost, thereby altering the tidal prism and increasing saltwater intrusion into the interior portions of eastern Barataria Basin.
Salinity Regimes	Continued barrier and interior land losses results in conversion to open water habitats; increased number of tidal inlets, disruption of the tidal prism and increased salinity intrusion into upper Barataria Basin.	Implementation would result in little, if any impacts on salinity regimes.	Implementation would result in little, if any, impacts on salinity regimes to the Caminada Headland area. However, Shell Island would not be restored, resulting in the eventual loss of the island and increasing salinity intrusion into upper portions of the eastern Barataria Basin.

SIGNIFICANT RESOURCE	No Action Alternative (FWOP)	C5/S5(Recommended Plan /NER)	C5
Water Quality	Decrease in water quality in upper portions of Barataria Basin; increasing potential for accidental discharges due to exposed infrastructure because of continued coastal land loss.	Short term and minor water quality impacts primarily during construction e.g., increased turbidity, decreased DO associated with placement of dredged material.	Short term and minor water quality impacts primarily during construction e.g., increased turbidity, decreased DO associated with placement of dredged material.
Vegetation Resources	Without coastal barrier system restoration vegetation resources, including beach pioneer, frontier zone, dune, barrier grassland, salt flats, salt marsh, intertidal mud flats, and spoil banks associated with barrier and coastal wetland habitats are expected to decrease not only within the study area, but throughout coastal Louisiana.	Net total of 1,684 acres of vegetated barrier habitats restored. Plantings of native species increase important and critical vegetated habitats used by fish and wildlife.	Net total of 990 acres of vegetated barrier habitats restored. Plantings of native species increase important and critical vegetated habitats used by fish and wildlife.
Wildlife Resources	Loss of important and essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, migratory neotropic bird stopover habitat, nursery, and other life requirements.	Restore a total of 1,719AAHUs for a net total of 1,684 acres of important and essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, migratory neotropic bird stopover habitat, nursery, and other life requirements.	Restore a total of 988 AAHUs for a net total of 990 acres of important and essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, migratory neotropic bird stopover habitat, nursery, and other life requirements.
Fisheries Resources	Loss of transitional estuarine-marine habitats used for spawning, nursery, nesting, and foraging by commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms.	Net total of 1,684 acres of transitional estuarine-marine habitats used for spawning, nursery, nesting, and foraging by commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms.	Net total of 990 acres of transitional estuarine-marine habitats used for spawning, nursery, nesting, and foraging by commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms.
Essential Fish Habitat (EFH)	Continued institutional recognition of EFH. Continued loss of barrier habitats will adversely impact EFH including essential spawning, nursery, nesting, and foraging habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms.	The 1,698 acres existing water bottoms converted to Gulf subtidal = 223 acres, converted to beach = 111 acres, converted dune = 383 acres, converted to supratidal = 164 acres, and converted to marsh = 817 acres. The 987 acres of existing marsh on the converted to Gulf subtidal equals 0 acres, converted to beach equals <1 acre, converted dune equals 102 acres, converted to supratidal equals 105 acres, and converted to (remain) marsh equals 781 acres	The 925 acres existing water bottoms converted to Gulf subtidal = 223 acres, converted to beach = 58 acres, converted dune = 231 acres, converted to supratidal = 0 acres, and converted to marsh = 413 acres. The 977 acres of existing marsh on the Caminada Headland converted to Gulf subtidal equals 0 acres, converted to beach equals 0 acres, converted dune equals 101 acres, converted to supratidal equals 103 acres, and converted to (remain) marsh equals 773 acres.

SIGNIFICANT RESOURCE	No Action Alternative (FWOP)	C5/S5(Recommended Plan /NER)	C5
Water Bottoms and Benthic Resources	Patterns of benthic seasonal abundance in the Barataria system are not clear. Peak abundances and lowest abundances occur at different times in the different salinity regimes and may be correlated to the salinity pattern of a particular area or the migratory patterns of estuarine dependent predators.	26,506,500 cy borrow material required that directly impacts a total of 1,020 acres of water bottoms including 315 acres at Ship Shoal, 334 acres at the Caminada Headland gulf borrow site, 255 acres at the Mississippi River borrow site, 124 acres of Bayou Lafourche and 116 acres at the Empire borrow site.	10,500,500 cy of borrow required that directly impacts a total of 649 acres of water bottoms including 315 acres at Ship Shoal and 334 acres at the Caminada Headland Gulf borrow site.
Plankton Resources	Continued degradation and loss of barrier wetlands eventually result in decrease of available nutrients and detritus, which could lead to the conversion of primarily estuarine-dependent plankton species assemblages to more marine and open water plankton species assemblages.	Restoration of 1,684 net acres would increase the amount of dissolved organic compounds and detritus exported from the created and nourished barrier habitats thereby benefiting local plankton populations by increasing the planktonic food web.	Impacts similar to Alternative C5/S5 Recommended Plan except 990 acres would create fewer benefits to plankton resources.
Threatened & Endangered Species	Continued loss of barrier habitat and coastal wetlands resulting in loss of critical habitat (such as the Gulf shoreline) for piping plover and other threatened or endangered species, such as sea turtles which may utilize barrier habitats.	Proposed action is not likely to adversely impact brown pelican or piping plover or piping plover critical habitat. Proposed action would not adversely impact any other threatened or endangered species or their critical habitat. Rather, the Recommended Plan would restore 1,684 net acres of barrier habitats, including critical habitat for piping plover.	Proposed action is not likely to adversely impact any threatened or endangered species or their critical habitat. Rather, would restore 990 net acres of barrier habitats, including critical habitat for piping plover.
Historic & Cultural Resources	Cultural resources existing on Caminada Headland and Shell Island would be exposed to high energy Gulf elements or inundated, putting them at a greater risk of damage and destruction.	Intact deposits recorded within the project footprint have been eroded and destroyed by recent storms. However, SHPO has determined that covering these sites with sediments during restoration would provide some protection from further risk of destruction.	Impacts similar to those described for Alternative C5/S5 Recommended Plan.
Population	Study area is remote and uninhabited.	Study area is remote and uninhabited.	Study area is remote and uninhabited.
Infrastructure	Continued land loss and degradation leads to increased costs for maintaining and repairing existing oil and gas infrastructure.	This alternative would cover the existing exposed shoreline protection feature (cement-filled geotextile bags and concrete mattress) near Port Fourchon as well as cover over any buried pipelines on the Caminada Headland and Shell Island.	Impacts similar to those described for Alternative C5/S5 Recommended Plan except there would be no restoration feature on Shell Island.

SIGNIFICANT RESOURCE	No Action Alternative (FWOP)	C5/S5(Recommended Plan /NER)	C5
Employment and Income	Study area is remote and uninhabited, employment and income primarily related to commercial and recreational fisheries and oyster leases which may locally decrease due to barrier habitat degradation and loss of 3,750 acres from Caminada Headland and 386 acres from Shell Island.	Alternative would provide indirect benefits to commercial and recreational fisheries by increasing the quantity and quality of essential fish habitat necessary for nursery and other aquatic life functions as well as prevent existing oyster leases from being directly exposed to the higher saline waters of the Gulf	Impacts similar to Alternative C5/S5 Recommended Plan except 990 acres would benefit commercial and recreational fisheries and oyster leases.
Commercial Fisheries	The continued wetland habitat losses within the study area, combined with widespread coastal wetland loss throughout coastal Louisiana, would contribute to the overall decrease in productivity of Louisiana's coastal fisheries.	Short term impacts during construction would limit commercial fisheries. This would be offset by restoration of net 1,684 acres of barrier habitats increasing the quantity and quality of essential fish habitat necessary for nursery and other aquatic life functions.	Impacts similar to Alternative C5/S5 Recommended Plan except restoring 990 net acres of barrier habitats increasing the quantity and quality of essential fish habitat necessary for nursery and other aquatic life functions.
Oyster Leases	Loss of barrier habitats results in increased salinity conditions making these areas unsuitable for the viable culture of oysters.	24 oyster leases (about 904 acres) will be acquired for Shell Island; 8 leases (about 170.5 acres) will be acquired for Caminada Headland. Restoration of net 1,684 acres of barrier habitats increasing the quantity and quality of aquatic habitat as well as prevent existing oyster leases from being directly exposed to the higher saline waters of the Gulf.	Impacts would be similar to Alternative C5/S5except restoration of net 990 acres of barrier habitats increasing the quantity and quality of aquatic habitat as well as prevent existing oyster leases from being directly exposed to the higher saline waters of the Gulf
Oil, Gas, & Mineral	Not implementing proposed barrier restoration would have no impacts on these resources.	No oil or gas resources would be impacted. However 26,506,500 cy of sediments extracted from Ship Shoal, the Caminada Headland gulf borrow site, Bayou Lafourche borrow site, Mississippi River borrow site, the Empire borrow site.	No oil or gas resources would be impacted. However, 10,500,500 cy of sediments extracted from Ship Shoal the Caminada Headland Gulf borrow site.
Pipelines	Increased damages and probable relocations of pipeline assets.	Restoration would cover pipelines thereby provide some undetermined level of protection to pipelines from exposure.	Impacts similar to Alternative C5/S5 Recommended Plan except 990 net acres would provide some undetermined level of protection to pipelines from exposure.

SIGNIFICANT RESOURCE	No Action Alternative (FWOP)	C5/S5(Recommended Plan /NER)	C5
Navigation	Barrier system loss would expose navigation along Bayou Lafourche and to a lesser degree Empire Waterway to high energy gulf waters. Continued barrier system deterioration would require increased maintenance of Bayou Lafourche and Empire Waterway. As barrier deterioration continues, shoreline erosion will result in existing Belle Pass jetties becoming unattached (similar to Empire jetties) to the shoreline, reducing or eliminating their effectiveness.	Short term impacts due to construction limiting the movements of vessels near Bayou Lafourche and the Empire Canal. Restoration would buffer these waterways from higher energy gulf waters.	Impacts similar to Alternative C5/S5 Recommended Plan except impacts to Shell Island would be similar to the No Action Alternative.
Flood Control	There are no flood control structures within or nearby the study area.	Impacts similar to the No Action Alternative	Impacts similar to the No Action Alternative
Hurricane Protection Levees	There are no hurricane protection levees within or nearby the study area.	Impacts similar to the No Action Alternative	Impacts similar to the No Action Alternative
Agriculture	No agriculture within or nearby the study area; unlikely to have agriculture in study area.	Impacts similar to the No Action Alternative	Impacts similar to the No Action Alternative
Forestry	No forestry within or nearby the study area; unlikely to have forestry in study area.	Impacts similar to the No Action Alternative	Impacts similar to the No Action Alternative
Water Supply	There are no water supply facilities within the study area.	Impacts similar to the No Action Alternative	Impacts similar to the No Action Alternative

SIGNIFICANT RESOURCE	No Action Alternative (FWOP)	C5/S5(Recommended Plan /NER)	C5
Aesthetics	Continued human population growth and development and other human activities have the potential to destroy, enhance, or preserve visual resources.	Restoration and renourishment of the Caminada Headland could greatly increase the visual interests in the area. Shell Island is more remote and not as visually significant to the public, visual impacts will be minimal to the public view shed.	Restoration to the Caminada Headland could greatly increase the visual interests in the area.
Recreation Resources	Potential loss of recreational resource base due to coastal land loss and fish and wildlife habitat deterioration.	Recreational resources temporarily unavailable during construction activities. However, recreation opportunities may increase with restoration of 1,684 net acres of barrier habitats used by fish and wildlife.	Impacts similar to Alternative C5/S5 Recommended Plan except restoration of 990 net acres of barrier habitats increasing the quantity and quality of recreational opportunities
Noise	Continued human activities (e.g., recreation) have some associated noise pollution. Further institutional recognition likely to be enacted.	Short-term minor noise impacts associated with construction activities. Any noise within OSHA standards.	Short-term minor noise impacts associated with construction activities. Any noise within OSHA standards.
HTRW	Probability of HTRW in the remote study area considered low.	Impacts similar to the No Action Alternative	Impacts similar to the No Action Alternative
Air Quality	Continued deterioration of air quality due to increases in human populations, industrial and motorized vehicle emissions in upper portions of the Barataria Basin.	364.7 tons of volatile organic compounds (VOC) ; 4,493.7 tons of nitrous oxide (NO_X)	Air quality determination prepared only for Recommended Plan.

4.0 AFFECTED ENVIRONMENT *(NEPA-Required)*

This chapter describes the climate, geology, and historic and existing conditions for significant environmental resources including: soils; offshore, nearshore, and riverine sand resources; barrier systems (including barrier shorelines, headlands, and islands); coastal processes and hydrology; salinity regimes, water quality; vegetation resources; wildlife resources (including birds, mammals, amphibians, and reptiles); fisheries; essential fish habitat (EFH); plankton; water bottoms and benthic resources; threatened and endangered species; historic and cultural resources; socioeconomic and human resources (population; infrastructure; employment and income; commercial fisheries; oyster leases; oil, gas, and minerals; pipelines; navigation; flood control; hurricane risk reduction levees; agriculture; forestry; and water supply); aesthetics (visual resources); recreation; and air quality. In addition, noise and hazardous, toxic, and radioactive waste (HTRW) are also considered. A resource is considered important if it is recognized by statutory authorities including laws, regulations, Executive Orders (EO), policies, rules, or guidance; if it is recognized as important by some segment of the general public; or if it is determined to be important based on technical or scientific criteria. The final programmatic EIS for the LCA Study (USACE 2004) presents detailed historic and existing information relevant to this current study. Consistent with 40 CFR Part 1502.21, that information is incorporated by reference.

The impacts of the 2010 Deepwater Horizon oil spill on coastal Louisiana remain uncertain at this time (2011). The impacts of the oil spill and the various actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, and others) could potentially adversely impact USACE water resources projects and studies within the Louisiana coastal area. Potential impacts could include factors such as changes to existing conditions, as well as changes to future-without and future with project conditions.

4.1 GENERAL

4.1.1 Climate

The study area is located on the lower edge of the Barataria Basin of the Mississippi River Deltaic Plain. The National Data Buoy Center (http://www.ndbc.noaa.gov/), part of the National Oceanic and Atmospheric Administration (NOAA), provides a climatic summary from December 1984 to November 2001 for station GDIL1 at Grand Isle, Louisiana (http://seaboard.ndbc.noaa.gov/data/climatic/GDIL1.pdf), which is located east of the Caminada Headland. Climate in the study area is semitropical, primarily influenced by the Gulf of Mexico and largely determined by two pressure ridges. Data is shown in **table 4-1**.

Table 4-1. Climate Statistics.

	Minimum	Mean	Maximum
Air Temperature	14.2°F (-9.9 °C)	70.3 °F (21.3 °C)	93.7 °F (34.3 °C)
Sea Temperature	28.6 °F (-1.9 °C)	72.9 °F (22.7 °C)	95.0 °F (35 °C)
Air Pressure	29.1 in (987.2 mb)	30.0 in (1017.5 mb)	30.8 in (1041.9 mb)
Wind Speed	0.0 mph (0.0 kph)	0.0 mph (0.0 kph)	0.0 mph (0.0 kph)
Wind Direction, Summer		44% SE	
Wind Direction, Winter		38% N	
Rainfall (mostly summer)		65 in (165.1 cm)	

4.1.2 Tides and Currents

Site specific tidal information is not available; the closest tide gauge is located at Grand Isle, Louisiana, which is immediately adjacent to the eastern-most portion of the Caminada Headland and approximately 18 miles (29.0km) west of Shell Island. Tides at Grand Isle are diurnal, with a mean tide range of approximately 1.1 feet (33.5 cm). Tidal datums, determined by NOAA over a 5-year period between January 1997 and December 2001, are provided in **table 4-2**.

Table 4-2. Tidal Datums at Grand Isle, Louisiana

	Elevation (feet)		
	MLLW	**NGVD 29**	**NAVD 88**
Highest Observed Water level (8/29/2005)	5.59	5.92	5.37
Mean Higher High Water (MHHW)	1.06	1.39	0.84
Mean High Water (MHW)	1.05	1.38	0.83
Mean Sea Level (MSL)	0.53	0.86	0.31
Mean Tide Level (MLT)	0.53	0.86	0.31
North American Vertical Datum of 1988 - NAVD88 (2004.65)	0.22	0.55	0.00
Mean Low Water (MLW)	0.01	0.34	-0.21
Mean Lower Low Water (MLLW)	0.00	0.33	-0.22
National Geodetic Vertical Datum of 1929 - NGVD29 (1983)	-0.33	0.00	-0.55
Lowest Observed Water Level (12/24/1989)	-2.20	-1.87	-2.42

Source: NOAA - 5 September 2009, http://www.co-ops.nos.noaa.gov/benchmarks/8761724
Tidal datums referenced to Modified Tidal Datum Epoch 2002-2006
NAVD88 relationships are based on NAVD88 (2004.65) elevation on 876 1724 Tidal 11 of 3.12 feet.
NGVD29 relationships are based on NGVD29 (1983) elevation on 876 1724 Tidal 13 of 3.67 feet.
NGVD29 relationships are valid for this benchmark at the time of comparison

Offshore and littoral current velocities average between 0.7 to 1.0 feet/second (fps [0.2 to 0.3 meters/second (mps)]) and 1.2 fps to 1.7 fps (0.4 mps to 0.5 mps), respectively (USACE 2002). Peak ebb and flood current velocities in Grand Bayou Pass were measured to be 3.6 fps and 2.4 fps (1.1 to 0.7 mps) (SJB and CEC 2004). No current velocity data was found for Coupe Bob or Fontanelle Pass.

The Caminada Headlands lay at the mouth of Bayou Lafourche on the western edge of the Barataria Basin. Freshwater input is from Bayou Lafourche and includes a small diversion from the Mississippi River (Davis Pond). Not counting Bayou Lafourche, circulation and flushing patterns in neighboring estuaries are driven by tides, rainfall, and winds. Offshore and littoral current velocities are the same as above and average between 0.7 fps to 1.0 fps and 1.2 fps to 1.7 fps, respectively (USACE 2002).

4.1.3 Waves

4.1.3.1 Shell Island

Waves in the project areas are generated primarily by local winds, though significant wave events may occur due to distant storms. Tropical storms occur about every 2 years and generate the largest waves. Wave statistics generated for the project areas utilize the 1980 to1999 hindcast at WIS Station 132 (USACE, 2004) located at 29°5' N, 89°40' W. The station is located offshore and hindcasting waves from

all directions. The average significant wave (H_{m0})[1] is 2.6 ft (0.8 m) high with a period of 4.0 seconds[2]. Approximately 43 percent of waves originate offshore between 146° to 281°. The largest storm waves are associated with tropical storms that occur between August and October when water is warmest and typically come from the southeast, which is somewhat less of a problem for this location because of the sheltering effect of the lower Mississippi River. Waves however, refract around obstructions and the resulting attack can be significant. The average wave direction varies from east in October to south in July. However, within the onshore direction band, the wave direction is relatively constant throughout the year. The largest and longest waves come from the south-southeast around the tip of southwest pass.

Offshore wave heights for the 20 percent, 10 percent, and 5 percent (5-year, 10-year, and 20-year) conditions range from 15 feet to 20 feet (4.6 m – 6.1 m), with corresponding periods of 11.3 seconds to 13.5 seconds coming from the south (183°).

4.1.3.2 Caminada Headland

The Caminada Headland is located farther west of Southwest Pass than Shell Island and is therefore exposed to more southeasterly winds and waves. The Caminada Headland is midway between WIS 129 and WIS 130, but the data from WIS 129 is slightly more conservative (i.e. larger waves) so its data is reported here. The mean significant wave height (H_{m0}) and period (T) for all waves were 3.28 feet (1.0 m) and 5 seconds respectively. Approximately 66 percent of waves originate between 79° and 214°. Southwest Pass provides little protection to the Caminada Headland from major storm systems coming from the southeast.

4.1.4 Storms and Hurricanes

Hurricanes and tropical storms typically occur over the study area between June and November. On average, since 1871, a tropical storm or hurricane is expected somewhere within the state of Louisiana every 1.2 years; hurricanes make landfall about every 2.8 years (source: http//www.srh.weather.gov/lch/research/lahurclimo.php; Stone et al. 1997; Roth 1998). Historic data from the National Hurricane Center dataset on tropical cyclones (including tropical depressions, tropical storms, and hurricanes) along the Louisiana coast from 1899 to 2007 indicates a total of 63 storms, of which 49 were Category 3 or less.

The National Climatic Data Center (http://www.ncdc.noaa.gov/oa/climate/research/2005/katrina.html) indicates that tropical cyclone activity in the Atlantic basin has been above normal since 1995. This has been largely in response to the active phase of the multi-decadal signal. The average number of named storms since 1995 has been 13, compared to 8.6 during the preceding 25 years during which time the multi-decadal signal was in an inactive phase. An average of 7.7 hurricanes and 3.6 major hurricanes since 1995 compares to 5 hurricanes and 1.5 major hurricanes from 1970 to 1994.

The storm surge, a dome of water near the center of the storm, is typically the major component of destruction from a hurricane to coastal areas. Storm surge flooding across southeast 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). Consequently, Louisiana's low-lying coastal wetlands and barrier islands are eroded at a

[1] Significant wave refers to highest 1/3 of waves, which is approximately what viewers will report as average wave height in the field. H_{m0} refers to zero-moment wave, which is the same as the significant wave in deep water but is a more useful measure of wave height in shallow water due to changing wave shape.
[2] Waves are measured by height and length but from the beach, wave length is more easily measured in seconds and converted to length with formulas.

faster rate when a hurricane or storm crosses over Louisiana (Guntenspergen 1998). 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).

Storm wind statistics were compiled by Coastal Planning & Engineering (CPE 2003 based on National Data Buoy Center Station, http://www.ndbc.noaa.gov/) at the Grand Isle tide station from 1984 to 2001, and are presented in **table 4-3**. These wind data are considered as part of the project design criteria.

Table 4-3. Storm Wind Statistics (source: CPE 2003).

Frequency	Return Period	Stage (NAVD88, ft)	Speed (mph)	Direction (deg)
Quarterly	Quarter	1.6	41	2
Semi-annual	Semi-Annual	1.6	45	22
0.99	Annual	1.6	47	24
0.50	2 yrs	1.6	50	19
0.33	3 yrs	2.7	51	350
0.25	4 yrs	3.4	52	321
0.20	5 yrs	4.0	53	301

Due to the counter-clockwise rotation of winds, tropical storms passing west of Grand Isle usually cause the most damage, partly due to higher velocity but mainly because they drive seawater into the low-lying bays and estuaries. Coastal wetlands are depleted at a faster rate when a hurricane or storm crosses over Louisiana (Guntenspergen 1998). Although the storm surge is typically the major component of destruction from a hurricane, additional hazards include high winds, extreme rainfall rates, river flooding, salinity intrusion, sediment transport, tornados, levee collapse, and pollution of surge waters (Huh 2001, Pielke 1997). 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).

Hurricane and storm damages to coastal marsh habitats 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 storm 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 and McPherson 1998).

The Louisiana barrier system is the first line of defense against hurricanes and storms providing some protection to estuaries, wetlands, and coastal populations. These islands take the initial impact of hurricanes and tropical storms but are disappearing quickly. Between 1980 and 2002 Shell Island, which protects a portion of the Barataria Basin, lost 101.5 feet per year (30.9 m/yr) to storm erosion, sea level rise, and reduced sediment supply. Sallenger (2000) reported that Hurricane Andrew stripped sand from 70 percent of the barrier islands, more than 43.4 miles (70 km) of dune habitat, leaving coastal marshes exposed to future storm events. More recently, Hurricane Katrina (2005) had sustained winds of 115 knots just 2 hours before making landfall at Buras, Louisiana as a Category 4 cyclone. Approximately 100 square miles (259 sq km) of wetlands in the Mississippi delta were transformed overnight into shallow open water. Not only did the hurricane storm surge erode and uproot large areas of wetlands, it

also deposited huge quantities of muddy sediments 1.5 inches to 4.0 inches [4 cm to 10 cm] thick in many places.
On September 1, 2008, Hurricane Gustav made landfall as a Category 2 near Cocodrie, Louisiana. Hurricane Ike made landfall as a Category 2 at Galveston, Texas on September 13, 2008. The extent of damages to the LCA BBBS project area from these storms is still being determined.

4.2 GEOLOGY

This resource is institutionally significant because of NEPA. This resource is technically significant because geologic conditions can place constraints on the nature, design, or location of the Recommended Plan, as well as determine the impacts which the Recommended Plan would have on other resources. This resource is publicly significant because bedrock may be too hard for excavation or too weak to support proposed structures; mineral deposits may be destroyed or occluded by development of the Recommended Plan; the existence of active faults or other hazardous geomorphic structures may compromise the Recommended Plan.

4.2.1 Geomorphic and Physiographic Setting of the Barrier System

The study area is comprised of a chain of barrier islands and headlands, separated by tidal inlets, which enclose shallow bays. The most prominent physiographic features are the numerous narrow beaches and their associated dunes, overwash fans, spits, tidal inlets, marshes, and bays. Elevations range from a maximum of approximately 5 feet NAVD88 on the highest dunes to near 0 in the back barrier marshes. All of the island segments are retreating. Erosion, reworking, and redistribution of the coarser deltaic material led to the development of the barrier island chain present today. Much of the erosion and transport of material takes place during storms (frontal passages and tropical storms/hurricanes).

In general, there has been a net export of material from the barrier shoreline. Longshore transport is eastward from Belle Pass and westward from Shell Island as evident by island migration patterns and spit development on the ends of island segments. The longshore currents converge in the vicinity of the eastern end of Grand Terre Island. The tidal passes, which separate many of the Barataria barrier island segments have increased in, cross sectional area and inhibit longshore transport of material. The flood and ebb tide deltas associated with the tidal inlets capture much of sediment moving longshore.

The subsurface is generally composed of less than 20 feet of fine sand with shell material overlying up to 100 feet of marsh/interdistributary deposits. The marsh/interdistributary deposits contain very soft gray clay with organics and minor shell material.

4.2.2 Sea Level Change and Relative Subsidence

A number of studies (e.g., Parker 1992) have attempted to determine the global mean sea level (MSL) trend. Although most coastal regions of the world indicate a MSL rise, some coastlines show rapidly falling local mean sea level (LMSL). This is a consequence of water level gages measuring relative LMSL change, which combines the effects of absolute MSL change and any vertical land movement. Various averaging schemes and/or corrections for vertical land motions have been devised, resulting in estimates of global MSL rise ranging from 0.04 inches/year to 0.09 inches/year (1.0 mm/yr to 2.4 mm/yr) (Douglas et al., 2001), which need to be accounted for in attempting to determine local mean sea level rise for the region (**figure 4-1**). The latest research in estimating potential acceleration in global sea level rise can be found in Church (2006).

Relative subsidence and reworking of the abandoned deltaic deposits is occurring throughout the barrier system. Long-term (>100 years) relative subsidence rates, calculated using radiocarbon dating of buried peat deposits, range from 1.0 feet/century to 4.0 feet/century (3.0 mm/yr to 12.2 mm/yr). Rates are highest near Belle Pass and the eastern most islands. Rates are generally highest where Holocene sediments are thickest. A primary factor governing land loss along the Louisiana shoreline is relative sea level rise, the rise in sea level relative to the adjacent coastlands.

Relative sea level rise consists of two components (NRC 1987):

- Eustatic sea level change– defined as the global change in oceanic water level relative to a fixed datum (e.g. NAVD88), presently about 1 mm/yr.
- Subsidence– defined as the local change in land elevation relative to the same vertical datum.

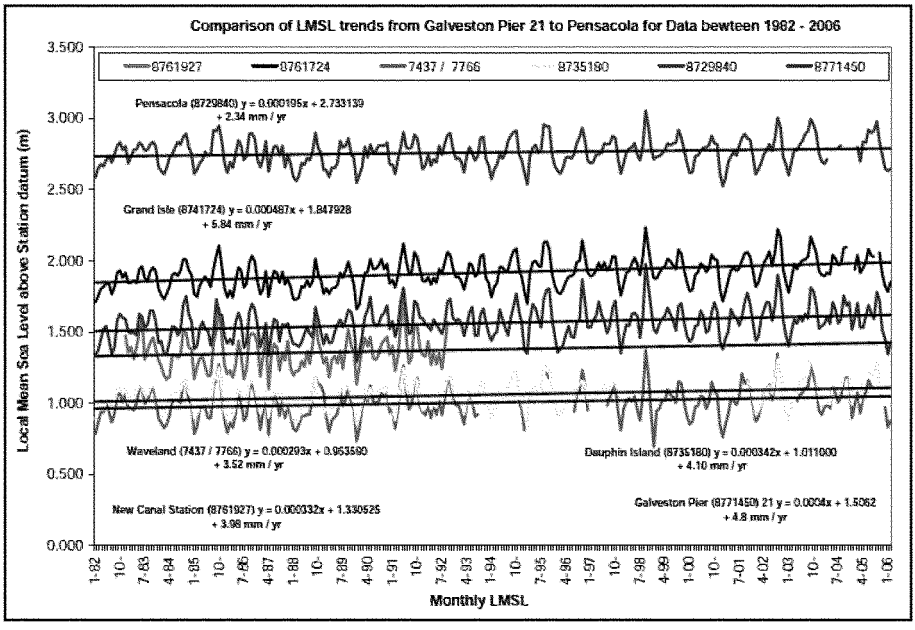


Figure 4-1. Local mean sea level trends from 1982 to 2006.

Along the Louisiana coast, the land elevation is decreasing while, the mean sea level elevation is increasing, resulting in significant land loss. The expected relative sea level rise at construction (2011) is 0.0509 feet/year (15.5 mm/yr). Over the 50-year period of analysis (2011 to 2061) the rate of relative sea level rise is increasing and is expected to equal 0.0599 ft (18.3 mm/yr) in 2061. For the purposes of design and analysis, the rate of relative sea level rise is treated as a constant over the 50-year period of analysis, equal to 0.055 feet/year (16.8 mm/yr). Approximately 80 percent of the relative sea-level rise at this location is due to subsidence.

The average seasonal cycles in monthly local mean sea level can show wide variations depending on the seasonal variations in water temperature, winds, and circulation patterns currents in the nearby coastal

ocean. Zervas (2001) presents an analysis of the seasonal variations for the NWLON stations in which he shows that seasonal variations can be a significant factor in determination of sea level trends.

Figure 4-2 shows a plot of monthly local mean sea levels for Grand Isle. There is a bi-modal variation with secondary high and low in May and July, respectively. Hurricane season, from June through November, coincides with the periods of high monthly local mean sea levels--this generally adds to the elevation of storm surge.

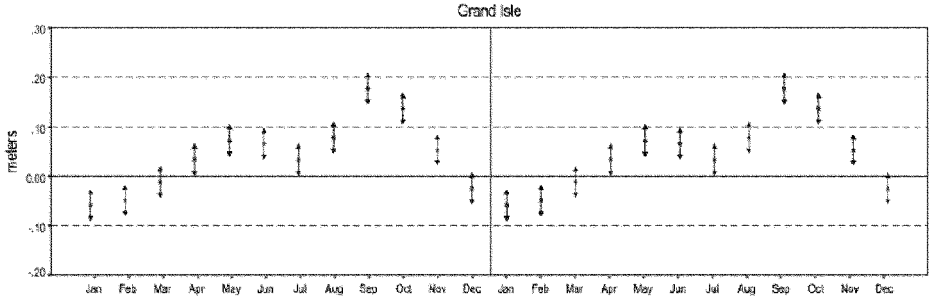


Figure 4-2. Local Sea Level at Grand Isle, Louisiana.

4.2.3 Ship Shoal Geology

Ship Shoal is approximately 31-miles long (50- km long) and 5 km to 12 km (1.2 to 7.4 miles) in width with relief of up to 3.9 yards (3.6 meters). Water depth ranges from 7.6 yards to 9.8 yards (7 meters to 9 meters) on the eastern side of the shoal to approximately 3.2 yards (3 meters) over the western reaches (Penland et al. 1986). The shoal constitutes a remnant of an ancient barrier shoreline that has been modified by processes related to transgression and submergence of the Maringouin delta complex (Krawiec 1966; Frazier 1967). The geologic setting of Ship Shoal, including discussion of sediment facies, shoal depositional environments, sediment textures, sand resource estimates is discussed in detail in the final PEIS for the LCA Study (USACE 2004) and is incorporated by reference.

Ship Shoal contains an estimated 1.56 billion cubic yards (cy) (1.2 billion cubic meters (m^3) of sand. Shoal-crest deposits contain 145.6 million cy (112 million m^3) of sand and comprise the unit within the zone of active normal and storm processes. The highest relative energy levels occur over the shoal crest in water depths that range from 8.8 ft (2.7 m) in the west to 22.9 ft (7.0 m) in the east. Seaward from the shoal, a discontinuous sand sheet extends across the shelf marking shoal retreat landward. The landward migration allows sediment to be transported from the seaward to leeward slope to the sand body of the shoal.

The shoal front contains an estimated 562 million cy (430 million m^3) of sand and is located on the upper depositional slope between 4 m and 6 m isobaths at the western end of the shoal and the 8 m and 10 m isobaths in the east. Sand is transported landward from the shoal front to the shoal-base environment as the shoal migrates toward the onshore. The shoal-base sand lies between the 8 m and 9 m isobaths at the western end of the shoal and the 11 m and 12 m isobaths of the eastern portion. This area is below the fair-weather wave base. The volume of beach quality sand in this area is estimated at 837 million cy (640 million m^3).

4.3 SOIL RESOURCES

This resource is institutionally significant because of the Council on Environmental Quality (CEQ) memorandum of August 11, 1980, entitled "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.*). This resource is technically significant in determining soils engineering and environmental suitability, based on their physical and chemical properties, for proposed activities. This resource is significant to the public for determining suitability of construction capabilities, agriculture suitability, and suitability for septic tank type disposal of sanitary waste.

4.3.1 Historic and Existing Conditions

Coastal land loss is directly and inextricably linked to the five factors that influence the process of soil formation: 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. Interactions among soil forming factors results in differences among the soils and has an effect on the type of properties expressed in soils at any given site. The soils along the barrier islands are of the Scatlake series in the Caminada Headland area (Mathews 1983; Mathews 1984) and the Felicity series in the Shell Island area (Trahan 2000).

4.4 OFFSHORE, NEARSHORE, AND RIVERINE SEDIMENT RESOURCES

Offshore, nearshore, and riverine sediment resources are institutionally significant because of NEPA; the Coastal Zone Management Act; the Estuary Protection Act; the Marine Protection, Research, and Sanctuaries Act; the Outer Continental Shelf Lands Act; Public Law 103-426; the Magnuson Fishery Conservation and Protection Act; the Fish and Wildlife Conservation Act; the Fish and Wildlife Coordination Act; and the Submerged Land Act. This resource is technically significant to determine the availability, suitability, and physical and mineralogical composition of borrow material for restoration of the barrier system. This resource is publicly significant because the potential borrow areas are water bottoms from riverine, near-shore, and offshore waters which support different aquatic organisms which directly and indirectly influence commercial and recreational fisheries, as well as the wave climate.

The offshore and nearshore borrow areas provide EFH for the various life stages of white shrimp (*Penaeus setiferus*) and brown shrimp (*Penaeus aztecus*), red drum (*Sciaenops ocellatus*), red snapper (*Lutjanus campechanus*), Spanish mackerel (*Scomberomorus maculates*), King mackerel (*Scomberomorus cavalla*), cobia (*Rachycentron canadum)*, bluefish (*Pomatomus saltatrix*), little tunny (*Euthynnus alletteratus*), bonnethead shark (*Sphyrna tiburo*), and Atlantic sharpnose shark (*Rhizoprionodon terraenovae*). In addition, these borrow areas provide important nursery and foraging habitats supportive of economically important marine fishery species (personal communication, NMFS scoping comment letter dated June 15, 2005).

4.4.1 Offshore Sand Resources

4.4.1.1 Historic and Existing Conditions

The morphology of coastal Louisiana is the product of combining relative sea-level rise with regressive delta building sequences and transgressive delta abandoning sequences of the Mississippi River (Penland *et al.*, 1985; 1986; Coleman *et al.*, 1998). Over the last 7,000 years, the Mississippi River has built six major delta lobes (Frazier 1967). Except for the Modern delta and Atchafalaya delta complexes, all other abandoned deltas have responded to the Holocene transgression by undergoing erosion, subsidence, sediment redistribution, and landward migration. The Isles Dernieres, Timbalier islands, and Ship Shoal are all products of these processes. **Figure 4-3** shows approximate extents of Holocene and Pleistocene layers in the present delta. The subsurface is generally composed of less than 20 feet (6.1 m) of fine sand with shell material overlying up to 100 feet (30.5 m) of marsh/interdistributary deposits. The marsh/interdistributary deposits contain very soft gray clay with organics and minor shell material.

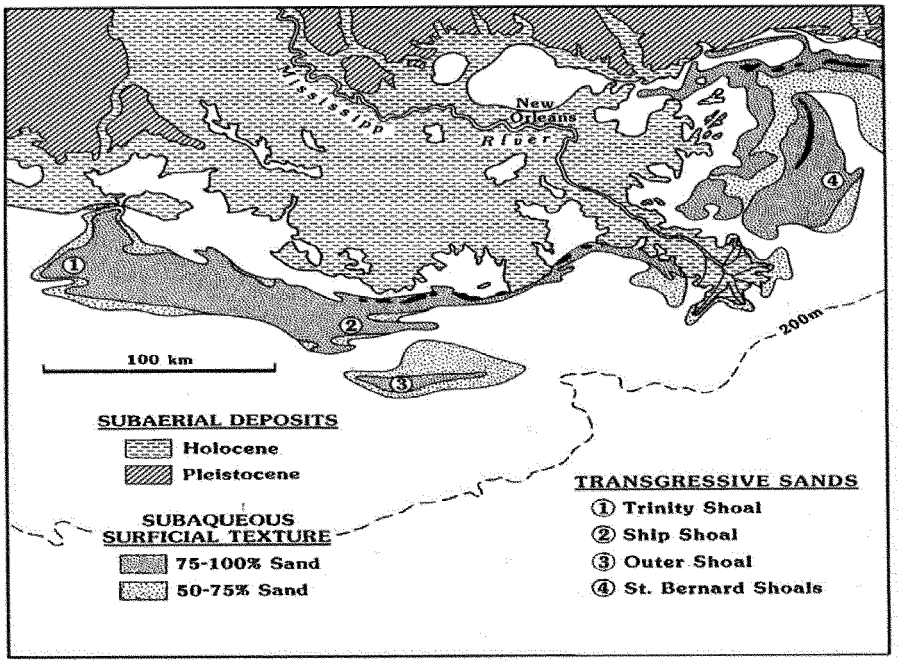


Figure 4-3. Louisiana offshore sand sources: Trinity Shoal, Ship Shoal, Outer Shoal, and St. Bernard Shoals *(from Penland et al. 1986).*

4.4.1.1.1 Ship Shoal

Sediment from Ship Shoal is anticipated to be used to nourish the Caminada Headland beaches. Sediment samples collected from the Headland beaches have a composite sample mean grain size of 0.164 millimeter (mm). Vibracore samples from the South Pelto Block of Ship Shoal have a composite sample

mean grain size of 0.157 mm. Ship Shoal, the largest submerged shoal off Louisiana, is a Holocene sand body located inner shelf about 9.32 miles (15 km) seaward of the Isles Dernieres. Ship Shoal is approximately 31 miles long (50 km) and 5 km to 12 km (1.2 miles to 7.4 miles) in width with relief of up to 11.7 feet (3.6 m). Water depth ranges from 22.8 feet to 29.4 feet (7 meters to 9 meters) on the eastern side of the shoal to approximately 9.6 feet (3 meters) over the western reaches (Penland et al. 1986). Ship Shoal is a remnant of an ancient barrier shoreline that has been modified by processes related to transgression and submergence of the Maringouin delta complex (Krawiec 1966; Frazier 1967). The geologic setting of Ship Shoal, including discussion of sediment facies, shoal depositional environments, sediment textures, and sand resource estimates, is discussed in detail in the final PEIS for the LCA Study (USACE 2004) and is incorporated herein by reference.

Ship Shoal contains an estimated 1.56 billion cy (1,200E6 m^3) of very fine to medium sand. Crest deposits contain 145.6 million cy (112E6 m^3) of sand and comprise the unit within the zone of active normal and storm processes. The highest relative energy levels occur over the shoal crest in water depths that range from 8.8 ft (2.7 m) in the west to 22.9 ft (7.0 m) in the east. Seaward from the shoal, a discontinuous sand sheet extends across the shelf marking shoal retreat landward. The landward migration allows sediment to be transported from the seaward to leeward slope to the sand body of the shoal.

During 2003, the LDNR conducted detailed geotechnical investigations in South Pelto blocks 12 and 13 and found several pipelines, highlighted sonar targets, and identified magnetic-anomaly clusters. **Figure 4-4** displays the location of the proposed borrow sites, buffers (no-dredge zones as defined by cultural resource surveys), and vibracore sites.

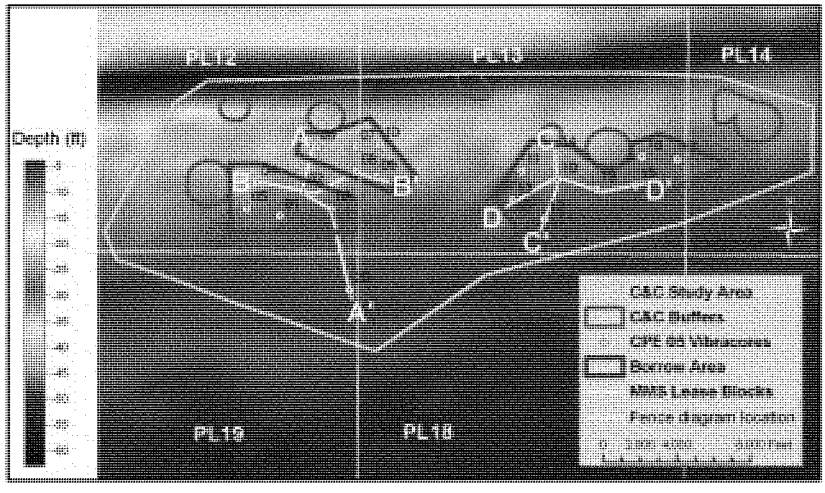


Figure 4-4. Ship Shoal South Pelto borrow area with buffer (no-dredge) zones and location of vibracores. Also shown are Minerals Management Service lease blocks (white rectangles). Bathymetry obtained from the NOAA-NOS dataset is used for visualization purposes only.

The mean grain size of replacement material should be the same or slightly larger than the *in situ* beach. James (1975) examined criteria that would indicate the probable behavior of borrow material on a natural beach and devised an overfill factor and methodology to describe the amount of source material required to compensate for the losses that occur from natural winnowing processes along the shoreface. McBride

et al. (1989) used James' overfill factor formula to calculate that the overfill factor for the Isles Dernieres shoreline using sand from Ship Shoal is 1.03. Based on that overfill factor, Ship Shoal sand constitutes an excellent source of sand for Isles Dernieres beach nourishment projects (see **table 4-4**). Additional sand sources include blocks 80 and 88 in the South Timbalier area.

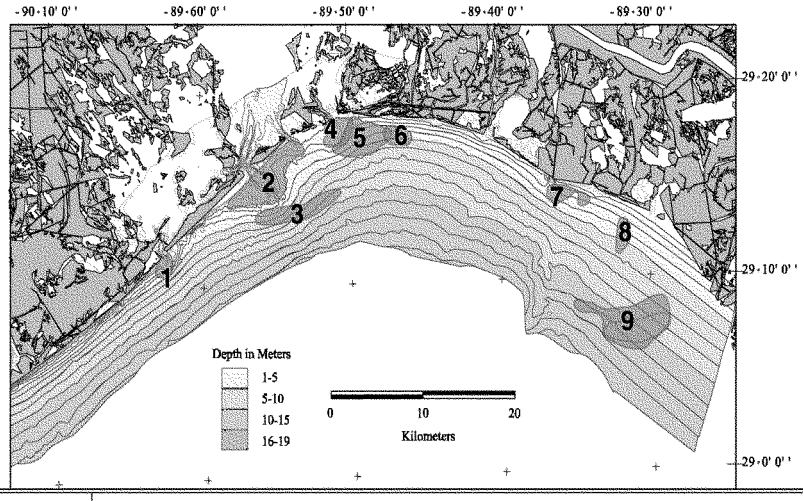
Table 4-4. Sand volume and sedimentological characteristics for Ship Shoal borrow areas.

Borrow Area	Mean Phi	Mean mm	Sorting	Skewness	Kurtosis	Volume of sand (mcy)
Area - A	2.6	0.16	0.75	- 5.94	50.62	9.1
Area - B	2.35	0.20	1.02	- 3.9	20.37	6.41
Area - C	2.42	0.19	1.01	- 4.42	25..69	12.76
Total						**28.3**

Vibracore samples from the South Pelto Block have a composite mean grain size of 0.157 mm, which are very similar to sands on the Caminada Headlands. Initial compatibility analysis determined an overfill ratio of 1.08. Comparison of the native and South Pelto samples using the overfill factor (Ra) analysis resulted in a value less than 1.02. Comparative analysis of the sediments using the Renourishment Factor (Rj) results in an average value of 1.17. Hence, it is concluded that sediments from the South Pelto block are suitable for beach and dune restoration. An overfill ratio of 1.08 is recommended to be used in design volume analysis. Depending on core locations, when detail design of the borrow area is conducted, selective dredging analysis may be beneficial in providing a coarser and more compatible borrow area material for constructing the beach and dune fill on the Caminada Headland.

4.4.1.1.2 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 coastal restoration (see **figure 4-5**). 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 4-5**). The nine sand bodies potentially contain between 396 million and 532 million cy (300.9 and 404.3 million m^3) and can be characterized into three surficial 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 (433.2 million m^3) 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 4-5 Barataria nearshore sand resources *(source: Kindinger et al. 2001).*

4.4.1.1.3 Mississippi River Sand Resources

It is expected that sediments from the Mississippi River would be used to rebuild Shell Island. The Mississippi River is one of the most studied, engineered, and heavily trained rivers in the world. McClelland Engineers and John Chance Land Surveys, Inc. (1988) under contract to Kellogg, Brown & Root (KBR), Inc., conducted geotechnical and geophysical investigations in the Mississippi River meander corresponding to CPE Target Area P1. This meander displays stratigraphic relationships that are similar to models described in the literature for meander point bars where grain sizes become coarser with increasing distance from the river bank and increasing depth. Boring data for the Nairn Point Bar indicate sand thicknesses of 70 feet. The Nairn Point Bar deposit has two major sedimentary units:

(1) a featureless mud bottom from the riverbank to about 25 feet water depth, and
(2) a sand bottom with surface waves (mega-ripples) from 25 feet to their survey depth limit (**Figure 4-6**).

Sand composition was homogenous with a slight coarsening downward. This meander deposit is shown as a seismic image in **Figure 4-6**. Average grain size is 0.17 mm.

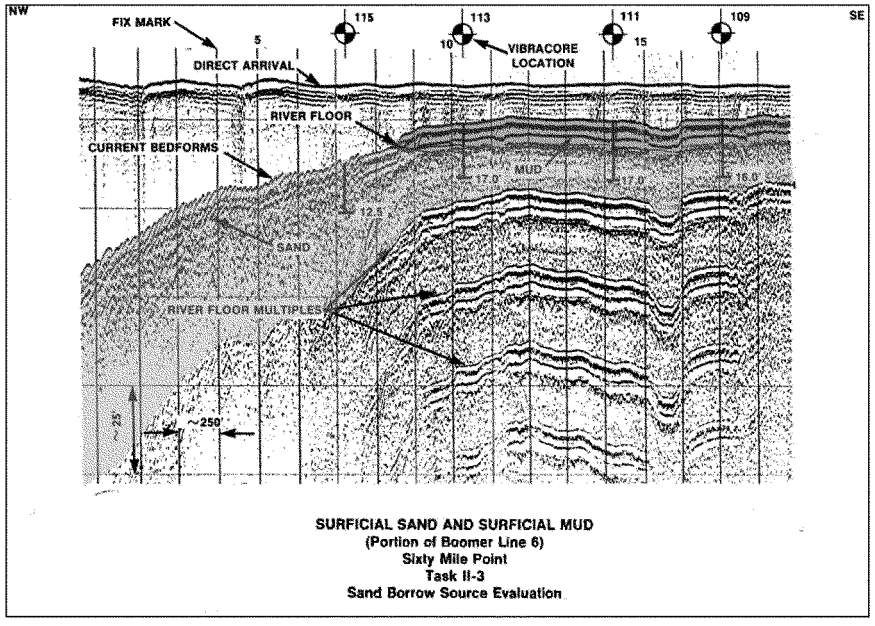


Figure 4-6. Seismic reflection profile of the Nairn Point Bar showing featureless muddy sediments occurring from the riverbank to about -25 feet depth. Sand deposits with surface ripples occur from -25 to the thalweg. The cross section shows that the sand deposit measures 75 feet thick (modified from McClelland, 1988).

4.4.1.1.4 Empire Reach

A study for restoration of Scofield Island in 2004 (CPE 2004) assessed sand resources in the Mississippi River. The results indicate that large volumes of good quality sand may be available in the lower river. Three potential sand sources (P1, P2 and P3) were identified between river mile (RM) 35 and RM 22. P1 is located near Empire between RM 32 and RM 34; P2 is located between RM 31 and RM 25; and site P3 is located between RM 24 and RM 22. A secondary potential sand target (S1) is identified between RM 20 and RM 18 at the Fort Jackson river bend.

Of these three deposits, P1 is located in a river meander where greater sediment thickness may be expected due to the presence of vertically stacked sand bars. Site P2 is located along a gentle river bend on the eastern side of the river, which may prohibit the use of pipeline dredges because of logistical difficulties associated with laying a pipeline across the Mississippi River. Surface samples obtained in this area identify a mean grain size of 0.19 mm to 0.28 mm. Surface sand waves are about 6 feet thick, but underlying sands may be useful too.

The secondary sand target S1 mapped along the Fort Jackson meander may be morphologically and compositionally similar to site P1 because it is also located on a meander point bar. Rick Smith (*personal*

communication), from Weeks Marine, Inc., reported that they constantly dredge large quantities of "sandy" sediments from this area. It was estimated that cumulative sand volumes for all of these sites ranged from 6 million to 20 million cy based on 3-foot and 10-foot deep cuts.

During 2005, a sand search to define resources for beach nourishment was conducted by LDNR between RM 35 and RM 15 that included geographically positioned, bathymetric magnetic seismic sub-bottom and sidescan sonar survey of the riverbed. Thirteen vibracores and 23 line-miles of survey data were obtained (**figure 4-7**). Most of the cores contained relatively clean sand from top to bottom with the exception of the cores obtained near riverbanks.

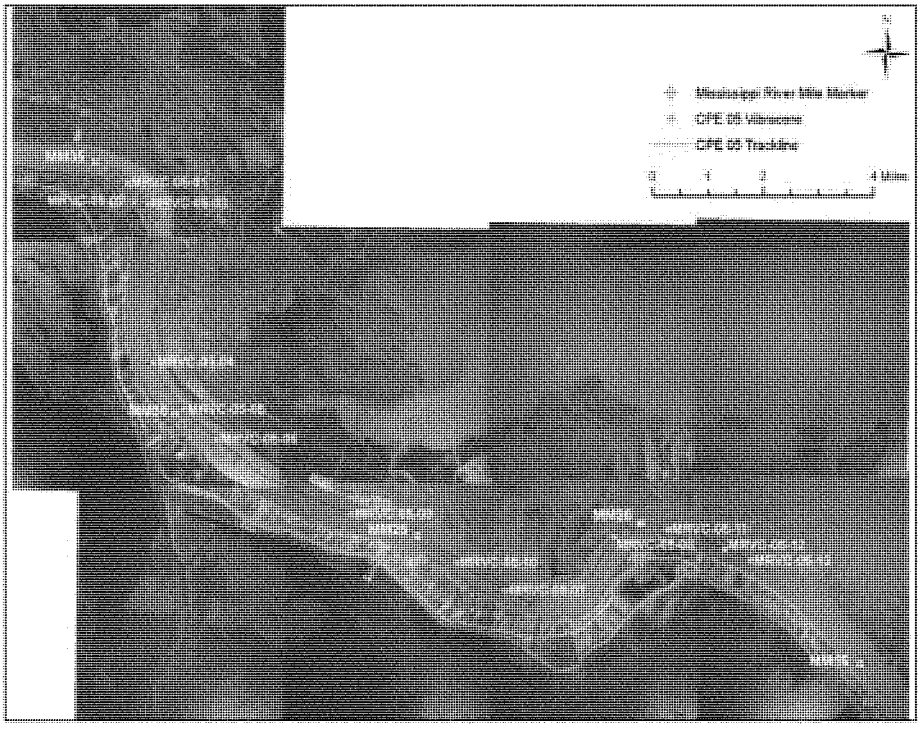


Figure 4-7 Location of vibracores and tracklines between RM 35 and MM15 along the Mississippi River.

The sand most likely continues below vibracore penetration depth because there is no clear seismic reflection boundary apparent on the seismic traces. Sand waves between 1 foot and 5 feet high are observed in the seismic imagery in water depths between 40 feet and 70 feet. Vibracores opposite Empire showed mostly siliciclastic sand with less than 2 percent fines and becoming progressively thinner towards the riverbank. Samples at RM 25 revealed 15 feet of clean siliciclastic sand between 50 feet and 80 feet thick. Near RM 20 on the east-northeast side of the river, sand contained intercalated clay layers,

0.5 feet to 1.1 feet thick, in the upper 10 feet followed by relatively clean sand (0.13 mm, less than 5 percent silt) from 10 feet to 15.7 feet.

Three vibracores were obtained on the western side of the river at RM 20. The northern narrower segment of the deposit contained 20 feet of intercalated layers of sand and clay. The mid-section of the deposit contained clean sand in the upper 8 feet and sand intercalated by two clay layers. The wider southern segment of the deposit contains mostly clean sand. In all cases, the imagery indicates the presence of sand below the depth of penetration. **Table 4-5** displays a composite summary of Mississippi River vibracore sedimentological parameters.

Table 4-5. Composite summary of Mississippi River vibracores sedimentological parameters.

Vibracore	Effective length (ft)	Mean (mm)	Phi mean	Phi sorting	% silt
MRVC-05-01 Composite	14.60	0.20	2.32	1.03	1.54
MRVC-05-02 Composite not used in composite calculations - outside of deposits					
MRVC-05-03 Composite	17.30	0.23	2.14	0.42	0.72
MRVC-05-04 Composite	12.60	0.21	2.22	0.45	0.55
MRVC-05-05 Composite	15.80	0.16	2.61	0.34	1.35
MRVC-05-06 Composite	12.80	0.14	2.84	0.34	2.09
MRVC-05-07 Composite	16.30	0.22	2.16	0.42	0.40
MRVC-05-08 Composite	13.20	0.14	2.86	0.39	2.87
MRVC-05-09 Composite	12.10	0.14	2.87	0.26	0.99
MRVC-05-10 Composite	13.70	0.21	2.23	0.66	1.31
MRVC-05-11 Composite not used in composite calculations - outside of deposits					
MRVC-05-12 Composite	15.90	0.13	2.92	0.37	4.20
MRVC-05-13 Composite	16.90	0.15	2.77	0.33	1.46
Investigation Area	**161.20**	**0.17**	**2.53**	**0.58**	**1.59**

4.4.1.1.3.1 Obstructions

Sidescan sonar investigations were conducted to map the occurrence of potential dredging obstructions and bottom topography. Georeferenced mosaics overlain on aerial photographs show surface sand waves that are generally orientated transverse to the riverbanks. Well-developed sand waves and ridges oblique to riverbanks were observed at several places. As a general trend, the reflectivity becomes higher near riverbanks and lighter towards the thalweg.

Potential sand volumes in these Mississippi River surveys were calculated from data contained in vibracores and seismic reflection profiles **(table 4-6)**. Sand thickness was extrapolated beyond vibracore recovery length when seismic records indicated continuity of the deposit. The total volume estimated from seven potential borrow sites is 37.9 million cy of clean sand. Where pipelines crossed the river, 500-foot buffers were included in borrow area design.

Table 4-6. Estimated sand volumes in potential borrow sites in the Lower Mississippi River.

Site	Location	Volume (cy)
A	Nairn Point Bar, starts 0.5 mile downriver from RM 35	10,500,000
B	Across the river from the Empire intersection, 1.5 mile upriver to 2 miles downriver from RM 30	14,940,000
C	1 mile upriver from RM 25	1,310,000
D	About 500 ft upriver from RM 25	245,000
E	Upriver from Ft Jackson Point Bar about 1 mile downriver from RM 25	6,380,000
F	Ft. Jackson Point Bar, northern segment, 0.5 mile upriver from RM 20	945,000
G	Ft. Jackson Point Bar, southern segment, 1.5 miles south of RM 20	3,580,000
Total		37,900,000

4.4.1.1.4 Bayou Lafourche Navigation Channel Sediment Resources

Bayou Lafourche is a 36.3 mile navigation channel in Lafourche Parish from Larose, Louisiana, to Belle Pass in the Gulf of Mexico. Channel dimensions in the jetties and bar reaches (Belle Pass) are 26 feet deep by 300 feet wide from Mile 0.0 to Mile -1.3 (**figure 4-8**). Maintenance dredging is usually conducted every two years. Federally-dredged shoaling material is beneficially used for beach nourishment in the jetty and Bar reaches of the channel. The average particle size distribution in the bar channel over the last five years was 33.9 percent sand, 48.9 percent silt, and 17.2 percent clay.

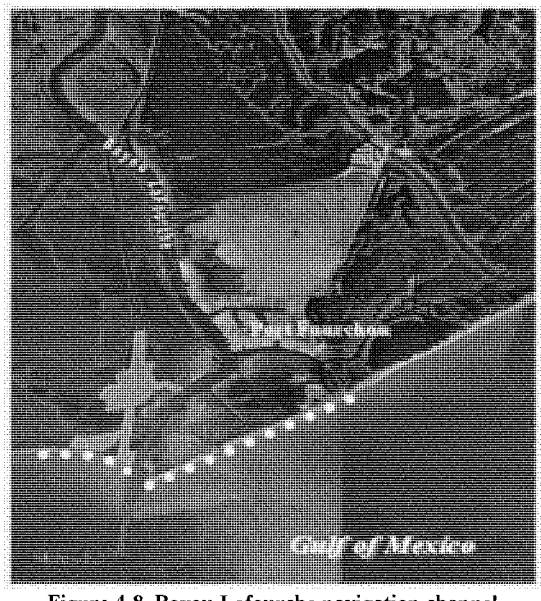


Figure 4-8. Bayou Lafourche navigation channel

4.5 BARRIER SYSTEMS: BARRIER SHORELINES, HEADLANDS, AND ISLANDS

This resource is institutionally significant because of NEPA; the Coastal Barrier Resources Act of 1990; the Endangered Species Act, the Coastal Zone Management Act; the Estuary Protection Act; the Marine Protection, Research, and Sanctuaries Act; the Outer Continental Shelf Lands Act; Public Law 103-426; the Magnuson Fishery Conservation and Protection Act; the Fish and Wildlife Conservation Act; the Migratory Bird Conservation Act, and the Fish and Wildlife Coordination Act. Section 3501 of the Coastal Barrier Resources Act of 1990 (16 U.S.C. §§3501-3510) describes the technical and public significance of these resources:

- 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.

4.5.1 Historic and Existing Conditions

Barrier systems provide protection to the wetlands, bays, and estuaries located behind the islands. Coastal barriers limit storm surge heights, retard saltwater intrusion and limit mechanical erosion by reducing wave energy at the margins of coastal wetlands (Williams et al. 1992). According to the Working Group for Post-Hurricane Planning for the Louisiana Coast (2006) barrier islands and other features of the coastal landscape (e.g., shoals, marshes, and forested wetlands), can provide a significant and potentially sustainable buffer from wind wave action and storm surge generated by tropical storms and hurricanes. Geologic features such as barrier islands or the land mass and vegetated canopy associated with marshes and wetlands can block or channelize flow.

Louisiana's barrier systems in general, the Caminada Headland and Shell Island areas specifically, are experiencing some of the highest land loss rates in the Nation, due to both natural and man-made factors. Barrier beach and surf, dune, supratidal and intertidal wetlands and swale habitats within the study area have undergone substantial loss due to oil and gas activities (e.g., pipeline construction), construction of navigation channels and jetties, subsidence, sea-level rise, and marine and wind-induced erosion. Coastal processes acting on the abandoned headland include rapid landward transgression and more recently, breakup. Detailed descriptions and comparisons of the changes over the past 100 years in Louisiana's barrier islands is provided in the *Atlas of Shoreline Changes in Louisiana from 1853 to 1989* (Williams et al. 1992). In addition, the Louisiana Geological Survey prepared a comprehensive series of reports entitled *The Coastal Sand Dunes of Louisiana: An Inventory* (Ritchie et al. 1990; Ritchie et al. 1995). More recently, Conner et al. 2004 and Beall et al. 2004 examined the long-term and short-term shoreline change history, respectively, from the 1880s to 2002.

4.5.1.1 Barrier Shoreline Change

4.5.1.1.2 Shell Island Shoreline Change

Shell Island shoreline change analysis (Williams et al. 1992; Ritchie et al. 1995; Connor et al. 2004; Beall et al. 2004; USACE 2004) shows that the formation of Coupe Bob caused a quadrupling of the retreat rates of Shell Island and is the major reason for the disintegration of the island. The construction of the Empire Jetties in 1950 by contrast, increased shoreline recession approximately 10 feet/year along the easternmost 5,000 feet to 8,000 feet of the island. The shoreline along Shell Island has receded since the first recorded measurement in 1884 (Williams et al. 1992; Ritchie et al. 1995; Connor et al. 2004; Beall et al. 2004; USACE 2004). **Table 4-7** shows the total and annualized shoreline changes over various time periods. Historic shoreline analysis shows that Shell Island has a history of small inlets cutting through the island but these inlets closed naturally, as Grand Bayou and Fontanelle Pass were the dominant inlets connecting Bastian Bay and Shell Bay to the Gulf of Mexico. Shell Island was, at one time, a continuous island.

Table 4-7. Historic Shoreline Changes for Shell Island (source: Williams et al. 1992; Ritchie et al. 1995; Connor et al. 2004; Beall et al. 2004; USACE 2004).

Annualized Shoreline Change				
1884 to 1932	1932 to 1956	1956 to 1973	1973 to 1988	1988 to 2004
-13 ft/yr	-9 ft/yr	-22 ft/yr	-79 ft/yr	-89 ft/yr

4.5.1.1.3 Volumetric Changes

Mann and Thomson (2001) found that volumetric changes could be estimated from shoreline changes when the break in slope was used as the bottom of the active profile height (APH). By 2008, Shell Island was 90 percent under water, but surveys by Morris P. Hebert in 2000 and the 2005 survey by John Chance Land Surveyors are available. Being submerged prevents most wave attack so there is a good chance the profiles are still useful. However, only two of the profile tracks cross the existing islands, so the profiles are probably not as useful as desired. There are also historic shoreline images and measurements that have been made at various times since 1884 that show changes in the water-sand interface, which may be more useful in estimating year-to-year changes in the islands.

Because different hydraulic and erosive forces are at work on solid versus broken islands, volume changes were calculated using only shoreline changes between 1956 and 1973, the period between construction of the Empire Jetties and before formation of Coupe Bob in 1979 (**figure 4-9**). **Table 4-8** (also located in **appendix A, annex 2**) presents the volume change rate along the project area along with the shoreline change, active profile height, and distance between profiles used to develop volume estimates.

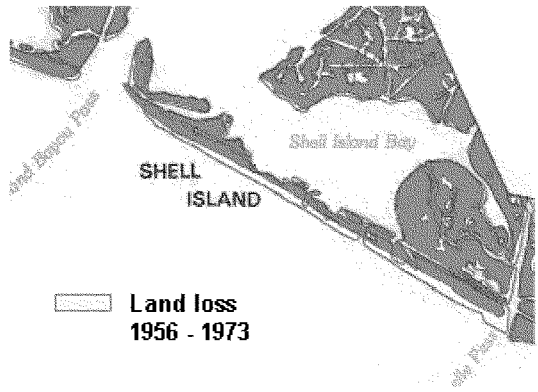


Figure 4-9. Shell Island Changes 1956 - 1973 (source: Williams et al. 1992).

Table 4-8. Shell Island Volume Change (Gulf Side) between 1956 and 1973 (Appendix A, Annex 2).

USGS Transect Number	Distance From Jetty (ft)	Cell Width (ft)	Active Profile Height (ft)	Shoreline Change (ft/yr)	Shoreline based Volume Change	
					cy/yr	cy/ft/yr
81	850	1,370	6.5	-39.3	-13,000	-7.2
80	1,880	1,145	6.5	-21.5	-6,000	-5.2
79	3,140	1,270	6.5	-32.6	-10,000	-7.9
78	4,430	1,315	6.5	-30.1	-9,600	-7.3
77	5,770	1,690	6.5	-28.3	-11,500	-6.8
76	7,810	2,120	6.5	-23.8	-12,100	-5.7
75	10,010	2,125	6.5	-27.2	-14,000	-6.6
74	12,060	1,825	6.5	-27.9	-12,300	-6.7
73	13,860	1,525	6.5	-27.4	-10,100	-6.6
72	15,110	1,545	6.5	-23.5	-5,800	-5.7
71	16,750	1,665	6.5	-27.7	-11,100	-6.7
70	18,440	1,715	6.5	-23.5	-9,800	-5.7
69	20,180	1,610	6.5	-19.0	-7,400	-4.6
68	21,660	1,435	6.5	-14.2	-4,900	-3.4
67	23,050	1,200	6.5	-7.9	-2,300	-1.9
66	24,060	1,300	6.5	15.3	4,800	3.7
65	25,650	795	6.5	-16.1	-3,100	-3.9
Total					-141,200	

Note: A negative value signifies shoreline recession or volumetric loss.

4.5.1.1.4 Caminada Headland Shoreline Change

The Caminada Headland short term erosion rates were calculated from the survey comparisons, the changes in shoreline position at the average existing dune elevation, 3.5 feet NAVD88, and Mean High Water (MHW), 1.53 feet NAVD88. (Note that the MHW elevation of 1.53 feet NAVD88 used in the analysis is different than the MHW elevation 0.83 feet NAVD88 shown in Tables 4-2 and C-3-6, which represents a more current value). These values are presented in **table 4-9** and represent the short-term erosion rates along the Caminada Headland. The erosion rates range from approximately 8 feet to 49 feet per year at the dune with an average of approximately 34 feet per year. The erosion rates at MHW are slightly higher, ranging from approximately 10 feet to 54 feet per year with an average of approximately 36 feet per year.

Table 4-9. Short Term Shoreline Change (CEC).

Shoreline Change Rate (ft/yr)	
Existing Dune (3.5 ft NAVD88)	-33.89
Mean High Water (+1.53)	-35.79

Over the last 100 years, the Caminada Headland has experienced an average shoreline erosion rate of 45 feet per year (USACE 2004). This is attributed to background erosion rates, which have varied from 9 feet to 45 feet per year and tropical storms and hurricanes. Tropical Storm Bill eroded the Caminada Headland beach by 60 feet to 80 feet in 2003. The Caminada Headland also suffered erosion from recent Hurricanes Katrina (2005), Gustav (2008), and Ike (2008).

Williams et al. (1992) examined the magnitude and impact of shoreline change along the Louisiana coastline, including the Caminada Headland. Their technique for shoreline mapping included comparing topographic or near-vertical aerial surveys over time. The high-water line was used as the shoreline for comparison purposes. Between Belle Pass and Caminada Pass, 43 transects were analyzed. Between 1887 and 1988, derived shoreline changes ranged from approximately 970 feet to 6,640 feet with an average of approximately 4,620 feet. These changes over the 101-year time frame equate to shoreline change rates of approximately 9.6 feet to 65.8 feet per year, with an average of approximately 45.8 feet per year. Shoreline change rates were highest in the area just east of Bay Champagne, and were slightly reduced in the area to the west of Belle Pass. Shoreline change rates were much reduced in the area located to the east to Caminada Pass.

Recent impacts of Hurricanes Gustav and Ike (2008) have necessitated maintenance dredging of Bayou Lafourche; with anticipated removal of approximately 560,000 cy of material from between Mile 0.5 and Mile 1.8 with a hydraulic cutterhead dredge. Dredged material would be deposited unconfined along the Gulf of Mexico shoreline adjacent to the jetties for beach nourishment purposes.

4.5.1.1.5 Barrier Headland Morphology

Tidal inlets and former distributaries of the Mississippi River have segmented the Caminada Headland since at least the early 1800s. Few changes in the Caminada Headland morphology have occurred prior to 1934, of note Belle Pass, Pass Fourchon, and Bayou Moreau have segmented the central Headland (**figure 4-10**). By 1956, the land area fronting Lake Champagne was breached as the shoreline retreated, Bay Marchand decreased over 70 percent in response to shoreline retreat, and the downdrift offset west of Belle Pass began to develop.

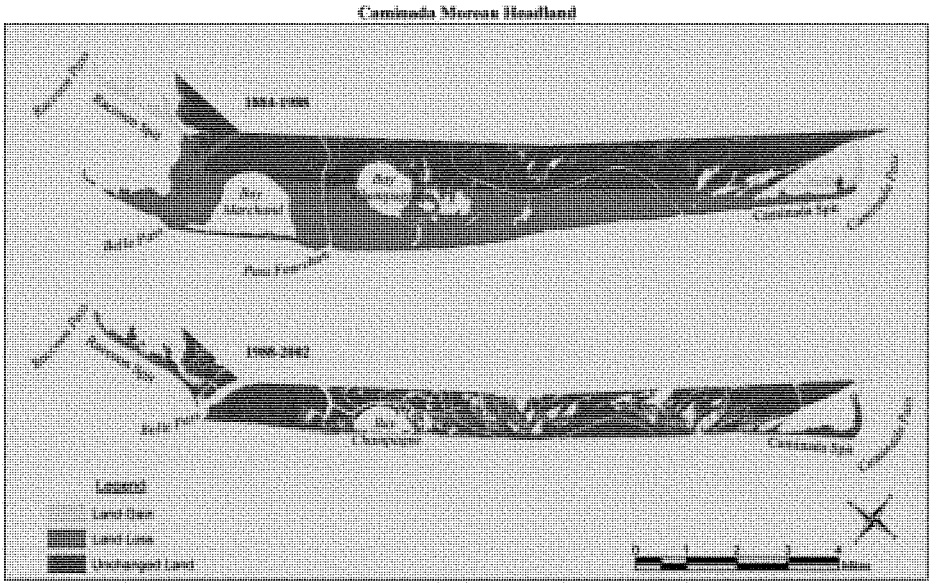


Figure 4-10. Caminada Headland Shoreline Change 1884 – 2002 (USACE 2004).

From 1956 to 1978 both Bayou Lafourche and Pass Fourchon widened while the downdrift offset became more acute. During this same time frame Bay Marchand was reduced to a pond. By 1988, continued shoreline retreat removed large quantities of sediment from the central portions of the Headland. Some of this sediment moved toward Grand Isle but was mostly lost in Caminada Pass. Other sediment moved west, but was blocked from reaching the Timbalier Islands by the Belle Pass jetties, causing the downdrift offset of the Caminada Headland area located west of Belle Pass to grow. Bay Champagne continued to diminish in size and Bay Marchand nearly disappeared. Bayou Moreau intersected the eroding shoreline at several locations; and numerous pipeline canals were constructed that further dissected this coastal headland (Williams et al., 1992).

4.5.1.1.6 Volumetric Change Analysis

Surveys from 2000 and 2005 were compared to calculate the volume of shoreline changes. The two components used for this calculation, gulf-side erosion and overwash accumulation on the landward side of the existing dune, are presented in **Table 4-10** and **Table 4-11**, respectively. **Table 4-11** presents the overwash volumes calculated based on the survey comparisons. Only four of the surveyed cross sections were included in the overwash volume calculations because profiles 1, 3, and 7 taken by Morris P. Herbert (MPH) do not extend far enough northward to make an accurate comparison.

Table 4-10 Cumulative shoreline volume changes (appendix A, annex 1).

Fenstermaker Transect	MPH Profile	Cross Section Change (sq ft)	Cross Section Change Rate (sq ft / yr)	Total Volume Change (cu ft)	Volume Change Rate (cu ft / yr)
A	1	-513	-103		
				-569,097	-113,819
B	3	-2737	-547		
				-1,274,734	-254,947
C	7	-3426	-685		
				-1,128,504	-225,701
D	10	-681	-136		
				-480,920	-96,184
E	12	-1774	-355		
				-132,419	-26,484
F	14	1098	220		
				513,044	102,609
G	16	1532	306		
			Total	-3,072,630	-614,526

Table 4-11 Overwash volume changes (appendix A, annex 1).

Fenstermaker Transect	MPH Profile	Cross Section Change (sq ft)	Cross Section Change Rate (sq ft / yr)	Total Volume Change (cu ft)	Volume Change Rate (cu ft / yr)
D	10	191.44	38.29		
				544,713	108,943
E	12	117.50	23.50		
				519,758	103,952
F	14	177.02	35.40		
				490,105	98,021
G	16	102.21	20.44		
			Total	1,554,576	310,915

4.5.2 Barrier Systems Provide Fish and Wildlife Habitat

Barrier islands, shorelines, and headlands 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). Estuarine environments are not discrete landscape units. Rather, they are a dynamic interrelated series of habitats (Doody 1996) closely linked by hydrological, geomorphic, and ecological processes (Roman and Nordstrom 1996). Estuarine shoreline environments provide essential habitat for migratory birds (Myers 1983), spawning and nursery habitat for marine fishes (McHugh 1980), and function as a filter to maintain water quality (Schubel and Kennedy 1984). Roman and Nordstrom (1996) suggest linkages among estuarine environments can be expressed as the transport of materials (e.g., shells from tidal flat to beach or sediment from eroding bluff to beach), cyclic coupling (e.g., marsh-tidal flat nutrient cycling), and utilization of multiple habitats by biota (e.g., movement of fishes between marsh surface, tidal channels, and seagrass beds).

Specifically, the Caminada Headland and Shell Island provide critical habitat for the endangered piping plover as well as important stopover habitat for migrating neotropcial birds (personal communication, USFWS, June 15, 2005). In addition these areas provide EFH for various life forms including red drum (*Sciaenops ocellatus*), red snapper (*Lutjanus campechanus*), Spanish mackerel (*Scomberomorus maculates*), King mackerel (*Scomberomorus cavalla*), cobia (*Rachycentron canadum*), bluefish (*Pomattomus salatrix*), little tunny (*Euthynnus alletteratus*), bonnethead shark (*Sphyrna tiburo*), Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), and various life stages of white shrimp (*Liptopenaeus setiferous*) and brown shrimp (*Farfantepenaeus aztecus*).

In addition, barrier wetlands and waterbodies provide nursery and foraging habitats supportive of various economically-important marine fishery species (personal communication, NMFS scoping letter dated June 15, 2005).

4.5.3 Oil, Gas, and Other Infrastructure

Port Fourchon serves as the inter-modal support hub for 75 percent of Gulf of Mexico drilling, 16 percent of U.S. domestic oil and gas production and is the nation's only offshore oil terminal, the LOOP. A direct hit on Port Fourchon by a major hurricane could have serious consequences to the U.S. domestic energy sector (http://www.laseagrant.org/hurricane/oil.htm#Q1). The vulnerability of Port Fourchon has been widely documented and was the focus of the 2005 docudrama – "Oil Storm" portraying a future oil-shortage crisis in the United States, precipitated by a hurricane destroying key parts of the United States' oil infrastructure (http://www.123cxp-tv.com/t/00951015589/).

The Caminada Headland, and to a lesser extent Shell Island, provide the first protective land for hundreds of pipelines from offshore drilling rigs in the Gulf of Mexico that send gas and oil to the mainland. The barrier shorelines and associated back marshes provide protection to pipelines and other nationally significant infrastructure from Gulf of Mexico waters. More detailed information is presented in Section 4.17 "Socioeconomic and Human Resources".

4.6 COASTAL PROCESSES AND HYDROLOGY

This resource is institutionally significant because of NEPA; the Clean Water Act; Flood Control Act of 1944; the Coastal Barrier Resources Act; the Rivers and Harbors Act of 1899; the River and Harbor and Flood Control Act of 1970; the Watershed Protection and Flood Prevention Act; the Submerged Land Act; the Coastal Zone Management Act; the Safe Drinking Water Act; the Estuary Protection Act; the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response, the Compensation, and Liability Act (CERCLA); and Executive Order 11988 Floodplain Management. This resource is technically significant because Civil Works water resources development projects typically impact (positively or negatively) the interrelationships and interactions between water and its environment. This resource is publicly significant because the public demands clean water, hazard-free navigation, and protection of estuaries and floodplains.

4.6.1 Storm Surge

Storm surge is the rise of the sea surface due to storm forces and is attributable to several factors including wind shear stress, reduced atmospheric pressure, and waves. An estimate of these changes is important to the development of the design of beach fill. Storm stages for the project area are based on observed water levels at Grand Isle dating from 1893 to 2005 and appear in column 4 of **Table 4-12**.

Wave setup, the superelevation due to wave motion, was estimated using the *Coastal Engineering Manual* (USACE 2001) method and is listed in column 3 of **Table 4-12**. Storm stages were then back calculated and appear in column 2. These estimates include the effects of wind setup, barometric pressure, and astronomical tides.

Table 4-12. Storm Stage, Grand Isle, Louisiana.

Return Period (years)	Storm Stage (feet NAVD88)	Wave Setup (feet)	Stage + Wave Setup (feet NAVD88)
5	2.8	3.6	6.4
10	3.9	4.2	8.1
20	5.2	4.6	9.7
50	6.9	5.4	12.3
100	8.4	5.9	14.3

4.6.2 Shell Island

4.6.2.1 Volumetric Changes

Mann and Thomson (2001) found that volumetric changes could be estimated from shoreline changes when the break in slope was used as the bottom of the active profile height (APH). By 2008, Shell Island was 90 percent under water, but surveys by Morris P. Hebert in 2000, and the 2005 survey by John Chance Land Surveyors are available. Being submerged prevents most wave attack so there is a good chance the profiles are still useful however only two of the profile tracks cross the existing islands so the profiles are probably not as useful as desired. There are also historic shoreline images and measurements that have been made at various times since 1884 (e.g., Williams et al. 1992) that show changes in the water-sand interface, which may be more useful in estimating year-to-year changes in the islands.

Because different hydraulic and erosive forces are at work on solid versus broken islands, volume changes were calculated using only shoreline changes between 1956 and 1973, the period between construction of the Empire Jetties and before formation of Coupe Bob in 1979 (**figure 4-11**). The total Gulf-side shoreline-based volume change rate is an estimated 141,200 cy/yr (appendix A, annex 2).

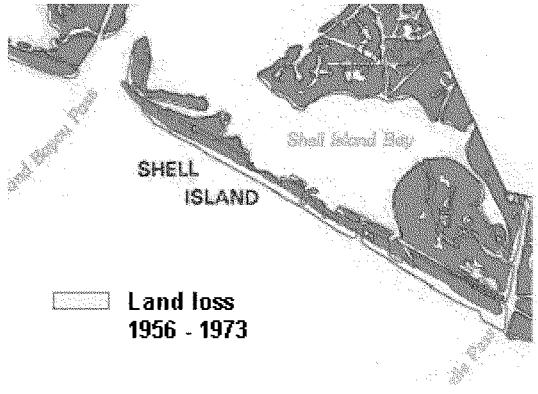


Figure 4-8 Shell Island Changes 1956 - 1973 (Williams et al 1992).

4.6.2.2 Dynamic Morphosedimentary Model

Louisiana's barrier islands typically have a gulf-side face composed of sand, while the main body of the island is composed of both sand and finer sediments. A dynamic morphosedimentary model (Campbell 2005) was used to estimate the total cross-shore and longshore shore sediment transport for Shell Island. Assuming relative sea level rise is 0.043 feet/year **(appendix A, annex 2)**, a total of 2.0 cy/foot/year are required to maintain elevation. Since Shell Island was retreating an average of 8.4 feet/year, certain assumptions could be made about the shape and evolution of the island, but since the island is now submerged, the method was approximate. The total historic retreat due to cross-shore processes is estimated at 20.0 feet/year. The average shoreline recession between 1956 and 1973 was approximately 26 feet/year **(appendix A, annex 2)**. The difference between the cross-shore component of retreat and the measured retreat is 6.0 feet/year. This difference is attributed to longshore loss. The active profile height (+4 feet, NAVD88 to –5 feet, NAVD88) used to calculate longshore transport results in the longshore loss volume of 2.1 cy/foot/year. The total longshore littoral transport loss estimated by the model is approximately 46,300 cy/year. The model does not give the distribution or direction of this sediment transport, only that 46,300 cy/year were lost from the island by longshore processes.

4.6.2.2.1 Sediment Budget Development

Volume changes provide the basis for tracking the movement of material. A distinction is made between a sediment budget accounting for all material (sand, silts, and clays) and a sediment budget based on the available sand. From a coastal engineering perspective, it is the volume of sand within the system that is important, as the sand provides protection from wave attack. When silt and clay are exposed, they are suspended in the water column and transported offshore. **Figure 4-12** shows the sediment budget graphically, with the volume accounting for relative sea level rise (RSLR) and overwash being transported to the north, the cross-shore transport of fines to the south (offshore), and the longshore transport to the east and west.

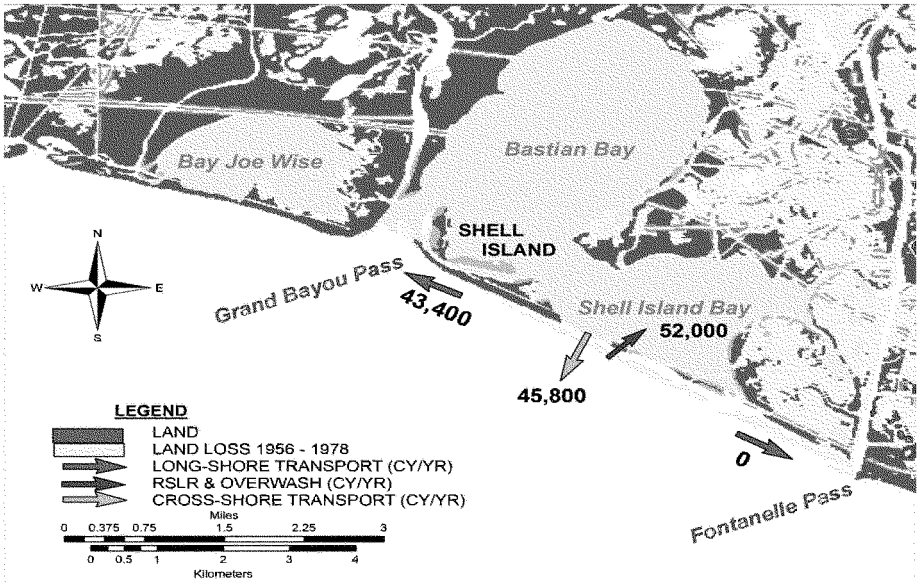


Figure 4-9. Sediment Budget for 1956-1978 Period (Appendix A, Annex 2).

The net longshore transport rate between 1956 and 1973 increased to a maximum of approximately 46,300 cy/year towards the western end of the island before decreasing slightly to 43,400 cy/year at the western end. The development of the longshore transport curve allows the prediction of sediment transport under the nourished, with-project condition assumed to exist between 1956 and 1973. It should be recognized that this section only developed a net longshore transport rate that is composed of both east-to-west transport and west-to-east transport. Longshore losses for alternatives that comprise two separate islands with Coupe Bob in the middle will be higher than the longshore loss for a single island alternative.

4.6.2.3 Ebb Shoal Formation

Tidal inlets often have flood and/or ebb shoals depending on local conditions. In 1973, there was a small ebb shoal at Grand Bayou Pass, but with the destruction of Shell Island, the pass has now closed. Restoration of Shell Island would likely cause new ebb shoals to form at the ends of the island. The surface area of Shell Island Bay, determined from 2004 aerial photos, was estimated to be 2,300 acres with a tidal prism of 2,400 acre-feet. In 1978, most of the back bay marsh had disappeared and by 2008, the area was mostly open water. Consequently, the present tidal prisms are actually much larger. However, for this report, it was assumed that the 1978 tidal prism for Shell Island Bay flowed in and out of Fontanelle Pass (Empire Waterway) to the east and between the remnants of Shell Island East in the center. SJB and CEC (2003) estimated that 39.8 percent of the tidal prism for Bay Joe Wise on the west flowed through Coupe Bob while 19.7 percent flowed through Grand Bayou (now closed). The rest of the Bay Joe Wise tidal prism flowed through Pass Chaland. The volume passing through Coupe Bob was therefore 18.4 acre-feet. With the closure of Grand Bayou, the total tidal prism flowing through Coupe Bob is assumed to be 6,400 acre feet.

Work by O'Brien (1931, 1969) and Jarrett (1976) related minimum throat cross-sectional area of an inlet below mean tide level and the size of the tidal prism. The equilibrium cross-section of Coupe Bob is estimated to be about 6,300 square feet with 1978 geometry. Similarly, Walton and Adams (1976) developed a relationship to predict the size of ebb shoals based on inlet cross-section. Together, these relationships suggest that if Coupe Bob is restored, it will require 3.3 million cy of sand for its ebb shoal however several items are under-represented: the tidal range may be greater than 1.05 feet, and the bays are much larger today than in 1978.

4.6.3 Caminada Headland

4.6.3.1 Historic and Existing Conditions

The Caminada Headland gulf shoreline is approximately 13 miles long extending from Caminada Pass on the eastern end to Belle Pass on the western end. Grand Isle is east of the Headland, the Timbalier Islands lie west. The back-barrier marsh component of the Caminada Headland is separated from the Chenier Unit to the north by a pipeline canal and is bounded to the south by the gulf shoreline. The Chenier Unit is the area between the back-barrier marsh and State Highway 1. It is composed of a system of elevated ridges that support a maritime forest important to the physical integrity of the estuary and is home to many neotropical migratory birds. It is thought that these ridges were created by physical process that reworked sediments in between intermittent historical periods of sediment input from the east. This area has suffered land loss from subsidence and hydrologic isolation caused by impoundment from construction of roadways.

4.6.3.1.1.1 Volumetric Change Analysis

Surveys in 2000 and 2005 were compared to calculate the volume of shoreline changes on the Caminada Headland. The total cumulative shoreline volume change was estimated at -3,072,630 cubic feet, with a volume change rate of -614,526 cubic feet/year. The overwash total volume change was estimated at 1,554,576 cubic feet with a volume change rate of 310,915 cubic feet/year

4.6.3.1.1.2 Inlet Processes

In 1935, the major navigation inlet through Belle Pass was stabilized with the construction of riprap jetties, which have adversely impacted the longshore transport along the Caminada Headland to the west, trapping sand, and causing disrupting the downdrift sediment transport to the Timbalier Islands. The jetty/bar reach of the Federal navigation channel is dredged annually, removing approximately 600,000 cy per year (personal communication, Mr. Ed Creef, Operations Division, USACE, 2009). The dredged material is placed on the beach near the jetties. This provides an estimate of the sediment transport rate from the Caminada Headland to the west. The other potential sources of sediment, e.g. freshwater inputs and stormwater runoff, are considered negligible because Bayou Lafourche has a small drainage basin with very little slope. Bayou Lafourche, a tributary of the Mississippi River, was primarily responsible for the land building in the area, including the Caminada Headland. However, with the building of the Mississippi River flood control levees, the connection between Bayou Lafourche and the Mississippi was closed in the early 20th century.

Caminada Pass is unarmored and unstructured. There is evidence of longshore transport from west to east along the eastern section of the Caminada Headland, including spit growth at an unknown rate (Ritchie et al., 1995) and bypassing of about 83,000 cy per year to Grand Isle (USACE July 2004). Information on ebb and flood shoal changes, current velocities and tidal prism for both inlets is unavailable.

4.6.3.1.1.3 Sediment Budget, Historical Sediment Transport Patterns

Ritchie's et al. (1995) summary of diverging sediment transport along the Caminada Headland has been confirmed in other publications. **Figure 4-13** depicts the general Headland features and divergence of transport with the node located in the vicinity of Bayou Moreau. Williams et al. (1992) reported the historical shoreline changes along the Caminada Headland. The reported rates were highest just east of Bay Champagne, corresponding to the location of sediment divergence reported by Ritchie, then reducing slightly to the west to Belle Pass, and reducing significantly to the east to Caminada Pass. The computed shoreline change rates at MHW were highest at Transect C, which crosses Bay Champagne and then reduces by approximately 33 percent to the west. This reduction in shoreline change rate is attributed to the breakwaters and jetty impounding sand. Shoreline change rates to the east do not exhibit any trends.

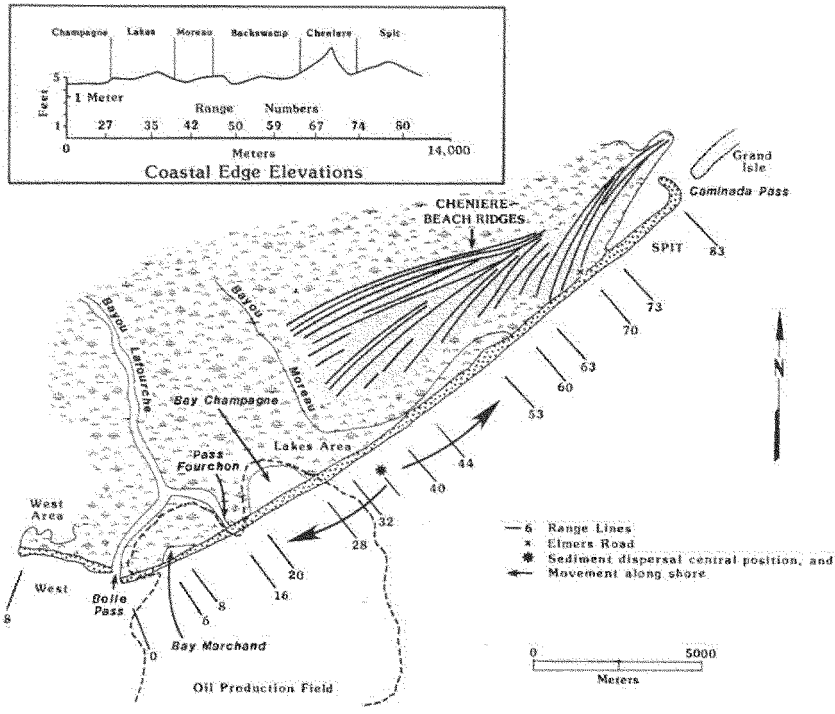


Figure 4-10. Sediment dispersal along the Caminada Headland (Ritchie, et al, 1995).

The cumulative volume change along the Headland from Transect A to G between 2000 and 2005 equals approximately 615,000 cy per year. The overwash accumulation on the landward side of the existing dune for the same time period between Transects D and G equals approximately 311,000 cy per year. The cumulative change includes the overwash accumulation. Therefore, the total net gulf shoreline erosion loss equals approximately 926,000 cy per year. The sediment budget is presented in **figure 4-14**.

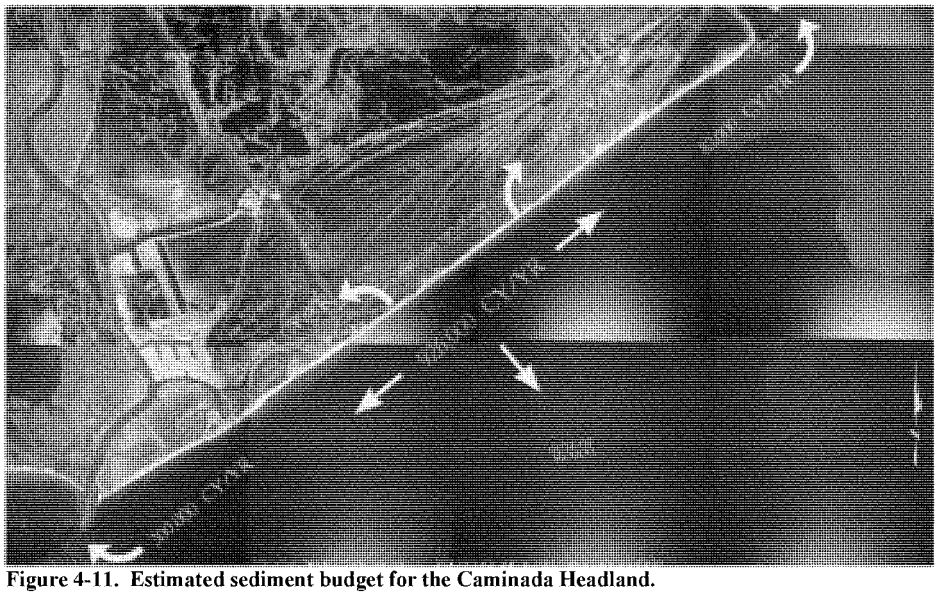


Figure 4-11. Estimated sediment budget for the Caminada Headland.

4.7 SALINITY REGIMES

This resource is institutionally significant because of NEPA, the Coastal Barrier Resources Act, and the Coastal Zone Management Act. This resource is technically significant because of the role that salinity plays in land loss and the survival, distribution, and impacts to plants, wildlife, and fisheries resources. This resource is publicly significant because alteration of salinity regimes can accelerate land loss and adversely impact commercial and recreational fishery opportunities.

4.7.1.1 Historic and Existing Conditions

Kohdrata (2004) indicates that salinity levels of the Gulf of Mexico around Grand Terre Island follow annual river patterns and are approximately 28 parts per thousand (ppt) in the fall when flow is low and 18 ppt in the spring when flow is high. Baumann, R.H. (1987) found the long-term salinity regime at Grand Terre has a spring low of about 16 ppt, followed by an autumn high of about 28 ppt. Inland, the seasonal salinity pattern becomes bimodal, with higher salinities occurring during spriug and fall. Swenson (2000) found that coastal salinities were inversely proportional to Mississippi River discharge, with a range of 10 ppt to 20 ppt, but with a fairly wide distribution, as shown in **(figure 4-15)**. However, the river usually peaks in the spring when local rainfall is also common. The data covers a period before operation of Davis Pond Diversion, which also lowers salinities when the river is high and would reinforce this trend.

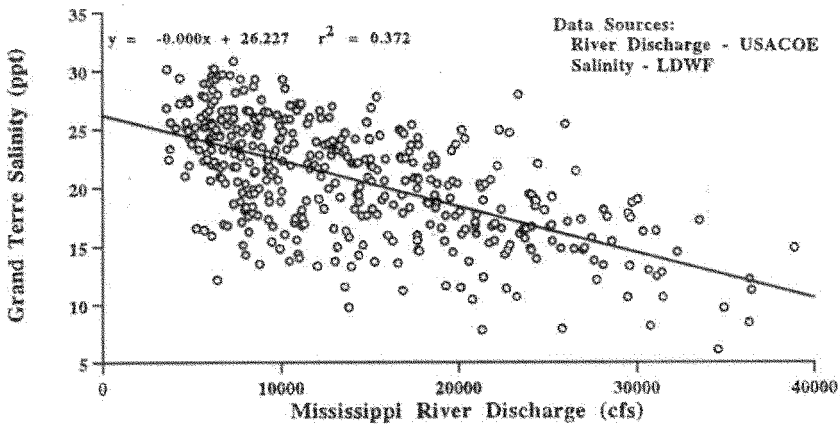


Figure 4-12 Mean Monthly Salinity 1961 -1996 (Swenson 2000)

Barrier islands function to absorb the impacts of storm surges thereby buffering interior estuarine marshes as well as regulating salinities (Fruge 1982; Chabreck 1988). By absorbing the impact of high-energy marine processes, barrier islands help to reduce the erosion of the mainland. According to the Louisiana Gulf Shoreline Restoration Report Louisiana Coastal Area (LCA) 2004 Study, a comprehensive model that can evaluate the spatial and temporal links that barrier islands have with the interior bays and coastal marshes is unavailable. The study showed that the hydrodynamics of the mixing zone are influenced by the barrier islands but the hydraulic conveyance of the embayment and the marsh are probably more important. The more open water and conveyance channels in the marshes, the greater the penetration of tidal energy into the marsh and the farther the mixing zone of fresh and saltwater will move into the marsh.

4.8 WATER QUALITY RESOURCES

This resource is institutionally significant because of the Clean Water Act, as amended, the Pollution Prevention Act, the Safe Drinking Water Act, and the Water Resources Planning Act. This resource is technically significant to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. This resource is publicly significant because of the desire for clean water and water-related activities such as boating, swimming, fishing, and as a source of potable water for human and animal consumption.

4.8.1 Historic and Existing Conditions

Historic and existing water quality issues for rivers and streams in coastal Louisiana include the transport of nutrients, pesticides, synthetic organic compounds, trace elements, suspended sediments, and bacteria. The Louisiana Department of Health and Hospitals coordinates with the LDEQ, the LDWF, and the Louisiana Department of Agriculture and Forestry to issue water body advisories aimed at protecting the public's health.

The LDEQ assesses four categories for water use under the use under the Louisiana Environmental Regulatory Code (LAC Title 33, Chapter 11) that would apply to the study area.

- *Primary Contact Recreation* includes activities such as swimming, water skiing, tubing, snorkeling, skin diving, and other activities that involve prolonged body contact with water and probable ingestion.
- *Secondary Contact Recreation* includes fishing, wading, and recreational boating, and other activities that involve only incidental or accidental body contact and minimal probability of ingesting water.
- *Fish and Wildlife Propagation* includes the use of water by aquatic biota for aquatic habitat, food, resting reproduction, and cover, including indigenous fishes and invertebrates, reptiles, amphibians, and other aquatic biota consumed by humans.
- *Oyster Propagation* includes the use of water to maintain biological systems that support economically important species of oysters, clams, mussels, and other mollusks consumed by humans so that their productivity is preserved and the health of human consumers of these species is protected.

In the study area, Fish and Wildlife Propagation was identified as being impaired. The USEPA and LDEQ identified elevated mercury levels the suspected causes for impairment for Fish and Wildlife Propagation, citing atmospheric deposition as the source of this impairment (LDEQ 2006). On March 8, 2006, the Louisiana Department of Health and Hospitals, along with the Louisiana Department of Environmental Quality and the LDWF, issued a fish consumption advisory for king mackerel, cobia, blackfin tuna, and great amberjack taken off the coast of Louisiana (LDHH 2006). This advisory is based on fish sampling in the Gulf of Mexico off the coast of Louisiana where unacceptable levels of mercury in fish tissues were detected for king mackerel, cobia, blackfin tuna, and great amberjack.

4.8.1.1 Water Quality, Sediment Quality, and Elutriate Quality Data

For the purposes of assessing historic and existing conditions of the dredged material proposed for placement into the aquatic environment for beach and marsh restoration at the Caminada Headland and Shell Island, as well as the re-nourishment of the Caminada Headland, the guidance document entitled Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual, commonly referred to as the Inland Testing Manual (USEPA/USACE 1998), provides guidance for the characterization of impacts to the aquatic environment from the dredged material placement activity. The Inland Testing Manual uses a tiered approach to investigate these impacts, with the demands of each tier requiring more research and further testing. If a dredged material management decision can be made at a given tier, no further testing is required; hence, it would not be necessary to move to the next tier of investigation. For a Tier I level investigation of dredged material disposal impacts, the following statements, taken from the Inland Testing Manual, apply:

> *Subpart G of the 404(b)(1) guidelines requires the use of available information to make a preliminary determination concerning the need for testing of the material proposed for dredging. This principle is commonly known as "reason to believe." The decision not to perform testing based on prior information must be documented in order to provide a reasonable assurance that the proposed discharge material is not a carrier of contaminants (by virtue of the fact that it is sufficiently removed from sources of pollution) [230.60(b)]. The reason to believe that no testing is required is based on the type of material to be dredged and/or its potential to be contaminated. For example, dredged material is most likely to be free of contaminants if the material is composed primarily of sand, gravel, or other inert material and is found in areas of high current or wave energy [230.60(a)]. In addition, knowledge of the proposed dredging site proximity to other sources of contamination, as well as that gained from previous testing or through experience and knowledge of the area to be dredged, may be utilized to conclude that there is no*

reason to believe that contaminants are present [230.60(b)] and, therefore, no need for testing.

Tier I is a comprehensive analysis of all existing and readily available, assembled, and interpreted information on the proposed dredging project, including all previously collected physical, chemical, and biological monitoring data and testing for both the dredged material excavation site and the proposed disposal site. Only limited testing, to determine the applicability of exclusions, maybe necessary in this tier. If the information set compiled in Tier I is adequate to meet the exclusions or is complete and comparable to that which would satisfy Tier II, III, or IV, as appropriate, factual determinations can be made without proceeding into the higher tiers. For an evaluation to be completed within Tier I, the burden of evidence of the collected information must be adequate to make factual determinations.

Tier I evaluation of water quality, sediment quality and elutriate quality (an elutriate is a mixture of dredging site water and sediment that simulates and is used to predict the chemical properties of dredged material effluent waters exiting the restoration site during a dredged material pumping operation) was conducted for all potential borrow sites. Potential beach/dune fill material borrow sites include: the South Pelto block of Ship Shoal (**figure 3-2**, **figure 4-3** and **figure 4-4**), and the Nairn site at the Mississippi River (**figure 3-10** and **figure 4-7**). Potential marsh fill borrow sites include the Caminada Headland and Empire borrow areas (**figure 3-2** and **figure 4-5**). The Caminada Headlands borrow area is located adjacent to Bayou Moreau and approximately 1.5 miles offshore from the Caminada Headlands (**figure 3-2**). The proposed Caminada Headland re-nourishment borrow area is Bayou Lafourche navigation channel (**figure 4-5**). Water, sediment, and elutriate data for these borrow areas were extracted from the following sources:

- 1994 Port Fourchon Feasibility Study (USACE 1994). The study includes water, sediment, and elutriate data for Belle Pass. The data described in this integrated report is for sediment samples located within 8 miles of the Caminada Headlands borrow area and within the proposed Caminada Headland re-nourishment borrow area. At the time samples were collected from Belle Pass (1989), Port Fourchon was less developed, and it would thus be expected that sediment quality would be less influenced by Port Fourchon industry than at present. Therefore, the sample results are expected to act as a surrogate for Caminada Headlands borrow area sediment chemistry.

- 2007 Louisiana Department of Natural Resources (LDNR) Caminada Headlands and Shell Island Restoration Projects Water Quality Assessment Report (Providence Engineering and Environmental Group LLC, 2007). The report includes water, sediment, and elutriate data for the South Pelto borrow area, the Mississippi River borrow area, the Empire borrow area, and the Sandy point borrow area.

4.8.1.1.1 Surface Water Chemistry – Summary of Results

Results for chemical analyses of surface waters adjacent to the proposed restoration areas are useful in addressing the abilities of those waters to dilute the dredged material effluent waters, which would discharge from the site during dredged material disposal operations. Of the 117 chemical compounds analyzed from water samples taken adjacent to the Caminada Headland and Shell Island, laboratory instruments were only able to detect the presence of 4 metals in Caminada Headlands waters and 7 metals in Shell Island waters. All of the metals detected in these surface waters were below both USEPA and LDEQ water quality criteria (USEPA 2006; LDEQ 2008). A more detailed summary of the surface water chemistry results is available in the LCA BBBS 404(b)(1) evaluation.

4.8.1.1.2 Sediment Chemistry – Summary of Results

Sediment chemistry analysis is useful in determining, at a reconnaissance level, the potential for long-term effects of sediments on organisms that are in direct contact with surface sediments of the restoration areas. In addition, comparison of sediment chemistry to sediment screening values can be used to determine whether further investigation of the sediment (elutriate chemistry and biological testing, whereby aquatic organisms are directly exposed to sediments) is warranted.

Classes of chemical compounds detected in Belle Pass sediments (with the number of chemical compounds measured in each chemical class in parenthesis) included: metals (10), chlorinated pesticides (15), inorganics (7), and oil and grease. Analyses revealed a total of 6 metals, 2 inorganics, and 1 chlorinated pesticide. None of the chemical compounds detected exceeded saltwater sediment screening values (NOAA 2008). Sediment chemistry results utilizing the Belle Pass sediment data as a surrogate for the Caminada Headland borrow area and as data representative of the Caminada Headland re-nourishment area, indicate that placement of dredged sediments from these borrow areas would not result in adverse impacts to aquatic organisms.

Laboratory analysis for 117 chemical compounds in sediments from, the South Pelto, Sandy Point, Empire and Mississippi River borrow sites was only able to detect the presence of 8 metals in the South Pelto borrow area; 12 metals in the Sandy Point; 10 metals in the Empire borrow area; and 11 metals and 20 semivolatile organic compounds in Mississippi River borrow area sediments. None of these compounds were detected at concentrations exceeding saltwater sediment screening values. Therefore, no long term impacts to aquatic organisms would be expected due to the placement of dredged sediments from the South Pelto, Sandy Point, Mississippi River, or Empire borrow areas for barrier island restoration features. A more detailed summary of the sediment chemistry results is available in the LCA BBBS 404(b)(1) evaluation.

4.8.1.1.3 Elutriate Chemistry – Summary of Results

Results for the chemical analysis of elutriates can be used to estimate the chemical concentrations in dredged material effluent waters being discharged from the restoration site, and can assist in determining whether the discharge of dredged material effluent waters will result in any short-term impacts to the water column during discharge activities. Elutriate data is commonly reviewed for chemical compounds whose sediment concentration exceeds sediment screening values.

Because no sediment screening values were exceeded for the proposed borrow area sediments, the review of elutriates derived from these sediments is not necessary and no impacts to the water column would be expected from the proposed dredging material placement activities.

4.9 VEGETATION RESOURCES

This resource is institutionally significant because of the Coastal Barrier Resources Act of 1982; Coastal Zone Management Act of 1972; Emergency Wetlands Resources Act of 1986; Estuary Protection Act of 1968; Fish and Wildlife Conservation Act of 1980; the Fish and Wildlife Coordination Act of 1958, as amended; Migratory Bird Conservation Act; Migratory Bird Treaty Act; Endangered Species Act of 1973 (ESA); Magnuson Fishery Conservation and Management Act 1990; NEPA; the North American Wetlands Conservation Act; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; and Executive Order 13186 Migratory Bird Habitat Protection. Vegetation resources are technically significant because they are a critical element of the barrier shoreline habitats. Vegetation resources serve as the basis of productivity, contribute to ecosystem diversity, provide various habitat types for fish and wildlife, and are an indicator of the health of coastal habitats. Vegetation resources are publicly

significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

4.9.1 Historic and Existing Conditions

More detailed descriptions of vegetation resources is presented in appendix D. Barrier shorelines and associated back marsh areas are dynamic areas with considerable spatial and temporal variation in plant species distribution. The study area is subjected to varying degrees of natural and human disturbance. Vegetation is one of the most important factors in trapping and retaining sediments in the barrier shoreline system. The zones or communities of barrier island vegetation and the extent of their diversity are related to elevation, degree of exposure to salt spray, and storm events that cause overwash. These zones often intergrade with each other: beach pioneer zone → frontier zone → dune → barrier grasslands → salt flats → salt marsh → intertidal mud flats (after Ritchie et al. 1990 and 1995). Species presence and abundances in each of these zones (see **table 4-13)** are determined by availability of propagules, microclimate variation, and individual species adaptations. Initial colonization of a zone is frequently by species present in adjacent zones that can send out runners or stolons. Vegetation descriptions are based on a series of vegetation and elevation transects conducted in 1987 and 1988 along the Plaquemines shoreline from West Grand Terre Island to Scofield Bayou (Ritchie et al. 1990), along the Caminada headland from 1987 to 1990 (Ritchie et al. 1995), and field observations during the course of this present study.

4.9.2 Rare, Unique, and Imperiled Vegetative Communities

The Louisiana Natural Heritage Program describes imperiled vegetative communities occurring in the study area. These communities are nestled within the broader vegetative habitats and are important in that they contribute to the extensive diversity of the coastal ecosystem, enhance its productivity, and are essential to the stability of the bionetwork.

- Coastal mangrove thicket: Rarity rank S3/G2? (S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations. G2? = rank uncertain; imperiled globally because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range). Estuarine community generally found adjacent to or surrounded by salt marsh, and often on the leeward side of barrier islands. Restricted to Louisiana's outer coastal region due to black mangrove's inability to tolerate freezing temperatures. Extensive root systems stabilize the shoreline and reduce erosion. Cover and food provided by mangrove shrublands create an excellent nursery area for fish and shellfish. The presence of mangrove thickets within the salt marsh improves surrounding water quality by filtering nutrients and suspended sediments. Serves as important nesting areas for colonial waterbirds (Source: http://www.wlf.louisiana.gov/pdfs/experience/naturalheritage/naturalcommunities/Coastal_mangrove_BTNEP.pdf).
- Coastal dune shrub thicket: Rarity S1/G3? (S1= see previous description. G3? Rank uncertain; see above description). Occurs on established sand dunes and beach ridges on barrier islands and the mainland coast. Very limited extent in Louisiana due to poorly developed coastal dune system; often serve as important nesting areas for colonial waterbirds (source: http://www.wlf.louisiana.gov/pdfs/experience/naturalheritage/naturalcommunities/Coastal_dune_shrubthicket_BTNEP.pdf).

Table 4-13. Vegetation of study area (source: based on site visits and after Ritchie et al. (1990); and Ritchie et al. (1995)).

Plant Species	Beach Pioneer Area	Frontier Zone	Dune	Barrier Grassland	Salt Flats	Salt Marsh	Intertidal Mud Flats	Spoil Banks
Agalinis maritima (seaside gerardia)			X					
Agalinis purpurea (purple gerardia)			X					
Amaranthus greggii		X						
Atriplex cristata (sea-beach orach)	X							
Atriplex cristata (sea-beach orach)		X				X		
Avicennia germinans (black mangrove)								
Baccharis halimifolia (groundsel bush)			X			X		X
Batis maritima (saltwort)						X		
Borrichia frutescens (sea ox-eye)			X	X		X		
Bostrichia spps						X		
Cakile geniculata (sea rocket)	X	X	X					
Chenopodium album (pigweed, lamb's-quarters)	X	X	X					
Cissus trifoliata (marine-vine)								X
Colocasia esculentum (elephant ear)	X							
Croton punctatus (beach tea)	X	X	X	X				
Cuscuta gronovii (common dodder)						X		
Cuscuta indecora (pretty dodder)						X		
Cynanchum angustifolium (milkweed vine)				X				
Cynodon dactylon (Bermuda grass)		X	X					
Cyperus spp.	X	X	X	X	X			
Distichlis spicata (salt grass)	X	X		X		X		X
Ectocarpus spps						X		
Enteromorpha spps						X		
Eustoma exaltatum (seaside gentian)				X	X			
Fimbristylis castanea (sand rush)				X	X			
Heliotropium curassavicum (seaside heliotrope)	X							X
Heterotheca subaxillaris (camphor weed)			X					
Hydrocotyle bonariensis (sand pennywort)		X	X	X				
Ipomoea pes-caprae (goatsfoot morning glory)		X						
Ipomoea imperati (beach morning glory)		X	X	X				
Iva frutescens (marsh elder)			X	X		X		X
Juncus roemerianus (black needle rush)						X		
Lantana camara (lantana)								X
Limonium carolinianum (sea lavender)				X	X			
Lonicera japonica (Japanese honeysuckle)								X
Morella cerifera (*Myrica cerifera*, wax myrtle)				X				X
Panicum amarum (bitter panicum)		X	X	X				
Panicum repens (dog-tooth grass)	X	X	X	X				
Paspalum vaginatum (seashore paspalum)				X				
Phragmites australis (roseau cane)				X				
Phragmites communis (roseau cane)		X						
Phyla nodiflora (frogfruit)				X				
Polysiphonia spps						X		
Portulaca oleracea (common purslane)	X							
Rhynchospora colorata (*Dichromena colorata*, white-topped sedge)				X				
Sabatia stellaris (common marsh pink)				X	X			
Salicornia bigelovii (Bigelow glasswort)					X	X		
Salicornia virginica (creeping glasswort)					X			
Schizachyrium littorale (maritime bluestem)			X	X				
Schoenoplectus americanus (*Scirpus olneyi*, (three-cornered grass)				X				
Uniola paniculata (sea oats)			X					
Sesbania drummondii (rattlebox)		X	X	X				
Sesuvium portulacastrum (sea purslane)	X	X	X		X			
Simphyotrichum tenuifolium (*Aster tenuifolius*, saltmarsh aster)				X				
Solidago sempervirens (seaside goldenrod)		X	X	X		X		X
Spartina alterniflora (smooth cordgrass, oyster grass)		X				X		X
Spartina patens (marsh-hay cordgrass)	X	X	X	X		X		X
Sporobolus virginicus (coastal dropseed)	X	X	X	X	X			
Strophostyles helvula (wild bean)			X	X				

- Coastal dune grassland: Rarity Rank S1S2/G2G3 (S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation. S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation. G2 = imperiled globally because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range. G3 = either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21 to 100 known extant populations)). Occurs on beach dunes and relatively elevated backshore areas (ridges) above intertidal beaches on barrier islands and on the mainland. (source: http://www.wlf.louisiana.gov/pdfs/experience/naturalheritage/naturalcommunities/Coastal_dune_grassland_BTNEP.pdf).

4.9.3 Invasive Plant Species

Although Chinese tallow (*Triadica sebifera*) and other potentially invasive species (e.g., cogongrass *Imperata cylindrica*) that are infesting gulf coast wetlands, savannas, and forests have been sighted on rare occasions, no problems caused by encroachment of invasive plant species have been reported on Louisiana's barrier islands (personal communications C. Steyer, NRCS; K. Bahlinger, LDNR; M. Hester, LSUNO; M. Materne, LSU Agcenter; I. Mendelssohn, LSU; C. Reid, LDWF; J. Visser, LSU). This is likely due to the extreme environmental conditions, such as higher salinities, shifting substrates, and frequent storm disturbance that severely limit suitability of the habitat for colonization.

4.10 WILDLIFE RESOURCES

This resource is institutionally significant because of NEPA; the Coastal Zone Management Act; the Estuary Protection Act; the Fish and Wildlife Coordination Act of 1958, as amended; the Migratory Bird Conservation Act of 1929, as amended; the Migratory Bird Treaty Act (1918); the Endangered Species Act of 1973 (ESA), as amended; the Fish and Wildlife Conservation Act of 1980; the North American Wetlands Conservation Act; Executive Order 13186; the Migratory Bird Habitat Protection Act; and the Marine Mammal Protection Act. Wildlife resources are technically significant because they are a critical element of the barrier shoreline ecosystem, they are an indicator of the health of various coastal habitats, and many wildlife species are important recreation and commercial resources. Wildlife resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

The USFWS commented that significant fish and wildlife resources that should be fully considered and addressed in the final FEIS include: migratory and resident shorebirds, wading birds, waterfowl, neotropical songbirds, threatened and endangered species (and their designated habitat), estuarine-dependent fishes and shell fishes, and important coastal habitats such as emergent marsh, submerged aquatic vegetation, shallow open water, beach, dune, maritime forest, and back-barrier marsh (personal communication, USFWS, June 15, 2005).

4.10.1 Historic and Existing Conditions

Wildlife distributions in barrier systems are influenced by landforms, climate, salinity, tides, vegetation, other animals, and human activities (Day et al. 1989). Wildlife, their general habits and habitat requirements potentially occurring in the study area are described in the following: Conner and Day (1987), Abernethy (1987), Condrey et al. (1995), Louisiana Coastal Wetlands Conservation and

Restoration Task Force and the Wetlands Conservation and Restoration Authority (1999) (hereinafter referred to as the Coast 2050 Report (1999)).

Amphibians and Reptiles: Little if any information exists regarding the population status of amphibians and reptiles in the study area. Condrey et al. (1995) indicates that virtually nothing is known about the populations of 7 species of salamanders and 13 species of frogs and toads reportedly occurring in the Barataria-Terrebonne National Estuary. With the exception of American alligator (*Alligator mississippiensis*) harvest data, there is a general lack of data on the status and trends of most of the reptiles worldwide (Gibbons et al. 1999) as well as those species that may inhabit the study area. Generally, direct harvest and loss and degradation of habitat has resulted in the depletion of all the Barataria Basin's commercially important reptiles (Condrey et al.1995). The herpetofauna typically found in the Gulf salt marsh environments are the Gulf salt marsh snake (*Nerodia clarkii clarkia*), the Gulf coast toad (*Bufo valliceps*), and the diamondback terrapin (*Malaclemys terrapin)* (Abernethy (1987). Condrey et al. (1995) reports that coastal erosion and barrier island retreat directly threatens the diamond-backed terrapin (*Malaclemys terrapin*).

Mammals: Other than fur harvest records, little is known about the status and trends of mammals throughout the Barataria-Terrebonne Basin (Condrey et al. 1995). The interagency Coast 2050 Report (1999) characterizes the current population status, population trends since 1985, and population projections to 2050 for several furbearers, (including nutria, muskrat, mink, river otter, and raccoon) and three game mammals (rabbit, squirrel, and deer) for various habitat types throughout the study area. Deer and squirrel have not been historically present or are no longer present throughout the entire study area. Rabbit populations have been steady since 1985, but only in the Caminada Headland area. Furbearer population trends since 1985 are reportedly decreasing throughout the entire study area.

Avifauana: The study area is located within the Mississippi River migration flyway (Bellrose 1980) that is a major bird migration corridor within North America. The study area is an important staging area for migrating neotropical passerines. Abernethy (1987) reports 411 species of birds inhabit the Barataria-Terrebonne estuary. The decline in populations of neotropical passerine migrants is a serious conservation problem; one that may be linked to the availability of suitable en route habitat where energy reserves critical to successful migration can be replenished rapidly and safely (Moore et al. 1990). The study area is also important to shorebirds and waterfowl, as well as providing important wintering and breeding habitat for many different species of seabirds, shorebirds, wading birds, waterfowl, raptors, and songbirds (Lowery 1974b; Helmers 1992; Chabreck et al.1989; Martin and Lester 1991; Condrey et al. 1995; BTNEP 1996; Coast 2050 Report 1999). Martin and Lester (1991) and Visser and Peterson (1994) provide information and maps regarding colonial nesting seabirds and wading bird populations in the study area. Condrey et al. (1995) cites 353 species of birds occurring throughout the Barataria-Terrebonne estuary. Condrey et al. (1995) summarize the historical trends and causes for change, habitat requirements, and major factors affecting selected groups of avifauna species occurring throughout the Barataria-Terrebonne estuary system.

The Coast 2050 Report contains information collected by the Region 2 Regional Planning Team that included parish, state, Federal, and academic representatives. Information on fish and wildlife resources is reported in the Coast 2050 Report by specific mapping unit. The Fourchon mapping unit encompasses the Caminada Headland area; the Barataria barrier shoreline mapping unit contains the Shell Island area. Region 2 includes the Breton, Barataria, and Mississippi River hydrologic basins. The Coast 2050 Report (1999) characterized the current population status, population trends since 1985, and population projections to 2050 for 14 prominent avifauna species and/or species groups (**table 4-14**). Avifauna considered by the Coast 2050 Report include seabirds; wading birds; shorebirds; dabbling and diving ducks; geese; raptors; rails, coots, and gallinules; other marsh open water residents; other woodland residents; other marsh open water migrants; and other woodland migrants.

Table 4-14 functions, status, trends, and projections of birds within the study area (source: Coast 2050 Report (1999).

Habitat Types: OW = Open Water; AB = Aquatic Bed; FM: Fresh Marsh; IM = Intermediate Marsh; SM = Salt Marsh; FS = Fresh Swamp; HF = Hardwood Forest; BB = Barrier Beach; AU = Agricultural/Upland. Habitat types comprising less than 5 percent of unit are sho

Status: NH = Not Historically Present; NL = No Longer Present; Lo = Low Numbers; Mo= Moderate Numbers; Hi = High Numbers.

Functions of Particular Interest: Ne = Nesting; St = Stopover Habitat; W = Wintering Habitat; Mu = Multiple Functions

Trends (since 1985) Projections (through 2050): Sy = Steady; D = Decrease; I = Increase; U = Unknown. (Source: adapted from Coast 2050 Report (1999).

Mapping unit	Type	% of unit	Brown Pelican				Bald Eagle				Seabirds				Wading Birds				Shorebirds				Dabbling Ducks				Diving Ducks			
			function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection
Barataria Barrier Shorelines	OW	74	W	Hi	I	I		NH			Mu	Hi	Sy	Sy		NH				NH				NH			W	Lo	D	D
	SM	20		NH				NH			Mu	Mo	D	D	Mu	MO	D	D	Mu	Mo	D	D	W	Lo	D	D	W	Lo	D	D
	HF	1		NH				NH				NH				NH				Nh				NH				NH		
	BB	2		NH				NH			Mu	Mo	D	D	Mu	Lo	D	D	Mu	Mo	D	D		NH				NH		
Fourchon	OW	50	W	Hi	I	I		NH			Mu	Hi	Sy	Sy		NH				NH			W	Lo	Sy	D	W	Lo	Sy	D
	SM	39		NH				NH			Mu	Hi	Sy	D	Mu	Hi	Sy	D	Mu	Hi	Sy	D	W	Lo	Sy	D	W	Lo	Sy	D
	HF	2		NH				NH				NH				NH				NH				NH				NH		
	BB	3		NH				NH			Mu	Hi	D	D	Mu	Lo	Sy	D	Mu	Hi	D	D		NH				NH		
	AU	6	W	Lo	I	I		NH				NH			Ne	Mo	Sy	D	Mu	Lo	Sy	D		NH				NH		

			Geese				Raptors				Rails, Coots, and Gallinules				Other Marsh/OW Residents				Other Woodland Residents				Other Marsh/OW Migrants				Other Woodland Migrants			
			function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection	function	status	trend	projection
Barataria Barrier Shorelines	OW	74		NH				NH				NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	SM	20		NH				NH			Mu	Lo	D	D	Ne	Mo	D	D		NH			Ne	Mo	D	D		NH		
	HF	1		NH			St	Mo	D	D		NH				NH			Ne	Mo	D	D		NH			Mu	Hi	D	D
	BB	2		NH				NH				NH				NH				NH			Mu	Mo	Sy	Sy		NH		
Fourchon	OW	50		NH				NH				NH			Mu	Mo	Sy	Sy		NH			Mu	Mo	Sy	Sy		NH		
	SM	39		NH				NH			W	Lo	Sy	D	Mu	Hi	Sy	D		NH			Mu	Hi	Sy	D		NH		
	HF	2		NH			St	Mo	Sy	D		NH				NH			Ne	Mo	Sy	D		NH			Mu	Mo	Sy	D
	BB	3		NH				NH				NH				NH				NH				NH				NH		
	AU	6		NH			Mu	Lo	Sy	D		NH				NH			Ne	Lo	Sy	D		NH			Mu	Lo	Sy	D

The Comprehensive Conservation Action Plan outlined in the Barataria Terrebonne National Estuary Program Report (BTNEP) #30 (Wiedenfield et al. 1996) recommends habitat protection of important habitats for birds, especially cheniers, which are described as extremely small and vulnerable to development or loss through natural processes. The BTNEP recommendations include:

1. The Cheniere Caminada should be purchased for perpetual maintenance as wooded habitat for migrants and as a site for a migration monitoring station.
2. A private lands initiative could be utilized for protection of other cheniers.
3. Barrier island restoration projects should specifically include provisions for birds.
4. Beaches used by nesting seabirds should be protected by being fenced off and marked with signs during the breeding season, and plans should be made for the protection of the breeding colonies in the event of an oil spill.
5. Increasing freshwater and sediment flow into the estuary would also benefit bird populations.
6. Managers of already-existing public lands should develop plans for including birds in their management objectives.

4.10.1.1 Invasive Species

The nutria (*Myocastor coypus*) and the Norway rat (*Rattus norvegicus*) are the primary invasive mammalian species that could occur throughout the study area (http://invasive.btnep.org/). However, the nutria is typically found in the freshwater swamps and marshes of the Barataria-Terrebonne estuary system, which are located outside of the study area (Condrey et al. 1995; http://invasive.btnep.org/default.asp?id=86). The monk parakeet (*Myiopsitta monachus*), Eurasian collared-dove (*Streptopelia decaocto*), English sparrow (*Passer domesticus*), European Starling (*Sturnus vulgaris*), and cattle egret (*Bubulcus ibis*) are all potential invasive avian species that could be found in the study area (http://invasive.btnep.org/default.asp?id=51).

4.11 FISHERY RESOURCES

Fishery resources are institutionally significant because of the Fish and Wildlife Coordination Act of 1958, as amended; the Endangered Species Act of 1973; the Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (Magnuson-Stevens Act); the Coastal Zone Management Act; and the Estuary Protection Act. Fishery resources are technically significant because they are a critical element of many valuable freshwater and marine habitats, they are 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. Fishery resources in the study area include marine and estuarine finfish and shellfish.

4.11.1 Historic and Existing Conditions

The study area is characterized by a variety of aquatic habitats, but consists primarily of numerous large expanses of shallow open water resulting from the widespread coastal wetland loss throughout coastal Louisiana. These saline areas typically do not contain submerged aquatic vegetation. Shallow open water is now the dominant habitat type throughout the study area. Within the Shell Island area, large expanses of once emergent marsh and interior shallow waters are now connected directly with the Gulf of Mexico. The moderate- to high-salinity marine and estuarine waters of the study area provide nursery and foraging habitat for many estuarine-dependent finfish and shellfish species of commercial and recreational importance.

The NMFS scoping comment letter dated June 15, 2005, indicates that the study area's coastal wetlands provide nursery and foraging habitat that supports economically important marine fishery species, such as Atlantic croaker (*Micropogonias undulates*), red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), bay anchovy (*Anchoa mitchilli*), spotted seatrout (*Cynoscion nebulosus*), Gulf menhaden (*Brevoortia patronus*), striped mullet (*Mugil cephalus*), blue catfish (*Ictalurus furcatus*), tarpon (*Megalops atlanticus*), and southern flounder (*Paralichthys lethostigma*). The NMFS also indicated that some of these species serve as prey for other Federally-managed fish species such as mackerels, snappers, groupers, billfishes, and sharks.

Barrier islands provide three primary zones of habitats for shellfish and finfish. These zones of habitats include the surf zone beach; back island low-energy zones that are sand flats or marsh; and intra-island ponds, lagoons, and meanders. These habitats are characterized by specific physical attributes and can have quite different fish fauna.

The Barataria estuary, a dynamic aquatic zone where fresh water dilutes seawater, serves as nursery area for a variety of these economically important fish and shellfish from the Gulf of Mexico (Zimmerman and Minello 1984; Rozas and Odum 1987; Mclvor and Odum 1988; Hettler 1989; Kneib 1991; Rozas 1992; Rozas and Reed 1993). Most of the economically important saltwater fishes and crustaceans harvested in Louisiana spawn offshore and then use estuarine areas for a nursery habitat. According to the Coast 2050 Report (1999) the status of most major commercially important fish and invertebrate species have been declining throughout the study area. Only Spanish mackerel populations have increased.

Boesch and Turner (1984), Day et al. (1989), and Herke (1995) recognized the importance of Gulf of Mexico estuaries to fishery resources. Implicit in the concept of salt marsh systems as "nurseries" for economically important fishes and invertebrates is that the shallow waters associated with the marsh provide protection for critical life history stages (Boesch and Turner 1984). Estuaries are not closed, self-contained ecological systems; rather, their production of organic matter is as dependent on material contributed from land and sea as is their brackishness (Kutkuhn 1966). Estuaries represent some of the most productive habitats in the world.

The borrow sites in the lower Mississippi River may be home to as many as 150 fish species (Fremling 1989). Baker et al. (1991) estimates that 91 species of freshwater fishes inhabit the lower Mississippi River, with more than 30 other species present intermittently. Most riverine fishes inhabit areas along the channel bottom (Baker et al. 1991) and near the banks (Pennington et al. 1983).

The fisheries characteristic of the Port Fourchon navigation bar channel borrow site would be similar to those described above for the Barataria estuary.

The offshore borrow site at Ship Shoal and the nearshore borrow sites support white and brown shrimp and spotted seatrout fisheries as well as more saline species of Federally-managed fish species such as mackerels, snappers, groupers, billfishes, and sharks. These species are major components of the Ship Shoal ecosystem. White and brown shrimp are opportunistic benthic-feeding omnivores. Spotted seatrout are important predators on white and brown shrimp.

4.11.2 Invasive Species

Although the Australian spotted jellyfish (*Phyllorhiza punctata*) is present in the Gulf of Mexico every summer, there has not been a major population explosion since 2000 (source: http://invasive.btnep.org/default.asp?id=110).

4.12 ESSENTIAL FISH HABITAT

EFH is institutionally significant because of the Magnuson-Stevens Act of 1996 (Public Law 104-297) which promotes the protection, conservation, and enhancement of EFH. This resource is technically significant because EFH includes those waters and substrate necessary to Federally-managed fish species for spawning, breeding, feeding or growth to maturity. EFH is publicly significant because of the high value that the public places on seafood and the recreational and commercial opportunities EFH provides. The EFH designation is an important component of building and maintaining sustainable marine fisheries through habitat protection. Specific categories of EFH that have been designated in the project area include estuarine emergent wetlands; mud, sand, and shell substrates; estuarine and marine water column; and natural structural features in the proposed fill area. The project area includes existing intertidal and sub-tidal habitats including vegetated marsh, tidal flats and beaches, and shallow open water bottoms, all of which provide EFH for Federally-managed species. In the proposed borrow areas, EFH categories include marine water column and non-vegetated bottoms. 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). The generic amendment was prepared as required by the Magnuson-Stevens Fishery Conservation and Management Act.

4.12.1 Historic and Existing Conditions

Aquatic and tidally influenced wetland habitats in the study area, including potential offshore borrow site(s), consist of EFH for the species and life stages listed in **table 4-15** (personal communication NMFS, 2005). **Table 4-15** identifies EFH for specified species life stages, the marine or estuarine system utilized by the species, and the relative abundance by salinity zone. The NMFS also identified coastal wetlands as providing nursery and foraging habitat that support economically important marine fishery species such as spotted seatrout, southern flounder, Atlantic croaker, Gulf menhaden, striped mullet, and blue crab. These species serve as prey for other Federally-managed fish species such as mackerels, snappers, groupers, billfishes and sharks. All wetlands and bays in the study area are EFH and an important consideration in the development of any restoration plan (personal communication NMFS 2005).

An EFH alteration of particular concern is the marsh loss experienced along the Louisiana coast. While the land/water interface is one of the most productive fishery habitats (Faller 1979; Gosselink, 1984, Minello et al. 1984, Zimmerman et al. 1984) and this interface generally increases with marsh break up, at some point much of the marsh has been lost and the length of the land/water interface decreases. Wetland loss rates in the Barataria basin are extremely high, due to a variety of factors. In the study area, it is likely that the land/water interface is already rapidly decreasing, which could result in reductions in fishery production in the area.

EFH alterations of particular concern in Louisiana are marsh loss, and maintenance of habitat, 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 (GMFMC 1988). In addition to being designated as EFH for a number of species, aquatic and wetlands habitats in the project area provide nursery, foraging, and predator refugia habitat that support other marine fishery species discussed in section 4.11 "Fishery Resources." Some of these species serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC.

Table 4-15. Essential Fish Habitat which has been designated for managed species and life stages within either the fill or borrow sites in the Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline Restoration Project study area. (Source: NMFS, Patrick Williams November 17, 2011)

Species	Life Stage	System	EFH
Brown shrimp	eggs	M	<18-110 m; sand/shell/soft bottom
	larvae/postlarvae	M/E	<82 m; planktonic, sand/shell/ soft bottom, SAV, emergent marsh, oyster reef
	juvenile	E	<18 m; SAV, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
	adults	M	14-110 m; sand/shell/soft substrate
White shrimp	eggs	M	<9-34 m; sand/shell/soft bottom
	larvae/postlarvae	M/E	<82 m; planktonic, soft bottom, emergent marsh
	juvenile	E	<30 m; soft bottom, emergent marsh
	adult	M	9-34 m; soft bottom
Red drum	eggs	M	Gulf of Mexico (GOM) <46 m
	larvae/postlarvae	E	all estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	juvenile	M/E	GOM <5 m all estuaries SAV, sand/shell/soft/hard bottom, emergent marsh
	adults	M/E	GOM 1-46 m all estuaries SAV, pelagic, sand/shell/soft/hard bottom, emergent marsh
Red snapper	adults	M	7-146 m; reefs, hard/sand/shell bottoms
Lane snapper	eggs	M	4-132 m; pelagic
	larvae	E/M	4-132 m; reefs, SAV
	juvenile	E/M	<20 m; SAV, mangrove, reefs, sand/shell/soft bottom
Dog snapper	juvenile	E/M	SAV, mangrove, emergent marsh
Dwarf sand perch	juvenile	M	hard bottom
Greater amberjack	eggs	M	1-183 m; pelagic
	larvae	M	1-183 m; pelagic
	juvenile	M	1-183 m
Lesser amberjack	eggs	M	pelagic
	larvae	M	pelagic
Gray triggerfish	eggs	M	10-100 m; reefs
	postlarvae/juvenile	M	10-100 m
King mackerel	larvae	M	9-180 m; pelagic
	juvenile	M	<9 m; pelagic
Cobia	eggs	M	pelagic
	larvae	M	11-53 m; pelagic
	juvenile	M	5-183 m; pelagic
Bonnethead shark	juvenile	E	inlets, estuaries, coastal waters <25 m
	adult	M	< 25 m

[1]**E=estuarine, M=marine**

4.13 WATERBOTTOMS AND BENTHIC RESOURCES

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

4.13.1 Historic and Existing Conditions

The bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what could be called a "benthic effect" (Day et al. 1989). Benthos is generally intended to include the entire bottom community and its immediate physical environment, all of which have been termed the "benthic boundary layer" (Day et al. 1989). The major consumer groups of the benthic habitat include: bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink 1993).

According to Day et al (1989), the benthic community structure is not static; it provides a residence for many sessile, burrowing, crawling, and even swimming organisms. The specific composition and distribution of the macroinfaunal community (i.e., those relatively large organisms residing beneath the sediment surface) in any given area is a function of the response of individual species to such factors as sediment characteristics, salinity regime, position in the intertidal zone, and oxygen levels. 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.

Connor and Day (1987) found the numerical density of the macrobenthic fauna was low in the lower portions of the Barataria Basin. However, the patterns of benthic seasonal abundance in the Barataria system are not clear. Peak abundances and lowest abundances occur at different times in the different salinity regimes and may be correlated to the salinity pattern of a particular area or the migratory patterns of estuarine dependent predators.

Britton and Morton (1989) characterize the organisms commonly seen on sandy Gulf of Mexico beaches as strand biota that are not inhabitants, but castaways from a richer offshore fauna. This strand biota, comprised of three different groups, is deposited upon the upper beach by high tides and storm waves. The bottom-dwelling component consists of organisms such as shells, sea whips, sea pens, sand dollars, and worm tubes. The flotsam-attached biota include organisms such as gooseneck barnacles (*Lepas anatifera*), marine wood boring isopods, Portuguese man-o-war (*Physalia physalia*), jellyfish, mollusks, and crustaceans. The final group of strand biota, comprised of two components, is associated with floating gulfweed (Saragssum species). The sessile biota lives attached to the algae; the motile biota may cling to the algae but is capable of independent existence.

The borrow area in the Mississippi River would be located along the inside bend of the river near Nairn, Louisiana. The distribution of benthos in the Mississippi River is influenced by substrate composition, current velocity, and physical variables that may vary seasonally and spatially (Beckett and Pennington 1986). Although the Mississippi River main channel supports few macroinvertebrates (Becket et al. 1983; Beckett and Pennington 1986), this habitat supports midges and microturbellarians, and worms are

typically found in the sand substrates within the main channel (Baker et al. 1991). Sand and gravel substrates of the Mississippi River main channel supports few macroinvertebrates (Wright 1982; Beckett et al. 1983; Beckett and Pennington 1986). Natural clay banks of the Mississippi River contain abundant numbers of burrowing mayflies and caddisflies (Beckett et al. 1983; Beckett and Pennington 1986).

The benthos of the borrow area in the Port Fourchon bar channel would be similar to that described above for the lower Barataria basin by Conner and Day (1987) and the sandy gulf beaches described by Britton and Morton (1989).

Offshore sand shoals (e.g., Ship Shoal) and the nearshore sand bodies represent potential sources for the millions of tons of sand sediment that would be necessary for coastal 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 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 year to two years for the benthic communities to recover from either of these events (Baker et al. 1981).

Baker et al. (1981) sampled the LCS, including Ship Shoal, to determine the ecological effects of petroleum production platforms in the central Gulf of Mexico. Results indicate that the benthic communities of the Ship Shoal varied from that found throughout the LCS (**table 4-16**).

Table 4-16. 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 in the taxa Osteichytes (69.3 percent) and Decapoda (30.7 percent) (**table 4-16**). 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 151.8 lbs/hr (68.7 kg/hr) in comparison to an average of 43.3 pounds/hr (19.6 kg/hour) 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).

4.14 PLANKTON RESOURCES

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

4.14.1 Historic and Existing Conditions

Plankton is composed of three groups: the bacterioplankton, phytoplankton, and zooplankton (Knox 2001). Plankton communities serve several important roles in the coastal waters of Louisiana. Bacterioplankton are primarily decomposers; phytoplankton are the primary producers of the water column, and form the base of the estuarine food web; zooplankton provide the trophic link between the phytoplankton and the intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fish species (Day et al. 1989). Most of the fish and other nektonic species are part of the planktonic community only for the early stages of their life cycles (Thompson and Forman 1987). Various publications have characterized the plankton communities in the Barataria Basin estuary (Perret et al. 1971; Gillespie 1971, 1978; Bouchard and Tuner 1976; Conner and Day 1987).

Phytoplankton are single-cell algae that drift with the motion of water. The dominant groups are diatoms and dinoflagellates; other important groups include cryptophytes, chlorophytes (green algae), and chrysophytes (blue-green algae). Phytoplankton productivity is a major source of primary food-energy for most estuarine ecosystems throughout the world (Day et al. 1989). Species composition of a given phytoplankton community is a function of various environmental factors including salinity, turbidity, nutrients, turbulence, and depth (Day et al. 1989).

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.

Within the Barataria Basin, the zooplankton community is dominated by eopepods of the genus Acartia (Gillespie 1971, 1978; Bouchard and Turner 1976; Conner and Day 1987). Perret et al. (1971) indicates the dominant member of the zooplankton community throughout Louisiana was the copepod Acartia tonsa. Zoeae (a larval stage in some crustaceans) can make up a large component of the meroplankton. Fish larvae (e.g., *Brevoortia patronus, Anchoa mitchilli, Menidia beryllina and Mugil cephalus*) and fish eggs were found throughout the Barataria Basin (Conner and Day 1987). 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. 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 (Perret et al. 1971). In addition, the abundance of certain zooplankton may be indicative of good fishing areas. Conner and Day (1987) indicate that in most estuaries, zooplankters feed on phytoplankton or ingest detritus or both. Most zooplankters are filter feeders and the suspended detritus particulate material in the waters of Barataria is probably a major food source.

Biological factors such as predation by nekton and ctenophores, duration of the larval stages of meroplankton, and changes in the aquatic environment brought by the zooplankton populations themselves are important biological factors in the regulation of zooplankton densities (Bouchard and Turner 1976; Conner and Day 1987). Bouchard and Turner (1976) found that salinity largely influenced the distribution of zooplankton. Gillespie (1978) found spring zooplankton peaks were related to temperature. Conner and Day (1987) identified the following factors affecting zooplankton populations: tidal flushing, inflow of freshwater carrying organic detritus, river discharge, water depth, tidal changes, turbidity, and dissolved oxygen.

4.15 THREATENED AND ENDANGERED SPECIES

This resource is institutionally significant because of the Endangered Species Act of 1973, as amended; the Marine Mammal Protection Act of 1972; and the Bald Eagle Protection Act of 1940. Endangered (E) and threatened (T) species are technically significant because the status of such species provides an indication of the overall health of an ecosystem. These species are publicly significant because of the desire of the public to protect them and their habitats.

4.15.1 Historic and Existing Conditions

Factors regarding the historic and existing conditions for threatened and endangered species in the study area principally stem from the alteration, degradation, and loss of barrier habitats; human disturbance and exploitation; and pollution. The continued high rate of land loss throughout the study area over the past 100 years continues to reduce available coastland resources to threatened and endangered species. This creates increased intra- and interspecific competition for rapidly depleting resources between not only the various threatened and endangered species but also other more numerous fauna. A more detailed description of the historic and existing conditions for those threatened or endangered species that may be found in the study area is provided in appendix D, Biological Assessment.

Within the State of Louisiana there are 23 animal and 3 plant species (some with critical habitats) under the jurisdiction of the USFWS and/or NMFS, presently classified as threatened or endangered (**table 4-17**). 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, no plant species and only 11 animal species are potentially within the study area (including borrow areas).

Table 4-17. Threatened and Endangered Species in Louisiana (E=Endangered; T= Threatened; C=Candidate) (Species in bold type are those found within the study area)

Species Under Jurisdiction of the USFWS		Species Under Jurisdiction of NMFS	
Status	**Common Name** *Scientific Name*	**Status**	**Common Name** *Scientific Name*
Mammals		Marine Mammals	
E[1]	Florida Panther (*Felis concolor coryl*)	**E**	**Sperm whale (*Physeter macrocephalus*)**
E[1]	Red wolf (*Canis rufus*)	**E**	**Sei whale (*Balaenoptera borealis*)**
E	**West Indian manatee (*Trichechus manatus*)**	**E**	**Humpback whale (*Megaptera novaeangliae*)**
T	Louisiana black bear (*Ursus americanus luteolus*)	**E**	**Finback whale (*Balaenoptera physalus*)**
		E	**Blue Whale (*Balaenoptera musculus*)**
Birds		Sea Turtles[4]	
E[2]	Bachmans's warbler (*Vermivora bachmanii*)	**E**	**Hawksbill sea turtle (*Eretomchelys imbricata*)**
E[1]	Eskimo curlew (*Numenius borealis*)	**E**	**Kemp's (Atlantic) ridley sea turtle *Lepidochelys kempii*)**
E[1]	Ivory-billed woodpecker (*Campephilus principalis*)	**E**	**Leatherback sea turtle (*Dermochelys coriacea*)**
E	Least tern; interior population (*Sterna antillarum*)	**T**	**Green sea turtle (*Chelonia mydas*)**
E	Red-cockaded woodpecker (*Picoides borealis*)	**T**	**Loggerhead sea Turtle (*Caretta caretta*)**
T	**Piping plover (*Charadrius melodus*)**	Fish	
		T	**Gulf sturgeon (*Acipenser oxyrinchus desotoi*)**
Reptiles		Candidate Species[5]	
E	**Hawksbill sea turtle (*Eretomchelys imbricata*)**		Dusky shark (*Carcharhinus obscurus*)
E	**Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempii*)**		Sand tiger shark (*Odontaspis taurus*)
E	**Leatherback sea turtle (*Dermochelys coriacea*)**		Night shark (*Carcharinus signatus*)
T(S/A)[3]	**--American alligator (*Alligator mississippiensis*)**		Speckled hind (*Epinephelus drummondhayi*)
T	Gopher tortoise (*Gopherus polyphemus*)		Saltmarsh topminnow (*Fundulus jenkensi*)
T	**Green sea turtle (*Chelonia mydas*)**		Jewfish (*Epinephelus itajara*)
T	**Loggerhead sea turtle (*Caretta caretta*)**		Warsaw grouper (*Epinephelus striatus*)
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*)		

[1] The Florida panther, red wolf, Eskimo curlew, and ivory-billed woodpecker are presumed to be extinct in the state.

[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 NMFS 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 4-16 displays Federally-listed threatened and endangered species, as well as other rare animal species and important bird areas in the study area (source: Louisiana Natural Heritage Program). For a more complete description of all threatened and endangered species occurring within Louisiana, 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 1996a) that assigns each species a Listing Status, Lead Region, Population Status, Recovery Plan, Plan Stage Recovery Achieved, and Recovery Priority.

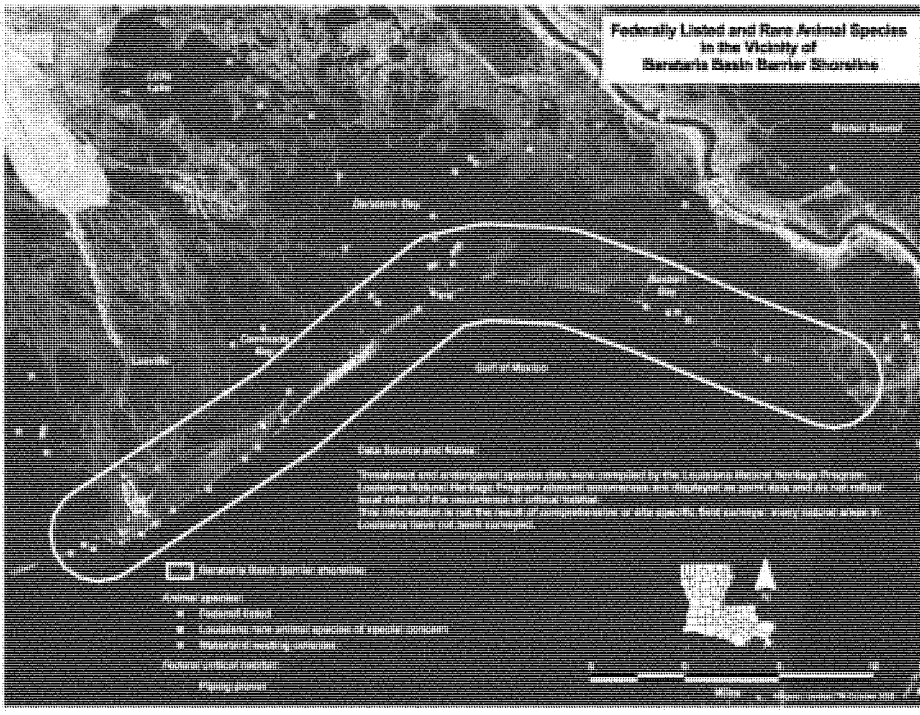


Figure 4-16. Federally listed rare animal species and important bird areas in lower Barataria Basin (source: Louisiana Natural Heritage Program)

The Endangered Species Act of 1973, as amended, requires the designation of critical habitat for all threatened and endangered species. Critical habitat is habitat essential for the conservation or recovery of an endangered or threatened species. In the July 2001 Final Rule (Federal Register, Vol. 66, No. 132), the USFWS designated critical habitat for wintering populations of the endangered piping plover, which includes portions of the Caminada Headland (**figure 4-17**).

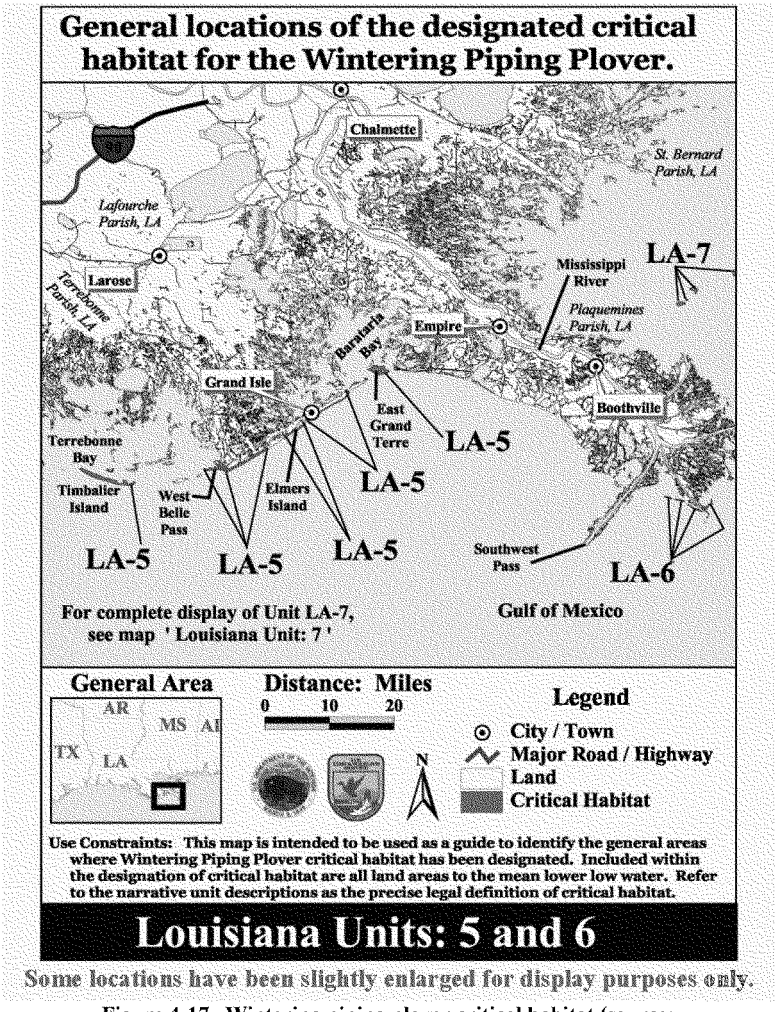


Figure 4-17. Wintering piping plover critical habitat (source: http://www.fws.gov/plover/finalchmaps/Plover_LA_5_to_6.jpg).

Coordination with the USFWS and NMFS was initiated to determine potential impacts of the proposed action on threatened and endangered species and their critical habitats. A Biological Assessment (BA) has been prepared (see appendix D Biological Assessment) to address potential impacts to piping plover critical habitat (**figure 4-17**). Portions of this section concerning organisms under the jurisdiction of the USFWS were coordinated and 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 were coordinated with input from members of the Endangered Species regional office in Florida.

Threatened and endangered species outside of the study area would not likely be affected by the Recommended Plan. There are no known threatened or endangered floral species in the vicinity of the Recommended Plan. Species that may be found in the study area include the piping plover which winters in coastal Louisiana, frequenting outer beaches and occasionally foraging on mudflats within the study area. The West Indian manatee has been reported in the Lake Pontchartrain system, during the summer months and may be a rare visitor in the study area. The pallid and shovelnose sturgeon are known to inhabit the lower Mississippi River, but recent sampling efforts conducted by ERDC have not been able to document their presence south of river mile 85 above Head of Passes. It is believed that their presence within the vicinity of the Mississippi River borrow area is rare.

Five endangered whale species might be present in offshore Louisiana waters. During aerial surveys conducted May 1980 to April 1981 in the region south of Marsh Island, Louisiana, there was only one sighting of endangered whales (Fritts et al. 1983). The sighting was of a pod of four sperm whales about 229-km (142 miles) south of Marsh Island. Other endangered whale species have been previously sighted off Louisiana, but they are typically found in water greater than 1,000 m (3,300 ft) deep (Schmidly 1981; Fritts et al. 1983). The final programmatic BA for the Louisiana Coastal Area Ecosystem Restoration Study (USACE 2004) indicates a low potential for impacting cetaceans with proposed restoration measures, which includes the present study, across the entire coastal Louisiana area. A total of 28 cetaceans have been reported in the Gulf of Mexico waters (Davis et al. 2002; see also 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. Strandings of whales have occurred throughout the gulf coast. However, the 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 Recommended Plan.

There are three species of turtle (hawksbill, Kemp's ridley, and leatherback) classified as endangered and two species of turtles (green and loggerhead) classified as threatened which may occur in the project area. Any of the turtles could potentially inhabit the general vicinity of the coastal portions of the study area (NMFS and USFWS 1991a, 1991b; NMFS and USFWS 1992a; USFWS and NMFS 1992b; NMFS and USFWS 1993). Both green and hawksbill sea turtles are more tropical in their distribution and rarely seen in the north central Gulf of Mexico. The remaining species have been sighted in Louisiana coastal waters. Fritts et al. (1983) sighted 15 loggerhead sea turtle individuals and two leatherback sea turtle individuals. Hard shelled (probably loggerhead) sea turtles were found to be present in consistent numbers during surveys off Louisiana in April 1987 (0.04 turtles/km2) and October 1987 (0.05 turtles/km2) (Lohoefener et al. 1988). Leatherback sea turtles, however, showed greater abundance during the October 1987 survey (0.027 turtles/km2 than during the April 1987 survey (0.004 turtles/km2). The reason for the absence of the Kemp's ridley sea turtle in these surveys is unknown; however, these turtles are known to be common inhabitants of the shallow coastal waters between Marsh Island and the Mississippi River Delta. Coastal Louisiana appears to be an important habitat for sub-adults as well as a feeding habitat for this species (Hildebrand 1982).

4.16 HISTORIC AND CULTURAL RESOURCES

These resources are institutionally important because of the National Historic Preservation Act of 1966, as amended; the Abandoned Shipwreck Act of 1987; the Archeological Resources Protection Act of 1979; and NEPA as well as other statutes. Cultural resources are technically important because of their association or linkage to past events, to historically important persons, and to design and/or construction

values; and for their ability to yield important information about prehistory and history. Cultural resources are publicly important because preservation groups and private individuals support their protection, restoration, enhancement, or recovery.

4.16.1 Prehistoric and Historic Conditions

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 meters (m) below present sea level. Therefore, the prehistoric archaeological high-probability zone is a contiguous area between the Federal/State of Louisiana boundary and the 45-m bathymetric contour.

The historical period in Louisiana begins with the early European exploration of the Mississippi River during the 16th century and continues to present. The Spanish were the first Europeans to claim the Louisiana region some time between 1519 and 1528. The French began colonization efforts in Louisiana during the late 17th century. Louisiana was then ceded back to the Spanish in 1762. As part of the negotiation leading to the Louisiana Purchase in 1803, Spain restored western Louisiana to France, which shortly thereafter sold the Louisiana Territory to the United States.

During the last years of Spanish colonial government, the first primitive canals were cut through the Lafourche marshes to aid early settlers in their pursuits. Some canals were dredged for farmland drainage, others for trapping use, and still others for access to navigable waterways and to the port of New Orleans. Some of these early channels were maintained and improved through the years and remain in use today (Davis 1985:150-152; R. Christopher Goodwin & Associates, Inc. 1984:21-22; 1986:13-14, 57). Two artificial canals connected the Mississippi River above New Orleans to bayou waterways that flowed into the Gulf of Mexico. In addition to Dubreuil's west bank canal, the waterway through the "Petit Desert" connected the Mississippi to Bayou Segnette as early as 1794.

Based on our understanding of the geomorphology and previous archaeological studies conducted in the study area, it is expected that historic archaeological sites would be found within this setting, and that earlier prehistoric sites would have been either destroyed by previous construction or have been impacted by hurricane, wave action and natural erosion activities.

4.16.2 Existing Conditions

Examination of historic maps of the area with recent surveys conducted by USACE contractors, indicate a number of anomalies in the offshore project areas that should be avoided or further investigated if avoidance is not possible. Much of the barrier island area has been impacted by Hurricanes Katrina and Rita in 2005 and Gustav and Ike in 2008. No cultural resources were discovered along the terrestrial shorelines of the project area, and therefore, no cultural resources would be impacted by project implementation.

4.17 SOCIOECONOMIC AND HUMAN RESOURCES

This resource is institutionally significant because of NEPA, the Estuary Protection Act, the Clean Water Act, the River and Harbors Acts, the Watershed Protection and Flood Protection Act, and the Water Resources Development Acts. Of particular relevance is the degree to which the Recommended Plan affects public health, safety, and economic well-being; and the quality of the human environment. This resource is technically significant because the social and economic welfare of the nation may be

positively or adversely impacted by the proposed action. This resource is publicly significant because the public's concern for health, welfare, and economic and social well-being from water resources projects.

4.17.1 Population and Housing

4.17.1.1 Historic and Existing Conditions

The project area is located in remote and uninhabited coastal wetlands within Lafourche, Jefferson, and Plaquemines Parishes. There are no communities or human populations in the project area. Nevertheless, there are population centers near the project area. The nearest populated areas to the Caminada Headlands are Port Fourchon and Grand Isle, Louisiana. The nearest populated area to Shell Island is Empire, Louisiana.

4.17.2 Infrastructure

4.17.2.1 Historic and Existing Conditions

The study area, Port Fourchon in particular, contains substantial assets belonging to the shipping, oil, and gas industries, as well as significant personal property. **Table 4-18** shows a breakdown of the assets contained just in the port area, for which the Lafourche Parish Assessor's office estimates a value of nearly half a billion dollars.

Table 4-18 Estimated Value for all Assets in Port Fourchon, Louisiana.

Type	Assessed Value	Fair Market Value
Watercraft	$50,275,780	$335,171,867
Public Service	1,657,930	6,631,720
Personal Property	13,944,860	92,965,733
Real Estate	2,378,030	23,780,300
	$68,256,600	**$458,549,620**
Source: Lafourche Parish Assessor		

The major roadway nearest the study area is Louisiana Highway 1, which leads into the area of Leeville, Port Fourchon, and Grand Isle. The road is used for bringing supplies to the port, with traffic studies showing over 1,000 trucks moving in and out of the port daily. The cargo is typically comprised of pipe, tools, machinery, and personnel, along with supplies and services necessary to support industry workers (food and water, garbage removal, etc.). Louisiana Highway 1 also brings in fishermen, commercial and recreational, who are critical to the local economy. Highway 1 is particularly important to fishermen operating out of Grand Isle.

Louisiana Highway 1 is the only evacuation route for the areas listed previously in times of emergencies (such as hurricanes), and is critical for both of the main industries. Moreover, the magnitude of oil and gas activity in the area makes it important from a national perspective. Even a temporary shutdown of this road could lead to oil and gas shortages throughout the nation and significantly higher prices for both commodities.

4.17.3 Employment and Income

4.17.3.1 Historic and Existing Conditions

The project area is located in remote and uninhabited coastal wetlands within Lafourche, Jefferson, and Plaquemines Parishes. There are no communities or human populations in the project area; hence, there is no employment or income base. The area may support sources of income related to oil and gas exploration and production, and commercial and recreational fishing.

4.18 ENVIRONMENTAL JUSTICE

Environmental Justice (EJ) is institutionally significant because of Executive Order 12898 of 1994 (E.O. 12898) and the Department of Defense's Strategy on Environmental Justice of 1995, which direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population exists where the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than in the general population. Low-income populations as of 2000 are those whose income are $22,050.00 for a family of four and are identified using the Census Bureau's statistical poverty threshold.

The Census Bureau defines a "poverty area" as a Census tract with 20 percent or more of its residents below the poverty threshold and an "extreme poverty area" as one with 40 percent or more below the poverty level. This is updated annually at http://aspe.hhs.gov/poverty/09poverty.shtml. This resource is technically significant because the social and economic welfare of minority and low-income populations may be positively or disproportionately impacted by the proposed actions. This resource is publicly significant because of public concerns about the fair and equitable treatment (fair treatment and meaningful involvement) of all people with respect to environmental and human health consequences of Federal laws, regulations, policies, and actions.

A potential disproportionate impact may occur when the percent minority in the study area exceeds 50 percent and/or the percent low-income exceeds 20 percent of the population. Additionally, a disproportionate impact may occur when the percent minority and/or low-income in the study area are meaningfully greater than those in the reference community. For purposes of this analysis, all Census Block Groups within a one mile radius of the project footprint are defined as the EJ study area. Lafourche and Plaquemines Parishes, of which the Louisiana Coastal Area (LCA) Barataria Barrier Basin Shoreline (LCA BBBS) project is located, is considered the reference community of comparison, whose population is therefore considered the EJ reference population for comparison purposes.

The methodology, consistent with E.O. 12898, to accomplish this EJ analysis includes identifying low-income and minority populations within the LCA BBBS project area using up-to-date economic statistics, aerial photographs, 2000 and 2010 U.S. Census records, the 2005-2009 U.S. Census Bureau's American Community Survey (ACS) estimates[3], as well as conducting community outreach activities such as public

[3] The U.S. Census Bureau is now only providing population (including minority status) and housing characteristics in the decennial censuses. Other social characteristics (e.g., low-income) will now be provided in the U.S. Census Bureau's American Community Survey (ACS). The ACS provides estimates of social characteristics based on data collected over five years. The 2005-2009 estimates represent the average characteristics over the 5-year period of time.

meetings. Despite the 2000 U.S. Census being 11 years old, it serves as a logical baseline of information and is the primary deciding variable per data accuracy and reliability for the following reasons:

- Census 2000 data is the most accurate source of data available due to the sample size of the Census decennial surveys. With one of every six households surveyed, the margin of error is negligible.
- The 2000 Census data are available at a much smaller geographic level than other survey sources, providing a more defined and versatile option for data reporting (currently the 2010 data are only available down to the county/parish level).
- Census information sheds light upon the demographic and economic framework of the area pre-Hurricane Katrina. By accounting for the absent population, the analysis does not exclude potentially low income and minority families that wish to return home.

Due to the considerable impact of Hurricane Katrina upon the New Orleans metropolitan area, and the likely shift in demographics and income, the 2000 Census data are supplemented with more current 2005-2009 ACS and 2010 census data. The 2010 decennial census and 2005-2009 ACS data are utilized for reference purposes only to show changing trends in population since 2000.

4.18.1 Historic Conditions

The concept of "environmental justice" is rooted in Title VI of the Civil Rights Act of 1964, which prohibited discrimination based on race, color and national origin, and other nondiscrimination statutes as well as other statutes including the NEPA of 1969, the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970, and 23 U.S.C Section 109 (h). In 1971, the CEQ annual report acknowledged racial discrimination adversely affects the environment of the urban poor. During the next 10 years, activists maintained that toxic waste sites were disproportionately located in low-income and areas populated by "people of color." By the early 1980s, the environmental justice movement had increased its visibility and broadened its support base (Commission for Environmental Equality 2009).

This led to the United Church of Christ (UCC) undertaking a nationwide study and publishing Toxic Waste and Race in the United States (UCC 1987). This eventually gained the attention of the Federal Government and in 1992 the USEPA's Office of Environmental Equity was established. In 1994, EJ was institutionalized within the Federal Government through Executive Order 12898 (EPA 1995a), which focused Federal attention on human-health and environmental conditions in minority and low-income communities (EPA 1995a, 1995b, 1995c, 1995d).

Executive Order 12898 requires greater public participation and access to environmental information in affected communities. The results of early efforts and research (UCC 1987) into EJ suggested that environmental amenities and toxic waste sites were not uniformly distributed among income groups, classes, or ethnic communities. Disparities of this nature may have been and continue to be the result of historical circumstances, lack of community participation, or simply inadequate or inappropriate oversight. Consequently, dialogue with some community groups were not conducted and their concerns not considered in the decision making process on local or Federal actions.

4.18.2 Existing Conditions

The proposed LCA BBBS project area covers two barrier islands just off of Louisiana's coast in Lafourche and Plaquemines Parishes, Louisiana. The Caminada Headland, located in Lafourche Parish, has several residents and oil and gas industries located in the vicinity. Shell Island, located in Plaquemines Parish, is unpopulated and severely eroded. The 2000 Census records indicate that the

minority population in Lafourche Parish was 18.8 percent and the low-income population was 16.5 percent. In 2010, the minority population in Lafourche Parish was 22.0 percent[4]. In Lafourche Parish, the proposed project area is located in Census Tract 211 which in 2000 had a minority population of 10.3 percent and a low-income population of 14.8 percent. In the 2005-2009 period[5], Census Tract 211 had a minority population of 11.8 percent and a low-income population of 12.7 percent. In 2000, the minority population in Plaquemines Parish was 32.3 percent and the low-income population was 18 percent. In 2010, the minority population in Plaquemines Parish was 32.2 percent. In Plaquemines Parish, the Census Tract within closest proximity to the proposed project area is Census Tract 506. In the 2005-2009 period, Census Tract 506 had a minority population of 34.4 percent and a low-income population of 6.0 percent.

Analyses of the above information show that the percentages of the population in the project area that are minority and low-income are comparable to that of both Lafourche and Plaquemines Parishes. Additionally, the minority population in the project area does not exceed 50 percent of the total population and the low-income population does not exceed the 20 percent threshold. As a result, the LCA BBBS project area is determined to not be a minority and/or low income population per Executive Order 12898.

4.19 COMMERCIAL FISHERIES

4.19.1.1 Historic and Existing Conditions

Commercial landings (by weight) of fish and shellfish, including freshwater fish, in the Barataria-Terrebonne estuarine basins are presented in table 4-21 (source: personal communication, NMFS August 9, 2005). Fluctuations in year-to-year landings can be caused by a variety of factors including winter freezes, drought, tropical storms, and transportation costs, and usually do not indicate long-term environmental problems. Individual organisms produce large numbers of eggs, so populations can recover quickly from short-term detrimental conditions. However, long-term (3 years or more) declines in landings can signify that there are ongoing environmental problems and/or over-fishing of the resource, or a weakening market. The main environmental problem would be the disappearance of estuarine marsh nursery areas. Remaining areas cannot support as many young. **Table 4-19** contains the fishery landings data provided by the NMFS divided into individual species of shellfish and finfish (personal communication, NMFS, August 11, 2005).

[4] As stated previously, the decennial censuses will no longer be providing information on income.
[5] The 2005-2009 estimates represent the average characteristics over the 5-year period of time.

Table 4-19. Major Commercial Fishery Landings Within the Study Area 1985-2004 x 1,000 pounds (Source: NMFS, preliminary, unpublished data. Data presented are for the combined landings in Jefferson, Lafourche, and Plaquemines Parishes. Minor differences between the sums of Sub-totals and Totals for some years are due to rounding).

RELEVANT SPECIES	1985	1986	1987	1988	1989	1990	1991
Finfish:							
Catfish & bullheads*	568.7	676.7	465.4	937.5	713.1	*	*
Catfish, Blue*	*	*	*	*	*	171.8	166.4
Catfish,Channel*	*	*	*	*	*	718.2	63.5
Black drum	1,047.7	2,889.1	3,926.4	4,984.2	1,714.7	1,401.8	1,054.3
Red drum **	1,708.4	4,597.7	3,320.0	183.4	24.8	2.4	**
Garfish	323.9	248.2	156.3	317.8	264.0	95.6	234.0
Menhaden***	***	***	***	***	***	***	***
Mullet, Striped or Black	26.1	65.4	348.3	621.5	1,126.5	2,141.2	2,625.4
Spotted sea trout	719.1	1,249.0	1,272.1	916.3	874.1	482.4	852.0
Tuna, all	281.9	2,509.6	5,833.2	12,545.1	8,185.6	3,742.1	2,431.5
Shellfish:							
Blue crab, hard	5,597.2	4,543.7	12,674.6	16,227.9	8,432.9	10,344.2	12,283.2
American oyster, all	10,221.4	8,728.8	7,771.4	7,681.3	5,584.3	4,744.7	4,380.6
Shrimp, Brown	29,834.3	32,889.4	29,375.6	24,802.1	27,914.0	36,873.6	23,470.3
Shrimp, White	19,063.1	27,661.7	19,845.9	16,597.4	15,746.2	15,616.3	17,321.5

* Blue and channel catfish data prior to 1990 were reported in the catfish and bullheads group. Beginning in 2001, this smaller amount of other catfish species and bullheads were re-created as a separate group.

** The commercial harvest of red drum (redfish) was restricted in 1988. Limited landings data are available for this species since that period.

*** Menhaden landings represent by far the vast majority of all commercial landings; data have been withheld to avoid disclosure of confidential market data.

(continued on the following page)

Table 4-19 (cont.). Major Commercial Fishery Landings Within the Study Area 1985-2004 x 1,000 pounds (Source: NMFS, preliminary, unpublished data. Data presented are for the combined landings in Jefferson, Lafourche, and Plaquemines Parishes. Minor differences between the sums of Sub-totals and Totals for some years are due to rounding).

RELEVANT SPECIES	1992	1993	1994	1995	1996	1997	1998
Finfish:							
Catfish & bullheads*	*	*	*	*	*	*	*
Catfish, Blue*	131.9	82.9	125.7	109.3	106.8	266.4	274.4
Catfish,Channel*	122.6	179.0	105.0	158.7	275.5	189.5	211.2
Black drum	2,292.7	1,991.6	2,038.5	2,023.4	1,278.3	889.6	867.2
Red drum **	**	1.7	0.2	**	1.9	2.1	4.7
Garfish	207.1	324.5	278.9	192.1	119.3	141.4	94.0
Menhaden***	***	***	***	***	***	***	***
Mullet, Striped or Black	3,483.5	7,180.2	9,997.0	11,189.7	5,642.0	4,546.4	3,719.2
Spotted sea trout	580.3	776.0	679.3	513.7	534.3	410.4	94.4
Tuna, all	2,747.4	2,090.0	1,839.1	1,521.7	2,987.9	3,304.3	2,438.6
Shellfish:							
Blue crab, hard	13,684.5	11,361.0	8,821.0	8,297.2	9,138.0	9,068.3	9,046.0
American oyster, all	4,430.8	4,739.4	5,342.3	6,464.2	4,944.5	4,874.8	4,011.5
Shrimp, Brown	21,914.2	21,914.2	19,574.7	26,108.0	27,160.5	20,895.2	27,957.2
Shrimp, White	12,229.5	12,299.5	16,578.7	17,280.7	8,303.7	12,290.0	18,664.4

* Blue and channel catfish data prior to 1990 were reported in the catfish and bullheads group. Beginning in 2001, this smaller amount of other catfish species and bullheads were re-created as a separate group.

** The commercial harvest of red drum (redfish) was restricted in 1988. Limited landings data are available for this species since that period.

*** Menhaden landings represent by far the vast majority of all commercial landings; data have been withheld to avoid disclosure of confidential market data.

(continued on the following page)

Table 4-19 (cont.). Major Commercial Fishery Landings Within the Study Area 1985-2004 X 1,000 pounds (Source: NMFS, preliminary, unpublished data. Data presented are for the combined landings in Jefferson, Lafourche, and Plaquemines Parishes. (Minor differences between the sums of Sub-totals and Totals for some years are due to rounding).

RELEVANT SPECIES	1999	2000	2001	2002	2003	2004	General trends
Finfish:							
Catfish & bullheads*	*	*	50.0	8.0	53.4	63.4	decreasing as a total
Catfish, Blue*	247.6	199.9	172.4	2.7	64.4	73.1	grouping
Catfish,Channel*	25.4	14.0	14.8	96.8	1.7	4.0	
Black drum	1,288.9	1,591.6	1,704.6	1,767.3	1,721.9	1,436.9	stable
Red drum **	**	**	**	**	**	**	not applicable
Garfish	158.9	102.0	48.7	72.1	88.6	40.8	decreasing
Menhaden***	***	***	***	***	***	***	not applicable
Mullet, Striped or Black	4,652.6	2,423.2	2,899.0	1,836.8	2,836.2	3,990.7	stable
Spotted sea trout	70.8	34.2	106.5	68.2	18.7	18.2	decreasing
Tuna, all	2,998.5	2,836.0	1,423.5	1,426.8	872.7	845.4	decreasing
Shellfish:							
Blue crab, hard	10,435.9	13,273.1	11,233.3	14,713.4	13,015.9	12,662.8	stable
American oyster, all	4,493.0	4,545.7	4,149.8	2,171.1	4,341.1	5,487.6	stable
Shrimp, Brown	33,766.1	37,302.6	37,556.0	32,996.1	36,710.2	35,728.4	stable
Shrimp, White	20,339.1	29,814.2	22,125.3	21,465.9	28,397.3	35,678.9	increasing

* Blue and channel catfish data prior to 1990 were reported in the catfish and bullheads group. Beginning in 2001, this smaller amount of other catfish species and bullheads were re-created as a separate group.

** The commercial harvest of red drum (redfish) was restricted in 1988. Limited landings data are available for this species since that period.

*** Menhaden landings represent by far the vast majority of all commercial landings; data have been withheld to avoid disclosure of confidential market data.

Landings of most fish species are expected to vary somewhat from year-to-year depending on naturally varying environmental conditions. Menhaden landings represent by far the vast majority of all commercial landings; however, data are not presented here to avoid disclosure of confidential market data (personal communication NMFS, August 11, 2005). Brown shrimp are consistently the most numerous shellfish landings followed by white shrimp, blue crab, and oyster. Garfish, spotted sea trout, and tuna have shown generally decreasing trends since 1985. Black drum, striped or black mullet, blue crab, American oyster, and brown shrimp have shown stable trends since 1985.

Only white shrimp have displayed increasing fishery landing trends since 1985. However, the connection between fishery landings and salt marsh habitat loss is not clear (Baltz et al. 1993). One hypothesis is that marsh edge (i.e., perimeter) is the critical habitat for many species and that the nursery function will not decline and result in reduced landings until the quantity of marsh edge begins to decline.

4.19.2 Oyster Leases

4.19.2.1 Historic and Existing Conditions

Oysters are an important resource in the Barataria Basin. Oysters have been harvested in Louisiana for commercial sale for at least 150 years. Oyster leases are located throughout the study area and the nearest oyster seed grounds to the study area are located at Caillou (Sister) Lake and Bay Junop at the southern end of Bayou du Large. The seed grounds are managed by the LDWF to produce a ready supply of seed oysters that can be planted on private leases for later harvest. The oyster lease acreage in Plaquemines, Jefferson, and Lafourche Parishes is presented in **table 4-20**. Locations of oyster leases in the study area are shown in **figures 4-18** and **4-19**. Oyster leases have been a serious constraint on conducting coastal restoration since the beginning of early coastal restoration efforts in the 1990s.

Table 4-20. Oyster lease acreage in Jefferson, Lafourche, and Plaquemines Parishes. (source: http://oysterweb.dnr.state.la.us/oyster/oystertable.htm).

Year	Jefferson Parish (acres)	Lafourche Parish (acres)	Plaquemines Parish (acres)	Louisiana Total (acres)
1959-60	9,912	5,827	19,866	73,591
1969-70	14,161	11,535	43,020	138,837
1979-80	15,689	15,689	79,438	228,960
1990-91	25,268	18,870	142,871	345,394
2000	21,409	26,277	157,707	415,459
2001	20,780	27,402	150,181	419,900
2002	19,284	26,228	150,379	419,091
2003	18,552	24,891	148,140	409,209
2004	18,306	24,802	142,673	397,892
2005	18,093	23,706	140,600	392,763

Oyster lease acreage in Jefferson Parish steadily increased between 1959 to 1960 and 1990 to 1991 and steadily decreased to 2005. Lafourche Parish oyster lease acreage steadily increased between 1959 to 1960 to 2001 and has steadily decreased to 2005. Oyster lease acreage in Plaquemines Parish steadily increased between 1959 and 2002 and steadily decreased between 2003 and 2005.

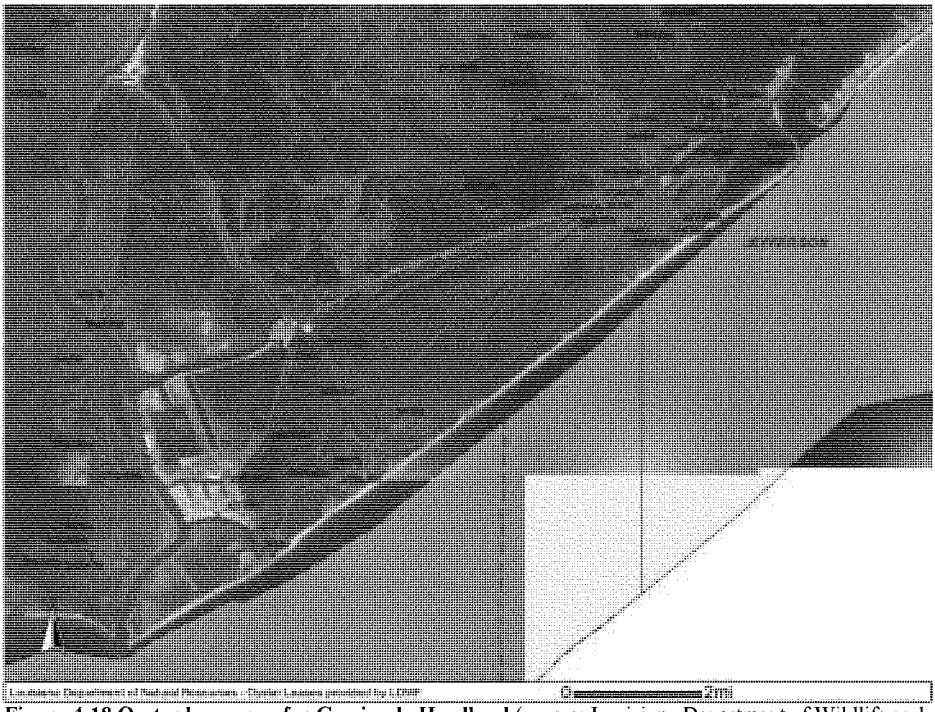


Figure 4-18 Oyster lease map for Caminada Headland (source: Louisiana Department of Wildlife and Fisheries).

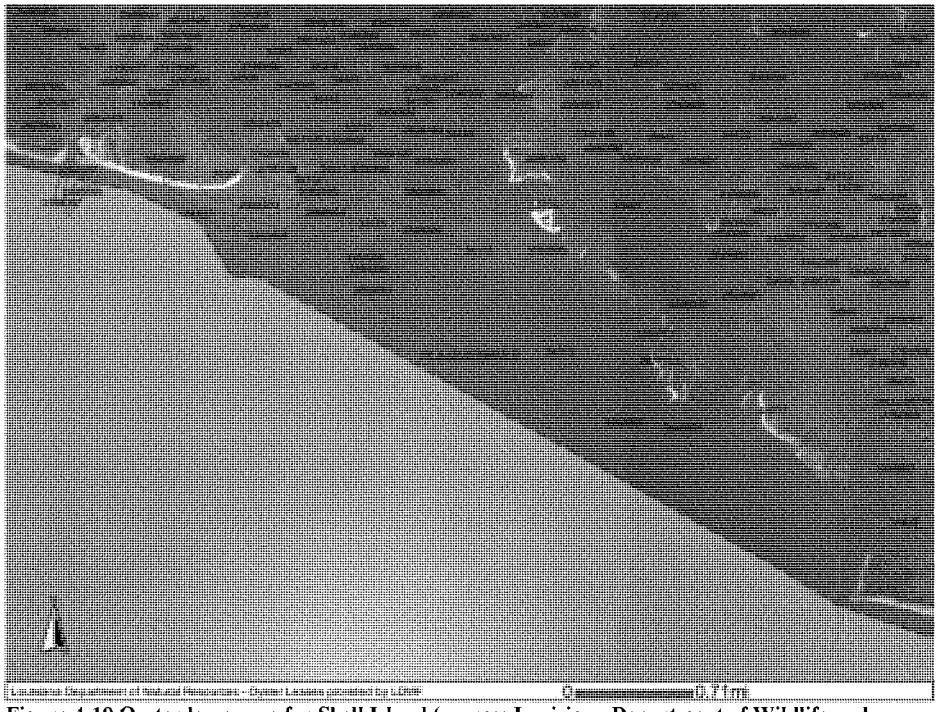


Figure 4-19 Oyster lease map for Shell Island (source: Louisiana Department of Wildlife and Fisheries).

4.19.3 Oil, Gas, and Minerals

4.19.3.1 Historic and Existing Conditions

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 offshore Outer Continental Shelf (OCS) has increased steadily since 1990 and now 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 from shore, and from Federal waters greater than three miles 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. 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. Three states (Texas, Louisiana, 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, gas production has been greater than what has been consumed in four of the five sectors: transportation, commercial, electric power, and residential sectors. 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 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.

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 business 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.

4.19.4 Pipelines

4.19.4.1 Historic and Existing Conditions

The study area is traversed by numerous oil and gas pipelines of various sizes, many within the footprints of the plan alternatives and in their immediate vicinity. The most important pipelines are the LOOP pipeline and the Mars pipeline. The LOOP is located 19 miles southeast of the port, and is the unloading and distribution point for all supertankers coming into the gulf. The pipe is loaded continuously, transmitting about 15 percent of the country's foreign oil and considerable domestic oil extracted in the gulf. Oil stored at the Galliano Salt Dome, the pipeline's distribution center, is pumped to over 30 percent of the nation's refining capacity. The Mars pipeline transmits oil and gas from platforms in the Gulf of Mexico to the LOOP Clovelly terminal, currently estimated at more than 20,000 barrels of oil and 25 million cubic feet of natural gas per day.

Along with these large pipelines are many smaller lines serving the same industries. The lines represent both a substantial investment and a substantial level of risk for the area. The pipelines are increasingly at risk from a combination of coastal erosion and local navigation. The erosion of wetland areas uncovers pipelines that had been buried in the marsh for protection. As land is converted to open water, the pipelines remain under water and unprotected from maritime traffic. Boat collisions with the underwater pipes result in substantial losses for the industry since collisions sometimes cause spills. With each spill production is impacted at both ends of the pipeline system—where oil is loaded, and where it is unloaded. In addition, cleanup costs can be substantial.

Only one significant facility from this industry is within the study area and is expected to erode into open water during the study period. The facility is owned by Chevron, which was contacted for the study. However, no estimate of the facility's value was furnished.

4.19.5 Navigation

4.19.5.1 Historic and Existing Conditions

Authorized navigation channels nearest the study area include Bayou Lafourche, with the major facility being Port Fourchon, and the Empire Waterway, near Shell Island. The 3,600 acre port provides services to domestic deepwater oil and gas producers operating in the Gulf of Mexico. Over 95 percent of the cargo moving in and out of the port relate to this industry, with 30 percent of the cargo moving by barge to and from inland and 70 percent by vehicle before going to or from offshore supply vessels. The importance of the port was underscored by the aftermath of Hurricanes Katrina and Rita, when oil and gas valued at about $10 billion dollars was unavailable to the nation for a 2-month period (Port Review, November 2005), causing gasoline prices to spike upward nationwide. The port's facilities also include the South Lafourche Airport, which the port commission plans to expand to include a 6,500-foot by 100-foot runway to accommodate large aircraft.

4.19.6 Flood Control

4.19.6.1 Historic and Existing Conditions

The project area does not contain any flood control or hurricane risk reduction structures.

4.19.7 Hurricane Risk Reduction Levees

4.19.7.1 Historic and Existing Conditions

The project area does not contain any hurricane risk reduction structures.

4.19.8 Agriculture

4.19.8.1 Historic and Existing Conditions

There are no agricultural activities within the study area. It is unlikely that any opportunities for agriculture would occur within the study area in the foreseeable future.

4.19.9 Forestry

4.19.9.1 Historic and Existing Conditions

There are no forestry activities within the study area. It is unlikely that any opportunities for forestry would occur within the study area in the foreseeable future.

4.19.10 Water Supply

4.19.10.1 Historic and Existing Conditions

The project area does not contain any water supply structures.

4.20 AESTHETICS (VISUAL RESOURCES)

This resource's institutional significance is derived from laws and policies that affect visual resources, most notably NEPA, the Coastal Barrier Resources Act of 1990, and the National Scenic Byway program. This resource is technically significant because of the visual accessibility to unique geological and botanical features that are an asset to the study area. Public significance is based on expressed public perceptions and professional evaluation.

It is National policy that aesthetic resources be protected along with other natural resources. Current planning guidance specifies that the Federal objective of water and related resources planning is to contribute to National Economic Development consistent with protecting the Nation's environment (ER 1105-2-100). The USACE established a number of environmental goals, including: (1) Preservation of unique and important aesthetic values; and, (2) Restoration and maintenance of the natural and man-made environment in terms of variety, beauty, and other measures of quality (ER 200-2-2). The Visual Resources Assessment Procedure (VRAP), WES Instructional Report EL-88-1, will be used to:

1. Identify and assess the existing visual resources conditions affected by the study.
2. Assess (describe magnitude, location, duration) and appraise (determine if beneficial or adverse) the visual impacts caused by alternatives.
3. Provide a replicable basis of support for any recommended mitigation.

The purpose of using this procedure is to have a systematic approach to consider aesthetic resources. Advantages of a systematic and quantifiable approach include the ability to assign a visual resource value to all of the landscape units within a study area, identify significant aesthetic resources, and to determine causes of adverse impact. Such a procedure provides a clear, tractable basis for including aesthetics in plan formulation, design, reformulation, and mitigation planning. As such, the VRAP is consistent with existing Federal and USACE water resources planning and environmental policies and regulations.

4.20.1 Historic and Existing Conditions

The VRAP uses changes in visual resources to measure and evaluate the visual impacts caused by a USACE project. The VRAP is composed of two parts, the Management Classification System (MCS) and the Visual Impact Assessment (VIA) Procedures. The MCS establishes an Assessment Framework for a project area and sets the visual resource criteria that are used throughout the visual assessment. The existing visual quality of an area is determined by inventorying the visual resources and comparing the inventory with the Assessment Framework. Using proposed alternatives, the VRAP measures the change in the visual resources and determines the compatibility or acceptability of the changes in the visual resources, i.e., the visual impact. Visual simulations of the with- and without-project conditions are used to determine changes in visual resources. The MCS criteria are used to determine the acceptability or compatibility of the visual impacts.

4.20.1.1 Landscape Character of the Gulf Coastal Plain

Identification of Regional Landscapes provides a frame of reference for the inventory and evaluation of visual resources; this MCS information enables the planner to inventory and evaluate resources and visual impacts in a consistent manner within each region and to make sound decisions in assessing the visual effects of proposed projects. The Regional Landscape covers a broad physiographic area in which landforms, water resources, vegetation, and climate tend to exhibit common characteristics. While the specific nature of these components and area land uses can vary considerably over short distances, the same characteristics are repeated throughout the region, giving the landscape an overall visual character

that is different from other regions. By establishing an individual Assessment Framework for each Regional Landscape, the value and importance of the region's visual characteristics are judged relative to the landscape context in which they occur, not in comparison with completely dissimilar landscapes.

The Gulf of Mexico's northern coast is dominated by a series of barrier islands separated by relatively shallow water bodies. Most of these islands and adjacent peninsulas have a cross section composed of several shore-parallel environments primarily low in topographic profile. Typically, the nearshore zone is identified by a system of bars and troughs parallel to the strandline. The active beach has a moderate sand slope, but grasses cover the dunes that customarily frame the foreshore berms. An island's midsection is frequently a series of beach ridges and intervening swales, covered by salt-tolerant vegetation, scattered shrubs, and clusters of trees. Marsh tidal-flat ecosystems, as well as mangrove communities, lie on the bay-shore side. These features vary in physiographic and cross-sectional profile according to the amount and type of Aeolian material, winds, tides, and the frequency of hurricanes.

These barrier islands have served humanity since the 17th century when farmers discovered that cattle released on barrier islands would forage and reproduce. In the late 19th and early 20th centuries, the islands were used for military bases, small settlements, hotels, and other recreation endeavors, such as lavish hunting clubs and camps.

4.20.1.2 Landscape Character of Louisiana's Coastal Lowlands

Within each Regional Landscape, similarity zones provide a more specific framework with which to define and evaluate the visual resources of a study area. The similarity zone represents a physiographic area of land that has common characteristics of landform, water resources, vegetation/ecosystems, land use, and land use intensity, as opposed to the diversity that can exist within the regional landscape.

Near-featureless marshes and adjacent water bodies span the Louisiana coast and vary in width from 25 kilometers to 80 kilometers. Exposed salt domes are over 40 meters above the sea-level marshes. There is less than a 4-meter height difference between the marsh and adjacent natural levees, cheniers, and beaches, and 1 meter in elevation can provide firm, habitable land.

Two physiographic provinces dominate the natural setting: the chenier and delta plains. The former extends from a site near High Island, Texas, eastward to Marsh Island, Louisiana, and has a relatively smooth and typical shoreline. Near the shoreface, the chenier plain (from the French, *chene,* meaning oak) is fronted by mudflats and backed by marsh with an intervening series of beach ridges capped with live oak trees *(Quercus virginiana).* The delta plain (which is east of Marsh Island) contains the Caminada Headland and Shell Island study areas. Numerous bays, lakes, and barrier islands characterize its highly irregular shoreline.

Barrier islands and marshes absorb wave energy and help retard natural or storm-induced erosion. The islands serve as the first line of defense against destructive hurricanes and storms and therefore receive the full force of their impacts. Washover fans, new tidal passes, diminished dunes, rearranged beaches, and general profile changes, via accretion, deposition, and erosion, are by-products of the passage of a hurricane. The islands are in a constant state of change.

Unlike those on most coasts, Louisiana's barriers are not completely developed for settlement. Principal developments in the coastal area are those associated with the location, development, and attraction of large mineral and fishery resources (for commercial and recreational use). Grand Isle is the exception; even so, it does not possess an extensive array of hotels, motels, high-rise buildings, or single-family residences.

Since World War II, Louisiana's coastal lowlands have seen rapid economic growth, much of which can be attributed directly to development of its hydrocarbon resources. As oil exploration and development moved across the coastal lowlands, virtually no section of the coast was spared canalization. A complex canal system has become a dominant part of the State's coastal geography and has expanded into well-defined, but unplanned, patterns. The canal system met the industry's needs and evolved into the most visible structural modification of the coastal zone.

Today scattered recreational dwellings and petroleum-related industries dominate the barrier islands' human-made landscape.

4.20.1.3 Viewpoint Inventory

Critical viewpoints, known as Key Observation Points (KOPs), were chosen based on their representation of the study area. These KOPs will be used later in a Visual Impact Assessment that rates the degree of visual contrast caused by the project. KOPs are usually found along commonly traveled routes, such as highways, access roads, or hiking trails. A KOP can either be a single point of view that an observer/evaluator uses to rate an area or panorama, or a KOP can be a linear view along a roadway, trail, or river corridor. Factors considered in selecting KOPs are: the angle of observation or slope of the proposed project area, the number of viewers of the project area, the length of time that the project is in view, the relative size of the project, the season of use, and light conditions. The evaluator rates the degree of visual contrasts based on Water Resources, Landform, Vegetation and Land use changes between the existing landscapes and how the landscapes would look in the future without any proposed project and with any disturbances caused by proposed project alternatives. KOPs utilize distance zones defined as divisions of a particular landscape being viewed. Distance zones are used to describe the part of a characteristic landscape that is being inventoried or evaluated. The three distance zones are:

Foreground: The limit of this zone is based upon distances at which details can be perceived.

Middle ground: This zone extends from foreground zone to 3 miles to 5 miles from the observer.

Background: This zone extends from middle ground to infinity.

This viewpoint inventory excludes any Shell Island KOPs as it is remote and is only viewed by occupants of the occasional recreational and commercial boat traffic.

4.20.1.3.1 Lafourche/Terrebonne Scenic Byway

This linear viewpoint that delineates the northern portion of the study is located along Louisiana Highway 1 (**figure 4-20**). Panoramic views of the study area and adjacent scenery are to the south, southeast and northwest. Foreground views are of marsh grass broken up by linear water bodies, circular ponds, shrub environments, petroleum related infrastructure, storm related debris (from Hurricanes Katrina and Rita) and recreational dwellings (camps). Middle ground views are of wetland areas broken up by water bodies, woody vegetation, and camps. Background views are primarily of the horizon with an occasional glimpse of offshore oil rigs located in the Gulf of Mexico.

Figure 4-20. Photograph taken April 2009 along Lafourche/Terrebonne scenic byway located along State Route 1 with linear viewpoint to the "southwest" of the study area.

4.20.1.3.2 Port Fourchon Public Beach Parking Area

This KOP can be found at the Port Fourchon Beach parking area located at the end of Louisiana Highway 3090. Panoramic views of the study area and adjacent scenery are to the south, southeast and northwest. Foreground views are typical of a beachfront recreational area affected by recent storms (Hurrieanes Katrina and Rita). Beige sand laced with white shell intermingled with a deteriorating (boudin bag) seawall and storm debris can be found within the foreground view. Also contained within the foreground view are near-shore breakwaters, back-beach dunes, the occasional shrub environment and wetland grasses. Middleground views are of less visually defined wetland areas broken up by Bay Champagne and small ponds, woody vegetation, and the Gulf of Mexico's marine environment. Background views are of offshore oil rigs (and other petroleum related infrastructure), the occasional recreational dwelling (camp) and the Gulf of Mexico's marine environment.

4.21 RECREATION RESOURCES

This resource is institutionally significant because of the Federal Water Project Recreation Act of 1965, as amended, and the Land and Water Conservation Fund Act of 1965, as amended. Recreational resources are technically significant because of the high economic value of recreational activities and their contribution to local, state, and national economies. Recreational resources are publicly significant because of the high value that the public places on fishing, hunting, and boating, as measured by the large number of fishing and hunting licenses sold in Louisiana, and the large per-capita number of recreational boat registrations in Louisiana.

4.21.1 Historic and Existing Conditions

Much of the recreation data has been extracted from the 1993 to 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 BBBS study area boundaries, the SCORP regions and the LCA BBBS 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.

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 4-21** displays Federal, state, and other important recreational resources.

Table 4-21 Federal, state, and other areas of important recreational resources

Wildlife/Recreation Areas	State Total	Barataria Basin
USFWS National Wildlife Refuges	16	
Jean Lafitte National Historic Parks and Preserves	6	1
Louisiana Wildlife Management Areas and Refuges	36	3
LA State Parks	17	2
State Historic Sites	12	
Important Bird Areas	15	1
Scenic Byways	16	1
Annualized Unit Day Value (UDV)*	$4.05 billion	$66.1 million

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, Barataria Basin). With the inclusion of private lands, more than 107,000 acres (43,335 ha) are available for hunting. 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., 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.

The extensive marsh wetlands, water bodies, beaches, and barrier islands of Louisiana's coastal area are ideally suited for outdoor recreational activities. The biological wealth and productivity of these natural resources support many species of native plants and animals, and provide for a variety of recreational pursuits. Major recreational activities occurring in the coastal area, specifically in and around barrier islands include sport fin-fishing (the most popular); waterfowl, recreational shrimping; boating; swimming; sailing; picnicking; camping; bird watching; and observing wildlife.

There are limiting factors on the potential recreational use of these abundant resources. These limiting factors include private land ownership, lack of public access, and competition with commercial activities such as commercial fishing and shrimping, and mineral exploration and extraction. The ever-increasing loss and shifting of the barrier islands resource itself is also a factor, limiting potential recreational use. Many of the camps located on the barrier islands are privately owned and are not available to the general public. Public access to the barrier islands are provided by public boat launching facilities found throughout the study area. Generally, these facilities are located along the developed ridges of land that extend along the Mississippi River or its former meanders into the marshlands. Approximately 30 boat-launching facilities provide recreational boat access to the study area's barrier islands.

The Wisner Wildlife Management Area is the only state or Federal-designated management area located in the study area.

Saltwater finfish species, such as spotted sea trout and redfish, are taken recreationally. Crabs, shrimp, and flounder are also a significant part of the recreational fishery. Waterfowl hunting is predominant in the wetlands protected by the barrier islands. This is because the marshes lie within the Mississippi Flyway, which is used extensively by many migratory birds.

The barrier islands of the Barataria Basin are also a resting area for migratory neo-tropical songbirds and waterfowl. Many of these birds are passing through coastal Louisiana on their way to nesting areas northward.

Many local and out-of-state sportsmen use numerous marsh camps that serve on a seasonal or weekend basis of operation as a starting point for various outdoor activities. Many of these camps, which are only accessible by boat, serve as clubhouses for the coastal area's numerous fishing and hunting clubs. Others are privately owned and are used almost exclusively for family oriented recreation. Numerous camps are located in the study area.

The primary users of the recreation resources of the study area are residents of southeastern Louisiana. As an example, approximately 39,000 pleasure boats were registered with the state for Lafourche,

Plaquemines, and Jefferson Parishes in January 2001. For the 2000-2001 season, approximately 16,000 resident hunting licenses, and over 81,000 resident fishing licenses were issued. Within these three parishes, there were approximately 9,000 non-resident 3-day charters to fish the coastal waters along and outside the barrier islands. The regional demand and use of the coastal area far exceeds the boundaries of these parishes.

4.22 NOISE

Noise is institutionally significant because of the Noise Control Act of 1972 that declares the policy of the United States to promote an environment for all Americans free from noise that jeopardizes their health or welfare; and the Occupational Safety and Health Standards (29CFR part 1910) regarding protection against the effects of noise exposure. Noise is technically significant because noise can negatively affect the physiological or psychological well-being of an individual (Kryter 1994) ranging 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 publicly significant because of the public's concern for the potential annoyance and adverse effects of noise on animals and wildlife and humans.

4.22.1 Historic and Existing Conditions

Noise, or unwanted sound, may be objectionable in terms of the nuisance, health, or well-being effects it may have upon humans and the human environment, as well as upon the animals and ecological systems in the natural environment (Kryter 1994). Generally, noise is a localized phenomenon. The Noise Control Act establishes a means for effective coordination of Federal activities in noise control and to provide information to the public regarding the noise emissions. There are many different sources of noise throughout the study area including: operation of commercial and recreational boats, water vessels, air boats, and other recreational vehicles; automobiles and trucks, and all terrain vehicles; aircraft; operation of machinery and motors; and human industry-related noise (such as oil and gas facilities).

4.23 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The Hazardous, Toxic, and Radioactive waste (HTRW) status of the proposed project area was investigated and is recorded in HTRW-ESA #253, on file in Planning Division South, at the MVN. MVN personnel made a field trip to the proposed project area on January 3, 2006, with a group of contracted engineers and consultants. They visited by boat all the sites where soil borings will be taken. There were no signs of HTRW problems, such as dead or discolored vegetation, stained soil, chemical sheens or odors, or dead or dying fish, amphibians, reptiles, or mammals, or discarded drums, tanks, or chemical containers. The most likely source of HTRW would be the presence of numerous oil and gas pipelines and wellheads in the area. Provided that care is taken not to disturb these pipelines, the probability of encountering HTRW with the Recommended Plan is low. If the designs change or the project area is expanded, the HTRW risk may have to be re-evaluated.

Deepwater Horizon April 20, 2010, Oil Spill

Certain oil and gas exploration and production (E&P) wastes are exempt from regulation as hazardous wastes under subtitle C of the Resource Conservation and Recovery Act (RCRA) (40 CFR Parts 260 to 279). However, the RCRA Subtitle C exemption does not preclude these wastes from control under state regulations, under the less-stringent RCRA Subtitle D solid waste regulations, or under other federal regulations, such as the Oil Pollution Act of 1990). In addition, although they are relieved from regulation as hazardous wastes, the exemption does not mean these wastes could not present a hazard to

human health and the environment if improperly managed. [US EPA, October 2002 "Exemption of Oil and Gas Exploration and Production Wastes from Federal Hazardous Waste Regulations"]

British Petroleum (BP) secured a lease from Mineral Management Services to drill and operate the Macondo Well, located in Mississippi Canyon (MC) Block 252, approximately 50 miles off the coast of Louisiana, within the Gulf of Mexico, in waters of the United States of America. Deepwater Horizon (DWH), the semi-submersible drilling platform, which was owned and operated by Transocean, Inc., was the mobile platform used for drilling this well. On April 20, 2010, the Macondo Well experienced a blow-out, resulting in an explosion on the Deepwater Horizon semi-submersible drilling platform, killing eleven workers, and resulting in continuous discharges of oil and natural gas from the wellhead into waters of the United States.

(http://www.restorethegulf.gov/release/2011/09/14/deepwater-horizon-joint-investigation-team-federal-scene-coordinators-release-fin, accessed September 29, 2011).

During the DWH incident, oil and natural gas were discharged from the wellhead, approximately 5,000 feet below the sea surface, for 87 days. The well was capped on July 15, 2010; however, the continuous discharges of oil, gas, and dispersants that were applied to the oil, have impacted the waters and coastline of the Northern Gulf of Mexico, including the State of Louisiana. The first oiling of Louisiana beaches occurred on approximately May 15, 2010, and the oiling of Mississippi, Alabama, and Florida beaches occurred on or about June 1, 2010 (UAC – OSAT, 2010 and OSAT2, 2011).

In June 2010, BP was ordered by the United States Coast Guard and United States Environmental Protection Agency, Region 6, to eliminate the unauthorized discharge from the Macondo Well; to immediately take any and all steps to remediate all oil-contaminated media; to submit a plan describing the actions to be taken to eliminate the discharge and to remediate the impacted waters of the United States and property in the affected states; and to take all necessary steps to comply with all federal regulations and each of the impacted State's Environmental Quality Act, Water Quality Regulations, and Solid Waste Regulations, individually.

(http://www.deq.louisiana.gov/portal/Portals/0/news/ BP_CCO_NOPP_MM-CN-10-00823.PDF, accessed September 27, 2011).

In the Directive, the U.S. Coast Guard, in consultation with the U.S. Environmental Protection Agency (EPA), specifies how the company should manage recovered oil, contaminated materials, and liquid and solid wastes collected during cleanup operations from the DWH spill. The Directive, signed on June 29, 2010 (Recovered Oil, Contaminated Materials and Liquid and Solid Waste Management Directive for Louisiana, June 29, 2010) , is meant to complement each state's activities by providing further oversight and imposing more specific requirements. The U.S. Coast Guard, along with EPA, and in consultation with the states, holds BP accountable for the implementation of the approved waste management plans and ensures that the Directive is followed in the Gulf Coast states.

The Directive creates enforceable requirements, implementation procedures, and oversight plans related to BP's handling of waste materials. Specifically, the Directive does the following:

Provides guidelines for community engagement activities and sets transparency requirements on information regarding the proper management of liquid and solid wastes.

Requires BP to give EPA and state agencies access to facilities or any location where waste is temporarily or permanently stored. Access includes allowing the agencies to perform any activities necessary, such as assessments, sampling or inspections.

Requires BP to comply with all applicable federal, state and local laws and regulations and to ensure that all facilities where waste is located or placed have obtained all permits and approvals necessary under such laws and regulations.

Finally, the Directive requires BP to submit to EPA and the Coast Guard specific plans, waste reports, and tracking systems for liquid and solid waste.

The DWH spill is classified as a Spill of National Significance (SONS), and BP accepted designation as the Responsible Party (RP) for the DWH event (Deepwater Horizon JIT, 2011). Under the 1990 Oil Pollution Act (OPA) and in accordance with the National Contingency Plan (NCP) that governs oil spills, the emergency response to the DWH spill is being federally administered by the USCG as the Federal On-Scene Coordinator (FOSC). Impacted States, under the Stafford Act, as well as the RP, have participated in the Unified Area Command's (UAC) response efforts. Clean-up action is being coordinated between the RP and the affected Gulf States, such as the State of Louisiana, federal and state trustees, and private property owners along the impacted coastal areas.

During 2010, the USCG-led Emergency Response activities included on-water and shoreline clean-up. The Response continues through 2011 with shoreline clean-up and the Natural Resources Damage Assessment (NRDA) Process, which is also implemented under OPA 90. The NRDA is responsible for all associated restoration and recovery action deemed necessary to ~~repair~~ mitigate damages that occurred to natural resources, caused by the DWH Spill. Assessments include, but are not limited to, damages to wildlife and wildlife habitat as a result of the spill.

The National Oceanic and Atmospheric Administration (NOAA) and the Department of Interior (DOI) are the designated federal lead agencies on the NRDA Team and are responsible for implementation of restoration projects to mitigate damages to natural resources. Additionally, NOAA is responsible for all NRDA assessments required to identify and quantify long term impacts caused by the oil spill. In Louisiana, the NRDA team includes USCG, DOI, NOAA, EPA, Louisiana Department of Natural Resources, Louisiana Department of Environmental Quality, and others, in cooperation with BP.

Beginning in early May 2010, sampling and monitoring were conducted in both the surface and sub-surface environments of the Gulf of Mexico, to locate any oil and/or dispersant-related constituents from the DWH spill and associated Response. A multitude of state and federal agencies, BP contractors, academics, and NGOs were brought together, and on August 18, 2010, USCG chartered an Operational Science Advisory Team (OSAT), made of up the aforementioned groups, to perform pre-impact sampling and numerous other sampling programs throughout the Area of Response (AOR).

The sampling period is defined in the Final OSAT Report as that period of time between the rig explosion and shoreline oiling. Additionally, this final summary report included an assessment of the qualitative and quantitative analytical data collected in the nearshore, offshore, and deep-water zones during Response and provided an assessment of the distribution of actionable oil and dispersant-related constituents that remain in the water column and/or bottom sediments, and it provides a summary of sampling results, to inform decision makers on further oil removal operations (OSAT 2010, Pg. 1)

In February of 2011, the OSAT group was brought back together by the USCG and charged with producing a scientific, risk-based Net Environmental Benfits Analysis (NEBA) using data collected from the DWH spill, from the near shore, surfzone, and shoreline where oil impacts had occurred. The mission of OSAT-2, as it became known, was to inform the FOSC, in a timely manner, of the fate (degradation) and effects (toxicity) of oil residues remaining on, under, or near the shoreline. This team became a

crucial link between the daily review of data and the FOSC, providing situational data and analysis to the USCG's National Incident Commander (NIC), Unified Area Command (UAC), for use in directing the on-going Emergency Response operations. Response operations took place in four zones: at the source of the spill, off-shore, near-shore, and on-shore. OSAT outlined progressive stages of the federal emergency response actions. Reports were developed at the completion of each stage of operation (e.g. OSAT and OSAT 2).

Along the near-shore and in-shore areas of the Barataria Basin Barrier Shoreline Restoration (BBBSR), the Environmental Unit, functioning as part of Unified Command, implemented the Shoreline Cleanup Assessment Technique (SCAT) process that involved teams of trained observers who survey affected coastal areas to document shoreline oiling conditions. SCAT related activities were divided into three stages (see UAC, 2010a):

Stage I: On-water recovery of bulk oil;

Stage II: Cleanup of oil from intertidal areas until the source was controlled;

Stage III: Removal of oil from shorelines (shoreline types: sand, wetlands/marsh, man-made) to habitat-specific "No Further Treatment" (NFT) guidelines, once source control was achieved;

Stage IV was initially intended to be a patrol and maintenance function, to be performed by Operations as oiling conditions declined along shorelines during 2011. This Stage began with what was known as the 2011 Spring Surveys and further addresses shoreline cleanup on an "as needed" frequency for an unspecified duration, or until it was agreed by the SCAT team and SOSCs that endpoints had been reached on individual segments within all shoreline types. In some cases, Stage 4 Shoreline Treatment Recommendations (STRs) were written to complete cleanup that began in Stage III for segments that met Stage III NFT, but were determined to still need treatment.

The Shoreline Cleanup Completion Plan (SCCP), formerly known as Stage V, is the current stage of Response that will be used to transition shoreline segments out of active response back to the National Response Center (NRC) processes for responding to oil, as defined in the National Contingency Plan (NCP).

The Coast Guard's role will end with the completion of Emergency Response clean-up required of BP, and completion of full documentation of Response events. A SCAT 4 completion report will be written to document the full range of emergency clean-up actions undertaken as part of the Emergency Response (Capt. Hein, USCG Federal On-Scene Coordinator (FOSC) e-mail communications, August 20, 2011 and September 28, 2011). The Coast Guard will continue with an oversight role and legacy oil spill response duties as a part of the National Response Center. Following removal actions, should any new MC252 material surface, the Coast Guard will respond via the NRC Process, to ensure that the responsible party removes any oiled material, as deemed applicable.

Reports on the Emergency Response to the DWH spill will be made available by the USCG, the lead response agency, as designated under OPA, and are included in the reference section of this EIS.

The DWH spill resulted in oil deposition on a variety of shoreline types throughout the Northern Gulf of Mexico, including the Caminada Headland and Shell Island reaches of the LCA BBBS. The shoreline at the Caminada Headland and the remnant shoreline at Shell Island are both characterized as non-amenity beaches and are currently undergoing final clean-up and treatment from effects of the DWH spill. To confirm that shoreline segments within the Caminada Headland and Shell Island reaches have met 2011-

2012 Endpoints, a final inspection by the SCAT teams will be conducted, at which time the affected segments will be formally signed out of the Emergency Response (Capt. J. Hein, USCG FOSC e-mail communication, August 20, 2011 and September 28, 2011). The cleanup standard for heavily oiled non-residential beaches, such as Fourchon Beach and Caminada Headland, is that No Further Treatment (NFT) is needed when less than 1% visible surface oil and oiled debris remains on the beach. The determination of when this point is reached relies on the visual observations of experienced professionals, rather than an actual measurement. [MC 252 Stage III SCAT - Shoreline Treatment Implementation Framework, Louisiana; 9 September 2010]

4.24 AIR QUALITY

This resource is institutionally significant because of the Clean Air Act of 1963, as amended, and the Louisiana Environmental Quality Act of 1983, as amended. Air quality is technically significant because of the status of regional ambient air quality in relation to the National Ambient Air Quality Standards (NAAQS). Air quality is publicly significant because of the desire for clean air and public health concerns expressed by many citizens.

4.24.1 Historic and Existing Conditions

The USEPA, in accordance with the Clean Air Act, set national air quality standards for pollutants considered harmful to public health and the environment. The Clean Air Act 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.

National air quality standards have been set by the USEPA for six common pollutants (also referred to as "criteria pollutants") including: ozone, particulate matter, carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead. States are required by the Code of Federal Regulations 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, nitrogen dioxide, sulfur dioxide, particulate matter less than 10 microns in size; 1,000 tons per year of carbon monoxide; or 5 tons per year of lead. Since ozone is not an "emission," but the result of a photochemical reaction, states are required to report emissions of volatile organic compounds (VOC), which are compounds that lead to the formation of ozone.

Effective December 1, 1995, Jefferson Parish was redesignated from a nonclassifiable area to an ozone attainment area (see http://www.deq.state.la.us/evaluation/ozone/statuso3.htm). Effective February 25, 2002, Lafourche Parish was redesignated from a nonattainment area to an attainment area for ozone (http://www.deq.state.la.us/evaluation/ozone/statuso3.htm). Jefferson, Lafourche, and Plaquemines Parishes are currently classified by the LDEQ as being in an attainment area. Consequently, there is no requirement to balance an air quality budget or prepare a general conformity determination.

As required by Louisiana Administrative Code, Title 33 (LAC 33:III.1405 B), an air quality applicability determination will be made for the Recommended Plan (see section 5-20 "Air Quality"). This will include consideration of each separate project feature of the Recommended Plan for the category of general conformity, in accordance with the Louisiana General Conformity, State Implementation Plan (LDEQ 1994). An air quality determination will be calculated, based upon direct and indirect air emissions. Direct emissions include those resulting directly from construction of the Recommended Plan. 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, State Implementation Plan, section 1405 B.2), the VOC emissions for the proposed construction would be classified as *de minimus* and no further action would be required.

5.0 ENVIRONMENTAL CONSEQUENCES *(NEPA-Required)*

This chapter describes the potential environmental consequences of implementing alternative plans considered for restoration of the Caminada Headland and Shell Island. The following environmental analysis compares the No Action Alternative (future without-project conditions) to the final array of two alternatives carried over for detailed analysis:

Alternative C5/S5 (Recommended Plan and NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

Alternative C5: Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment

Impact analysis described in this chapter is based on a combination of scientific and engineering analyses, professional judgment, and previously compiled information. The Recommended Plan was developed by considering the best combination of restoration alternatives for the Caminada Headland and Shell Island that would meet the study objectives. All restoration alternatives considered during the alternative plan formulation process are described in more detail in chapter 3 "Alternatives", section 3.3. The NER Plan is also the Recommended Plan and will be referred to as the Recommended Plan for the remainder of this Chapter.

The environmental analysis includes comparison of the potential direct, indirect, and cumulative impacts. Direct impacts are those effects that are caused by the action and occur at the same time and place (40 CFR 1508.8(a)). For example, unavoidable effects on fish and wildlife from the placement of dredged material to restore/create barrier shoreline. 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 (40 CFR 1508.8(b)). For example, the reduction in hurricane storm surge that indirectly results from restoration/creation of the barrier system of shorelines, headlands, and islands and salt marsh. 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 (40 CFR 1508.7). For example, the incremental impacts of barrier island restoration at several areas throughout the basin, could, collectively, significantly modify an entire basin's barrier system. The cumulative impact analysis follows 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" as well as the 2007 USACE "NEPA Analysis Guidance Manual." **Table 5-2** summarizes cumulative impacts for all important resources including those related to the 2010 Deepwater Horizon oil spill as well as impacts from CWPPRA, and CIAP projects.

Impacts of the 2010 Deepwater Horizon oil spill on coastal Louisiana remain uncertain at this time even though the relief well process was successfully completed on September 19, 2010 and the federal government declared the well "effectively dead". The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area, including the LCA BBBS project. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local

sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available. If at any time petroleum or crude oil is discovered on project lands, all efforts will be taken to seek clean up by the responsible parties, pursuant to the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.).

Ongoing documentation of the impacts associated with the 2010 Deepwater Horizon Oil spill can be found in several governmental sources. The USFWS Situation Report for November 30, 2010 (http://www.fws.gov/home/dhoilspill/) was as follows:

- U.S. Fish and Wildlife employees responding in the Gulf region: 59
- Total responders: 3,294
- Oiled coastline:
  - Louisiana: 335.1 miles oiled. Heavy to moderate oil on 69.4 miles.
  - Mississippi: 83.6 miles oiled. Heavy to moderate oil on 3.4 miles.
  - Alabama: 64.8 miles oiled. Heavy to moderate oil on 0.3 miles.
  - Florida: 64.8 miles oiled. Heavy to moderate oil on 0.4 miles.
- The following estimated amounts of oiled debris have been removed from sensitive lands since August 16:
  - Florida: 855,022 lbs
  - Alabama: 550,080 lbs
  - Mississippi: 1,916,517 lbs

Clean-up activities have been running continuously, weather permitting, on Department of Interior lands in Mississippi, Alabama, and Florida. Many of the DOI lands are approaching a "No Further Treatment" designation, and will transition into a Maintenance & Monitoring Program for the foreseeable future. Bon Secour National Wildlife Refuge: Four hand crews at Perdue and Ft. Morgan Units continue to remove submerged oil and remove tarballs from beaches, averaging 6,000 lbs. of oil/day. Refuge staff continue to respond to multiple sea turtle strandings.

The USACE, New Orleans District Regulatory Branch has considered and responded to approximately 55 emergency permits related to the 2010 Deepwater Horizon oil spill and are described in **Table 5-1**. Of potential impact to the LCA BBBS are several permits that have constructed or will shortly construct protective berms, Hesco baskets, rip-rap, bulkheads, and concrete fill to close gaps and washover areas along the Caminada Headland. In addition, the State of Louisiana is permitted to dredge and fill to construct six sand berm reaches along the shoreline of the Chandeleur Islands/Breton National Wildlife Refuge westward to Baptiste Collette Bayou and along the seaward shoreline of Timbalier Island eastward to Sandy Pont. Material to construct the berms would be dredged from Ship Shoal, South Pelto, the Mississippi River Offshore Disposal Site, Pass a Loutre, St. Bernard Shoal and Hewes Point. Emergency permits have the following clause that provides for removing, relocating or altering emergency permitted structures, if necessary, and upon due notice from the Corps. The dynamic nature of the impacts associated with the 2010 Deepwater Horizon oil spill will require, as reflected by the permit clause, additional consideration in the near future for USACE Civil Works projects, such as LCA, along coastal Louisiana.

> *The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee shall be required upon due notice from the Corps of Engineers, to remove, relocate, or alter the*

structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

Table 5-1. USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/pas/mvnoilspill.asp dated August 4, 2010)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
MVN-2010-01038-EJJ	Deepwater Horizon Oil Spill - LANG - Pier on MRGO to Unload Oil Spill Booms - St Bernard Parish	St. Bernard Parish	NOD-20	5-May-10	6-May-10		
MVN-2010-01039-EFF	Deepwater Horizon Oil Spill - LADWF - Install Concrete Fill to Close Gaps on Elmers Island - Jefferson Parish	La. Wildlife&Fisheries	NOD-20	6-May-10	7-May-10		
MVN-2010-01039-EFF*	Deepwater Horizon Oil Spill - LADWF - Install Concrete Fill to Close Gaps on Elmers Island - Jefferson Parish	La. Wildlife&Fisheries	NOD-20	1-Jul-10	2-Jul-10		
MVN-2010-01041-WB	Deepwater Horizon Oil Spill - Lafourche Parish Government - Sand bags along Fourchon Beach between Parish Line & LA Hwy 3090	Lafourche Ph Government	NOD-20	10-May-10	11-May-10		
MVN-2010-01041-WB*	Deepwater Horizon Oil Spill - Lafourche Parish Government - Riprap and bulkhead along Fourchon Beach between Parish Line & LA Hwy 3090	Lafourche Ph Government	NOD-20	17-May-10	17-May-10		
MVN-2010-01041-WB*	Deepwater Horizon Oil Spill - Lafourche Parish Government - HESCO baskets along Fourchon Beach between Parish Line & LA Hwy 3090	Lafourche Ph Government	NOD-20	21-May-10	21-May-10		
MVN-2010-01041-WB*	Deepwater Horizon Oil Spill - Lafourche Parish Government - Elevate a protective Berm at Thunder Bayou-Lafourche Parish	Lafourche Ph Government	NOD-20	2-Jul-10	2-Jul-10		
MVN-2010-01066-ETT	Deepwater Horizon Oil Spill - State of Louisiana - Barrier Island Sand Berm Project - Jefferson, Plaquemines, St Bernard Parishes	La. OCPR	NOD-20	12-May-10	27-May-10		
MVN-2010-01066-ETT*	Deepwater Horizon Oil Spill - State of Louisiana - Modification to Barrier Island Sand Berm Project - Jefferson, Plaquemines,	La. OCPR	NOD-20	6-Jul-10	15-Jul-10		

Table 5-1. USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/pao/mvnoil/spill.asp dated August 5, 2010)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
	St Bernard Parishes						
MVN-2010-01098-EFF	Deepwater Horizon Oil Spill - Plaquemines Parish - Sandbag Operation at Pelican and Seofield Islands	La. DNR	NOD-20	14-May-10	14-May-10		
MVN-2010-01098-EFF*	Deepwater Horizon Oil Spill - Plaquemines Parish - Additional Sandbags at Pelican and Seofield Islands	Plaquemines Ph Govt	NOD-20	8-Jul-10	8-Jul-10		
MVN-2010-01136-WJ	Deepwater Horizon Oil Spill- State of Louisiana- Create Sand Protection Berm-Isles Dernieres Chain, Terrebonne Parish	La. OCPR	NOD-20	18-May-10		6-Jul-10	
MVN-2010-1143-EFF	Deepwater Horizon Oil Spill- State of Louisiana- Install pilings and booms east of Biloxi Marsh Area, St. Bernard Parish	La. OCPR	NOD-20	19-May-10	20-May-10		
MVN-2010-01149-EJJ	Deepwater Horizon Oil Spill - Tiger Dams on Grand Isle	Jefferson Ph Government	NOD-20	21-May-10	21-May-10		
MVN-2010-01151-WB	Deepwater Horizon Oil Spill - Terrebonne Parish Government, Trinity Island, sand bags	Terrebonne Ph Govt	NOD-20	24-May-10			4-Jun-10
MVN-2010-01152-EOO	Deepwater Horizon Oil Spill - Little Lake Club - Marsh Plugs N of Turtle Bay - Jefferson Parish	Little Lake Club	NOD-20	24-May-10	26-May-10		
MVN-2010-01265-EJJ	Deepwater Horizon Oil Spill; sand bags at Shell Cut and Chaland Pass	Plaquemines Ph Govt	NOD-20	7-Jun-10			15-Jun-10
MVN-2010-01267-WB	Deepwater Horizon Oil Spill - Terrebonne Parish Government, install sheetpile with setbacks for Closure of Canal 19 on Timbalier Island	Terrebonne Ph Govt	NOD-20	4-Jun-10	4-Jun-10		
MVN-2010-01271-EOO	Deepwater Horizon Oil Spill - Rock Jetties at 5 Passes, Grand Isle Area - Jefferson, Plaquemines Parishes	Jefferson Ph Government	NOD-20	8-Jun-10		3-Jul-10	

Table 5-1. USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/Portals/56/docs/regulatory/Deepwater_Horizon_Emergency_Permit_Request_Summary_Table_Updated_Summary_6_2010.pdf)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
MVN-2010-01397-EBB	Deepwater Horizon Oil Spill - Queen Bess Island Inflatable Coffer Dams - Jefferson	Jefferson Ph Government	NOD-20	8-Jun-10	8-Jun-10		
MVN-2010-01335-WB	Deepwater Horizon Oil Spill - Cameron Parish Gov - Emergency authorization, HESCO Baskets/Sand Bags on Rockefeller WMA – Cameron Parish	Cameron Ph Govt	NOD-20	11-Jun-10	11-Jun-10		
MVN-2010-01337-EBK	Deepwater Horizon Oil Spill - Amigo Enterprises - Emergency authorization, Breton Sound Dock Upgrade - Plaquemines Parish	Amigo Enterprises	NOD-20	11-Jun-10	11-Jun-10		
MVN-2010-01337-EBK*	Deepwater Horizon Oil Spill - Amigo Enterprises - Emergency authorization, Breton Sound Dock Upgrade (new pumps and culvert) – Plaquemines Parish	Amigo Enterprises	NOD-20	8-Jul-10	8-Jul-10		
MVN-2010-01338-WJJ	Deepwater Horizon Oil Spill, Terrebonne Parish, Dredge and Place Fill to Create Embankment	Terrebonne Ph Govt	NOD-20	11-Jun-10			15-Jun-10
MVN-2010-01336-EFF	Deepwater Horizon Oil Spill - Plaquemines Parish - Emergency authorization Dredging of Happy Jack Canal & Wilkinson Canal – Plaquemines Parish	Plaquemines Ph Govt	NOD-20	11-Jun-10			24-Jun-10
MVN-2010-01342-EOO	Deepwater Horizon Oil Spill - Jefferson Parish - Emergency Authorization, Pilings and boom installations in Cominsky Pass, Barataria Pass, Pass Abel, Four Bayou Pass and Chaouvin Rompollo Pass - Jefferson & Plaquemines Parish	Jefferson Ph Government	NOD-20	11-Jun-10	14-Jun-10		
MVN-2010-01342-EOO*	Deepwater Horizon Oil Spill - Modification to booms in Pass abel and Four Bayou Pass - Jefferson Parish	Jefferson Ph Government	NOD-20	18-Jun-10	18-Jun-10		

Table-5.1: USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/Portals/56/docs/regulatory/Horizon/Horizon_Table_Updated_August_2_2010)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
MVN-2010-01150-EB	Deepwater Horizon Oil Spill - LA DOTD Emergency Authorization for Temporary by-pass road & bridge on LA Hwy 624, north of Bayou La Loutre - St. Bernard Parish	LaDOTD	NOD-20	14-Jun-10	14-Jun-10		
MVN-2010-01172-EBK	Deepwater Horizon Oil Spill - Breton Sound Dock Expansion on Bayou La Loutre - St. Bernard Parish	Amigo Enterprises	NOD-20	16-Jun-10	16-Jun-10		
MVN-2010-01142-WB	Deepwater Horizon Oil Spill - Vermilion Parish - Emergency Authorization to construct 14 inlet/outlet across breaches along west of Vermilion Parish	Vermilion Parish Police Jury	NOD-20	21-Jun-10	25-Jun-10		
MVN-2010-01171-WB	Deepwater Horizon Oil Spill - EP - Emergency Authorization for Piling/Boom Installation at Raccourci Lake – Lafourche Parish	BP America Production Co	NOD-20	22-Jun-10	24-Jun-10		
MVN-2010-01176-EBK	Deepwater Horizon Oil Spill - Pass Abel Boom Installation - Jefferson & Plaquemines	BP America Production Co	NOD-20	23-Jun-10	24-Jun-10		
MVN-2010-01158-EPP	Deepwater Horizon Oil Spill - Amigo Enterprises - Breton Sound Dock Expansion on Bayou La Loutre & MRGO - St. Bernard Parish	Amigo Enterprises	NOD-20	23-Jun-10	23-Jun-10		
MVN-2010-01173-EBK	Deepwater Horizon Oil Spill - Pass Abel West Boom Installation - Jefferson & Plaquemines Parishes	BP America Production Co	NOD-20	25-Jun-10	28-Jun-10		
MVN-2010-01349-WJI	Deepwater Horizon Oil Spill - Emergency Authorization to Fill Breaks along Twin Pipeline Canal Levee - Terrebonne, Lafourche Parishes	Terrebonne Pb Levee and Conservation District	NOD-20	29-Jun-10			7-Jul-10
MVN-2010-01350-EPP	Deepwater Horizon Oil Spill - Plaquemines Parish - X-Tex Fabric Fence near Williamson Canal	Plaquemines Pb Govt	NOD-20	29-Jun-10	30-Jun-10		

Table 5-1. USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/pao/mvnoilspill.asp dated August 6, 2010)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
MVN-2010-01554-WB	Deepwater Horizon Oil Spill - Emergency Authorization for Pilings and Booms at Wine Island & Raccon Island in Terrebonne Parish	La. Wildlife&Fisheries	NOD-20	30-Jun-10	1-Jul-10		
MVN-2010-01570-WB	Deepwater Horizon Oil Spill - Emergency Authorization for installation of Tiger Dams on Elmers Island, Breach 4 to Bayou Thunder Breach, GOM - Lafourche & Jefferson Parishes	Lafourche Ph Government	NOD-20	30-Jun-10	1-Jul-10		
MVN-2010-01581-EKK	Deepwater Horizon Oil Spill - Caminada Pass, Boom Installation - Jefferson Parish	BP America Production Co	NOD-20	30-Jun-10	1-Jul-10		
MVN-2010-01588-WJJ	Deepwater Horizon Oil Spill - Terrebonne Levee & Conservation District - Emergency Authorization To Install Geotextile Fabric along Twin Pipeline Canal Levee - Terrebonne, Lafourche Parishes	Terrebonne Ph Levee and Conservation District	NOD-20	2-Jul-10	7-Jul-10		
MVN-2010-01593-EFF	Deepwater Horizon Oil Spill, Clear, grade, and deposit fill to improve property for oil spill response staging	Amigo Enterprises	NOD-20	2-Jul-10	2-Jul-10		
MVN-201--01635-EPP	Deepwater Horizon Oil Spill - Mr SWACO - Grand Isle Beach Sand Cleaning Project Emergency Authorization - Jefferson Parish	Mr SWACO	NOD-20	8-Jul-10	9-Jul-10		
MVN-2010-01700-WB	Deepwater Horizon Oil Spill - Pilings along Casse-Tete and Calumet Islands for boom installation - Lafourche Parish	BP America Production Co	NOD-20	13-Jul-10	14-Jul-10		
MVN-2010-01705-WB	Deepwater Horizon Oil Spill - Install HESCO baskets along Fourchon Beach from Breach No. 4 to Bayou Thunder - Lafourche Parish	BP America Production Co	NOD-20	13-Jul-10	15-Jul-10		
MVN-2010-01722-EBB	Deepwater Horizon Oil Spill - Piles and booms in Barataria Pass to protect Mendicant Island, Queen Bess Island and B. Beauregard	BP America Production Co	NOD-20	15-Jul-10	16-Jul-10		

Table 5-1. USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/pao/mvnoilspill.asp dated August 3, 2010)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
	Island - Jefferson Parish						
MVN-2010-01722-EBB*	Deepwater Horizon Oil Spill - Modification of Piles and booms in Barataria Pass to protect Meadiecant Island, Queen Bess Island and B. Beauregard Island - Jefferson Ph. The modification includes relocating and adding more pilings	BP America Production Co	NOD-20	22-Jul-10	22-Jul-10		
MVN-2010-01723-EPP	Deepwater Horizon Oil Spill - Piles and booms in Cat Bay along Cat Bay Islands - Jefferson Parish	BP America Production Co	NOD-20	15-Jul-10	16-Jul-10		
MVN-2010-01723-EPP*	Deepwater Horizon Oil Spill - Modification to piles and booms in Cat Bay along Cat Bay Islands - Jefferson Parish	BP America Production Co	NOD-20	23-Jul-10	23-Jul-10		
MVN-2010-1728-EPP	Deepwater Horizon Oil Spill - BP America Production Co - Piles in Cat Bay along (3) Bird Islands – Plaquemines Parish	BP America Production Co	NOD-20	16-Jul-10	16-Jul-10		
MVN-2010-1728-EPP*	Deepwater Horizon Oil Spill - BP America Production Co - Modification to Piles in Cat Bay along (3) Bird Islands – Plaquemines Parish	BP America Production Co	NOD-20	23-Jul-10	23-Jul-10		
MVN 2010-01753 EKK	Deepwater Horizon Oil Spill - BP America Production Co - Surf washing of sand on Grand Terre - Jefferson Parish	BP America Production Co	Withdrawn	19-Jul-10			27-Jul-10
MVN-2010-01780-EFF	Deepwater Horizon Oil Spill - Piling and Boom Installation in Caminada Bay - Lafourche & Jefferson Parishes	BP America Production Co	Issued	20-Jul-10	21-Jul-10		
MVN-2010-01783-ETT	Deepwater Horizon Oil Spill - Marsh Barriers in Blind & Customhouse Bays - Plaquemines Parish	La. OCPR	Withdrawn	21-Jul-10			5-Aug-10

Table 5-1. USACE New Orleans District Regulatory Branch Deepwater Horizon Emergency Permit Request (source: http://www.mvn.usace.army.mil/pao/mvnoilspill.asp dated August 4, 2010)

DA Number	Project Name	Applicant	Action	Date Rec'd	Date Issued	Date Denied	Date Withdrawn
MVN-2010-01784-EOO	Deepwater Horizon Oil Spill - Hesco Baskets, Point Chenier Ronquille to Grand Bayou Pass – Plaquemines Parish	Plaquemines Ph Govt	Withdrawn	21-Jul-10			30-Jul-10
MVN-2010-01879-EFF	Deepwater Horizon Oil Spill - Dredge Wilkinson Canal to access staging area at Myrtle Grove Marina – Plaquemines Parish	Plaquemines Ph Govt	Withdrawn	4-Aug-10			10-Aug-10
MVN-2010-01977-WB	Deepwater Horizon Oil Spill - BP-ELA 10-097 - Install (7) 3-pile dolphins & (3)single piles at Cocodrie Ducon Station-Terrebonne Parish	BP America Production Co	Issued	17- Aug-10	18-Aug-10		
MVN-2010-02064-EKK	Deepwater Horizon Oil Spill - Surf Washing on Grand Isle - Jefferson Parish	BP America Production Co	Withdrawn	23-Aug-10			31-Aug-10
MVN-2010-02077-EFF	Deepwater Horizon Oil Spill - Temporary Bridge at NE tip of Grand Isle to move heavy equipment used in oil spill cleanup - Jefferson Parish	BP America Production Co	Issued	24-Aug-10	2-Sept-10		
* Indicates modification to previously issued permit							

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Soil Resources	US, LA & SA: Natural processes of parent material, climate, organisms, relief, time, waves, runoff, and other factors result in soil formation and soil loss. Institutional recognition of the importance of soil resources with formation of Soil Conservation Service later to become Natural Resources Conservation Service. Upstream dams, locks, and reservoirs, become sinks for sediments carried by the Mississippi River thereby reducing the availability of sediments within the Mississippi River for building the deltaic plain and its barrier systems. Leveeing Mississippi River and tributaries eliminates seasonal overflows of sediment-laden waters responsible for soil building in deltaic plain and available sediments for alongshore transport to barrier systems.	US: Continued institutional recognition. Human activities (population growth, agriculture, industry, etc.) continue impacting natural processes of soil formation and soil loss. Soil conservation measures and construction of levees, dams, locks, and other structures reduces sediment loads in Mississippi River and tributaries. LA: Louisiana coastal land loss of over 1,900 square miles since the 1930s. Total of about 6,337 acres barrier habitat restored with beneficial use of dredged material (746 acres) and CWPPRA restoration projects (5,591 acres). SA: Caminada Headland losing soil resources at a rate of 45ft/yr; Shell Island is losing soil resources at a rate of 38.5 ft/yr. Loss of soils result in loss of estuarine- marine transitional vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; loss of productivity and reduction in important stopover habitats used by migrating neotropical birds.	US: Continued institutional recognition. Continued human activities and resultant degradation and loss of soil resources. LA: Continued coastal land loss with prediction of 328,000 acres (13,284 ha) lost over the next 50 years. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. SA: Continued barrier habitat loss with 3,750 acres of soil resources from Caminada Headland and all 386 acres of Shell Island soil resources are predicted to be lost over next 50 years. Construction of the 36,388 lf of protective sand against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island.	US: Continued institutional recognition. Continued degradation and loss of soil resources. Continued technical assistance and cost-sharing programs for soil conservation to reduce soil losses. LA: Without a comprehensive coast wide coastal restoration effort, coastal land loss would continue with prediction of nearly 328,000 acres (13,284 ha) loss over the entire Louisiana coastal area by 2050. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the loss of soil resources. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. C5/S5 (Recommended Plan/NER Plan): restore net total of 1,684 acres barrier soil resources. Construction of the 36,388 lf of protective sand against the 2010 Deepwater Horizon oil spill will provide positive impact with redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier system, especially near Shell Island. Positive synergistic interaction of Recommended Plan /NER impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) that would contribute to reducing estimated 328,000 acres by 2050 and reduce further degradation and loss of important estuarine/marine transitional habitat, increase productivity and restore important stopover habitat for migrating neotropic birds as well as provide critical habitat for threatened piping plover. C5: restore net total of 0 acres barrier soil resources; Shell Island cumulative impacts similar to the No Action Alternative.

**Cumulative impact analysis follows 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" as well as the USACE (2007) "NEPA Guidance Manual." Includes Spatial/Geographic Extent (Continental United States [US], Louisiana [LA], and Study Area [SA]; and Temporal (Past, Present, and Future Without-and Future With Project). Identifier Code: C5, C6, C9 = Caminada Headland Restoration Feature 5, 6 and 9 respectively; S1, S5 = Shell Island Restoration Feature 1 and 5 respectively; and the Recommended Plan/NER Plan.*

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Offshore, Nearshore, and Riverine Sand Resources	US, LA & SA: Natural processes of longshore transport, erosion, tides, etc., build and deplete offshore sand deposits. Institutional recognition of importance of resources with creation of MMS (now BOEMRE).	US & LA: Continued institutional recognition. LA: BOEMRE establishes Louisiana Sand Management Working Group to better manage offshore sand resources. Natural processes and human activities continue to build and deplete sand deposits. Ship Shoal used for CWPPRA TE-47 Whiskey West Flank Restoration. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. Increasing demands for oil and gas accelerate exploration and extraction activities thereby impacting sand resources. SA: Continued oil, gas, and mineral exploration and extraction activities on Ship Shoal and other offshore and nearshore sand resource areas. Nearshore and riverine sand resources continued to be utilized for fill in construction and civil works projects. Beneficial use of maintenance dredged material from Bayou Lafourche for maintaining Bayou Lafourche jetties and shoreline nourishment along Caminada Headland. CWPPRA BA-40 riverine sand mining for Scofield Island restoration of 234 acres (**tables 5-3 and 5-5**).	US & LA: Continued institutional recognition. Natural processes and human activities continue to build and deplete offshore sand deposits. Increased competition for offshore and nearshore areas especially for oil and gas exploration. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. SA: Continue beneficial use maintenance dredged material from Bayou Lafourche and to utilize riverine sand resources to construct civil works projects. Soil conservation practices continue thereby decreasing available sediments to replenish borrow sites. Construction 36,388 lf protective sand berm against the 2010 Deepwater Horizon oil spill provide redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island.	US & LA: Continued institutional recognition. Natural processes and human activities continue to build and deplete offshore sand deposits. Increased competition for offshore areas especially for oil and gas exploration. Continue to utilize riverine sand resources for fill in construction and civil works projects. Upstream soil conservation practices would likely continue resulting in decrease of available sediments to replenish sediment borrow sites. Implementing the Recommended Plan would result in a comparatively small reduction to offshore sand resources. LA: removal and redistribution of sand resources to construct the protective sand berms against the 2010 Deepwater Horizon oil spill will have undetermined long term impacts to Louisiana Coastal Area, but likely provide positive increased sediments into alongshore transport. C5/S5 (Recommended Plan/NER Plan): removal of 22,786,100 CY of borrow material. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island. Generally positive synergistic interaction of Recommended Plan /NER impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-5**). However, removal of borrow material for construction of all projects would have short term impacts on benthic organisms; if borrow areas appropriately designed, benthic organisms likely recolonize borrow sites of the Recommended Plan /NER and other actions within 1.5 – 2 years. Additional impacts include widespread redistribution of sand resources used as borrow. C5: removal of 10,500,000 CY of borrow material; Shell Island cumulative impacts similar to No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Barrier Systems: Barrier Shorelines, Headlands, and Islands	US & LA: Barrier systems naturally build and erode dependent on deltaic cycle and other geomorphic processes. Institutional recognition (Coastal Barrier Resources Act of 1990). Increased flood control (especially leveeing) of Mississippi River and tributaries following 1927 regional flooding further disrupts deltaic cycle and barrier system building in coastal Louisiana. SA: Construction of navigation channels, jetties, oil and gas exploration and access canals, and other structures along gulf shoreline alters longshore transport and sediment availability for land building processes.	US: Continued institutional recognition. Barrier systems continue building and eroding depending on human disruptions of natural geomorphic processes. LA: Continued disruption of deltaic cycle and longshore transport prevents rebuilding of barrier systems; increased storm frequency resulting in net losses of all Louisiana coastal barrier systems. Average rate of long-term (> 100 years) shoreline change is –19.9 ft/yr (6.1 m/yr). Average short-term rate (< 30 years) of shoreline change is 30.9 ft/yr (9.4 m/yr). Total of about 6,337 acres (2,564 ha) barrier habitat restored with beneficial use of dredged material (746 acres [302 ha]) and CWPPRA restoration projects (5,591 acres [2,262 ha]). See **tables 5-3 and 5-5** for other barrier island restoration efforts. SA: Annual average land loss at the Caminada Headland 45 ft/yr; annual average land loss at Shell Island 38.5 feet per year. CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**). Beneficial use of maintenance dredged material from Bayou Lafourche for maintaining Bayou Lafourche jetties and shoreline nourishment along Caminada Headland. CWPPRA BA-40 riverine sand mining for Scofield Island restoration of 234 acres (**tables 5-3 and 5-5**).	US: Continued institutional recognition, human and natural disruptions of geomorphic processes. LA: Continued disruption of deltaic cycle prevents rebuilding of barrier systems; continued or increasing storm frequency results in significant loss of many barrier islands and shorelines. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. SA: Land loss rates likely to continue similar to existing conditions rates. By 2050, Caminada Headland would lose 3,750 acres from the Caminada Headland and all 386 acres of Shell Island would be lost. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island.	US & LA: Continued institutional recognition. Barrier systems continue building and eroding depending on human disruptions of natural geomorphic processes; continued disruption of deltaic cycle and longshore transport prevents rebuilding of barrier shorelines, headlands, and islands; continued increased storm frequency results in significant loss of many barrier islands and shorelines. Implementing the Recommended Plan would result in a comparatively small reduction to the continued loss of barrier system resources. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. Introduction of sediments into barrier system and longshore currents likely beneficial to help renourish coastal Louisiana barrier system. C5/S5 (Recommended Plan/NER Plan): Caminada Headland and Shell Island benefits from the introduction of sediments; downstream areas benefit via littoral drift of sediments from restored barrier system. Positive synergistic interaction of Recommended Plan /NER impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) that would contribute to reducing estimated 328,000 acres by 2050 and reduce further degradation and loss of important estuarine & marine transitional habitat, critical piping plover habitat. Increase productivity and restore important stopover habitat for migrating neotropic birds as well as provide critical habitat for threatened piping plover. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Coastal Processes	US, LA, & SA: Natural coastal and Mississippi River and its tributaries processes of longshore transport, erosion, tides, etc., build and deplete barrier systems. Institutional recognition of importance of resources with creation of MMS now BOEMRE. SA: Construction of Empire Waterway jetties contribute to altering longshore transport resulting in increased land loss to Shell Island.	US & LA: Natural coastal and Mississippi River and its tributaries processes of longshore transport, erosion, tides, etc., build and deplete barrier systems. Institutional recognition of importance of resources with creation of Minerals Management Service. SA: As barrier land loss continues, hydrologic connections between the gulf and interior areas increase and exacerbate interior land loss and conversion of habitat types. Continued loss of barrier systems have resulted in reduction and loss of the natural protective storm buffering of these barrier systems. Empire jetty continues to reduce longshore transport contributing to further land loss of Shell Island.	US & LA: Natural coastal and Mississippi River and its tributaries processes of longshore transport, erosion, tides, etc., build and deplete barrier systems. Institutional recognition of importance of resources with creation of Minerals Management Service. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. Introduction of sediments into barrier system and longshore currents likely help renourish coastal Louisiana barrier system. SA: similar to existing conditions, except construction of 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island. Empire jetty impacts continue.	US & LA: Similar to No Action Alternatives (future without project conditions). LA: Undetermined impacts of constructing sand berm as protection against 2010 Deepwater Horizon oil spill. Introduction of sediments into barrier system and longshore currents likely beneficial to help renourish coastal Louisiana barrier system. Removal large volumes offshore sands for coastwide restoration efforts from thousands acres gulf bottoms could potentially alter wave dynamics and littoral drift dynamics if removal not conducted in appropriate manner to avoid, minimize, and reduce adverse impacts. C5/S5(Recommended Plan/NER Plan): Barrier system restoration, combined with interior marsh creation and restoration measures, likely alter tidal prism reducing formation of any additional tidal passes as well as "healing" (closing or narrowing) existing tidal passes and over wash areas. Recommended Plan/NER plan act together with other restoration efforts to reduce saltwater intrusion into more northern portions of the basin. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island. Empire jetty impacts continue. Positive synergistic interaction of Recommended Plan/NER Plan impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) contribute to reducing estimated loss of 328,000 acres by 2050 and reduce further degradation and loss of important estuarine/marine transitional habitat, increase productivity and restore important stopover habitat for migrating neotropic birds as well as provide critical habitat for threatened piping plover. Recommended Plan/NER Plan functions synergistically with Davis Pond and Myrtle Grove Diversion. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Salinity Regimes	US: Geomorphic and marine processes influence the tidal prism and salinity regimes. LA & SA: Salinity regimes in subprovinces naturally fluctuate in response to deltaic cycle, geomorphic and marine processes as well as other natural factors influencing the tidal prism.	US: Natural and human disruption of geomorphic and marine processes modify tidal prisms, influence salinity regimes, and facilitates saltwater intrusion into upper estuaries. LA: Human disruption of the deltaic cycle and geomorphic and marine processes, including construction of navigation and oil and gas access channels, modifies tidal prism and resulting in saltwater intrusion and higher salinities within interior portions of estuaries. SA: Continued land loss, increases in the number of in tidal inlets, disruption of the tidal prism, and conversion of barrier habitat and saline marsh habitat to open water alters salinity regimes.	US: Continued natural and human disruption of geomorphic and marine processes modifies tidal prisms, influence salinity regimes, and facilitate saltwater intrusion into upper estuaries. LA: Continued human disruption of deltaic cycle and other geomorphic and marine process allow saltwater intrusion into upper estuaries; navigation and oil and gas channels continue to facilitate saltwater intrusion. SA: Continued land loss, increased numbers of tidal inlets, disruption of the tidal prism, and conversion to open water alters existing salinity regimes to more saline regime. Proposed Davis Pond Diversion Modification and proposed Myrtle Grove diversion synergistically interact by freshening estuarine system and altering salinity regime to fresher conditions.	US & LA: Continued natural and human disruption of geomorphic and marine processes modifies tidal prisms, influence salinity regimes, and facilitate saltwater intrusion into upper estuaries. Continued human disruption of deltaic cycle and other geomorphic and marine processes that allows saltwater intrusion into upper estuaries; navigation and oil and gas channels continue to facilitate saltwater intrusion. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the human perturbations and disruption of salinity regimes. C5/S5 (Recommended Plan/NER Plan): Implementation would result in little, if any impacts on salinity regimes. Cumulative impacts Recommended Plan/NER Plan associated with all coastal restoration actions could contribute to maintaining existing salinity regimes. Positive synergistic interaction of Recommended Plan /NER Plan impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**). Proposed Davis Pond Diversion Modification and proposed Myrtle Grove diversion synergistically interact by freshening interior Barataria estuarine system and altering salinity regime to fresher conditions. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Water Quality	US, LA & SA: Degraded waterbodies due to untreated and uncontrolled discharges, especially in urbanized and/or industrialized areas. Enactment of Federal and state legislation (e.g. Clean Water Act) beginning in the 1970s to restore and protect waterbodies, especially with respect to point sources.	US: Continued institutional regulation. Nonpoint sources unregulated. According to the National Water Quality Inventory 2000 Report about 39 percent of streams, 45 percent of lakes, and 51 percent of estuaries assessed were not clean enough to support uses such as fishing and swimming). LA: Hurricane Katrina (2005) causes 10 major oil spills and 35 minor oil spills (total of **7,340,990** gallons) in southeast Louisiana; Deepwater Horizon oil spill April 2010 release about 4.9 million barrels crude oil cause extensive water quality damage to marine and coastal habitats, Gulf's commercial and recreational fishing and tourism. SA: 53,000-gallon oil spill from Chevron facility at Port Fourchon (source: http://www.laseagrant.org/hurricane/oil.htm). Impacts to existing infrastructure (especially oil and natural gas pipelines) along the Caminada Headland at Port Fourchon are at risk of damage and/or loss due to barrier land loss and could therefore contribute to further water quality degradation. These impacts could be offset to some extent by restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**)	US & LA: continued institutional regulations. Potential regulations of oil and gas industry to prevent adverse water quality impacts. LA & SA: impacts similar to existing conditions. Long-term impacts for 2010 Deepwater Horizon oil spill unknown and still under investigation. LA & SA: Increasing potential for accidental discharges due to exposed infrastructure because of coastal land loss. SA: Adverse impacts to infrastructure (especially oil and natural gas pipelines) along the Caminada Headland at Port Fourchon could result in continued risk of damage and/or loss due to barrier land loss and could therefore contribute to further water quality degradation. These impacts could be offset to some extent by restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**)	US & LA: Continued Federal and state programs that require and/or encourage protection of waterbodies. Similar to No Action. C5/S5 (Recommended Plan/NER): Short term and minor water quality impacts primarily during construction e.g., increased turbidity, decreased DO associated with placement of dredged material. The impacts of the 2010 Deepwater Horizon oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) unknown level of impacts to USACE water resources projects and studies within the Louisiana coastal area, including the BBBS study area. Positive synergistic interaction of Recommended Plan/NER Plan impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**). Proposed Davis Pond Diversion Modification and proposed Myrtle Grove diversion synergistically interact with Recommended Plan/NER Plan by stimulating vegetation productivity within interior Barataria estuarine system and thereby potentially improving water quality by restoring wetlands which filter pollutants. However, could also potentially adversely impact water quality if diverted river waters are contaminated and therefore contribute to degradation of wetlands thereby reducing their ability to filter pollutants. Or a combination of these extremes. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Vegetation Resources	US, LA & SA: Natural processes form vegetated barrier habitats and coastal wetlands. Institutional recognition of coastal barrier resources and wetlands (e.g., Coastal Barrier Resource Act, Estuary Protection Act, and others). LA: Accelerated deterioration and loss of Louisiana coastal wetlands of over 1.22 million acres (485,830 ha) since the 1930s. SA: Conversion of fragmented emergent barrier wetlands to shallow open water.	US & LA: Continued institutional recognition. Natural processes such as subsidence, wave erosion, as well as human activities causes deterioration and loss of vegetated barrier and wetland habitat. Louisiana coastal vegetated land loss of over 1,900 square miles since the 1930s. Total of about 6,337 acres barrier habitat restored with beneficial use of dredged material (746 acres) and CWPPRA restoration projects (5,591 acres). See **tables 5-3 and 5-5** for other barrier island restoration efforts. SA: Caminada Headland is currently losing vegetated wetlands at an average annual rate of 45ft/yr; Shell Island is losing vegetated wetlands at an average annual rate of 38.5 ft/yr. CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**). CWPPRA BA-40 riverine sand mining for Scofield Island restoration of 234 acres (**tables 5-3 and 5-5**).	US: Continued institutional recognition. Continued loss of wetlands and vegetative acreage due to natural processes and human activities. LA: Continued accelerated coast wide loss vegetated barriers systems. Most severe loss in Nation. Estimated loss of 328,000 acres vegetated wetlands by 2050. SA: Land loss rates continue similar to existing conditions. By 2050, Caminada Headland lose 3,750 acres vegetated wetlands from Caminada Headland; all 386 acres of Shell Island lost by 2011 to 2027, depending on which rate of land loss (short-term or long-term) is used. Continued accelerated vegetated wetlands loss. Loss of transitional estuarine-marine vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; loss of productivity; increased inter- and intra-specific competition for decreasing wetland resources. Loss of important stopover habitats used by migrating neotropical birds.	US: Continued institutional recognition. Continued loss of vegetative acreage due to natural processes and development. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the rate of loss of vegetation habitat. LA: Continued accelerated coast wide loss of vegetated barriers systems; most severe loss in Nation. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the rate of loss of vegetation habitat. C5/S5 (Recommended Plan/NER Plan): Net total of 684 acres of vegetated barrier habitats restored. Plantings of native species increase important and critical vegetated habitats used by fish and wildlife. Positive synergistic interaction of Recommended Plan /NER Plan impacts to 1,684 acres with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) contribute to reducing estimated loss of 328,000 acres by 2050 also reduce further degradation and loss of important estuarine/marine transitional vegetated habitat, increased productivity and restore important vegetated stopover habitat for migrating neotropic birds as well as provide critical habitat for threatened piping plover. Recommended Plan/NER Plan functions synergistically with Davis Pond and Myrtle Grove Diversion with restoration of vegetated habitats further inland. C5: similar to Recommended Plan/NER Plan except a net total of 990 acres; Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Wildlife Resources	US, LA & SA: Vast expanses of coastal wetlands and barrier systems provide diversity of habitats that enable wildlife populations to respond to natural population-regulating mechanisms. Institutional recognition of importance of resource with creation of U.S. Fish and Wildlife Service. Coastal land loss of over 1,900 square miles (492,097 ha) since the 1930s, most of which were suitable wildlife habitats.	US, LA & SA: Continued land loss results in decline and loss of suitable wildlife habitats; and increased interspecific competition for decreasing habitats. LA: About 6,337 acres (2,564 ha) of barrier habitat restored with beneficial use of dredged material (746 acres [302 ha]) and CWPPRA restoration projects (5,591 acres [2,262 ha]) most of which were suitable wildlife habitats. See **tables 5-3 and 5-5** for other barrier island restoration efforts restoring total of 641,804 acres of wildlife habitats. SA: Caminada Headland currently losing wildlife habitats at a rate of 45ft/yr; Shell Island is losing wildlife habitats at a rate of 38.5 ft/yr. CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of wildlife habitats at Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**).	US, LA, & SA: Continued land loss results in decline of suitable habitats and increased intraspecific competition for decreasing habitats. LA: cumulative impacts from various restoration projects of 641,804 acres continue to offset estimated loss of 328,000 acres wildlife habitat by 2050 (**tables 5-3**). SA: By 2050, Caminada Headland could lose 3,750 acres of wildlife habitats from the Caminada Headland and all 386 acres of Shell Island would be lost by 2009 to 2027, depending on which rate of land loss (short-term or long-term) is used. . Continued positive cumulative impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of wildlife habitats at Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**).	US & LA: Continued land loss results in decline of suitable wildlife habitats and increased interspecific and intraspecific competition for decreasing habitats. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the loss of suitable wildlife habitats and the continued impacts to wildlife populations. C5/S5 (Recommended Plan/NER Plan): Restore a total of 1,718.9 AAHUs for a net total of 684 acres of important and essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, migratory neotropic bird stopover habitat, nursery, and other life requirements. Positive synergistic interaction of Recommended Plan/NER Plan impacts to 1,684 acres with restoration of 641,804 acres wildlife habitat by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) contribute to reducing estimated loss of 328,000 acres by 2050 also reduce further degradation and loss of important estuarine/marine transitional wildlife habitat, increased productivity and restore important vegetated stopover habitat for migrating neotropic birds as well as provide critical habitat for threatened piping plover. Recommended Plan/NER Plan functions synergistically with Davis Pond and Myrtle Grove Diversion with restoration of vegetated habitats furtber inland. Continued positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of wildlife habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). To comply with the Migratory Bird Treaty Act of 1918, the Recommended Plan/NER Plan would require that the Corps comply with restrictions on construction during non-nesting periods, implement construction buffer zones during nesting season, and the development of a Nesting Prevention Plan. A detailed discussion of these requirements can be found in Section 5.8.2.1.1. C5: similar to Recommended Plan/NER Plan except a total of 988.3 AAHUs and a net total of 990 acres; Shell Island impacts similar to No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Fisheries Resources	US: Fisheries habitats generally reduced, while catch increased. Institutional recognition with creation of National Marine Fisheries Service. LA & SA: Disruption of deltaic cycle; reduction in sustainability of fisheries habitat, while access (marsh edge) increased; increased productivity and catch.	US: Regulated catch; habitat loss decreased by coastal restoration efforts, continued net habitat loss. Institutional recognition of essential fish habitat. LA: Total of about 6,337 acres barrier habitat restored with beneficial use of dredged material (746 acres) and CWPPRA restoration projects (5,591 acres) restores various fishery habitats (e.g., nursery habitat, and other). LA & SA: Sustained to increasing populations of fish resources. However, now experiencing loss of essential fish habitat, especially barrier habitats and coastal wetlands that function as nursery. 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. The 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive water quality damage to marine and coastal habitats, Gulf's commercial and recreational fishing and tourism.	US, LA & SA: Continued loss and degradation of essential fish habitat; net loss in fisheries population size and diversity. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide important barrier island like habitats and undetermined level of primarily positive impacts on protecting important estuarine habitats. SA: Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide undetermined level of primarily positive impacts on protecting important estuarine habitats especially near Shell Island. Without implementation of Recommended Plan/NER Plan, loss of the barrier systems and coastal wetlands throughout coastal Louisiana in general, and the study area in particular, continue to adversely impact essential spawning, nursery, nesting, and foraging habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms	US & LA: Continued loss of essential fish habitat; net loss in fisheries population size and diversity. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction, nationwide, to the continued decline in fisheries populations and diversity. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide important barrier island like habitats and undetermined level of primarily positive impacts on protecting important estuarine habitats. C5/S5 (Recommended Plan/NER Plan): Net total of 684 acres of transitional estuarine-marine habitats used for spawning, nursery, nesting, and foraging by commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide important barrier island like habitats and undetermined level of primarily positive impacts on protecting important estuarine habitats especially near Shell Island. Continued positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of wildlife habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). C5: similar to Recommended Plan/NER Plan except a net total of 990 acres

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Essential Fish Habitat (EFH)	US, LA & SA: Institutional recognition of the decline in essential fish habitat (Magnuson-Stevens Fishery Conservation and Management Act). General decrease in quality and quantity of essential fish habitat.	US: Continued institutional recognition. Continued degradation and loss of essential fish habitat. LA: Total of about 6,337 acres barrier habitat restored, or authorized for restoration with beneficial use of dredged material (746 acres) and CWPPRA restoration projects (5,591 acres) restores essential fish habitats. SA: Barrier habitat and coastal wetland losses leads to loss and degradation of essential fish habitat. 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 EFH available to marine species while decreasing estuarine-marine transitional EFH. The 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive water quality damage to marine and coastal habitats, Gulf's commercial and recreational fishing and tourism.	US, LA & SA: Continued institutional recognition. Continued degradation and loss of essential fish habitat. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide important barrier island like habitats and undetermined level of primarily positive impacts on protecting important estuarine and other EFH. SA: Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide undetermined level of primarily positive impacts on protecting important estuarine and other EFH especially near Shell Island. Without implementation of Recommended Plan/NER Plan, loss of the barrier systems and coastal wetlands throughout coastal Louisiana in general, and the study area in particular, continue to adversely impact spawning, nursery, nesting, and foraging EFH habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms	US & LA: Continued degradation and loss of essential fish habitat. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction, nationwide, to the loss of essential fish habitat. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide important barrier island like habitats and undetermined level of primarily positive impacts on protecting important estuarine and other EFH. C5/S5 (Recommended Plan/NER Plan): Net total of 684 acres of transitional estuarine-marine habitats used for spawning, nursery, nesting, and foraging by commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms. The 2010 Deepwater Horizon oil spill protective sand berm provides undetermined level of primarily positive impacts on protecting important EFH estuarine habitats especially near Shell Island. C5: similar to Recommended Plan/NER Plan except a net total of 990 acres

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Water Bottoms and Benthic Resources	US, LA & SA: 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. Benthic populations respond to natural population-regulating conditions such as predation, sediment characteristics, salinity regimes, position in the intertidal zone, and oxygen levels.	US: 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. Benthic populations respond to natural and human-induced perturbations to aquatic habitats. LA & SA: Benthic populations of saline-tolerant species become more prevalent in interior and upper portions of subprovinces as land loss and saltwater intrusion continues. Ship Shoal used for CWPPRA TE-47 Whiskey West Flank Restoration. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. Increasing demands for oil and gas accelerate exploration and extraction activities thereby impacting sand resources. SA: Beneficial use of maintenance dredged material from Bayou Lafourche for maintaining Bayou Lafourche jetties and shoreline nourishment along Caminada Headland. CWPPRA BA-40 riverine sand mining for Scofield Island restoration of 234 acres (**tables 5-3 and 5-5**) short-term impacts to benthic resources but would likely recolonize in 1.5 -2 years.	US: 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. Benthic populations continue to respond to natural and human-induced perturbations to barrier systems. LA & SA: Benthic populations of saline-tolerant species continue to become more prevalent in interior and upper portions of subprovinces as land loss and saltwater intrusion continues. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island. However, undetermined long term impacts on waterbottoms and benthic organisms, especially near Shell Island.	US & LA: 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. Benthic populations continue to respond to natural and human-induced perturbations. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction, nationwide, to the predominance of saline-tolerant populations. LA: Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will redistribute 19.7 million CY of sediment resources from Gulf waterbottoms into the sediment-starved Louisiana coastal barrier system. C5/S5 (Recommended Plan/NER Plan): 22,786,100 CY borrow material required that directly impacts a total of 1,409 acres of water bottoms. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island. However, undetermined long term impacts on waterbottoms and benthic organisms, especially near Shell Island. Recommended Plan /NER Plan impacts water bottoms and benthic resources to restore 1,684 acres would be in addition to impacts to these resources with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**). Adverse impacts of maintenance dredging of Bayou Lafourche would be in addition to placement of 650,000 CY material along Caminada Headland renourishment feeder berm C5: 10,500,500 CY of borrow required that directly impacts a total of 649 acres of water bottoms; Shell Island impacts similar to No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Plankton Resources	US, LA & SA: Plankton populations respond to natural population-regulating conditions (biological factors, tidal flushing, inflow of freshwater carrying organic detritus, river discharge, water depth, tidal changes, turbidity, and dissolved oxygen).	US: Plankton populations respond to natural and human-induced perturbations to aquatic habitats. LA: Plankton 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. SA: Species switching from fresh to saline-tolerant plankton populations that predominate much of the area.	US: Plankton populations continue to respond to natural and human-induced perturbations to aquatic habitats. LA & SA: Continued land loss throughout coastal Louisiana and the study area continues saltwater intrusion thereby favoring saline-tolerant plankton populations.	US: Plankton populations continue to respond to natural and human-induced perturbations to aquatic habitats. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the predominance of saline-tolerant populations. LA: Continued land loss throughout coastal Louisiana and the study area continues saltwater intrusion thereby favoring saline-tolerant plankton populations. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction to the predominance of saline-tolerant populations. C5/S5 (Recommended Plan/NER Plan): Restoration of 684 net acres would increase the amount of dissolved organic compounds and detritus exported from the created and nourished barrier habitats thereby benefiting local plankton populations by increasing the planktonic food web. Recommended Plan /NER impacts to plankton benthic resources to restore 1,684 acres would be in addition to impacts to these resources with restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**). C5: Impacts similar to Recommended Plan/NER Plan except 990 acres would create fewer benefits to plankton resources; Shell Island impacts similar to No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Threatened & Endangered Species	US, LA & SA: General decrease in populations and their critical habitats. Institutional recognition of decline in threatened and endangered species (Endangered Species Act) and their critical habitat.	US & LA: Continued institutional recognition of decline in threatened and endangered species and their critical habitat as National and state loss of species and their critical habitat continue. Total of about 6,337 acres barrier habitat restored with beneficial use of dredged material (746 acres) and CWPPRA restoration projects (5,591 acres) contribute to various habitats for threatened and endangered species. The 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive water quality damage to critical habitat for piping plover. SA: Continued loss of barrier habitat and coastal wetlands resulting in loss of critical habitat (such as the gulf shoreline) for piping plover and other threatened or endangered species. The 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive water quality damage to critical habitat for piping plover. CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**). CWPPRA BA-40 riverine sand mining for Scofield Island restoration of 234 acres (**tables 5-3 and 5-5**) thereby providing important resources for piping plovers and sea turtles.	US: Continued institutional recognition of decline in threatened and endangered species and their critical habitat as National and state loss of species and their critical habitat continue. Potential weakening of Endangered Species Act especially with regard to critical habitat. LA: Continued loss of barrier habitat and coastal wetlands resulting in loss of critical habitat (such as the gulf shoreline) for piping plover. Construction of 2010 Deepwater Horizon oil spill protective sand berm provides undetermined long term impacts on sea turtles. SA: Continued loss of barrier habitat and coastal wetlands resulting in loss of critical habitat (such as the gulf shoreline) for piping plover and other threatened or endangered species. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island which could benefit sea turtles.	US & LA: Likely continue to institute individual species recovery plans to maintain or increase populations and their critical habitat. However, this would occur within a framework of continued loss of critical habitat. Potential weakening of Endangered Species Act especially with regard to critical habitat. Implementing the Recommended Plan/NER Plan would result in a comparatively small reduction, nationwide, to the loss critical habitat and threatened and endangered species. C5/S5 (Recommended Plan/NER Plan): would be likely to adversely impact piping plover and/or piping plover critical habitat; and would not adversely impact any other threatened or endangered species or their critical habitat. Recommended Plan/NER Plan would restore 684 net acres of barrier habitats, including critical habitat for piping plover. Construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island which could benefit sea turtles. CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**). CWPPRA BA-40 riverine sand mining for Scofield Island restoration of 234 acres (**tables 5-3 and 5-5**) thereby contributing important resources for piping plovers and sea turtles. C5: similar to Recommended Plan/NER Plan except a net total of 990 acres; Shell Island impacts similar to No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Historic & Cultural Resources	US, LA & SA: Historic & cultural resources subjected to natural processes and manmade actions. Institutional recognition via National Historic Preservation Act (and others).	US, LA & SA: Human activities as well as natural processes can potentially degrade and/or destroy historic and cultural resources. Restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) would potentially impact cultural resources; however, all efforts would be made to avoid, minimize and reduce potential adverse impacts.	US, LA & SA: Human activities as well as natural processes can potentially degrade and/or destroy historic and cultural resources. Restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) would potentially impact cultural resources; however, all efforts would be made to avoid, minimize and reduce potential adverse impacts. These restoration efforts could offset potential adverse impacts to cultural resources due to loss of 328,000 acres by 2050 (**tables 5-3**).	US & LA: Human activities as well as natural processes can potentially degrade and/or destroy historic and cultural resources. LA: Restoration of 641,804 acres by other Federal, State, local and private restoration efforts (see **table 5-3 and 5-4**) would potentially impact cultural resources; however, all efforts would be made to avoid, minimize and reduce potential adverse impacts. These restoration efforts could offset potential adverse impacts to cultural resources due to loss of 328,000 acres by 2050 (**tables 5-3**). C5/S5 (Recommended Plan/NER Plan): Recommended Plan/NER Plan would work synergistically with other restoration projects to provide critical and essential barrier headlands and islands, which, in turn, would provide some protection to cultural resources that may otherwise be damaged or lost due to coastal land loss. Recommended Plan/NER Plan impacts to cultural resources to restore 1,684 acres would be in addition to impacts to these resources with restoration of 641,804 acres by other Federal, State, local and private restoration efforts C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to No Action Alternative
Population	US, LA & SA: Increasing populations in coastal areas.	US & LA: Large population centers and employment and tourist activities. SA: Study area is remote and uninhabited.	US & LA: Increasing population in urban and suburban areas, retreating population in rural coastal areas as land loss continues. SA: Study area is remote and uninhabited.	US & LA: Increasing populations in urban and suburban areas, retreating population in rural coastal areas as land loss continues. C5/S5 (Recommended Plan/NER Plan): Study area is remote and uninhabited. C5: Study area is remote and uninhabited.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Infrastructure	US, LA & SA: Increasing infrastructure in the form of roads, bridges, pipelines, homes, and businesses.	US: Heavy concentration of infrastructure throughout coastal communities nationwide. LA: Heavy concentration of infrastructure in several parts of the state. SA: Infrastructure primarily oil and natural gas pipelines and shoreline protection along the Caminada Headland at Port Fourchon, as well as Bayou Lafourche and Empire jetties are at risk of damage and/or loss due to barrier land loss. Empire jetty continues to reduce longshore transport contributing to further land loss of Shell Island.	US: Heavy concentrations of infrastructure along coastal areas nationwide. LA: Increasing damage to coastal infrastructure, reduced development of infrastructure in areas nearest to coast; relocation of some existing infrastructure assets. SA: Existing conditions continue, with the effects of continued land loss and degradation leading to increased costs for maintaining and repairing existing infrastructure e.g. exposed pipelines, etc., as well as undetermined cumulative impacts to storm reduction by barrier system.	US & LA: Heavy concentration of infrastructure along coastal areas nationwide. Increasing damage to coastal infrastructure, reduced development of infrastructure in areas nearest to coast; relocation of some infrastructure assets. C5/S5(Recommended Plan/NER Plan): barrier restoration of the Caminada Headland and Shell Island in additive combination with other barrier restoration projects (see **tables 5-3 and 5-5**) would provide some undetermined level of protection to nearby infrastructure. Empire jetty continues to reduce longshore transport contributing to further land loss of Shell Island, as well as contribute to providing undetermined positive cumulative impacts to storm reduction by restored barrier system. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Commercial Fisheries	US, LA & SA: Increases in fisheries industry, due to advancing technologies and increased fishing pressure.	US, LA & SA: Regulation of fishing maintains a billion dollar industry. LA: Total of about 6,337 acres barrier habitat restored with beneficial use of dredged material (746 acres) and CWPPRA restoration projects (5,591 acres) contribute to various fishery habitats. 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 commercially important fishery species. The 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive water quality damage to marine and coastal habitats, Gulf's commercial and recreational fishing and tourism.	US: Some decline expected as vulnerability of habitat increases. More regulation would be necessary to maintain a sustainable industry. LA: Long-term impacts for 2010 Deepwater Horizon oil spill unknown and still under investigation. LA & SA: Severe decline as coastal land loss continues. Without implementation of Recommended Plan/NER Plan, loss of the barrier systems and coastal wetlands throughout coastal Louisiana in general, and the study area in particular, continue to adversely impact essential spawning, nursery, nesting, and foraging habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms.	US & LA: Decline in commercial fisheries expected as vulnerability of habitat increases. C5/S5 (Recommended Plan/NER Plan): Net total of 684 acres of transitional estuarine-marine habitats used for spawning, nursery, nesting, and foraging by commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms. This would be in addition to restoration of similar habitats by other barrier habitat restoration projects. Continued positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). Long-term impacts of the 2010 Deepwater Horizon oil spill unknown and still under investigation. C5: similar to Recommended Plan/NER Plan except a net total of 990 acres and Shell Island impacts similar to the No Action Alternative.
Employment and Income	US, LA: Increasing population in coastal areas. SA: The study area is remote and uninhabited with no populations; there is no employment or income bases except for commercial and recreational fisheries in nearby waters.	US & LA: Employment and income for coastal areas typically revolve around tourist activities, oil and gas exploration. SA: The study area is remote and uninhabited with no populations; there is no employment or income bases except for commercial and recreational fisheries in nearby waters.	US & LA: Increasing population in urban and suburban areas, retreating population in rural coastal areas as land loss continues. SA: The study area is remote and uninhabited with no populations; there is no employment or income bases except for commercial and recreational fisheries in nearby waters.	US & LA: Increasing populations in urban and suburban areas, retreating population in rural coastal areas as land loss continues. C5/S5 (Recommended Plan/NER PLAN): Study area is remote and uninhabited. The study area is remote and uninhabited with no populations; there is no employment or income bases except for commercial and recreational fisheries in nearby waters. C5: Study area is remote and uninhabited.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Oyster Leases	US: Only major oyster leasing program is in Louisiana. LA & SA: General increase in acreage leased, production limited by saltwater intrusion in areas with no freshwater introduction.	US: Only major leasing program is in Louisiana. LA: Leveling off of acreage leased, production limited by saltwater intrusion in areas with no freshwater introduction. Production limited in areas by mortality from over fresbening by diversions. SA: 182,399 acres of oyster leases throughout study area.	US: Only major leasing program is in Louisiana. LA & SA: Gradual loss of production from leases near gulf coast due to increased salinities. Increased production in areas nearer freshwater introductions.	US & LA: Only major leasing program is in Louisiana. C5/S5(Recommended Plan)/NER Plan): synergistic effect of implementing Recommended Plan/NER Plan with a net total of 684 acres of barrier habitats and additive combination of impacts and benefits for overall net acres restored by other Federal, state, local and private restoration efforts as summarized in **table 5-4**. C5: similar to Recommended Plan/NER Plan except a net total of 990 acres and Shell Island impacts similar to the No Action Alternative.
Oil, Gas, & Mineral	US, LA & SA: Increasing development of refineries, wells, and other oil and gas producing facilities and equipment.	US, LA & SA: Large investment in refineries, wells, and other oil and gas producing facilities and equipment. LA&SA: 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive water quality damage to marine and coastal habitats, Gulf's commercial and recreational fishing and tourism.	US, LA & SA: Increased damages to refineries, wells, and other oil and gas producing facilities and equipment; probable relocations of these assets. Construction of 2010 Deepwater Horizon oil spill protective sand berm provides undetermined long term impacts on offshore sands resources. LA: Long-term impacts for 2010 Deepwater Horizon oil spill unknown and still under investigation.	US & LA: Same as future without-project conditions, except implementation of the Recommended Plan/NER 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). C5/S5 (Recommended Plan/NER Plan): the cumulative impact of protecting both covered and exposed pipelines by providing an additional layer of soil protection, thereby increasing protection from future storm surges. Construction of 2010 Deepwater Horizon oil spill protective sand berm provides undetermined long term impacts on offshore sands resources. C5: similar to Recommended Plan/NER Plan, except Shell Island cumulative impacts similar to the No Action Alternative
Navigation	US, LA & SA: Increasing port facilities and inland waterways and traffic.	US, LA & SA: Large investment in port facilities and inland waterways and traffic.	US, LA & SA: Probable damages to and relocation of port facilities and inland waterways and traffic.	US & LA: Greater investment in port facilities and inland waterways (as compared to the without-project condition). ….. C5/S5 (Recommended Plan/NER Plan): cumulative impact on commercial and recreational vessel traffic by some undetermined level during construction on the Bayou Lafourche and the Empire Canal. Maintenance dredging of Bayou Lafourche would be beneficially used for placement of 650,000 CY of borrow material along Caminada Headland renourishment feeder berm. C5: similar to Recommended Plan/NER Plan, except Shell Island cumulative impacts similar to the No Action Alternative

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Flood Control	US, LA & SA: Construction of flood control levees, pump stations, and control structures.	US, LA & SA: Large investment in flood control levees, pump stations, and control structures.	US, LA & SA: Increased investment in flood control levees, pump stations, and other flood control facilities to prevent damage due to land loss.	US & LA: Reduced investment in flood control facilities (as compared to without-project conditions). C5/S5 (Recommended Plan/NER Plan): While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links. C5: similar to Recommended Plan/NER Plan except the Shell Island area cumulative impacts similar to the No Action Alternative.
Pipelines	US, LA & SA: Development of extensive network of oil and gas pipelines.	US, LA & SA: Large investment in extensive network of oil and gas pipelines; increasing damages to and some relocation of these assets.	US, LA & SA: Increased damages and probable relocations of pipeline assets due to continued coastal land loss.	US & LA: Increased damages and probable relocations of pipeline assets due to continued coastal land loss. C5/S5 (Recommended Plan/NER Plan): the cumulative impact of protecting both covered and exposed pipelines by providing an additional layer of soil protection, thereby increasing protection from future storm surges. C5: similar to Recommended Plan/NER Plan except the Shell Island area cumulative impacts similar to the No Action Alternative.
Hurricane Risk Reduction Levees	US and LA: Construction of hurricane risk reduction levees and pumping capacity. SA: No hurricane risk reduction levees within or nearby study area.	US, LA: Large investment in hurricane risk reduction levees and pumping capacity. SA: No hurricane risk reduction levees within or nearby study area.	US, LA: Increasing investment in hurricane risk reduction facilities to prevent damage due to land loss. SA: No hurricane risk reduction levees within nearby study area.	US & LA: Increasing investment in hurricane risk reduction facilities to prevent damage due to land loss. C5/S5 (Recommended Plan/NER Plan): No hurricane risk reduction levees within or nearby study area. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.
Agriculture	US, LA & SA: Not an issue.	US, LA & SA: Institutional recognition. LA: Saltwater intrusion, especially in Chenier Plain problem for rice farmers. SA: There are no agriculture activities in study area.	US: Continued institutional recognition. LA: Continued coastal land loss and saltwater intrusion reduces opportunities for agriculture. SA: Unlikely to have agriculture activities in study area.	US: Continued institutional recognition. Implementing the Recommended Plan/NER Plan would not impact agriculture endeavors. LA: Continued coastal land loss and saltwater intrusion reduces opportunities for agriculture. Implementing the Recommended Plan/NER Plan would not impact agriculture endeavors. All Alternatives: Unlikely to have agriculture activities in study area.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Forestry	US, LA & SA: Not an issue.	US: Institutional regulation of forest harvest practices. LA: Institutional regulation of forest harvest practices. Continued coast wide forest deterioration, especially swamp and fresh wetland forests. SA: There are no forestry activities in study area.	US: Continued institutional recognition; however, increasing human populations result in continued loss of forested areas and reduces forestry opportunities. LA: Continued land loss and saltwater intrusion reduces forestry opportunities. SA: Unlikely to have forestry activities in study area.	US & LA: Continued institutional recognition; increasing human population growth and continued demand for diminishing forestry resources and reduced forestry opportunities. Implementing the Recommended Plan/NER Plan would have little if any impacts on forestry. All Alternatives: Unlikely to have forestry activities in study area.
Water Supply	US, LA & SA: Not an issue.	US & LA: Significant investment in water supply facilities (treatment plants, pipelines, etc.). SA: There are no water supply facilities within the study area	US & LA: Significant investment in water supply facilities (treatment plants, pipelines, etc.). SA: There are no water supply facilities within the study area	US & LA: Continned institutional recognition; continued saltwater intrusion; continued industrial pollution; continued changes to hydrology that affect water supply to wetlands. All Alternatives: Unlikely to have forestry activities in study area.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Aesthetics	US, LA & SA: Generally not an issue until recent times. Institutional recognition via Wild and Scenic Rivers Act, Scenic Byways, and others. Technical recognition via 1988 USACE Visual Resources Assessment Procedure.	US & LA: Human population growth, development, and other human activities have the potential to destroy, enhance, or preserve visual resources. LA&SA: 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil cause extensive aesthetic impacts. SA: Visual quality decreasing as land loss continues. Without implementation of wetland creation and shoreline protection measures, continued bank line erosion and sloughing of the shoreline and conversion of existing fragmented wetlands to open water habitats would persist. Degradation of the land would convert existing view sheds of marsh, wetland, dune, and beach to more open water views. Continued positive impacts to aesthetic resources from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). Long-term impacts of the 2010 Deepwater Horizon oil spill unknown and still under investigation.	US, LA & SA: Continued human population growth and development and other human activities have the potential to destroy, enhance, or preserve visual resources. LA&SA: Gulf wide extensive adverse impacts to aesthetic resources due to 2010 Deepwater Horizon oil spill released about 4.9 million barrels would eventually be combined with extensive coastwide land loss. SA: By 2050, lose 3,750 acres from the Caminada Headland and all 386 acres of Shell Island would be lost by 2009 to 2027 thereby adversely impacting aesthetic quality. Continued positive cumulative impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of habitats at Pass Chaland to Grand Bayou Pass (**tables 5-3 and 5-5**) would offset these aesthetic impacts to some degree.	US & LA: 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. C5/S5 (Recommended Plan/NER Plan): The increase in land mass to the Caminada Headlands and Shell Islands East and West would increase visual quality and the potential for long term storm protection to coastal Louisiana, some habitat restoration for wildlife and fisheries which also play a vital role in the "living landscape" and provide scale to critical view sheds. Continued positive impacts to aesthetic resources from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). Long-term impacts for 2010 Deepwater Horizon oil spill unknown and still under investigation. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

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 Alternative and the Recommended Plan /NER Plan)
Recreation Resources	US, LA & SA: Generally not an issue until recent times.	US: Nation-wide recreation in coastal environments is related to hunting, fishing, wildlife viewing, water sports, and other similar pursuits. LA & SA: Widespread coastal land loss causes dramatic changes in availability of recreational opportunities. Coastal land loss results in more open water habitat thereby providing potential increased recreational fishing opportunities. However, the production of the fishery may likely decrease resulting in less quality recreational experience. The 2010 Deepwater Horizon oil spill released about 4.9 million barrels crude oil caused extensive adverse economic impacts to recreation industry. These impacts are moderated somewhat by positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**).	US, LA & SA: Potential loss of recreational resource base due to coastal land loss. Associated adverse cumulative impacts onto recreation-dependent businesses. SA: recreational opportunities decrease in quality due to continued land loss of Caminada Headland and Shell Island. Recreational opportunities are primarily associated with open marine waters. These impacts are moderated somewhat by positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**).	US & LA: Slowing or reversing land loss and coastal erosion may protect recreation resources. C5/S5(Recommended Plan/NER Plan): the synergistic interaction of the effects of implementing restoration with a net benefit of 684 acres over 50 years with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **table 5-4.** Impacts from Recommended Plan/NER Plan are synergistically enhanced by CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). C5: similar to the Recommended Plan/NER Plan except a net total of 900 acres and Shell Island impacts similar to the No Action Alternative.
Noise	US, LA & SA: Generally not an issue until recent times. Institutional recognition - Noise Control Act of 1972.	US, LA & SA: Nuisance noise generally associated with areas of human development and activities e.g., boats, airboats, and other human activities may cause disturbances to fish and wildlife in remote regions of the study area.	US, LA & SA: Continued human population growth & development, recreation activities, indnstry, and other human activities typically have some associated noise pollution. Further institutional recognition likely to be enacted.	US & LA: Continued human population growth & development, recreation activities, industry, and other human activities that typically have some associated noise pollution. Further institutional recognition likely to be enacted. Implementing the. C5/S5 (Recommended Plan/NER Plan): cumulative impacts primarily related to potential short-term disruption, during construction activities, of fish and wildlife species and additive combination with other similar Federal, state, local and private restoration activities. C5: similar to the Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

Table 5-2. Comparison of Cumulative Impacts.*

SIGNIFICANT RESOURCE	Past Actions (Historic Conditions)	Preseut Action (Existing Conditions)	Future Without-Project The No Action Alteruative	Cumulative Iupacts (Couparison of Future With Proposed Action Impacts for each Restoration Alternative and the Recommended Plan /NER Plan)
HTRW	US, LA & SA: Generally not an issue until recent times. Natural sources of HTRW supplanted by human-induced HTRW. Institutional recognition (1992) by USACE via ER 1165-2-132 Hazardous, Toxic, and Radioactive Waste (HTRW) Guidance.	US & LA: Continued human population growth and development, industry, and other human activities would typically have some HTRW associated with them. Further institutional recognition would likely be enacted. SA: Phase 1 investigation found no HTRW concerns.	US, LA & SA: Continued human population growth and development, industry, and other human activities would typically have some HTRW associated with them. Further institutional recognition would likely be enacted.	US & LA: 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. C5/S5(Recommended Plan/NER Plan): Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the potential for cumulative impacts to the project area from implementation of the Recommended Plan/NER Plan would be low and would likely continue to be low into the future. C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.
Air Quality	US, LA & SA: Generally not an issue until recent times. Institutional recognition of resource via Clean Air Act. General deterioration of air quality due to increases in human populations and industry.	US, LA & SA: Continued institutional recognition. Continued deterioration of air quality due to increases in human populations, industrial and motorized vehicle emissions. These impacts are moderated somewhat by positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**).	US, LA & SA: Continued deterioration of air quality due to increases in human populations, industrial and motorized vehicle emissions. These impacts are moderated somewhat by positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**).	US & LA: Continued deterioration of air quality due to increases in human populations, industrial and motorized vehicle emissions. C5/S5 (Recommended Plan/NER Plan): Cumulative impacts would primarily be related to direct air emissions during construction activities and would likely continue to be low into the future. These impacts are moderated somewhat by positive impacts from CWPPRA BA-38 restore 334 acres, BA-35 restore 263 acres of transitional estuarine-marine fishery habitats at Pass Chaland to Grand Bayou Pass as well as other restoration efforts (**tables 5-3 and 5-5**). C5: similar to Recommended Plan/NER Plan except Shell Island impacts similar to the No Action Alternative.

5.1 SOIL RESOURCES

5.1.1 The No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing the LCA BBBS Project, would not have any direct impacts on soil resources. Existing conditions would persist. Land loss at the Caminada Headland would likely continue at rates similar to present (annual average loss of 45 feet per year). The coastal Louisiana land loss model presented in the LCA PEIS (USACE 2004) indicates that with no intervention, the Caminada Headland would lose about 3,750 acres from the headland and approximately 14,780 acres from the area to the north (an area extending inland between Bayou Lafourche and Caminada Bay) between the year 2000 and 2050. Without any action, the soil resources at the Caminada Headland would likely be converted into shallow open water bottoms with only a skeletal framework of higher natural barrier ridges and canal spoil banks likely remaining by 2050.

Land loss at Shell Island would likely continue at rates similar to present with an annual average rate of loss of 38.5 feet per year (range of 8.0 feet to 101.5 feet per year). The coastal Louisiana land loss model presented in the LCA Study (USACE 2004) predicted that all 386 acres of Shell Island could be lost by 2009 to 2027, depending on which rate of land loss (short-term or long-term) was used. There are no wetlands located landward of Shell Island that could reasonably be indirectly influenced by Shell Island.

Scatlake series in the Caminada Headland area and Felicity series in the Shell Island area would be the soil types primarily affected. Net primary productivity within the project area would continue to decline and existing wetland vegetation would continue to diminish. The ongoing conversion of existing fragmented back marsh emergent wetlands to shallow open water would continue with associated indirect adverse impacts including: the degradation and loss of coastal vegetation resources; degradation and loss of fish and wildlife habitat and species that utilize these barrier resources; conversion of EFH to shallow open water EFH; loss of marsh-related recreation; degradation of aesthetic landscapes; and potential declines in socioeconomic resources related to barrier wetlands .

Other indirect impacts would include the loss of important and essential vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; loss of productivity; loss of transitional habitat between estuarine and marine environments; and increased inter- and intra-specific competition between resident and migratory fish and wildlife species for decreasing wetland resources. There would also be a reduction in the availability of important stopover habitats used by migrating neotropical birds.

Cumulative impacts of the projected loss of soil resources from the study area would be in addition to the projected loss of soil resources throughout coastal Louisiana due to the continuing loss of Louisiana's coastal barriers. The LCA Study (USACE, 2004) estimated 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. The LCA Study (2004) also 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. However, these wetland soil losses would be offset to some extent by other Federal, state, local, and private restoration efforts not only within the Pontchartrain and Breton Basins, but across coastal Louisiana (**Table 5-3**). In addition, more recent restoration efforts would also cumulatively interact to help offset losses of soil resources in the project area, including the following:

Table 5-3 Net Acres Created, Restored, and/or Protected by Other Federal, State, Local, and Private Restoration and Regulatory Permitting Mitigation Efforts.

	Subprovince 1 (acres)	Subprovince 2 (acres)	Subprovince 3 (acres)	Subprovince 4 (acres)	Totals (acres)
Breaux Act CWPPRA[1]	16,498	37,829	25,130	32,195	111,652
State	2,543	9,043	5,200	1,972	18,758
PCWRP	14	41	371	31	457
Mitigation Civil Works Projects	4,990	0	5,000	0	9,990
Mitigation Regulatory Permits[2]	6,411	3,199	2,635	2,983	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
CIAP[4]	unknown	unknown	unknown	unknown	unknown
Other[3]	0	2,000	50,000	3,226	426,132
TOTALS	47,218	86,406	91,417	45,867	641,804

Source: adapted from USACE (2004); 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." Permit mitigation is from the District's Regulatory Branch database. Civil works mitigation is from the District's files.

[1]CWPPRA (Breaux Act) acres are updated from the USACE New Orleans District's 2010 Task Force book. CWPPRA acreages are based upon 20-year project life; all other acreages are 50 years.

[2]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.

[3]Other is 50,000 acres (20,250 ha) of non-mitigation land bought in fee in the Atchafalaya Basin by the District. 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.

[4]CIAP (Coastal Impact Assistance Program) Louisiana has received funding for 69 projects as of April 2011.

Louisiana has lost approximately 1,900 square miles (492,097 ha) of coastal wetlands since the 1930s (Dunbar et al. 1992; Barras et al. 1994; Barras et al. 2003). Approximately 10 percent of Louisiana's remaining coastal wetlands would be lost at a rate of approximately 6,600 acres per year (2,672 ha per year) resulting in an additional net loss of 328,000 acres (132,794 ha) by 2050 (Barras et al. 2003).

Under the No Action Alternative, the loss of the Shell Island barrier system would likely result in the coalescence of Bastian Bay and Shell Island Bays, thereby allowing the high energy forces of the Gulf of

Mexico to directly impact the few remaining interior wetland soil resources adjacent to the Mississippi River. The loss of these soil resources would result in the loss of differentiation between the estuarine system and the open Gulf of Mexico. In addition, the loss of soil resources would directly and indirectly adversely impact EFH, unique wildlife habitat (e.g., nursery, nesting, feeding, and roosting habitats), and critical habitat for threatened and endangered species such as the piping plover. The loss of soil resources would adversely impact fish and wildlife habitat that would likely increase competition between and within various fish and wildlife species for diminishing habitat resources. The loss of vegetated wetlands would also result in a loss in primary productivity. Water bodies would grow larger and wave erosion would accelerate. The continued loss of soil resources would also adversely impact the coastal community of Port Fourchon by reducing the storm buffering effect of the coastal barrier system on tropical storms.

More recently the 2010 Deepwater Horizon oil spill necessitated construction of protective sand berms along portions of the Louisiana Gulf Coast. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system as of April 4, 2011.

5.1.2 Future With-Project Conditions

5.1.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.1.2.1.1 Direct Impacts

Compared to the No Action Alternative, implementing the Recommended Plan/NER Plan would restore a total of 2,849 acres (1,153 ha) of soil resources including 2,066 acres (836 ha) of Scatlake series on the Caminada Headland and 783 acres (317 ha) of Felicity series on Shell Island **(Table 5-4)**. Shell Island would be restored as a single island with a total of 783 acres. This would include 317 acres of beach/dune and 466 acres of marsh on Shell Island.

Table 5-4 Acres of habitats restored and volume of borrow material for each alternative.

Alternative	Caminada Dune and Supratidal	Caminada Marsh (bayside intertidal)	Shell Island Dune and Supratidal	Shell Island Marsh (bayside intertidal)	Total Acres	Caminada/ Shell Island (C/S) Net Acres	AAHUs
C5/S5 (RECOMMENDED PLAN/NER PLAN)	880	1186	317	466	2849	(990/694) 1,684	1,718.9
C5	880	1186	N/A	N/A	2066	990	988.3

Notes:
Caminada 5 with renourishment
Shell Island 5: Dune and Marsh re-nourishment years 20 and 40. Single island restoration.

5.1.2.1.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing the Recommended Plan/NER Plan would be the restoration of a net total of 1,684 acres (681ha) of barrier soils over the 50-year period of analysis; including 990 acres (400 ha) of Scatlake series on the Caminada Headland and 694 net acres (281 net ha) of Felicity series on Shell Island (**Table 5-4**). Implementing the Recommended Plan/NER Plan would restore soil resources thereby reducing the net loss of soil resources from the Barataria barrier system. Borrow sediments used for barrier restoration would be subjected to biogeochemical processes, that would, over time, begin to more closely resemble the Scatlake and Felicity soils that they would be covering.

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland. Re-nourishment material would be placed uneonfined at approximately 100 to 300 feet from the existing shoreline in a "feeder berm" thereby allowing longshore transport and wave action to move and redistribute the sediment along the headland both to the east and the west. GENESIS simulations of the Caminada Headland shoreline change analysis without and with the re-nourishment feeder berm indicate that at the end of the 2-year period the feeder berm diffuses to the east and west of its initial placement by approximately 2,000 feet. Lateral diffusion will occur relatively quickly reducing the density of the feeder berm along the placement area.

Restoration of Shell Island as a single island would more closely follow the historic single island geomorphic configuration. In addition, although the Barataria barrier system is no longer in the prograding, sediment rich, portion of the deltaic cycle, re-nourishment of Shell Island would mimic the natural episodic barrier island re-nourishment of earlier historic times.

Other indirect impacts would be a net increase in barrier vegetation resources and the re-establishment of transitional habitat, between estuarine and marine environments, thereby providing important and essential fish and wildlife habitat used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The *in situ* soil resources at the borrow sites would continue to be subjected to natural (e.g., high energy Mississippi River, estuarine and marine forces) and man-made influences (e.g., navigation, dredging, oil and gas exploration and removal). The addition of soil resources to the sediment-starved Barataria barrier system would increase the opportunity for re-establishment of coastal vegetation that would increase the likelihood for soil accretion (Nyman et al. 1993). The interior wetland loss rate would be expected to decrease by about 50 percent with the added soil stability derived from a more contiguous wetland (Louisiana Coastal Wetlands Conservation and Restoration Task Force, 2006). The borrow areas (Mississippi River, Caminada and Empire near shore, and Ship Shoal) water bottoms would be re-colonized and continued to be utilized by benthic organisms.

5.1.2.1.3 Cumulative Impacts

Cumulative impacts would be the synergistic interaction of the effects of implementing the Caminada Headland and Shell Island restoration with a net benefit of 1,684 acres (681 ha) over 50 years with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-5**. Coastal barrier land loss in Louisiana has been addressed, to some degree, by efforts under CWPPRA program, and the beneficial use of dredged material requirements under Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 *et. seq* (**Table 5-5**).

Table 5-5. Other Barrier Island, Shoreline, Headland, and Back Barrier Marsh Restoration Efforts Constructed or Authorized for Construction.

Project Name	Acres
Beneficial Use for Barrier Island Restoration[1]	
Breton Island	51.5
Grand Terre	211.4
Wine Island	27.3
Beneficial Use for Shoreline/Beach Nourishment Restoration[2]	
Bayou Lafourche/Port Fourchon	Unknown
Freshwater Bayou	Unknown
Mermentau River	Unknown
Beneficial Use for Creation of Bird Islands[3]	
Atchafalaya River	299.0
Baptiste Collette	130.6
Queen Bess Island	25.8
Subtotal Beneficial Use Acres	**745.6**
CWPPRA Barrier Island Restoration[4]	
Barataria Barrier Island: Pelican Island and Pass La Mer to Chaland Pass (BA-38)	334.0
Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration (BA-35)	263.0
Riverine Sand Mining/Scofield Island Restoration (BA-40)	234.0
East Timbalier Island Sediment Restoration Phase 1 (TE-25)	1,913.0
East Timbalier Island Sediment Restoration Phase 2 (TE-30)	215.0
Isles Dernieres Restoration East Island (TE-20)	9.0
Isles Dernieres Restoration Trinity Island (TE-24)	109.0
New Cut Dune and Marsh Restoration (TE-37)	102.0
Ship Shoal: Whiskey West Flank Restoration (TE-47)	195.0
Timbalier Island Dune and Marsh Restoration (TE-40)	
Vegetative Plantings- Timbalier Island Planting Demonstration (TE-18)	
Whiskey Island Back Barrier Marsh Creation (TE-50)	272
Whiskey Island Restoration (TE-27)	1,239
Subtotal CWPPRA Acres	**5,158**
TOTAL ACRES	**59,036.6**

[1] These acres are current up to December 2004, and represent a combination of beach, backmarsh, high marsh, and scrub/shrub all of which are classified by the USACE Operations Division as barrier island habitat (personal communication, 2006, Ed Creef, USACE, Operations Division).
[2] Acreages are not easily tallied as water levels and wave erosion alter any counting efforts on a month-to-month basis. A proper estimation of acreage accrued/lost would require a GIS effort, for which there has been no funding in the past several years (personal communication, 2006, Ed Creef, USACE, Operations Division).
[3] These acres are current up to December 2004, Bird island habitat types are similar to that for barrier islands - a combination of habitat types (personal communication, 2006, Ed Creef, USACE, Operations Division).
[4] Acres are accurate as of December 2010 and account for a project life of 20 years.

Until recently, the largest single source of coastal restoration funding in Louisiana was the Federal-state partnership known as the CWPPRA program, also known as the Breaux Act. The CWPPRA program has dedicated an average of $50 million annually since 1990 to more than 147 restoration projects creating restoring or sustaining approximately 52,000 acres of coastal Louisiana wetlands (Belhadjali and Stead 2003). The CWPPRA program has recently been reauthorized to the year 2019. Thirteen barrier habitat restoration projects and one demonstration project have been authorized for construction or have been

constructed to date. However, current spending under the CWPPRA program constitutes less than 10 percent of the funding required to sustain coastal Louisiana (LCWTF 1998). The widespread land loss associated with Hurricanes Katrina and Rita (2005) may influence the Federal interest for providing the funding (estimated at $14.5 billion) necessary for sustaining coastal Louisiana.

Pursuant to Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 et. seq., the USACE MVN has beneficially used material dredged for navigation channel maintenance to restore or create approximately 745.6 acres of barrier habitats (**Table 5-5**). The Coastal Zone Management Act requires "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with state approved management programs." Guideline 4.2 of the Coastal Zone Management Act states:

> *Spoil shall be used beneficially to the maximum extent practicable to improve productivity or create new habitat, reduce or compensate for environmental damage done by dredging activities, or prevent environmental damage. Otherwise, existing spoil disposal areas or upland disposal shall be utilized to the maximum extent practicable rather than creating new disposal areas.*

However, funding for maintenance of navigational channels has decreased over the past several years and these trends are likely to continue into the future resulting in less dredged material available for beneficial use (personal communication Mr. Ed Creef, USACE, Operations Division).

Passage of the Water Resources Development Act of 2007 (WRDA 2007; Sections 7001 through 7016) authorized approximately $2 billion for implementation of the LCA Plan of coastal restoration projects, investigations, and programs that would positively impact soil resources as well as other natural resources throughout coastal Louisiana.

Projects and programs authorized over a 10-year period:

- Science and Technology Program, $100 million
- Demonstration Projects, $100 million

Five Initial (Near Term) projects, $828 million

- MRGO Environmental Restoration - $105.3 million
- Small Diversion at Hope Canal - $68.6 million
- Barataria Basin Shoreline Protection - $242.6 million
- Small Bayou Lafourche Reintroduction - $133.5 million
- Medium Diversion at Myrtle Grove - $278.3 million

Beneficial Use of Dredge Material, $100 million

Ten Additional Projects:

- Maintain Landbridge between Caillou Lake and the Gulf of Mexico
- Stabilize Gulf Shoreline at Point Au Fer Island
- Modification of Caernarvon Diversion
- Modification of Davis Pond Diversion
- Multipurpose Operation of Houma Navigational Canal Lock
- Terrebonne Basin Barrier Shoreline Restoration
- Small diversion at Convent / Blind River
- Amite River Diversion Canal Modifications
- Medium Diversion at White's Ditch
- Convey Atchafalaya River Water to Northern Terrebonne Marshes

More recently, construction of the 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island.

A summary comparison of cumulative impacts for soil resources, as well as all other significant resources, is presented in **Table 5-2**. The cumulative impact analysis follows 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," (CEQ 1997) and includes:

1. A spatial and geographic component of the potential impacts within the continental United States [US], Louisiana [LA], and the study area [SA].
2. A temporal component of past, present, no action (Future Without-Project Conditions), and Future With-Project Conditions for all alternatives in the final array carried over for detailed comparison, including the Recommended Plan/NER Plan.

5.1.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.1.2.2.1 Direct Impacts

Compared to the No Action Alternative, implementing alternative C5 would restore a total of 2,066 acres (836 ha) of Scatlake series on the Caminada Headland (**Table 5-4**). There would be no restoration of Shell Island.

5.1.2.2.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5 would be the restoration of a net total of 990 acres (400 ha) of Scatlake series barrier soils over the 50-year period of analysis on the Caminada Headland. Other indirect impacts to the Caminada Headland would be similar to those described for the headland under alternative C5/S5 (Recommended Plan/NER Plan) (**Table 5-4**). However, indirect impacts to Felicity series soils on Shell Island would be similar to those described under the No Action Alternative.

5.1.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 (see also **Table 5-2**) would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: the synergistic interaction of the effects of implementing the Caminada Headland restoration with a net benefit of 990 acres (400 ha) (**Table 5-4**) over the 50-year project period of analysis with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-5**. The cumulative impacts to Shell Island would be similar to those described under the No Action Alternative.

5.2 OFFSHORE, NEARSHORE, AND RIVERINE SAND RESOURCES

5.2.1 No Action Alternative (Future Without-Project Conditions)

Under the No Action Alternative, not implementing coastal barrier system restoration, existing conditions would persist. There would be no direct impacts on offshore, nearshore, or riverine sand resources. The offshore sand shoals at Ship Shoal would remain under the jurisdiction of BOEMRE and any human actions impacting this area would require a permit from BOEMRE. Under the No Action Alternative

offshore sand resources would not likely be impacted by similar restoration efforts. The distances involved with removal of offshore sands for use in coastal restoration or other related civil work projects are generally considered too great to be cost-effective for use in any but the largest coastal restoration activities or other equally large engineering endeavors.

In contrast, increasing demands for oil and gas would likely accelerate the exploration and extraction activities for these commodities thereby directly and indirectly impacting these offshore sand resources. It is also likely that Ship Shoal would continue to mitigate the adjacent wave field off the Louisiana coast, particularly during storm conditions (Stone et al. 2004). The interaction of fair weather waves with Ship Shoal would also likely continue to be negligible.

The Caminada Headland and Shell Island (Empire sand body) nearshore sand bodies would likely continue to be subjected to dredging or other sand extraction activities as well as oil and gas exploration and extraction. Because of their close proximity to the mainland, nearshore sand bodies would likely be dredged and utilized for coastal restoration efforts as well as for other civil works projects such as hurricane and flood risk reduction. Potential direct impacts of these activities include: turbidity plumes associated with dredging, removal of substrate, reduction in elevation of the seabed, and exposure of underlying layer with different characteristics (grain size, reduced dissolved oxygen levels and compaction); elevated levels of suspended inorganic and organic solids; creation of depressions, furrows, and pits could have an impact on the benthic community (after Nairn et al. 2004). Potential indirect impacts of dredging include: alterations in the wave transformation pattern, changing waves that reach the shore, and changing erosion and accretion processes affecting shoreline change; potential impacts to nekton such as impairment or retardation of respiration due to clogging of gill cavities; reduced ability of visual predators to capture prey; and feeding impairment (after Nairn et al. 2004).

Mississippi River sand resources would likely continue to be regularly utilized for civil works projects, coastal restoration, construction, and other purposes. Existing dams, reservoirs, and other upstream structures, as well as continued soil conservation practices, would likely continue, resulting in decreased riverine sediments that would replenish riverine sediment borrow sites. Potential direct and indirect impacts would be similar to those described previously, but within a freshwater riverine system.

Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. Construction of about 36,388 lf of protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 4.2 million CY of sediment resources into the sediment-starved Barataria barrier island system, especially near Shell Island.

Cumulative impacts of the No Action Alternative to borrow areas would be the continued persistence of existing conditions.

5.2.2 Future With-Project Conditions

5.2.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.2.2.1.1 Direct Impacts

Compared to the No Action Alternative, implementing Alternative C5/S5 (Recommended Plan/NER Plan) would directly impact a total of 1,409 acres of Gulf of Mexico and Mississippi River water bottoms

by removing a total of 22,786,100 CY of sand resources for use as borrow material. Impacts would include removal of 5,100,000 CY of borrow from 315 acres of Ship Shoal; removal of 5,360,000 million CY from 334 acres of Caminada Headland nearshore borrow site; removal of 8,635,700 million CY from 534 acres of Mississippi River borrow site; and removal of 3,650,400 CY from 226 acres from the Empire nearshore borrow area (**Table 5-5**).

Table 5-6. Borrow sites acres of waterbottoms impacted; assumed borrow depth of 10 feet.

Alternative (beach/dune or marsh restoration)	Borrow Volume (CY)	Borrow Depth (feet)	Acres of Waterbottoms Impacted
C5			
- Ship Shoal (beach/dune)	5,100,000	10	315
- Caminada Offshore (marsh)	5,360,000	10	334
- Mississippi River (beach/dune)	0	10	0
- Empire (marsh)	0	10	0
C5/S5			
- Ship Shoal (beach/dune)	5,100,000	10	315
- Caminada Offshore (marsh)	5,360,000	10	334
- Mississippi River (beach/dune)	8,635,700	10	534
- Empire (marsh)	3,650,400	10	226

Other direct impacts would include: turbidity plumes associated with dredging, reduction in elevation of the seabed and river bottoms, exposure of the underlying sediment layer with different characteristics (grain size, reduced dissolved oxygen levels and compaction); elevated levels of suspended inorganic and organic solids; creation of depressions, furrows, and pits could impact on the benthic community (Nairn et al. 2004). Direct impacts of dredging the Bayou Lafourche navigation channel are described in the 1994 final EIS (USACE 1994).

5.2.2.1.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5/S1 (Recommended Plan/NER Plan) would primarily be related to dredging and other construction activities associated with the removal of offshore, nearshore, and riverine borrow material. Operating dredging plants within the Mississippi River could potentially cause some interference or slowdown of Mississippi River navigation traffic. However, the USACE has had many years of experience in dredging activities along the Mississippi River and has developed dredging operation and management techniques to avoid, minimize, and reduce the potential of interference or slowdown of river navigation traffic. Dredging borrow from the Mississippi River would change river water bottoms topography and remove sediments from this riverine system. However, the Mississippi River is a highly dynamic system and sediments are typically transported from upstream during annual flooding events. The construction of levees along the Mississippi River has reduced the amount of sediment-laden waters that would typically flood and nourish the deltaic wetlands during high water (spring) flood events. Consequently, sediments from the Mississippi River are now constrained within the river and shunted off into the deeper Gulf of Mexico waters. The proposed action would replicate, to some extent, the pre-levee wetland-building and nourishment functions of sediment-laden flood waters.

Indirect impacts of dredging the Bayou Lafourche navigation channel are described in the 1994 final EIS (USACE 1994). Dredging for offshore and nearshore sand resources in Gulf of Mexico water bottoms

and placement of 10 million CY of borrow material for renourishment of the Caminada Headland could potentially change erosion and accretion processes that could potentially affect wave dynamics and shoreline rates of change. However, the borrow sites for offshore and nearshore sand resources are located greater than 3,000 feet from the existing shoreline and would likely have little, if any, impacts on wave dynamics or shoreline rates of change. Other potential indirect impacts, also primarily related to dredging activities, would be impacts to nekton and benthic organisms. Dredging activities and associated increases in suspended sediments could likely include impairment or retardation of respiration due to clogging of gill cavities; reduced ability of visual predators to capture prey; and feeding impairment (after Nairn et al. 2004). However, more mobile aquatic organisms could escape these potential impacts. These potential impacts would be of short term and conditions would return to ambient following construction.

Potential impacts of small scale sand mining on biological and physical interactions, such as EFH, have been investigated by several researchers including Kobashi and Stone (2009); Gelpi et al., (2009); Dubois et al., (2009); and Stone et al. (2009). Kobashi and Stone (2009) indicate substantial scientific uncertainties still exist as to whether and how significant depth changes (i.e. sand mining), sediment size and composition affect shoal bio-physical interactions as well as benthic biological habitats. Kobashi and Stone (2009) and Kobashi et al. (2009) conclude that large-scale sand mining that causes abrupt changes in bathymetry would have a profound impact on shoal physical and biological processes and is not recommended. Whereas small scale sand mining (e.g., removal of about 5 million CY of sands for restoration of the Caminada Headland), is expected not to cause significant adverse impacts on the physical or biological processes. These researchers caution, however, that post-mining monitoring is crucial as substantial scientific uncertainties still exist.

5.2.2.1.3 Cumulative Impacts

Compared to the No Action Alternative, cumulative impacts would be the synergistic effects of removing a total of 22,786,100 CY of sand resources from a total of 1,409 acres of Gulf of Mexico and Mississippi River water bottoms for construction of Alternative C5/S5 (Recommended Plan/NER Plan). Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system.

These impacts would be in addition to the incremental impacts associated with the removal of offshore, nearshore and riverine sand resources for construction of other barrier restoration projects (see **Table 5-5**).

5.2.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.2.2.2.1 Direct Impacts

Compared to the No Action Alternative, implementing alternative C5 would directly impact a total of 649 acres of Gulf of Mexico and Mississippi River water bottoms by removing a total of 10,500,000 CY of sand resources for use as borrow material. Impacts would include the removal of 5,100,000 CY of borrow from 315 acres of Ship Shoal and removal of 5,360,000 CY from 334 acres of the Caminada Headland nearshore borrow site. This alternative would not provide any restoration features for Shell Island (**Table 5-6**). Other direct impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan).

5.2.2.2.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan), except this alternative would not provide any restoration features for Shell Island. A smaller area (649 acres) of Gulf of Mexico and Mississippi River water bottoms would be impacted by the removal of only 10,500,000 CY of sand resources, resulting in fewer indirect impacts.

5.2.2.2.3 Cumulative Impacts

Compared to the No Action Alternative, cumulative impacts would be the synergistic effects of removing a total of 10,500,000 CY of sand resources from a total of 649 acres of Gulf of Mexico and Mississippi River water bottoms for construction of alternative C5. These impacts would be in addition to the incremental impacts associated with the removal of offshore, nearshore, and riverine sand resources for construction of other barrier restoration projects (see **Table 5-5**).

5.3 BARRIER SYSTEMS: BARRIER SHORELINES, HEADLANDS, AND ISLANDS

5.3.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on barrier systems. Existing conditions would persist. However, without implementation of the proposed coastal barrier system restoration, the Caminada Headland and Shell Island barrier systems would likely continue to loss land at rates similar to present with a projected loss of 3,750 acres from the Caminada Headland and 386 acres from Shell Island by 2050. Continued fragmentation and loss of the Caminada Headland and Shell Island barrier systems would further accelerate interior coastal wetland loss and conversion of interior wetlands to open water. The loss of Shell Island would likely result in the coalescence of Bastian and Shell Island Bays and connect directly to the Gulf of Mexico. However, this coastal land loss would be moderated, to some extent, by restoring approximately 6,336 acres of barrier habitats that have been constructed or are authorized for construction through actions by the CWPPRA and USACE program of beneficial use of dredged material (see **Table 5-2**).

Under the No Action Alternative the loss of the Caminada Headland and Shell Island barrier system would also adversely impact (indirectly) critical habitat for the threatened piping plover as well as important habitats for other threatened and endangered species including sea turtles and the brown pelican. Portions of the Caminada Headland barrier shoreline is designated by the USFWS as critical wintering habitat for the threatened piping plover (*Federal Register*, Vol. 66, No. 132). Continued loss of critical wintering habitat would adversely impact the recovery of the piping plover. Similarly, barrier shoreline foraging and haul-out areas commonly utilized by sea turtles would be lost (http://www.dec.state.ny.us/website/dfwmr/wildlife/endspec/atrifs.html). The Caminada Headland and Shell Island barrier systems provide foraging habitats for migratory birds and other wildlife (personal communication USFWS letter dated June 15, 2005), as well as EFH, including spawning, nursery, nesting, and foraging habitats, for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms (personal communication NMFS, June 15, 2005). The loss of these barrier systems would adversely impact these species and their habitats.

The loss of these barrier systems would also adversely impact the extraordinary scenic, scientific, recreational, natural, historical, archeological, cultural, and economic importance of the barrier system. In addition, 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 related structures in this "working coast."

More recently, construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system as well as provide protection for adjacent estuaries and creation of barrier island-like sand berm habitats.

5.3.2 Future With-Project Conditions

5.3.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.3.2.1.1 Direct Impacts

Compared to the No Action Alternative, implementing Alternative C5/S5 (Recommended Plan/NER Plan) would restore a total of 2,849 acres on the Caminada Headland and Shell Island. A total of 2,066 acres, including 880 acres of dune and 1,865 acres of marsh, would be restored on the Caminada Headland. Shell Island would be restored as a single island with a total of 783 acres. This would include 317 acres of beach/dune and 466 acres of marsh on Shell Island. Other direct impacts would be use of approximately 8,635,000 CY of borrow material from the Mississippi River to restore the dune system and approximately 3,650,400 CY of borrow from the near shore Empire borrow site would be used for marsh restoration on Shell Island. In addition, there would be two re-nourishments of Shell Island at 20 years and 40 years post-initial construction.

5.3.2.1.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be the restoration of a net total of 1,684 acres of barrier headlands and islands over the 50-year period of analysis; including 990 net acres (400 ha) on the Caminada Headland and 1,684 net acres on Shell Island .

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland over each 10 year period for a total estimated 39 million CY over the 50-year period of analysis. Re-nourishment material would be placed unconfined at approximately 100 to 300 feet from the existing shoreline in a "feeder berm" thereby allowing longshore transport and wave action to move and redistribute the sediment along the headland both to the east and the west. GENESIS modeling simulations of the Caminada Headland shoreline change analysis without and with the re-nourishment feeder berm indicate that at the end of the 2-year period the feeder berm diffuses to the east and west of its initial placement by approximately 2,000 feet. Lateral diffusion will occur relatively quickly reducing the density of the feeder berm along the placement area.

Barrier system restoration, including interior marsh restoration features, 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. This would have an undetermined, likely minimal, if any impact on retarding saltwater intrusion into more northern portions of the Barataria Basin. Restoration of the Caminada Headland and Shell Island would provide an undetermined level of natural storm buffering, reduction of storm surge heights, and would provide protection for the interior wetlands, bays, and estuaries. Restoration of the Caminada-Moreau Headland would provide an undetermined level of protection for the oil and gas pipeline infrastructure and their landfall sites, especially for the nationally significant LOOP facility. In addition, the restoration of Shell Island as one contiguous island would mimic the historic geomorphic configuration of the island.

Restoration of the Caminada-Moreau Headland and Shell Island would provide an undetermined level of support to the commercial and recreational resources 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 millions of cubic feet of natural gas into continental Unites States. Belle Pass is the entrance to Bayou Lafourche and Port Fourchon, one of the largest and fastest growing oil and gas ports in the Gulf of Mexico.

Additional indirect impacts would include:

- Restore critical piping plover shoreline habitat;
- Restore the beach ecotone (i.e., the transition zone between the land and sea);
- Restore important estuarine and marine transitional EFH; 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 Louisiana 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.

5.3.2.1.3 Cumulative Impacts

Compared to the No Action Alternative, cumulative impacts would be the synergistic effects of restoring a net total of 1,684 acres of barrier headlands and islands within the Barataria Basin barrier system over the 50-year period of analysis. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system as well as construct barrier island-like habitats. These impacts would be in addition to the incremental impacts associated with the restoration of other Louisiana barrier systems (see **Table 5-5**). These potential gains in barrier system restoration would be 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.

5.3.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.3.2.2.1 Direct Impacts

Compared to the No Action Alternative, direct impacts of implementing alternative C5 would include restoration of a total of 2,066 acres on the Caminada Headland. Shell Island would not be restored. Approximately 880 acres of dune and 1,186 acres of marsh would be restored on the Caminada Headland. Other direct impacts would be similar to those described for restoration feature C5 within alternative C5/S5 (Recommended Plan/NER Plan).

5.3.2.2.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) restoring a total of 2,066 acres on the Caminada Headland. Shell Island would not be restored. A total of 2,066 acres, including 880 acres of dune and 1,186 acres of marsh, would be restored on the Caminada Headland. Other direct impacts would be similar to those described for restoration feature C5 within alternative C5/S5 (Recommended Plan/NER Plan).

Compared to the No Action Alternative, indirect impacts of implementing alternative C5 would be the restoration of a net total of 990 acres of Caminada-Moureau Headland over the 50-year period of analysis. The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland for a total estimated 39 million CY over the 50-year period of analysis. Re-nourishment material would be placed unconfined at approximately 100 to 300 feet from the existing shoreline in a "feeder berm" thereby allowing longshore transport and wave action to move and redistribute the sediment along the headland both to the east and the west. GENESIS simulations of the Caminada Headland shoreline change analysis without and with the re-nourishment feeder berm indicate that at the end of the 2-year period the feeder berm diffuses to the east and west of its initial placement by approximately 2,000 feet. Lateral diffusion will occur relatively quickly reducing the density of the feeder berm along the placement area. All other indirect impacts would be similar to those described for restoration feature C5 in alternative C5/S5 (Recommended Plan/NER Plan).

5.3.2.2.3 Cumulative Impacts

Compared to the No Action Alternative, cumulative impacts would similar to those described for the C5 restoration feature in alternative C5/S5 (Recommended Plan/NER Plan) and would include the synergistic effects of restoring a net total of 990 acres of barrier headlands and islands within the Barataria Basin barrier system over the 50-year period of analysis. These impacts would be in addition to the incremental impacts associated with the restoration of other Louisiana barrier systems (see **Table 5-5**).

5.4 COASTAL PROCESSES AND HYDROLOGY

5.4.1 Coastal Processes

5.4.1.1 No Action Alternative (Future Without-Project Conditions)

The natural and human-induced land loss processes on Shell Island and the Caminada Headland would likely continue at the present rates. Marine influences and tropical storm events would be the primary factors affecting land loss of these features. 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. 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.

Shell Island Bay, north of the Shell Islands reach, is nearly open into the adjacent Bastian Bay **(Figure 5-2).** A single hurricane event may trigger the collapse of the interior bay system. A direct hurricane or tropical storm impact can be expected in less than 7 years. Complete opening of the bays double open water and fetch within these bays, decreasing their ecologic value. North of Bastian Bay, only a few marsh islands and small ridges separate it from the much larger Adams Bay. Coalescence of the three bays would continue and accelerate without this project. Without the project, a large sound would develop between Empire and the Gulf of Mexico. This sound would have a profound impact on the entire region. Ecologic changes would occur and storm surges would increase, thus requiring greater levels of flood and wave erosion protection.

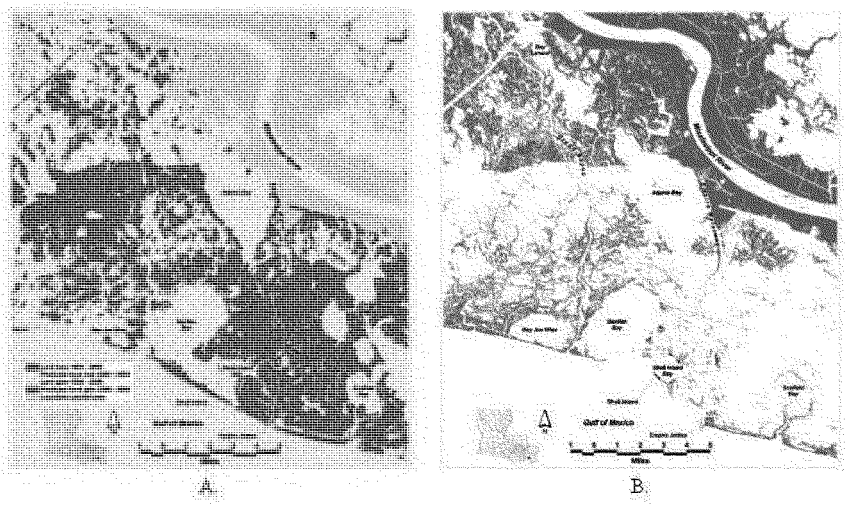


Figure 5-1. Shell Island Reach Land Loss (USGS 2004)

Figure 5-1 illustrates extreme land loss in this area and the 1,770 acres of land that are projected to be lost in the next 50 years north of the Shell Island Reach. This area is bounded by the north shore of Adams Bay on the north, the Shell Island Reach on the south, Grand Bayou on the west, and the Empire Waterway on the east. This area is approximately 22,000 acres in size. The window of time available is uncertain since the next direct strike of a hurricane cannot be predicted, but if barrier island restoration bypasses the window, the post-storm restoration would be for an entire bays system rather than a few miles of barrier island.

The Caminada Headland has some of the highest shoreline erosion rates in Louisiana. Without human intervention the Caminada Headland could fragment within the next 5 years to 20 years and transgress to a detached chain of three or more barrier islands. It would be much like the condition we now find at Shell Island, with equal or greater ecological consequences. As the headland fragments into islands, it would provide less protection to marshes to the north.

Bay Marchand, a small historic bay adjacent to Belle Pass, is now part of the Gulf of Mexico due to shoreline retreat. A similar fate is occurring to nearby Bay Champagne **(Figure 5-2)**. Over the last 100 years erosion has averaged about 45 feet per year. From the 1970s to 1988 it also averaged about 45 feet per year. Then, from 1989 to 2002, the rate was only 9 feet per year. However, in 2003, Tropical Storm Bill eroded the beaches back as far as 60 feet to 80 feet. Since Louisiana is impacted by tropical storms and hurricanes once every 1.2 years, it is likely that the 40+ feet per year erosion would continue. Thus, for this report, the 45 feet per year rate from the 1970s to 1988 would be used.

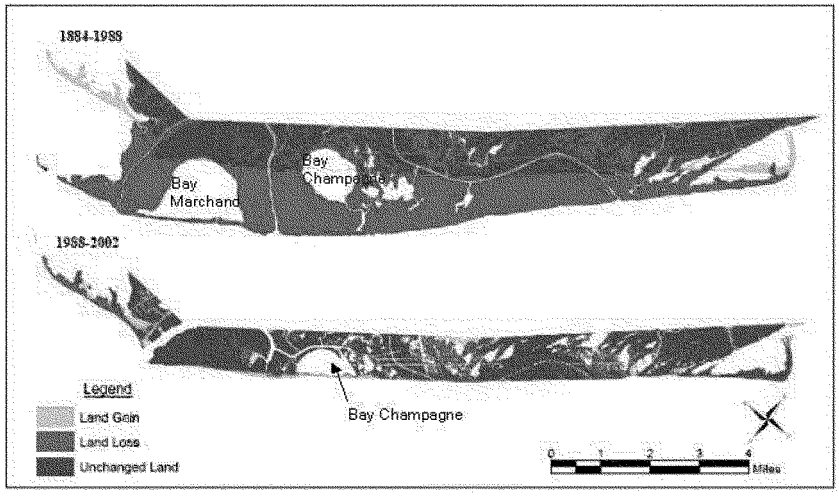


Figure 5-2. Map of the Caminada Headland illustrating historic land losses from 1884 to 1988 and 1988 to 2002. Note complete loss of Bay Marchand by 1988 and the continued loss of Bay Champagne by shoreline erosion.

An important factor in the retreat of the Caminada Headland is the existence of the Chevron canal **(Figure 5-3)**. This canal is approximately 1,200 feet from the shoreline. If no action is taken and shoreline erosion continues, the beach would reach this canal. When this happens the sand of the shoreline would fall into the canal, which is what has happened at Shell Island. At this point, the barrier shoreline ceases to function as a barrier and recession rates would increase dramatically. Using the average shoreline recession of 45 feet per year, this could occur in about 27 years (or far sooner if a near-miss or direct hit from a hurricane occurs). When the shoreline reached the canal at Shell Island, the recession rate jumped seven-fold from 20 feet per year to 138 feet per year. It is unlikely that such a dramatic increase would occur at Caminada Headland since there is much less open water behind the Chevron canal than there was at Shell Island. However, in 30 years there will be much more open water than there is now. It is probable that the increase would be about half of what was seen at Shell Island. This means that the rate would jump to 132 feet per year and thus, in 50 years, the shoreline could well be 4,200 feet inland from where it is now, just assuming a linear erosion rate.

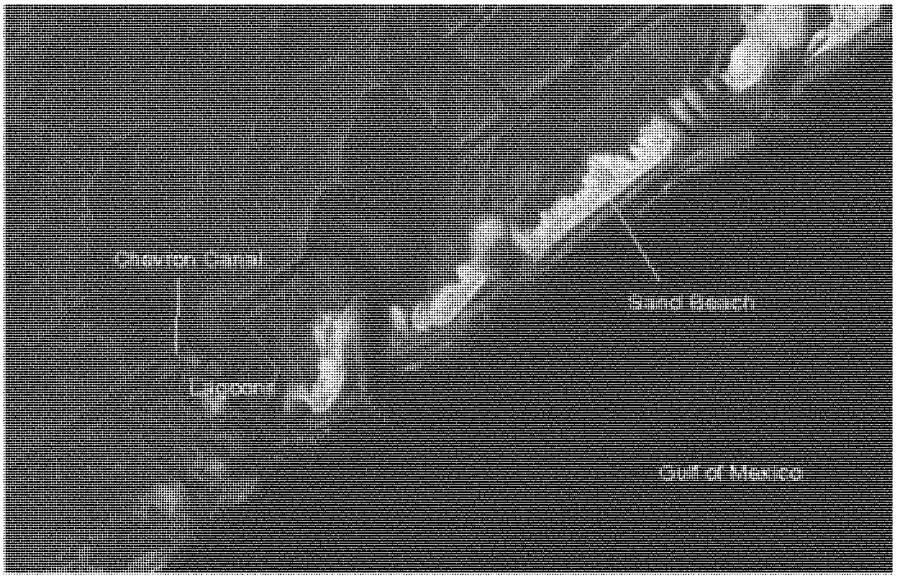
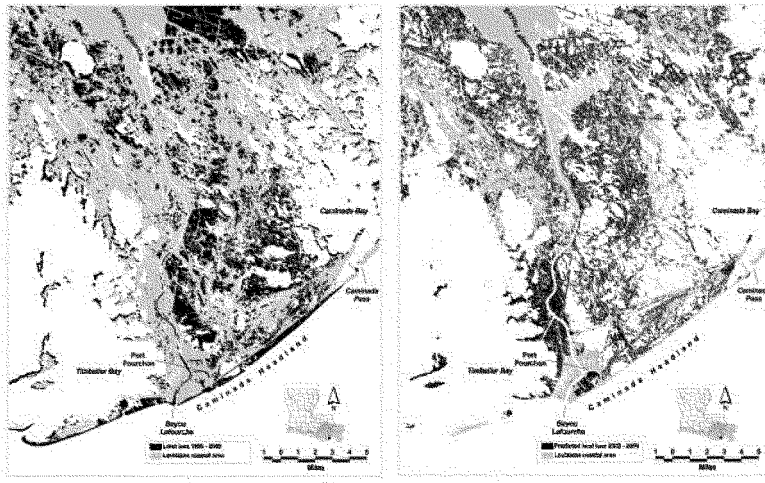


Figure 5-3. The Caminada Headland reach illustrating a small sand beach, over washes, interior lagoons and the Chevron Canal.

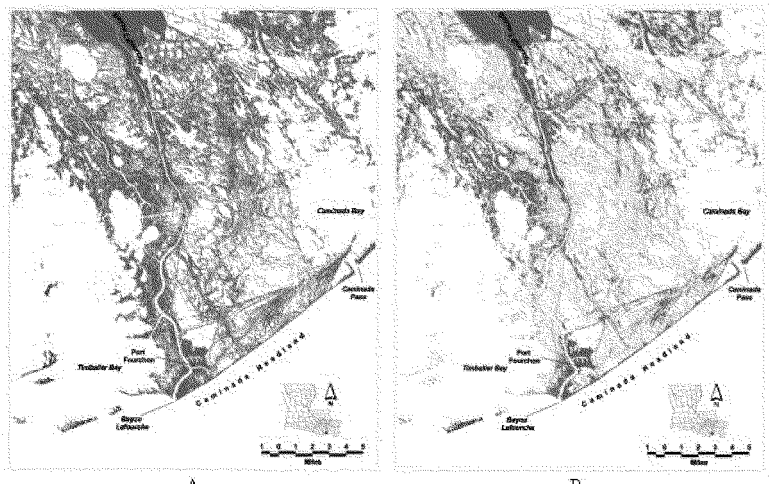
There is an erosional shadow to the east of the 13 barges where the beach has thinned and several overwash fans can be seen, some on the beach in front of Bay Champagne. There were multiple breaches in the overwash shadow during the 2002-2003 hurricane seasons. It is likely that within the next 5 years to 10 years this erosional shadow could cause a significant breach in the beach in front of Bay Champagne. The northeastern shore of this bay is very fragile due to numerous intersecting canals. It is highly probable that the headland could fragment somewhere over a nearly 2-mile area from the western shore of Bay Champagne to the remnant Bayou Moreau ridge and back to or past Highway 3090. This breach would change the western portion of the headland into Fourchon "island".

Additional evidence indicates that with no intervention, the Caminada Headland would not remain as it is now (**Figure 5-4**). This figure is from an interagency land loss model led by USGS and prepared for the LCA Study. Map A depicts the past loss from 1956 to 2000 and map B depicts the predicted loss between 2000 and 2050. During that time period, 3,750 acres are predicted to be lost from the headland and 14,780 acres from an area between Bayou Lafourche and Caminada Bay and about 12 miles north of the headland.



A. B.

Figure 5-4. Caminada Headland region showing land loss (USGS 2004).



A. B.

Figure 5-5. Caminada Headland region showing remaining land (USGS 2004).

Figure 5-4 illustrates the land distribution in 2000. **Figure 5-5** illustrates the predicted remaining lands by considering the projected losses from 2000 to 2050. It shows only a skeleton framework of wetlands remaining in 2050. The model does not project the loss of the gulf shoreline, but in actuality it would

likely be far north of where it is shown in **figure 5-5**. The area around Port Fourchon would be further isolated from the remaining mainland, and could become a detached small barrier island.

Most of the land depicted in 2000 in **figure 5-4** and **figure 5-5** is predicted to convert to open water due to subsidence, sea level rise, and erosion. These areas of open water would increase the tidal prism through the existing passes, especially Raccoon, and any new breaches. This would enlarge the cross sectional area of these passes. It is highly possible that sometime within the next 5 years to 20 years the shoreline would breach near Bayou Thunder von Tronc. As this breach widens and continues northward, Elmer's Island would truly become an island.

The central portion of what is now a headland would probably become a barrier island well before 2050. There would still be a surf zone, but the protected saline ponds and lagoons, which are now heavily used by fish and shellfish, would be much smaller (Bay Champagne and Elmer's Lagoon would be gone). In addition, there would be about 24,000 fewer acres of marsh in the Barataria Basin every 10 years.

Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will redistribute 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system. Long term impacts on the coastal processes should be primarily related to influx of sediment into the sediment-starved Louisiana barrier systems.

5.4.1.2 Future With-Project Conditions

5.4.1.3 C5/S5 (Recommended Plan/NER Plan) Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.4.1.3.1 Direct Impacts

Caminada Headland Alternative 5 with Re-nourishment:

The dune height is proposed to be +7 feet NAVD 88, which is slightly higher than the existing dune elevation in the area of +3.4 feet NAVD 88. The proposed dune width is 290 feet. The majority of the dune is sited landward over existing higher elevations, maximizing acreage and longevity. The advanced fill quantities account for initial losses due to shoreline equilibrium.

Landward and seaward slopes are set at a1V:20H. The beach fill template has a 65 ft wide seaward berm at an elevation of +4.5 feet NAVD 88 and a marsh fill template is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD 88. Approximately 13 miles of dune would be created. Fill quantities for the beach/dune and marsh fills would be 5.1 million and 5.36 million CY respectively.

The project direct boundary for alternative 5 includes approximately 1,361 acres of existing marsh, dune, supratidal, and gulf intertidal habitats at TY0. Project construction includes approximately 705 acres of new marsh, dune, supratidal and gulf intertidal habitats for a total of approximately 2,066 acres at TY1 with approximately 267 acres of these habitats left at TY50. It should be noted that the newly created acres would cover most of the existing acres in the direct project footprints. The Caminada Headland reach will include renourishment in conjunction with the dredging of the navigation channel at Belle Pass (Bayou Lafourche, Louisiana navigation project.) An estimated 3 million CY of material will be placed in the littoral zone over each ten year period for renourishment.

Shell Island Alternative 5:

Dune crest is a uniform 189 feet wide along the length of the island. Following equilibration of the beach fill, total island width would be approximately 1,240 feet wide (typical Louisiana barrier islands have widths of 1,000 feet to 1,500 feet wide). The landward dune crest of alternative 5 would be located in front of the existing shoreline, as with alternative 1.

The closure of Coupe Bob would be expected to return the tidal prism to its pre-1979 path of flowing through Grand Bayou and it would be expected that Grand Bayou would increase in size. The west end terminus of alternative 5 would be close to the western limit of the 1973 shoreline location of Shell Island in anticipation that Grand Bayou would start to widen.

Marsh width would be a uniform 735 feet. The recommended construction elevation is +2.0 feet, NAVD 88. Alternative 5 would initially be constructed with 10 years of advanced nourishment, requiring 5.6 million CY of beach fill, which would create 317 acres of beach/dune area (area above +2 feet, NAVD 88). The marsh fill would be re-nourished to its original construction template at 20 years and 40 years after construction. The marsh elevation would be below the MLW at TY18 (2027) before returning to its original elevation of +2.0 feet (NAVD 88) after TY20. For initial construction, total fill quantities for the beach/dune and marsh fills are 5.6 million CY and 2.1 million CY respectively. Beach/dune fill quantity for renourishment at year 20 and year 40 would be 1.5 million CY. Marsh fill quantities would be 0.9 million CY for year 20 and 0.6 CY for year 40.

5.4.1.3.2 Indirect Impacts

Alteration of gulf water bottoms by removal of large volumes of sand resources that would be required for coastal restoration of barrier systems may change wave dynamics, thereby potentially changing onshore storm-wave impacts, leading to greater shoreline erosion. However, borrow sites would be located a minimum of 3,000 feet (914 m) from the shoreline to minimize the potential for increased erosion, due to potential changes in wave climate of unprotected shorelines.

Also, alteration of gulf water bottoms may change littoral drift dynamics. 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. Filling the existing shoreline gap at Shell Island would enhance longshore transport to down drift shorelines. Restoration of the Caminada headland would enable the headland to continue its function of nourishing Grand Isle with sand transport.

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland for a total estimated 39 million CY over the 50-year period of analysis. Renourishment material would be placed unconfined at approximately 100 to 300 feet from the existing shoreline in a "feeder berm" thereby allowing longshore transport and wave action to move and redistribute the sediment along the headland both to the east and the west.

Figure 5-6 and **Figure 5-7** display the GENESIS model simulations of the Caminada Headland shoreline change analysis without and with the feeder berm, respectively. The results indicate that at the end of the 2-year period the feeder berm diffuses to the east and west of its initial placement by approximately 2,000 feet.

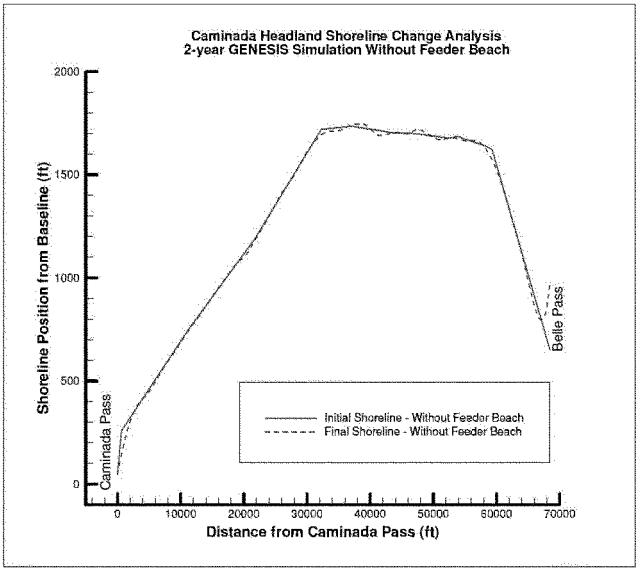


Figure 5-6. Initial versus Final GENESIS Shoreline Comparison for Without Feederberm.

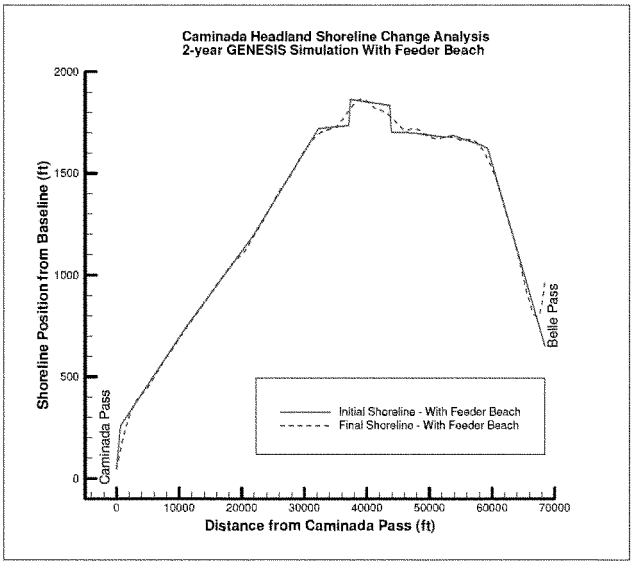


Figure 5-7 Initial versus Final GENESIS Shoreline Comparison for the With Feederberm.

Lateral diffusion will occur relatively quickly reducing the density of the feeder berm along the placement area. The added width will afford protection to the upper beach by attenuating wave run-up and thus reducing storm damage. Any storm damage reduction would be localized to the nodal zone and adjacent beaches as the fill diffuses. This methodology would avoid direct disturbance to piping plover critical habitat and would enable wave action to carry finer sediments onto the beach face making the material available for Aeolian transport to move onto the dune and thereby nourishing the barrier shoreline system. This will result in benefits to vegetation, fish and wildlife and various barrier habitats. The benefits of feeder berms are documented in the literature including Beachler (1993), Work and Otay (1996), Dean and Browder (2000), and Pendleton (2003).

Barrier system restoration, combined with interior marsh creation and restoration measures, would likely alter local tidal prism effects in the study area, 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.

The presence of the islands would also help reduce storm surges that could reach the back levee near Empire. Hurricane Danny, a weak Category 1 hurricane in 1997, caused a tremendous amount of damage to Empire and the surrounding communities because of the absence of the Shell Island Reach and the trajectory of this storm. This project incidentally helps to protect the communities of Empire, Sunrise, Buras, and Triumph.

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.

5.4.1.3.3 Cumulative Impacts

Cumulative impacts would include the synergistic interaction of the effects of implementing the Caminada Barrier Headland and Shell Island restoration with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts.

Restoration of the Caminada Headland would function synergistically with the Modification of the Davis Pond diversion project for marsh creation and with the Small Bayou Lafourche Reintroduction. The headland would provide some protection to the marshes that these projects preserved. The restoration of the Caminada Headland would also function synergistically with the proposed Third Delta Study, which would build a delta over time in Little Lake to the north. If the headland were preserved, it would provide protection to the developing delta from tides and saline waters. In turn, the nutrient-rich river water would nourish the marshes on the headland. If the headland is not preserved and becomes breached as described above, it could not serve these synergistic functions. The Caminada Headland would also provide some protection to any deltas that would develop if the management of the Birdsfoot Delta would create marsh to the west.

The restoration of the Shell Island Reach is a necessary element for any future barrier shoreline restoration strategies aimed at restoring the ecosystem functions of coastal barriers. It would function synergistically with the Medium Diversion at Myrtle Grove with Dedicated Dredging. The restoration of the shoreline gap at Shell Island would help preserve the marsh created and preserved by the Myrtle Grove project. The Shell Island Reach would also provide some protection to deltas that develop if management of the Birdsfoot Delta leads to creation of marsh to the west.

In general, the large volumes of sand required for LCA Study restoration efforts would significantly alter gulf bottoms over approximately 5,000 acres to 10,000 acres (2,025 ha 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 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.

Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a redistribution of 19.7 million CY of sediment resources into the sediment-starved Louisiana coastal barrier system.

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 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.

5.4.1.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.4.1.4.1 Direct Impacts

See section 5.4.1.3.1 for direct impacts from Caminada Headland alternative 5.

5.4.1.4.2 Indirect Impacts

See section 5.4.1.3.2 for a general discussion of indirect impacts for the Caminada Headland and Shell Island project alternatives.

5.4.1.4.3 Cumulative Impacts

See section 5.4.1.3.3 for a general discussion of cumulative impacts for the Caminada Headland and Shell Island project alternatives.

5.5 SALINITY REGIMES

5.5.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing Barataria barrier shoreline restoration, would have no direct impacts on salinity regimes. Existing conditions would persist.

The indirect impacts associated with the No Action Alternative would also be negligible. The Caminada Headlands and Shell Island restoration projects alone would have an undetermined, likely minimal, if any impact on retarding saltwater intrusion influence on regional salinities with or without implementation, due to the fact that inlets to the coastal bay areas of the Barataria basin would allow for substantial saltwater to enter the basin, with or without these project features.

The cumulative impacts to salinity for the No Action Alternative would also be negligible. The Future Without-Project mean salinity distributions for the Barataria Basin are displayed in **figure 5-8** (USACE 2004). Modeling of the Barataria basin conducted for the programmatic EIS for the LCA Ecosystem Restoration Study (USACE 2004) assumed that the Davis Pond diversion would be running all year at 5,000 cfs. Presently, 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 ppt to 2 ppt.

Within the study area, the Caminada Headland area (box 4A) would likely have the highest mean salinity range of greater than 10 ppt. The Shell Island area (box 4B) would likely have a mean salinity range of 4 ppt to 6 ppt. This modeling is still applicable for the subject study, and, therefore, the No Action Alternative would result in these approximate salinities.

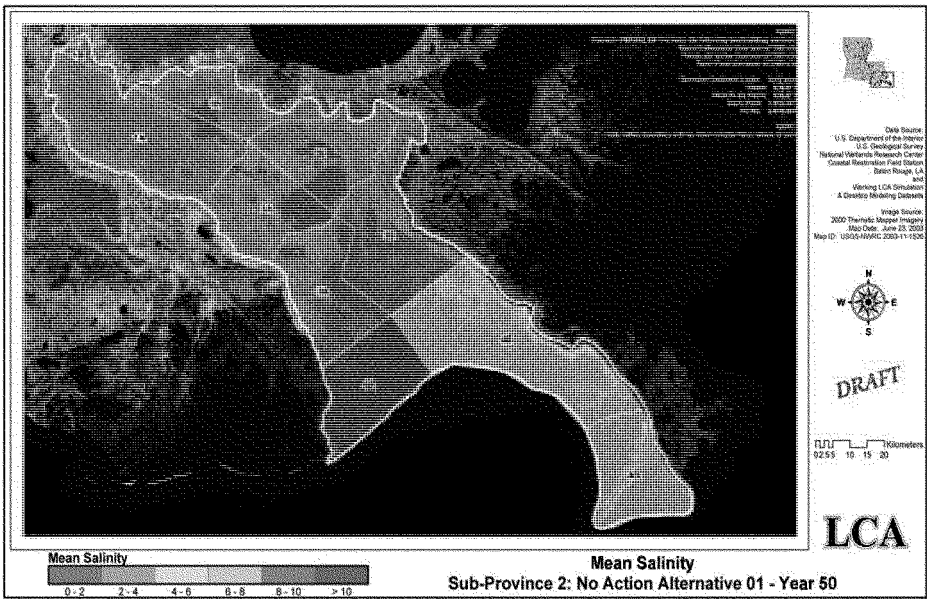


Figure 5-8. Modeling outputs displaying mean salinity under base and Future Without-Project conditions in Subprovince 2. Modeling was conducted for the programmatic EIS for the LCA Ecosystem Restoration Study (USACE 2004) and assumed that the Davis Pond diversion would be running all year at 5,000 cfs.

5.5.2 Future With-Project Conditions

5.5.2.1 C5/S5 (Recommended Plan/NER Plan): Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.5.2.1.1 Direct Impacts

Any direct impacts to salinity regimes associated with implementing this alternative would be negligible, if at all. Dredged material effluent discharges associated with the project features may result in negligible local effects on salinity (depending on the salinity of waters at the source location of the dredged material source) which would quickly become dispersed and diluted.

5.5.2.1.2 Indirect Impacts

The reductions in inland salinities due to the proposed action alone would be expected to be negligible; therefore, no indirect impacts would be expected as a result of the Recommended Plan/NER Plan.

5.5.2.1.3 Cumulative Impacts

For cumulative impacts associated with all coastal restoration activities within the Barataria basin, the salinity regime would be similar to the No Action Alternative conditions, except salinities would be slightly lower in the Caminada Bay and nearby headland areas (LCA 2004).

5.5.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Renourishment

5.5.2.2.1 Direct Impacts

The direct impacts associated with this alternative would be identical to those of the Recommended Plan/NER Plan.

5.5.2.2.2 Indirect Impacts

The indirect impacts associated with this alternative would be identical to those of the Recommended Plan/NER Plan.

5.5.2.2.3 Cumulative Impacts

Cumulative impacts for this alternative would be similar to those associated with the Recommended Plan/NER Plan.

5.6 WATER QUALITY RESOURCES

5.6.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, or not implementing the BBBS Project, would have no direct impact on water quality resources, as existing conditions would continue into the future.

Without implementation of the Barataria Basin shoreline restoration, the Barataria Basin would still be affected by natural and anthropogenic activities having both beneficial and detrimental effects to water

quality. Some of these activities include: other restoration efforts, including other LCA, CWPPRA, USACE, NRCS, and LDNR projects; Federal and state water quality management programs; programs addressing hypoxia in the northern Gulf of Mexico; the continuation of erosion and subsidence of coastal Louisiana; oil and gas development; and Federal, state, and municipal flood-damage reduction and navigation projects. The future of water quality for coastal Louisiana is dependent on a responsible, watershed approach to managing these activities.

A majority of the present and future activities would persist without the Barataria Basin shoreline restoration and would affect surface water quality conditions throughout Louisiana. The cumulative impacts associated with these activities without the Barataria Basin shoreline restoration are included 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, as well as 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 the LDEQ, which is known as the Louisiana Pollutant Discharge Elimination System (LPDES).

- The LDEQ 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.

- The 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 for waters that do not meet applicable water quality standards after implementation of technology-based controls.

- 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.

- 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.

These programs would continue to develop with or without the Barataria Basin shoreline restoration to ensure that Louisiana public health and natural resources remain protected. With these programs in place, it is expected that water quality conditions within the State of Louisiana would likely improve overall. However, activities with the potential for negative effects on water quality would also continue to occur with or without the proposed restoration features. In addition, present and future Federal, state, local, and private ecosystem restoration projects would probably improve water quality conditions throughout Louisiana.

- Industrial, commercial, and residential development along the coast would continue. Development activities would result in 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, resulting in additional areas of degraded water quality.

- The most notable activity that would continue to occur without the proposed restoration features 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, resulting in 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. In addition, other forms of infrastructure could potentially be exposed due to coastal erosion, including wastewater collection systems and other commercial industry related systems.

Gulf Oil Spill Additional Sample Collection

In conjunction with the BP Gulf of Mexico oil spill, the EPA has been conducting sampling and chemical analysis of air, surface water, and water bottom sediments to aid in determining the locations and mediums most affected by the spill, for the purposes of protection of human health and aquatic life (USEPA 2011). For the project area encompassed by the Barataria Basin Barrier Shoreline (BBBS) Restoration project, several sediment samples were collected for chemical analysis of compounds expected to be released by the oil spill and by dispersant application which are likely to be indicative of the short- and possibly long-term effects of the spill on borrow area and restoration area sediments.

Table 5-7 includes sediment chemistry results for samples collected by the EPA in the footprint of the BBBS project, and includes samples collected in proximity to the Caminada Headland and Shell Island, as well as to the nearshore borrow areas for both of these restoration features (see also **Figure 5-9**). Results were compared to NOAA Screening Quick References Tables (SQuiRTs) sediment screening values for available chemical compounds in order to predict whether nearshore borrow area sediments or existing sediments at restoration feature areas have the potential for adverse long-term impacts to benthic organisms (NOAA 2008). Eighteen (18) samples were collected in the vicinity of restoration features and nearshore borrow areas over a time period ranging from April 30 to September 17, 2010; between all of these samples analysis was conducted for two (2) different metals, fourteen (14) different polycyclic aromatic hydrocarbons, twenty one (21) semi-volatile organic compounds, total petroleum hydrocarbons (oil and gasoline), and eight (8) different volatile organic compounds.

For two samples located nearby Shell Island (one sample located inland and one sample located nearshore of the island), which were collected in September 2010, chemistry results exceeded low-level NOAA sediment screening values. For the sample collected inland of Shell Island (collected at EPA Station I.D. T001-SV231, 29.3218°N, -89.738067°W), the measured concentration of nickel exceeded the effects-range low (ERL) screening value, while the measured concentration of dibenzo(a,h)anthracene exceeded the threshold-effects level (TEL) screening value. For the sample collected nearshore to Shell Island (collected at EPA Station I.D. T008-R650, 29.26712°N, -89.69924°W), the measured concentration of nickel exceeded the TEL screening value. These exceedences of screening values are indicative of possible effects levels for associated contaminants. For the remaining samples located in the vicinity of both restoration features and associated nearshore borrow areas, no contaminant concentrations were measured at levels exceeding NOAA sediment screening values.

Table 5-7. Sediment chemistry results for samples collected by the EPA in the footprint of the BBBS project.

		Station I.D.:	T001-SV231	T008-R650	2008 NOAA Screening Quick Reference Tables (SQuiRTs) Screening Levels for Marine Sediments			
		Latitude:	29.3218	29.26712				
		Longitude:	-89.738067	-89.69924				
Parameter	Units	Collection Date:	9/14/2010	9/3/2010	TEL	ERL	PEL	ERM
Nickel	µg/kg		24,900	19,300	15,900	20,900	42,800	51,600
Dibenzo(a,h)anthracene	µg/kg		6.50	5.50	6.22	63.4	135	260

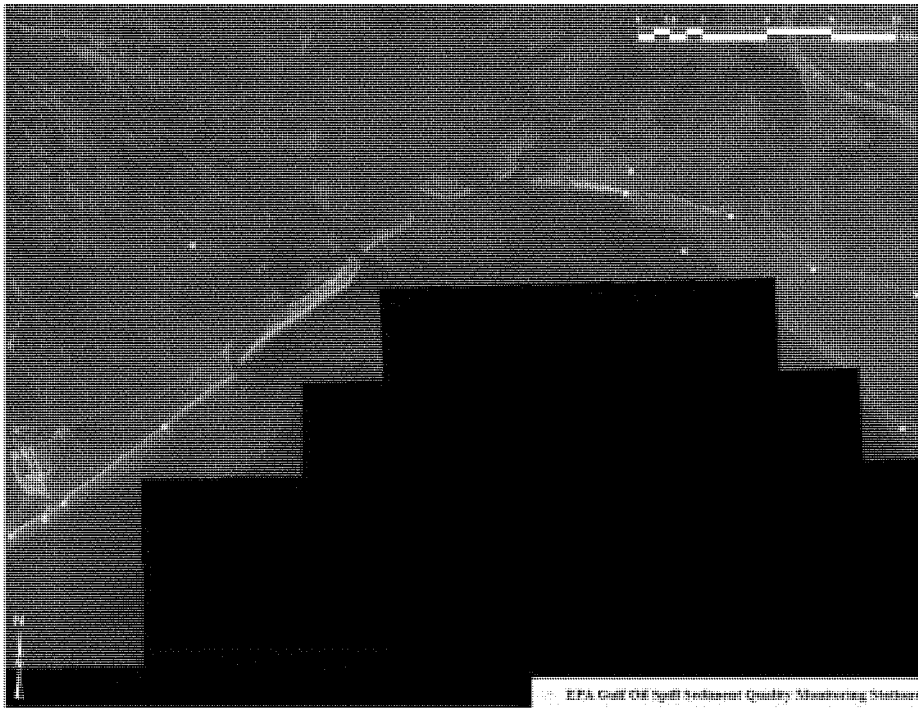


Figure 5-9. EPA Gulf Oil Spill Sediment Quality Monitoring Stations.

Based on the evaluation of available sediment chemistry results for EPA samples collected in the vicinity of restoration features and associated nearshore borrow areas, it is possible that restoration areas and nearshore borrow areas for the BBBS project may contain levels of contaminants in sediment that could have adverse effects on bethic organisms. However, most sediment samples collected in the vicinity of restoration features and nearshore borrow areas did not reveal any levels of contaminants exceeding NOAA sediment screening values, and the two samples which did reveal exceedences of sediment screening values only revealed possible effects levels for two contaminants. Therefore, available sediment chemistry results do not indicate that, overall, placement of nearshore borrow sediments for

marsh restoration at Shell Island and the Caminada Headland would result in adverse long-term impacts to benthic organisms. However, as the EPA samples analyzed are not site-specific, and because remnant oil from the spill remains in areas of coastal Louisiana, this conclusion is not steadfast and only represents an evaluation of best available information.

Following the BP oil spill, a report was prepared by USCG Operational Science and Advisory Team (OSAT) characterizing sub-sea and sub-surface oil and dispersants (OSAT 2010). The purpose of the report was "to provide the Federal On-Scene Coordinator for the Deepwater Horizon MC252 Spill of National Significance with sufficient information to determine the presence or absence of sub-surface oil and dispersants amenable to removal actions under the provisions of the Clean Water Act, the Oil Pollution Act of 1990, and the National Oil and Hazardous Substances Pollution Contingency Plan.

Key finding in this report which relate to borrow areas and restoration features (as included in the executive summary of the report) include the following:

- No deposits of MC252 oil in the liquid phase were identified in sediments beyond the shoreline
- No exceedences of EPA Human Health of dispersant benchmarks were observed
- After August 2010, less than 1% of water samples and approximately 1% of sediment samples exceeded EPA Aquatic Life benchmarks for polycyclic aromatic hydrocarbons (PAHs). No exceedences observed in water samples were found to be a result of MC252 oil, and only sediment exceedences within 3 km of the MC252 wellhead were found to be a result of MC252 oil.
- Published research summarized in the report indicates MC252 oil is weathering and biodegrading naturally.

The report also documents the finding of tar mats in sub-tidal nearshore areas which have the potential to remobilize and cause shoreline re-oiling. Based on the executive summary prepared for the report (insufficient time was available to review the remainder of the report), it does not appear that borrow area sediments would contain levels of contaminants associated with MC252 with the potential to cause adverse impacts to aquatic organisms.

Additionally, and more recently, the Louisiana Office of Coastal Protection and Restoration conducted an evaluation of sediments in the South Pelto block of Ship Shoal, a proposed borrow area for the BBBS project (BEM 2011). Although insufficient time was available to prepare a summary of this evaluation based on a thorough review of its contents, the abstract for the evaluation states that sediments evaluated are not expected to adversely affect aquatic organisms.

As a result of the widespread coverage of the BP oil spill, it is possible that oil sheens or slicks may be observed either at the disposal sites or near the dredging sites during dredging operations, and field personnel / dredging crew should periodically inspect both the dredging and disposal sites for the presence of oil during daylight hours. Periodic inspections may coincide with shift changes, repositioning of equipment, or other activities related to dredging and disposal operations. Time conducted and results of these inspections should be recorded. If oil in any form is observed, dredging should cease and the USCG National Spill Response Center should immediately be contacted (1-800-424-8802). The USCG New Orleans Sector (504-365-2200) should then be notified of the incident. Field personnel should document the incident (take photographs, mark location and time observed, record color and size of sheen, etc.) to assist the USCG's investigation and response. Dredging operations should not resume until approved by the USCG and CEMVN.

5.6.2 Future With-Project Conditions

5.6.2.1 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 — Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 — Single Island with 10-year Advanced Fill and 2 Re-nourishments

5.6.2.1.1 Direct Impacts

For the Recommended Plan/NER Plan, direct impacts to water quality would be as described in the discussion of historical data and additional data collection (sections 4.8.1.1 and section 4.8.1.2). The discharge of dredged material effluent waters from the proposed restoration features would not result in significant adverse short- or long-term or short-term impacts to the adjacent aquatic ecosystem. The nature of these dredged material effluent discharges would be expected to be short-lived, and therefore would only result in temporary and minor impacts to water quality. Renourishment of the Caminada Headland and Shell Island would result in the long-term resuspension of sand throughout the length of these barrier shorelines. These direct water column impacts are anticipated to be minor due to the extensive duration over which material placed for renourishment will require to disperse.

5.6.2.1.2 Indirect Impacts

The Recommended Plan/NER Plan may result in minor improvements to water quality as wetlands serve as natural filters for improving water quality. In addition, the development of a more robust barrier shoreline may provide a less permeable barrier for high salinity coastal waters entering inland areas, as well as for freshwater exiting inland regions; however, reductions in inland salinities due to the Recommended Plan/NER Plan alone would be expected to be very minor.

5.6.2.1.3 Cumulative Impacts

The Recommended Plan/NER Plan would contribute towards the restoration of a chain of barrier islands, which serve in part to protect coastal wetland areas from erosive forces; as a result of contributing to the protection of coastal wetlands, this chain of barrier islands would in turn contribute to the improvement of water quality within the basin, as wetlands serve to improve water quality. In synergy with other projects, the Recommended Plan/NER Plan would be expected to aid in the increased retention of freshwater in some areas of the basin. The expected 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, freshwater marshes are sensitive to salinity levels, while varying seasonal levels of salinity have positive impacts on various commercial and recreational fisheries. Overall, the stabilization of salinities, or the relocation of saltier water zones gulfward, would benefit those who utilize the basin.

At a state level, the Recommended Plan/NER Plan would contribute to present and future Federal, state, local, and private ecosystem restoration projects to improve water quality conditions throughout Louisiana.

5.6.2.2 Alternative C5: Caminada Headlands Restoration Feature 5—Preferred Dune with Expanded Marsh with Renourishment

5.6.2.2.1 Direct Impacts

Direct impacts would be the same as the Recommended Plan/NER Plan for the Caminada Headlands feature; however, because no restoration feature would be selected for Shell Island, no impacts would be associated with Shell Island.

5.6.2.2.2 Indirect Impacts

Indirect impacts would be the same as the Recommended Plan/NER Plan for the Caminada Headlands feature; however, because no restoration feature would be selected for Shell Island, no impacts would be associated with Shell Island.

5.6.2.2.3 Cumulative Impacts

Cumulative impacts would be the same as the Recommended Plan/NER Plan for the Caminada Headlands feature; however, because no restoration feature would be selected for Shell Island, no impacts would be associated with Shell Island.

5.7 VEGETATION RESOURCES

5.7.1 No Action Alternative (Future Without-Project Conditions)

The analysis of the No Action Alternative and Future With-Project conditions for vegetation resources relied on historic trends and modeled future predictions of land loss and barrier and marsh habitat changes, especially the predicted conversion of salt marsh and barrier habitat to open water (after USACE 2004).

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on vegetation resources. Existing conditions, including habitat degradation and loss, would persist. Without implementation of the proposed coastal barrier system restoration vegetation resources, including beach pioneer, frontier zone, dune, barrier grassland, salt flats, salt marsh, intertidal mud flats, and spoil banks associated with barrier and coastal wetland habitats would be expected to decrease not only within the study area, but also throughout coastal Louisiana.

Indirect impacts would include a decline in wetland vegetation as well as net primary productivity within the study area. The ongoing conversion of existing fragmented emergent wetlands to shallow open water would continue with associated indirect impacts on coastal vegetation, fish and wildlife resources, EFH, recreation, aesthetic, and socioeconomic resources. Other indirect adverse impacts that would result from the loss of important and essential vegetated habitats used by fish and wildlife are the loss of shelter, nesting, feeding, roosting, cover, nursery, and other life requirements for fish and wildlife; loss of productivity; loss of transitional habitat between estuarine and marine environments; and increased inter- and intra-specific competition between resident and migratory fish and wildlife species for decreasing wetland resources. This would also reduce the availability of important stopover habitats used by migrating neotropical birds.

Modeling of Subprovince 2 (the Barataria Basin, including the study area) conducted for the programmatic EIS for the LCA Ecosystem Restoration Study (USACE 2004) predicted approximately 20

percent of the total existing emergent wetland acres in the subprovince would likely be lost by 2050. The majority of vegetated coastal land loss, primarily in the saline and brackish marsh habitats and coastal barrier habitats, is expected to occur throughout the lower portions of the Barataria Basin, including the study area. Anticipated freshwater inputs into the upper portions of the Barataria Basin from the existing Davis Pond diversion and similar proposed actions such as the Myrtle Grove diversion, are expected to expand the area of fresh conditions southward in the Barataria Basin. Existing intermediate marsh habitat would convert to fresh marsh habitat and any remaining brackish and saline habitats, not converted to open water, would convert to fresh and intermediate habitats, respectively. Modeling for the LCA Ecosystem Restoration Study also predicts a nearly 100 percent decrease of existing saline marsh acres. A large portion of existing vegetated acres is predicted to be lost throughout the lower portions of the Barataria basin. Loss of saline marshes, through conversion to open water, is predicted to be severe throughout the southwest part of the subprovince (i.e., the Caminada Headland and adjacent nearby areas).

The predicted proportional distribution of habitat types throughout Subprovince 2 (Barataria Basin) reflects the decrease in habitat diversity that is expected as more saline marshes are lost or converted to fresher conditions. Of the remaining acres of emergent habitat in the subprovince, over 90 percent would be divided evenly between fresh marsh and swamp/wetland forest habitats; the remaining 9 percent would 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 would occur along the coastal shoreline (including the study area) 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. Modeling results also predict that the loss of emergent wetlands would likely be accompanied by a 25 percent decrease in vegetation productivity throughout the subprovince.

The trend in barrier island loss is characterized by simultaneous reduction of total area and elevation, which imposes further restrictions on environmental conditions that are already limiting. With regard to vegetation, the result has been the reduction in the size and diversity of vegetation zones in varying degrees across all of the barrier islands. Continued degradation and loss of existing areas, combined with loss of replenishing processes, has also accelerated decline in the interdependent processes of plant production and vertical maintenance necessary for a stable barrier island ecosystem.

The existing conditions of the vegetative community on the eastern remnant of Shell Island is an excellent illustration of the final stages of degradation prior to an island becoming an intertidal mud flat or a submerged shoal that is only occasionally exposed. Field investigations in July 2005 found the remaining eastern fragments of the island composed of sand-shell spits and very low, narrow strips of vegetated area. Oyster grass composed nearly 100 percent of the existing vegetation (**Figure 5-10**) with a few inclusions small thickets of black mangrove at slightly higher elevations (**Figure 5-11**). Only trace amounts of other species were noted, such as marsh-hay cordgrass, salt grass, sea purslane, and glasswort.

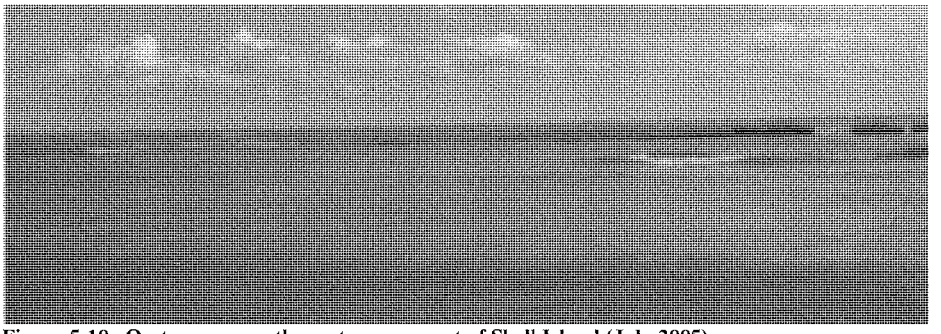


Figure 5-10. Oyster grass on the eastern remnant of Shell Island (July 2005).

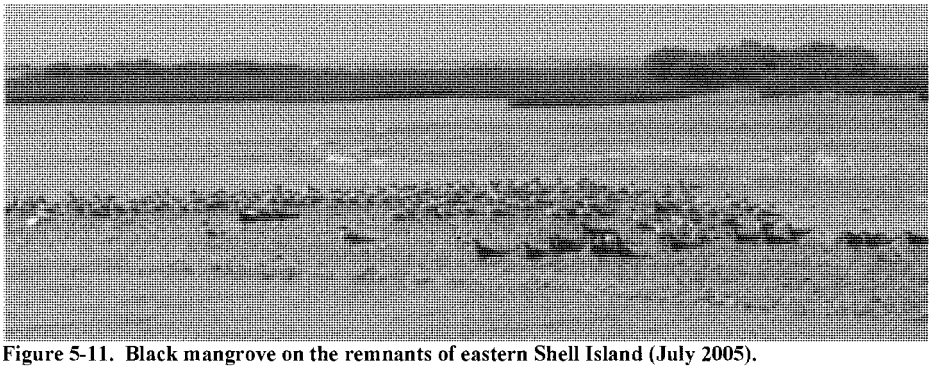


Figure 5-11. Black mangrove on the remnants of eastern Shell Island (July 2005).

Under the No Action Alternative, if any habitat suitable for vegetation remains within the study area over the 50-year period of analysis, conditions would likely be similar to the existing conditions on eastern Shell Island. Expected typical vegetative communities would exhibit extremely low diversity and diminished size. In addition to losses associated with decreased biomass contributions, other critical functions of barrier island plant communities in the project area would also be reduced or lost entirely, including protection against substrate erosion, and contributions of food and physical structure for cover, nesting, and nursery habitat for wildlife and fisheries.

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coast wide barrier habitat loss and degradation, as well as the benefits and impacts of other state and Federal barrier system restoration projects (table in the vicinity, as detailed in section 4.1.1. WRDA of 2007 authorized design and implementation of a freshwater diversion at or near Violet, Louisiana, for the purposes of reducing salinity in the western Mississippi Sound, enhancing oyster production, and promoting the sustainability of coastal wetlands. Preliminary modeling (personal communication, Ms. Tomma Barnes, USACE Project Manager for the Violet Diversion, August 12, 2008) indicates it would require up to 15,000 cfs (425 m^3/sec) to accomplish these goals. Coupled with the closure structure on the MRGO channel at the Bayou La Loutre ridge, the diversion at or near Violet, Louisiana would freshen the surrounding waters, albeit to an unknown extent. This could result in a

conversion of some saline marshes to brackish marshes in the southern reaches of the project area. However, such wetland conversion would probably have little effect on the species composition of the wetlands in the project area other than a slight shift towards less salt-tolerant species. The introduction of nutrients would likely increase the productivity of the nearby marshes.

5.7.2 Future With-Project Conditions

5.7.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.7.2.1.1 Direct Impacts

Compared to the No Action Alternative, direct impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would primarily result from construction activities related to placement of borrow material on existing fragmented dune, supratidal, intertidal (gulfside and bayside) and shallow open water habitats. Alternative C5/S5 (Recommended Plan/NER Plan) would restore a total of 2,849 acres. Alternative C5/S5 (Recommended Plan/NER Plan) would restore 880 acres of dune and supratidal habitats on Caminada Headland and 322 acres on Shell Island. This alternative would also restore 1,186 acres of marsh or bayside intertidal habitat on Caminada Headland and 351 acres on Shell Island (**Table 5-4**). Shell Island would be restored as a single island with 317 acres of dune and supratidal habitats and 466 acres of marsh (**Table 5-4**). Alternative C5/S5 would also include two re-nourishment events of dune, supratidal and marsh habitats at year target year (TY) 20 and TY 40 post-construction. Following initial construction each habitat type would continue losing elevation and would convert to the next lower-elevated vegetation type. For example, there would be 153 acres of dune at TY 1, but only 58 acres of dune at TY 20. However, renourishment events at TY 20 and TY 40 would result in 153 acres of dune at TY 21 and TY 41, respectively.

Dune restoration for all alternatives would include installation of sand fencing and plantings of native vegetation that would be anticipated to promote additional dune elevation by capturing Aeolian sands. One shore parallel fence would be installed about 50 feet north of the southern toe of the dune to continue the capture of transported sand until the surface is vegetated. The sand fence would extend along the total length of the constructed dune. Sand fences must be installed in sequence/phases. The installation should start from the southern side of the dune so as to build dune towards the Gulf of Mexico and proceed north. Additional rows of sand fencing could be added once the existing sand fence is full (i.e. sand is stacked up to the top of the fence.)

Seeding of the dune platform (aerial or ground application) would be considered depending on the time of the year construction is completed. Rye grass seed could be considered if construction is completed in the summer or fall to be used as a ground cover during the winter months. Bermuda grass seed has been dispersed on the barrier island dune platforms in the past as well, but with strong objection by the Federal and state wildlife agencies as it is non-native. Dune and supratidal plants would consist of a variety of dune species including bitter panicum (*Panicum amarum var amarum* 'Fourchon'), sea oats (*Uniola paniculata* 'Caminada'), marshhay cordgrass (*Spartina patens* 'Gulf Coast') and gulf cordgrass (*Spartina spartinae*). Plants shall be grown mainly in four inch containers (sea oats in a slightly larger container). Species recommendations may change due to soil properties and conditions, elevation after final construction, salinity, available soil moisture, and other site conditions. Other plants that could be considered to add diversity (depending upon availability) include seacoast bluestem (*Schizachyrium maritimum*), seashore dropseed (*Sporobolous virginicus*), and salt grass (*Distichlis spicata*). Woody species that would be considered for planting (depending upon availability) on the dune and supratidal

swale areas include, but are not limited to matrimony vine, wax myrtle, *Iva frutescens*, *baccharis* species, and hercules club. Plants on the dune, supratidal, and marsh platforms would be installed 5-feet apart with 20-feet between rows. However, woody vegetation would be planted at a density of 10-feet on center.

Marsh plantings would primarily consist of smooth cordgrass (*Spartina alterniflora* 'Vermilion'). Depending upon availability, a smaller planting of black mangrove (*Avicennia germinans* 'Pelican') may be incorporated to add a larger seed bank for black mangroves. Plants shall mainly consist of vegetative plug material, four inch containers, or tube-tainers (mangroves). The Shell Island marsh platform is estimated to be approximately 45,000 feet long. It is hard to estimate the marsh platform planting area, as it appears that the marsh creation would be filling in canals and broken marsh. However, if half of the fill area on the marsh platform is to be planted that would be approximately 22,500 feet of planting platform. Plants are estimated by placing rows approximately 20 feet apart (20 rows) with plants approximately 3-feet on center.

5.7.2.1.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5/S1 (Recommended Plan/NER Plan) would be a net increase of 1,684 acres with 1,718.9 average annual habitat units (AAHUs) (**Table 5-4**) of important and essential vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; increased vegetation growth and productivity; and reduced inter- and intra-specific species competition between resident and non-resident fish and wildlife species for limited coastal vegetation. Alternative C5/S5 (Recommended Plan/NER Plan) would restore and rehabilitate dune, supra tidal and intertidal vegetated coastal barrier habitats; reduce conversion of these habitats to open water habitat; and provide higher quality EFH, especially nursery habitat, for several species, including brown and white shrimp, and blue crab. Vegetative plantings would contribute to re-establishment of a variety of wetland species that would further aid in sediment trapping. Vegetative productivity would likely increase due to increased vegetated acres of barrier habitats. Important stopover habitats used by migrating neotropical birds would be restored and sustained for future use over the 50-year period of analysis. Compared to the No Action Alternative, alternative C5/S5 (Recommended Plan/NER Plan) would delay the conversion of vegetated barrier habitats to open water habitats over the 50-year period of analysis.

5.7.2.1.3 Cumulative Impacts

Compared to the No Action Alternative, cumulative impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be the synergistic effects of restoring a net total of 1,684 acres of vegetated barrier headlands and islands within the Barataria Basin barrier system over the 50-year period of analysis. These impacts would be in addition to the incremental impacts associated with the restoration of other Louisiana barrier systems (see **Table 5-5**). The net gain in vegetated barrier habitats would be in contrast to the continued long-term significant loss of vegetated barrier habitats that would continue, to varying degrees, for the remaining 251 miles (404 km) of Louisiana barrier shorelines along the Gulf of Mexico.

5.7.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.7.2.2.1 Direct Impacts

Compared to the No Action Alternative, implementing alternative C5 would restore a total of 2,066 acres on the Caminada Headland (**Table 5-4**). There would be no restoration of Shell Island. Direct impacts

would be similar to those described for alternative C5/S5 except Shell Island direct impacts would be similar to those described under the No Action Alternative.

5.7.2.2.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5 would be the restoration of a net total of 990 acres and 988.3 AAHUs on the Caminada Headland (**Table 5-3**). Other indirect impacts to the Caminada Headland would be similar to those described for the Caminada Headland under alternative C5/S5 (Recommended Plan/NER Plan). Indirect impacts of this alternative to Shell Island would be similar to those described under the No Action Alternative.

5.7.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: the synergistic interaction of the effects of implementing the Caminada Headland restoration with a benefit of 990 acres (400 ha) over the 50-year project period of analysis with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-4**. The cumulative impacts to Shell Island would be similar to those described under the No Action Alternative.

5.7.3 Future With Project (any alternative) - Invasive Species

Several barrier island restoration projects have been implemented in the past 15 years to 20 years, with the majority (executed) through the CWPPRA program. To date, no invasive species impacts resulting from those projects are known to have been reported or documented. In addition, query of several individuals knowledgeable of Louisiana barrier island ecosystems and current restoration efforts yielded no reports or observations evidencing any displacement of natural vegetative communities by invasive species (personal communication C. Steyer, K. Bahlinger, M. Carloss, M. Hester, G. Linscombe, M. Materne, Irv Mendelssohn, and C. Reid, J. Visser). Based on this, and the fact that the Recommended Plan/NER Plan would create barrier island habitat with features on a scale similar to existing projects and includes native species plantings to quickly establish targeted vegetative communities, the anticipated risk of causing conditions favorable to encroachment and impacts by invasive species would be negligible.

5.8 WILDLIFE RESOURCES: BIRDS, MAMMALS, AMPHIBIANS, AND REPTILES

5.8.1 No Action Alternative (Future Without-Project Conditions)

Analysis of the Future Without-Project conditions and Future With conditions for wildlife resources relied on predictions of continued coastal land loss and the predicted conversion of barrier habitat and salt marsh to shallow open water. Other factors, such as habitat changes elsewhere in a species' range cannot be predicted and were not considered in these projections.

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on wildlife resources. Existing conditions would persist. Without implementation of proposed coastal barrier system restoration, the fragmentation and loss of the Caminada Headland and Shell Island barrier systems and back marsh would continue to adversely impact foraging, nesting, wintering, resting, refugia, and other important habitats for resident and migratory birds and other wildlife (personal communication USFWS, June 15, 2005). Continued fragmentation and deterioration of barrier and marsh habitat quality, conversion of marsh and barrier habitats to open water, and the dwindling availability of

suitable barrier and marsh habitats for use by wildlife would be expected to result in a general decline of wildlife populations throughout the Barataria basin in general, and the study area specifically. Direct adverse impacts to wildlife may result from events such as tropical storms and hurricanes, but would be expected to be smaller in comparison to indirect impacts. Indirect impacts to wildlife may result from the expected continuation of land loss and further loss of habitat supportive of different wildlife species. In the short-term, land loss and predicted sea level changes would be likely to increase open water habitats. In the long-term, as open water replaces barrier and wetland habitats and the extent of land to water interface decreases, wildlife productivity would likely decline. The estimated loss of 3,750 acres from the Caminada Headland and all 386 acres from Shell Island would be cumulatively added to all other barrier and wetland wildlife habitat losses throughout coastal Louisiana and the Nation.

5.8.1.1 Amphibians and Reptiles

BTNEP report #21 (Condrey et al. 1995) provided detailed historic and existing (circa 1993-94) population trends, but did not make any predictions of amphibian and reptile populations trends into the future. Despite infrequent sightings of the American alligator along the Caminada Headland, the interagency Coast 2050 Report (1999) indicates that the American alligator has been historically absent from barrier shoreline habitats throughout the study area and will no longer be present in other habitats throughout the study area. The green (Rebel 1974), Kemp's ridley, leatherback, and loggerhead sea turtles presently utilize the barrier habitats along Louisiana's coast (Dundee and Rossman 1989). Continued loss of barrier habitats would likely further threaten the recovery of these threatened and endangered species. It is likely the continued loss of barrier and wetland habitats would become a general limiting factor for those amphibian and reptile species that utilize the study area. This would likely result in increased inter- and intra-specific competition for decreasing barrier and wetland habitats and associated resources.

5.8.1.2 Mammals

Other than fur harvest records, little is known about the status and trends of mammals throughout the Barataria-Terrebonne basin (Condrey et al. 1995). The interagency Coast 2050 Report (1999) indicates that in all presently occupied habitats, and with the exception of rabbit, all furbearer and game mammal populations to 2050 would decline throughout the entire study area. Rabbit populations are predicted to remain steady in salt marsh and hardwood forest habitats in the Fourchon mapping unit and decrease or be no longer present in the other habitat types and the Barataria barrier shoreline mapping unit. It is likely the continued significant loss of barrier and wetland habitats would become a general limiting factor for most mammal species utilizing barrier habitats, except for rabbits. This would likely result in increased inter- and intra-specific competition for decreasing barrier habitats and associated resources.

5.8.1.3 Birds

Condrey et al. (1995) predicts that wintering habitat would become limiting for waterfowl that use the Barataria-Terrebonne estuary system in the future as restoration of northern habitat proceeds. The interagency Coast 2050 Report (1999) indicates that seabirds, wading birds (only in the Fourchon mapping unit), and other marsh/open water residents and migrants populations within the study area are projected to be steady to 2050. All other representative bird groups (including: shorebirds; dabbling ducks; diving ducks; geese; raptors; rails, coots and gallinules; and other woodland resident and migrants) not categorized as "no longer present" or "not historically present" are projected to decrease. It is likely that the continued significant loss of barrier habitats would become a general limiting factor for many bird species, especially for neotropical migrants, the threatened piping plover and brown pelican. This would likely result in increased inter- and intra-specific competition for decreasing barrier and wetland habitats and associated resources.

About 12 percent of the worlds 9,800 bird species may face extinction within the next century (Youth 2003). Based on the North American Breeding Bird Survey's records between 1966 and 1998, some 28 percent of 403 thoroughly monitored species showed statistically significant negative trends. In 2002, the National Audubon Society declared that more than a quarter of U.S. birds were declining or in danger.

Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a barrier island-like habitat (sand spits) usable by various fish and wildlife species.

5.8.2 Future With-Project Conditions

5.8.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.8.2.1.1 Direct Impacts

Compared to the No Action Alternative, direct impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would primarily result from construction activities related to placement of borrow material on existing fragmented dune, supratidal, intertidal (Gulfside and bayside) and shallow open water habitats. Alternative C5/S5 (Recommended Plan/NER Plan) would restore a total of 2,849 acres of beach, dune, supratidal and marsh habitats for use by different wildlife species (**Table 5-4**). Shell Island would be restored as a single island with a total of 783 acres of wildlife habitat. During implementation of alternative C5/S5 (Recommended Plan/NER Plan), construction activities may disrupt or displace wildlife species. However, any such impacts would be localized and temporary, and most wildlife species would move to an area with more favorable conditions and return after construction is completed. No permanent displacement would be expected from the construction of the foreshore protection features.

Migratory Bird Impacts

Construction activities could also disturb or potentially result in a "Take" of colonial-nesting wading birds, terns, gulls, skimmers, shorebirds, or brown pelicans during the construction period. The Migratory Bird Treaty Act of 1918, as amended (MBTA), established a Federal prohibition, unless permitted by regulations, to:

> *"pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this convention ... for the protection of migratory birds ... or any part, nest, or egg of any such bird." (16 U.S.C. 703)*

All colonial nesting wading and water birds are protected by the MBTA. The MBTA prohibits "Take" and Executive Order 13186 of 2001(Responsibilities of Federal Agencies to Protect Migratory Birds) requires that actions of Federal agencies be designed to avoid and minimize impacts to migratory birds. The MBTA prohibits the capture or lethal take of migratory birds; however, the MBTA does not prohibit harassment of migratory birds.

The USFWS and LDWF require 1,000-foot "no work" areas around active colonial wading-bird nesting colonies during the nesting season (February 15 through September 1). However, the extended length of construction (estimated 936 day construction period), will require the USACE to continue coordinating

with the USFWS and LDWF in order to determine appropriate prevention and abatement procedures to prevent disturbance of nesting and/or takings of these wildlife species.

The key to deterring colonial wading birds from establishing active nesting colonies is timing, persistence, organization, and diversity of abatement measures. A Nesting Prevention Plan would be developed, in coordination with the USFWS and LDWF, that outlines known habitat conditions of the project area, expected and potential colonial wading birds and other migratory birds, regulatory overview of Federal and state statutes relating to the implementation of a Nesting Prevention Plan, proposed abatement methods and techniques, safety and communication plans, ambient noise study implementation, monitoring of the project area, and reporting the status of the abatement measures. All abatement measures would be conducted by wildlife biologists familiar with colonial wading bird ecology and with proposed abatement methods (e.g., stationary and active audio and visual repellents and others). Prior to and during the nesting season, the project area would be inspected by qualified personnel for the presence of nesting colonies during the nesting season. In addition to surveillance, nesting prevention measures would be employed to discourage and prevent wading birds from nesting within a 1,000 foot range of the project areas. Active nesting prevention measures would be coordinated with the USFWS and LDWF and likely required from January to September during the year of construction. If measures to prevent colonial nesting bird populations are not successful in the project area, construction-related activities that would occur within 1,000 foot of a colony could be restricted to the non-nesting period, which in this region generally extends from September 1 to February 15, depending on the species present. This restriction would likely pose significant problems to construction activity schedules. If wading bird nesting colonies become established in the project area, the 1,000 ft buffer must be maintained unless coordination with the USFWS indicates that the buffer zone may be reduced based on the species present or an agreement is reached with USFWS that allows a modified process to be adopted.

Most of the Barataria Basin barrier shoreline is designated as critical wintering habitat for the endangered piping plover (Federal Register, Vol. 66, No. 132). The Endangered Species Act of 1973 (ESA), as amended, prohibits unauthorized taking of endangered or threatened species. Section 7 of the ESA requires Federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat. The USACE will continue to closely coordinate with the USFWS in determining specific actions to avoid and minimize potential impacts to these species and their critical habitat. Therefore, abatement measures to prevent colonial wading-bird nesting should not disturb brown pelicans, interior least terns or piping plovers on their wintering habitat.

Louisiana state law also protects species listed as threatened or endangered under the ESA, or species determined by the secretary of the LDWF to be threatened or endangered. The brown pelican and interior least tern are listed as state endangered; piping plover is listed as state threatened. The taking of any state threatened or endangered species is prohibited by state law; therefore, abatement measures to prevent colonial wading-bird nesting should not disturb brown pelicans, interior least terns or piping plovers on their critical wintering habitat.

In order to minimize potential impacts to migratory bird species, the sequencing of construction could also allow these birds to temporarily relocate to nearby suitable habitat within the study area. Prey species smothered by dune and beach creating activities would re-colonize in the project boundary within two years following completion of construction activities (USFWS, 2010a). During the PED phase, the USACE will continue to coordinate with the USFWS and LDWF to further assess construction sequencing and determine the feasibility of staggering construction such that only one island is disturbed at any point in time. This will minimize disturbance to the piping plover during construction and maintain an abundance of critical habitat within the immediate vicinity of the disturbed island.

Staggered implementation of renourishment events would also be considered to minimize potential adverse impacts to colonial-nesting wading birds, terns, gulls, skimmers, shorebirds, or brown pelicans. However, as with initial construction, staggering construction could significantly delay project implementation and completion.

5.8.2.1.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be a net increase of 1,684 acres with 1,718.9 average annual habitat units (AAHUs) (**Table 5-4**) of important and essential vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; increased vegetation growth and productivity; and reduced inter- and intra-specific species competition between resident and non-resident fish and wildlife species for limited coastal vegetation. Alternative C5/S5 (Recommended Plan/NER Plan) would restore and rehabilitate dune, supratidal and intertidal vegetated coastal barrier habitats; reduce conversion of these habitats to open water habitat; and provide higher quality EFH, especially nursery habitat, for several species, including brown and white shrimp, and blue crab. Important stopover habitats used by migrating neotropical birds would be restored and sustained for future use over the 50-year period of analysis. Compared to the No Action Alternative, alternative C5/S5 (Recommended Plan/NER Plan) would delay the conversion of important and essential vegetated barrier habitats to open water habitats over the 50-year period of analysis.

The ecology of the barrier shoreline assemblages of plants and animals is complex including a broad range of arthropods, benthic, sea turtles, insects, mammals, shore birds and wading birds, as well as large flocks of skimmers, terns, and gulls. Many of these plants and animals are adapted to the routine tidal inundation and overwash. However, storm surges can devastate some animal populations. Dean (2002) report that the Perdido Key beach mouse, and endangered species, was completely annihilated following Hurricane Frederic (1979), and was only re-established through transplanting animals from another area. The renourshment via feeder berm will benefit the headland both to the east and west as longshore transport nourishes the beach profile and adds width to the shoreline. The added width will afford protection to the back barrier habitats by attenuating wave run-up and thus reducing storm damage. The restored and periodically renourished beach and dune system will thereby afford greater protection and habitat than one that continues to erode.

5.8.2.1.3 Cumulative Impacts

Compared to the No Action Alternative, cumulative impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be the synergistic effects of restoring a net total of 1,684 acres of important and essential wildlife barrier habitats over the 50-year period of analysis. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a barrier island-like habitat (sand spits) usable by various fish and wildlife species. These impacts would be in addition to the incremental impacts associated with the restoration of other Louisiana barrier systems used by many different species of wildlife (see **Table 5-4**). The net gain in barrier habitats used by many different species of wildlife would be in contrast to the continued long-term significant loss of wildlife habitats that would continue, to varying degrees, for the remaining 251 miles (404 km) of Louisiana barrier shorelines along the Gulf of Mexico.

5.8.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.8.2.2.1 Direct Impacts

Compared to the No Action Alternative, implementing alternative C5 would restore a total of 2,066 acres of essential and critical wildlife habitats on the Caminada Headland (**Table 5-4**). There would be no restoration of Shell Island. Direct impacts would be similar to those described for alternative C5/S5 except Shell Island direct impacts on wildlife resources would be similar to those described under the No Action Alternative.

5.8.2.2.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5 would be the restoration of a net total of 990 acres of essential and critical wildlife habitats with 988.3 AAHUs on the Caminada Headland (**Table 5-4**). Other indirect impacts to the Caminada Headland would be similar to those described for the Caminada Headland under alternative C5/S5 (Recommended Plan/NER Plan). Indirect impacts of this alternative to Shell Island would be similar to those described under the No Action Alternative.

5.8.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: the synergistic interaction of the effects of implementing the Caminada Headland restoration with a benefit of 990 acres(400 ha) of essential and critical wildlife habitats over the 50-year project period of analysis with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-4**. The cumulative impacts to Shell Island would be similar to those described under the No Action Alternative.

5.9 FISHERIES RESOURCES

5.9.1 No Action Alternative (Future Without-Project Conditions)

The analysis for Future Without-Project conditions and Future With conditions for fisheries resources relied on predictions of land loss, barrier and marsh habitat changes, and consideration of seasonal habitat changes (e.g., freshwater discharge, salinity, and temperature variation). Other factors, such as the impacts of habitat changes elsewhere in a species' range, cannot be predicted and were not considered in these projections.

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on fisheries resources. Existing conditions would persist. Without implementation of proposed coastal barrier restoration, the loss of the barrier systems and coastal wetlands throughout coastal Louisiana in general, and the study area in particular, would continue to adversely impact essential spawning, nursery, nesting, and foraging habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms (personal communication NMFS letter dated June 15, 2005). Direct impacts to fisheries may result from events such as hypoxia, red tides, or tropical storms and hurricanes; but are expected to be smaller in comparison to indirect impacts. Indirect impacts to fisheries may result from the expected continuation of land loss and further loss of habitat supportive of estuarine and marine fishery species. In the short-term, land loss and predicted sea level changes are

likely to increase open water habitats available to marine species. In the long-term, as open water replaces barrier and wetland habitats and the extent of marsh to water interface begins to decrease, fishery productivity is likely to decline (Rozas and Reed 1993; Minello et al. 1994). 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 years to 105 years.

Other considerations on the Future Without-Project impacts to fisheries are predator/prey relationships; water quality, salinity, and temperature; harvest rates; wetland development activities (dredge/fill); habitat conversion (e.g., wetland to open water); 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. 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, especially since the widespread impacts of Hurricane Katrina. This increased interest 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 as land loss continues, existing fisheries habitat may directly convert from 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 is likely 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 would follow if marsh loss continues and the overall value of the area as fisheries habitat would 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 would experience a decline in the long-term and a shift in the area of greatest productivity. Although the conversion of marsh into open water would 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 would 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.

The Coast 2050 Report (1999) indicates that populations of most major commercially important fish and invertebrate species in the Shell Island area (Barataria Barrier Island/Barataria Barrier Shoreline mapping unit) and the Caminada Headland area (Fourchon and Fourchon Shoreline mapping units) are expected to decline in the study area over the next 50 years. For all mapping units, data shows that most of the estuarine dependent assemblage (red and black drum, spotted seatrout, Gulf menhaden, white and brown shrimp, and blue crab) and the estuarine resident assemblage (American oyster) have shown decreasing trends over the last 10 years to 20 years in this unit. The same trends are predicted to occur into the future. Only Spanish mackerel populations are expected to increase.

In response to the 2010 Deepwater Horizon oil spill the barrier berm project was initiated in an attempt to protect Louisiana's coastal marshes from being severely impacted by oil. The sand berm project required 19.7 million CY of material to be dredged primarily from Hewes Point and then placed at various re-handling sites further impacting Gulf waterbottoms and benthic resources. In the vicinity of the Shell Island component; berm number W8 has currently received approximately 1.3 million CY of sandy fill material. This material is placed in a linear fashion and is stacked with a slope of approximately 25:1.

Impacts to the existing conditions are not known at this time. As this sand berm is reworked by tidal forces impacts to water depth or sediment composition could result in the project area. It is believed that as this sand berm is reworked it will provide a barrier island-like habitat (sand spits) usable by various fish species.

Other direct, indirect, and cumulative impacts related to the 2010 Deepwater Horizon oil spill are still being determined. It is likely that these impacts would be similar to previous oil spill impacts. For example, a study conducted on the Amoco Cadiz spill in 1978 revealed that "light oil" resulted in considerable detrimental impacts to the benthic communities. However, a separate study revealed that the benthic organisms were contaminated, but were not adversely impacted, from a spill of heavy crude (University of Delaware, 2010). In 2003, Donlan et al. assessed the impacts of the North Cape oil spill on communities of piping plover in Rhode Island. The study first examined the abundance of prey species on Moonstone Beach (the oiled island) and compared it to that of an adjacent, un-oiled beach (Goosewing). Although the abundance of benthic organisms was not significantly different between the two beaches, the species composition was considerably dissimilar. For example, only two Amphilporeia were found in the sampling station on Moonstone, compared to 456 at Goosewing. This reinforced the common belief that amphipods are the first group of organisms to disappear and one of the last to recolonize once exposed to oil.

Another example of previous oil spill impacts to nearshore demersal fisheries, that may be expected from the 2010 Deepwater Horizon spill, is described in Jewett et al. (2002). Between 1990 and 1995, Jewett et al. (2002) assessed the impacts of the Exxon Valdez oil spill on the benthic communities in Prince Williams Sound, Alaska. The metrics of the study included concentrations of hydrocarbons and benthic community composition, diversity, biomass, and abundance. These metrics were compared between a number of reference sites and oiled sites. The comparison was conducted in 1990 (approximately 16 months after the spill, 1991, 1993, and 1995. According to the authors, the "total abundance and biomass of epifauna were generally higher at oiled sites, primarily because of higher densities of epifaunal bivalves. Otherwise, there were few consistent community-wide responses to oiling in diversity, richness, total abundance, total biomass, or the abundances of major taxonomic groups (e.g. polychaetes or bivalves)." The lack of a stronger community-wide response was attributed to the varying sensitivities of benthic organisms. For example, oil-sensitive amphipods such as *Isaeidaes* and *Phoxocephalidaes* were found in lower concentrations at the oiled sites. These impacts were evident throughout the duration of the study (i.e. 6 years after the spill). However, stress-tolerant and opportunistic organisms such as polychaetes were found in higher concentrations at the oiled sites due to organic enrichment. The study also revealed that hydrocarbon concentrations in the sediment were high (up to 15,300 ng/g) in eel grass beds immediately adjacent to the oiled shorelines, but sharply declined after 1990 (Jewett et al.,1999). Although the benthic organisms and habitat types within Prince Williams Sound vary from that of the Project Area (eelgrass beds versus sand beds and mud flats), the study does provide an indication of the resiliency and recovery rates of benthic communities as a whole. Furthermore, the results of the study indicate that the species composition of the benthic communities is expected to shift as a result of the 2010 Deepwater Horizon oil spill. Additional impact to water bottoms and benthic organisms within coastal Louisiana resulted from the construction of the 83,258 lf sand berm designed to protect against the 2010 Deepwater Horizon Oil Spill.

5.9.2 Future With-Project Conditions

5.9.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.9.2.1.1 Direct Impacts

Direct impacts to fisheries resources would generally be associated with construction activities including dredging and placement of borrow material. Sessile or slow moving fisheries resources would likely suffer some mortality or injury during placement of shoreline protection and/or during dredging and placement of borrow material. Construction activities would temporarily increase turbidity, temperatures and biological oxygen demand (BOD); and decrease dissolved oxygen. These temporary conditions would likely displace more mobile fisheries species from the construction area. Following construction, displaced fisheries species would likely return to the project area.

The excavation of borrow material for restoration of the Caminada Headland and Shell Island would impact a total of 1,072 acres of water bottoms (**Table 5-6**). Increases in turbidity and temperature and a decrease in dissolved oxygen (DO) associated with these actions would be temporary and localized.

5.9.2.1.2 Indirect Impacts

Construction of alternative C5/S5 (Recommended Plan/NER Plan) would provide a net benefit of 1,684 acres of barrier habitats and 1,718.9 AAHUs compared to the No Action Alternative, which would provide important transitional estuarine/marine habitats and valuable EFH (**Table 5-4**). Restored barrier headlands and islands would provide habitats for foraging, breeding, spawning, and cover for a variety of larval, juvenile and adult fishes. A localized increase in biodiversity and some fish populations would be expected by the net increase of emergent wetlands constructed by alternative C5/S5 (Recommended Plan/NER Plan) compared to the No Action Alternative. More nutrients and detritus would be added to the food web, thereby increasing fish productivity and providing a benefit to local fisheries. Recreational activities, such as fishing, would also benefit from the increase in fish populations.

Renourishment of the Caminada Headland would have short-term adverse impacts to fisheries resources, primarily due to dredging and placement operations. For example, Palmer et al. (2008) reported significant sand-mining related declines in macrofaunal abundance, biomass, and diversity within coastal Louisiana. Condrey and Gelpi (2010) report that sand mining may have negative impacts on spawning blue crabs on Ship Shoal and that sand-mining disturbance and subsequent reduction in available macrofauna prey would result in negative effects on spawning blue crab health and fecundity. Specifically, Condrey and Gelpi (2010) indicate that sand mining on the Ship/Trinity/and Tiger Shoal Complex (STTSC) is expected to result in some decline in blue crab fecundity and condition factor through a reduction in food supply. In addition, increases in suspended sediments associated with sand mining may increase the mortality of crab larvae. Condrey and Gelpi (2010) further indicate that sand mining practices which minimize these potentially negative impacts should be carefully considered, along with regulations which will protect the contribution these crabs make to the stability of Louisiana's traditional inshore fishery. A continuance of the cautious approach to sand mining being exhibited by MMS for the STTSC is recommended by Condrey and Gelpi (2010), given the possibility that fecundity of blue crab on the STTSC becomes seasonally limited by prey abundance under prevailing natural conditions.

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland for a total estimated 39 million over the 50-year period of analysis. Renourishment material would be placed unconfined at approximately 100 to 300 feet from the existing shoreline in a "feeder berm" thereby allowing longshore transport and wave action to move and redistribute the sediment along the headland both to the east and the west. However, any such impacts would be of short-duration (about 36 days of actual dredge material pumping over about 70 day period) during renourishment events. The total net gulf shoreline erosion rate is approximately 926,000 CY per year with an overwash rate of 547,000 CY/year that is captured in the back barrier marsh. Approximately 300,000 CY/year is lost to Belle Pass; with the remaining 83,000 CY/year lost to Grand Isle. Hence fisheries resources off the Caminada Headland are adapted to the movement of material through longshore transport.

The long-term sustainability of local fisheries would be more likely with implementation of alternative C5/S5 (Recommended Plan/NER Plan) than in the No Action Alternative. Increased productivity, as a result of increased vegetated barrier habitats would provide indirect benefits to fisheries through an increase in the energy inputs into the food web of the ecosystem in this area.

Louisiana has an extensive and productive oyster lease program, compared to other states, providing more than 50 percent of the Nation's oyster harvest (USACE 2004). Implementation of alternative C5/S5 (Recommended Plan/NER Plan) would be expected to indirectly benefit local oyster populations. Restoration of transitional habitats would provide higher quality habitats that would better sustain and maintain local oyster populations as compared to the No Action Alternative.

5.9.2.1.3 Cumulative Impacts

Cumulative impacts would be the synergistic effect with the additive combination of impacts and benefits for overall net acres restored by other Federal, state, local, and private restoration efforts (**Table 5-5**). Alternative C5/S5 (Recommended Plan/NER Plan) would synergistically interact with other Federal, state, local, and private restoration efforts (**Table 5-5**) providing important and essential transitional wetland habitats thereby increasing the base of the existing food web and providing a positive benefit to local area fisheries.

Louisiana's oyster lease program provides more than 50 percent of the Nation's oysters. Hence, any project that impacts oyster resources in Louisiana would impact nationwide oyster harvest, in addition to impacting the contribution of this industry to the local, state, and national economy (USACE 2004). However, oyster populations are anticipated to benefit from implementing not only alternative C5/S5 (Recommended Plan/NER Plan), but other larger-scale coastal restoration efforts.

Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a barrier island-like habitat (sand spits) usable by various fish and wildlife species.

5.9.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.9.2.2.1 Direct Impacts

Direct impacts of implementing alternative C5 would be similar to alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: excavation of borrow material for restoration of the

Caminada Headland would impact a total of 649 acres of waterbottoms (**Table 5-6**). Shell Island would not be restored.

5.9.2.2.2 Indirect Impacts

Indirect impacts of implementing alternative C5 would be similar to alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: construction of alternative C5 would provide a net benefit of 990 acres of barrier habitats and 988.3 AAHUs (**Table 5-6**). Shell Island would not be restored.

5.9.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: construction of alternative C5 would provide a net benefit of 990 acres of barrier habitats and 988.3 AAHUs (**Table 5-6**). Cumulative impacts on Shell Island would be similar to those described for the No Action Alternative.

5.10 ESSENTIAL FISH HABITAT (EFH)

5.10.1 No Action Alternative (Future Without-Project Conditions)

The analysis for Future Without-Project conditions and Future With conditions for EFH relied on predictions of land loss, barrier and marsh habitat changes, and consideration of seasonal habitat changes (e.g., freshwater discharge, salinity, and temperature variation). Other factors, such as the impact of habitat changes elsewhere in a species' range cannot be predicted and were not considered in these projections.

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on EFH. Existing conditions would persist. Without implementation of the proposed coastal barrier restoration, the continued loss of barrier and wetland habitats throughout the study area would continue to adversely impact essential spawning, nursery, nesting, and foraging habitats for commercially and recreationally important species of finfish and shellfish, as well as other aquatic organisms (personal communication NMFS letter dated June 15, 2005).

Restoration of portions of the Barataria barrier shoreline (e.g., CWPPRA project BA-30 East/West Grand Terre Island Restoration; and, BA-38 Barataria Barrier Island Complex Project) would restore unique and important barrier habitats and help maintain a diversity of different categories of EFH throughout the Barataria barrier system. However, the cumulative impacts of barrier island loss, conversion of existing EFH, sea level change, increased storm intensity, and other natural perturbations are expected to lead to a decrease in the diversity of EFH most supportive of estuarine and marine species (see **Table 4-19**). 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-like, and more marine-like.

Marsh loss associated with the degradation phase of the Mississippi deltaic plain has increased the land/water interface and fishery production and productivity (Gagliano and van Beek 1975; and Neill and Deegan 1986). However, as the delta degradation phase continues, biological diversity and productivity also eventually declines. 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 Recommended Plan/NER Plan, 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 for the remaining subaerial categories of 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 study area to support Federally-managed species.

In response to the 2010 Deepwater Horizon spill the barrier berm project was initiated in an attempt to protect Louisiana's coastal marshes from being severely impacted by oil. In the vicinity of the Shell Island component; berm number W8 has currently received approximately 1.3 million CY of sandy fill material. This material is placed in a linear fashion and is stacked with a slope of approximately 25:1. Impacts to the existing conditions are not known at this time. As this sand berm is reworked by tidal forces impacts to water depth or sediment composition could result in the project area. It is believed that as this sand berm is reworked it will provide a barrier island-like habitat (sand spits) usable by various fish species.

5.10.2 Future With-Project Conditions

5.10.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments Direct Impacts

5.10.2.1.1 Direct Impacts

Implementing alternative C5/S5 (Recommended Plan/NER Plan) would restore a total of 2,849 acres of shallow open water and fragmented barrier habitats to higher quality and more continuous transitional barrier habitats. This increase in barrier habitat acreage would provide important and essential transitional wetland habitats used by fish and wildlife for spawning, nursery, foraging, cover, and other life requirements. Increased vegetation growth and productivity would also reduce inter- and intra-specific competition between resident and migratory fish and wildlife species for limited coastal vegetation resources.

Direct impacts of construction activities would result in the conversion of existing shallow open water and fragmented barrier wetland EFH into more continuous transitional emergent wetlands thereby increasing the quality of EFH in the Caminada Headland and Shell Island.

Increases in turbidity, coupled with a slight increase in temperature and biological oxygen demand (BOD), and decreased dissolved oxygen associated with construction activities would be temporary and localized. Although existing EFH would be initially negatively impacted, such impacts would be offset by the restoration of transitional barrier habitats, which are considered a higher-quality EFH.

Table 5-8 presents the number of acres of existing habitat types converted to other habitat types following implementation of the proposed action. For the Caminada Headland the number of acres of existing water bottoms converted to Gulf subtidal equals 223 acres, converted to beach equals 58 acres, converted dune equals 231 acres, converted to supratidal equals 0 acres, and converted to marsh equals 413 acres. The number of acres of existing marsh on the Caminada Headland converted to Gulf subtidal equals 0 acres, converted to beach equals 0 acres, converted to dune equals 101 acres, converted to supratidal equals 103 acres, and converted to (remain) marsh equals 773 acres.

Table 5-8. Number of acres of existing habitats converted to other habitat types following implementation of the proposed action.

Caminada Headland		
EFH Habitat Types	**Existing Acres (TY 0)**	**Converted Acres (TY1)**
Existing Open Water	925 ac	Gulf subtidal = 223 ac Beach (Gulf intertidal) = 58 ac Dune = 231 ac Supratidal = 0 ac Marsh = 413 ac
Existing Marsh	977 ac	Gulf subtidal = 0 ac Beach (Gulf Intertidal) = 0 ac Dune = 101 ac Supratidal = 103 ac Marsh = 773 ac
Shell Island		
Existing Open Water	773 ac	Gulf subtidal = 0 ac Beach (Gulf intertidal) = 53 ac Dune = 152 ac Supratidal = 164 ac Marsh = 404 ac
Existing Marsh	10 ac	Gulf subtidal = 0 ac Beach (Gulf intertidal) = < 1 ac Dune = <1 ac Supratidal = 2 ac Marsh = 8 ac

For Shell Island the number of acres of existing water bottoms converted to Gulf subtidal equals 0 acres, converted to beach equals 53 acres, converted dune equals 152 acres, converted to supratidal equals 164 acres, and converted to marsh equals 404 acres. The number of acres of existing marsh on Shell Island converted to Gulf subtidal equals 0 acres, converted to beach equals < 1 acre, converted to dune equals < 1 acre, converted to supratidal equals 2 acres, and converted to (remain) marsh equals 8 acres.

The acreage of various EFH habitats expected to remain subaerial by 2050.

For the Caminada Headland the total number of acres equals 2,492 acres at TY0. These acres evolve to a total of 1,023 acres: comprised of 245 acres of gulf intertidal, 345 acres of supratidal, and 433 acres of

marsh at 2050. For Shell Island the total number of acres equals acres at TY0. These acres evolve to a total of 469 acres: comprised of 48 acres of beach, 148 acres of supratidal, 0 acres of dune, and 273 acres of marsh.

5.10.2.1.2 Indirect Impacts

The restoration of a net total of 1,684 acres of transitional barrier wetlands with about 1,718.9 AHHUs would improve the quality of some categories of EFH including essential nursery habitats for many fishery species. Increases in turbidity, coupled with a slight increase in temperature and biological oxygen demand (BOD), and decreased dissolved oxygen associated with renourishment and feeder berm construction activities would be temporary and localized. Alternative C5/S5 (Recommended Plan/NER Plan) would not only increase the areal extent of EFH, but would also improve the quality of transitional barrier wetland habitats used by fish for spawning, nursery, forage, cover, and other life requirements. An increase in the acreage of transitional habitat between estuarine and marine environments would result in decreased inter- and intra-specific competition between resident and migratory fish species and would sustain a larger variety and greater diversity of species. Some of these species serve as prey to others; therefore, predator populations may be indirectly enhanced as compared to the No Action Alternative.

Potential impacts of small scale sand mining on biological and physical interactions, such as EFH, have been investigated by several researchers including Kobashi and Stone (2009); Gelpi et al., (2009); Dubois et al., (2009); and Stone et al. 2009. Kobashi and Stone (2009) indicate substantial scientific uncertainties still exist as to whether and how significant depth changes (i.e. sand mining), sediment size and composition affect shoal bio-physical interactions as well as benthic biological habitats. Kobashi and Stone (2009) and Kobashi et al., (2009) conclude that large-scale sand mining that causes abrupt changes in bathymetry would have a profound impact on shoal physical and biological processes and is not recommended. Whereas, small scale sand mining (e.g., removal of about 5 million CY of sands for restoration of the Caminada Headland) is expected not to cause significant adverse impacts on the physical or biological processes. These researchers caution, however, that post-mining monitoring is crucial as substantial scientific uncertainties still exist.

5.10.2.1.3 Cumulative Impacts

Cumulative impacts would be the synergistic effect of restoring a net total of 1,684 acres and 1,718.9 AAHUs with the additive combination of impacts and benefits for overall net acres of barrier habitats restored by other Federal, state, local, and private restoration efforts (**Table 5-4**). Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill will provide a barrier island-like habitat (sand spits) usable by various fish species. Alternative C5/S5 (Recommended Plan/NER Plan) would work synergistically with those projects to provide higher quality EFH.

5.10.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.10.2.2.1 Direct Impacts

Direct impacts of implementing alternative C5 would be similar to alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: excavation of borrow material for restoration of the Caminada Headland would impact a total of 649 acres of waterbottoms. Shell Island would not be restored.

5.10.2.2.2 Indirect Impacts

Indirect impacts of implementing alternative C5 would be similar to alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: construction of alternative C5 would provide a net benefit of 990 acres of barrier habitats and 988.3 AAHUs. Shell Island would not be restored.

5.10.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: construction of alternative C5 would provide a net benefit of 990 acres of barrier habitats and 988.3 AAHUs. Cumulative impacts on Shell Island would be similar to those described for the No Action Alternative.

5.11 WATER BOTTOMS AND BENTHIC RESOURCES

5.11.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on water bottom and benthic resources. Existing conditions would persist. Very little information relative to water bottoms and benthic biology of Ship Shoal is available. The Minerals Management Service, now BOEMRE, funded a project to design a comprehensive physical and biological monitoring program for sand mining activities in the U.S. outer continental shelf including Ship Shoal (Nairn et al. 2004).

The patterns of benthic seasonal abundance in the Barataria system are not clear. Peak abundances and lowest abundances occur at different times in the different salinity regimes and may be correlated to the salinity pattern of a particular area or the migratory patterns of estuarine dependent predators (Conner and Day 1987). 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 the salinity regime, sediment characteristics, oxygen levels, detritus, desiccation, extreme ranges in temperatures, dissolved oxygen, and current velocity.

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, as land loss continues and the study area becomes more open to the gulf, it is expected that benthic community species diversity would increase throughout the study area. In contrast, benthos numerical abundance would likely decrease as the habitat becomes more saline (Philomena 1983). However, this may be moderated by changes in the operation of the Davis Pond diversion, currently being discussed by the state, which could potentially freshen the upper portions of the study area, especially in the Caminada Headland area.

Meiofauna, nematodes, and harpacticoid copepods would likely continue to be abundant in the study area. In sandy sediments of the beach face, interstitial meiofauna would likely continue to dominate. High densities of meiofauna in intertidal mud flats would likely continue. Burrowing meiofauna would likely continue to dominate in the aerobic zone of muddy sediments. The numerical density of the macrobenthic fauna would likely continue to remain low in the lower portions of the Barataria basin (Conner and Day 1987). Polychaetes and nemerteans would likely continue to be prevalent in brackish and marine environments (Philomena 1983).

The effects of oil on the health of benthic communities can be both acute and chronic in nature. According to the USFWS, oil can be directly toxic to these organisms or impact them through physical smothering, altering metabolic and feeding rates, and altering shell formation. Intertidal benthic communities may be particularly vulnerable when oil becomes highly concentrated in narrow bands along the shoreline (USFWS, 2004). Barnacles and other sessile species are vulnerable to smothering by heavy oils while the physiological effects of the hydrocarbons can considerably reduce the mobility of the more mobile species (University of Delaware, 2010). Additionally, sediments can become reservoirs for the spilled petroleum. Some benthic invertebrates can survive the initial exposure, but may accumulate high levels of contaminants in their bodies that can be passed on to predators (USFWS, 2004).

The magnitude of the potential impacts is also a function of the characteristics of oil spilled. For example, a study conducted on the Amoco Cadiz spill in 1978 revealed that "light oil" resulted in considerable detrimental impacts to the benthic communities. However, a separate study revealed that the benthic organisms were contaminated, but were not adversely impacted, from a spill of heavy crude (University of Delaware, 2010). In 2003, Donlan et al. assessed the impacts of the North Cape oil spill on communities of piping plover in Rhode Island. The study first examined the abundance of prey species on Moonstone Beach (the oiled island) and compared it to that of an adjacent, un-oiled beach (Goosewing). Although the abundance of benthic organisms was not significantly different between the two beaches, the species composition was considerably dissimilar. For example, only two Amphilporeia were found in the sampling station on Moonstone, compared to 456 at Goosewing. This reinforced the common belief that amphipods are the first group of organisms to disappear and one of the last to recolonize once exposed to oil. Between 1990 and 1995, Jewett et al. assessed the impacts of the Exxon Valdez oil spill on the benthic communities in Prince Williams Sound, Alaska. The metrics of the study included concentrations of hydrocarbons and benthic community composition, diversity, biomass, and abundance.

These metrics were compared between a number of reference sites and oiled sites. The comparison was conducted in 1990 (approximately 16 months after the spill, 1991, 1993, and 1995. According to the authors, the "total abundance and biomass of epifauna were generally higher at oiled sites, primarily because of higher densities of epifaunal bivalves. Otherwise, there were few consistent community-wide responses to oiling in diversity, richness, total abundance, total biomass, or the abundances of major taxonomic groups (e.g. polychaetes or bivalves)." The lack of a stronger community-wide response was attributed to the varying sensitivities of benthic organisms. For example, oil-sensitive amphipods such as Isaeidaes and Phoxocephalidaes were found in lower concentrations at the oiled sites. These impacts were evident throughout the duration of the study (i.e. 6 years after the spill. However, stress-tolerant and opportunistic organisms such as polychaetes were found in higher concentrations at the oiled sites due to organic enrichment. The study also revealed that hydrocarbon concentrations in the sediment were high (up to 15,300 ng/g) in eel grass beds immediately adjacent to the oiled shorelines, but sharply declined after 1990 (Jewett et all, 1999). Although the benthic organisms and habitat types within Prince Williams Sound vary from that of the Project Area (eelgrass beds versus sand beds and mud flats), the study does provide an indication of the resiliency and recovery rates of benthic communities as a whole. Furthermore, the results of the study indicate that the species composition of the benthic communities is expected to shift as a result of the 2010 Deepwater Horizon oil spill.

Additional impacts to water bottoms and benthic organisms within coastal Louisiana resulted from the construction of the 83,258 lf sand berm designed to protect against the 2010 Deepwater Horizon oil spill. The sand berm project required 19.7 million CY of material to be dredged primarily from Hewes Point and then placed at various re-handling sites further impacting Gulf waterbottoms and benthic resources.

5.11.2 Future With-Project Conditions

5.11.2.1.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments Direct Impacts

A total of 26,506,500 CY of borrow material would be required for implementing alternative C5/S5 (Recommended Plan/NER Plan). This would directly impact a total of 1,070 acres of water bottoms (**Table 5-6**). Placement of this borrow material for barrier habitat restoration would cover approximately 2,849 acres of shallow open water and existing fragmented barrier habitats. Placement of renourishment material would cover about 52 acres immediately offshore (about 100 feet to 300 feet) from the shoreline near Bayou Moreau. These actions would directly impact and destroy any slow-moving or sessile benthic organisms found within the proposed borrow areas, and intertidal footprints of the restoration sites. More mobile benthic species utilizing these areas would likely be displaced to more suitable habitats. Other direct impacts to the benthos would be localized and confined to construction areas. However, the prolific nature of the benthic community is expected to in rapid re-colonization of substrates once construction is completed.

5.11.2.1.2 Indirect Impacts

Indirect impacts to benthic resources would be related primarily to disturbance of water bottoms during placement of shoreline protection features and also during dredging and placement of borrow material. Short-term disturbance to benthic species would likely occur from increased turbidity, temperature and biological oxygen demand (BOD); and decreased dissolved oxygen due to hydraulic dredging, marsh creation, and placement of shoreline protection activities. Some smothering of benthic organisms may also occur from the resettlement of the dredge plume, but these impacts would be minimized through the use of silt curtains or other construction measures to minimize dredging impacts. Indirect impacts would be generally localized and temporary. Waters would return to ambient conditions following construction.

Dredging activities would cause temporary habitat degradation to existing waterbottoms used by benthos for various life requirements. Any such impacts would initially cause increased inter- and intra-specific competition between various benthic species for nearby available habitat resources. There could also be a shift in species composition to those benthic species more tolerant of disturbance. However, any such impacts would be temporary as benthos would likely quickly re-colonize areas disturbed by dredging activities. Actions taken to reduce potential impacts during construction could include the use of silt curtains and retention dikes to minimize the effects of runoff, overland flow, and sediment movement and erosion into adjacent waterways and marshes. These measures could also help to restrict the extent of increases in turbidity and suspended particulates to the immediate construction area.

Transitional barrier habitats restored by alternative C5/S5 (Recommended Plan/NER Plan) would indirectly benefit benthic resources by providing increased dissolved organic compounds and detritus that would, in turn, provide food and energy resources for benthic organisms. This would eventually increase local epifauna which, in turn, would help reduce turbidity, regenerate ammonia and phosphorous, and serve as important sources of food for birds, nekton, and people (Day et al. 1989).

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland for a total estimated 39 million CY over the 50-year period of analysis. Renourishment material would be placed unconfined at approximately 100 to 300 feet from the existing shoreline, near Bayou Moreau, in a "feeder berm" of about 52 acres thereby allowing longshore transport

and wave action to move and redistribute the sediment along the headland both to the east and the west. However, any such impacts would be of short-duration (about 36 days) during renourishment events.

5.11.2.1.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be the synergistic effect with the additive combination of impacts and benefits for overall net acres restored by other Federal, state, local, and private restoration efforts (**Table 5-4**). Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill required 19.7 million CY of material dredged primarily from Hewes Point and then placed at various re-handling sites further impacting Gulf waterbottoms and benthic resources.

Alternative C5/S5 (Recommended Plan/NER Plan) would work synergistically with those projects to provide critical and essential transitional barrier habitats, which provide energy inputs to the benthic food web.

Project-induced impacts totaling 1,070 acres of water bottoms and 2,849 acres of fragmented barrier habitats and the benthic organisms therein would be in addition to the impacts to benthic resources and their habitats caused by other wetland creation/nourishment and shoreline protection actions. However, any such impacts would be offset by the additional higher quality habitats restored, which would likely result in a net increase in benthic resources.

5.11.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.11.2.2.1 Direct Impacts

Direct impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with following exceptions: a total of 10,500,500 CY of borrow material would be required for implementing alternative C5. This would directly impact a total of 649 acres of water bottoms including 315 acres at Ship Shoal and 334 acres at the Caminada Headland near shore Gulf of Mexico borrow site. Placement of this borrow material for barrier habitat restoration would cover 2,066 acres of shallow open water and existing fragmented barrier habitats. There would be no restoration of Shell Island.

5.11.2.2.2 Indirect Impacts

Indirect impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: a total of 649 acres of waterbottoms would be directly impacted as a source of borrow for restoration of a net total of 990 acres of restored barrier habitats. There would be no restoration of Shell Island.

5.11.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: the synergistic interaction of the effects of implementing the Caminada Barrier Headland restoration would directly impact a total of 2,066 acres of water bottoms and those benthic organisms that utilize these areas. However, over the 50 year period of analysis the positive impacts associated with restoring a net total of 990 acres of barrier habitats would be combined with the additive combination of impacts and benefits for net acres restored by other

Federal, state, local, and private restoration efforts as summarized in **Table 5-4**. There would be no restoration of Shell Island.

5.12 PLANKTON RESOURCES

5.12.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on plankton resources. Existing conditions would persist. Plankton populations continue respond to changes in environmental conditions (Day et al. 1989). In particular, changes in salinity and nutrients can result in changes in plankton abundance and community structure. In the future, human population growth in Louisiana would likely 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 storm water runoff and application of fertilizers could increase over time as well, thus increasing the nutrient load on coastal waterbodies.

Increased nutrient concentrations would likely cause further deterioration of water quality in eutrophic lakes and bays, at times resulting in algal blooms, some of which could be noxious. Blooms are often characterized by a shift in community structure towards dominance by one or several species. Increased flows would shift the plankton community, displacing the marine species in favor of the freshwater species.

Indirect impacts of not implementing wetland creation/nourishment and shoreline protection features would result in the persistence of existing conditions including the continued degradation and eventual loss of wetlands. This loss of wetlands would eventually result in a decrease of available nutrients and detritus, which could lead to the conversion of primarily estuarine-dependent plankton species assemblages to more marine and open water plankton species assemblages.

Cumulative impacts would be the synergistic effect of the No Action Alternative on plankton resources with the additive combination of similar wetland degradation and wetland loss impacts to plankton resources throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects (**Table 5-4**).

5.12.2 Future With-Project Conditions

5.12.2.1.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments Direct Impacts

There would be localized and short-term adverse impacts, including mortality of some plankton populations, due to construction activities associated with placement of shoreline protection features, dredging and placement of borrow. During construction, there would be a localized and short-term decrease in available dissolved oxygen; an increase in turbidity, temperature and biological oxygen demand (BOD). Following construction and dredging operations, the area would return to ambient conditions and be re-colonized by plankton populations. Existing shallow open water and fragmented barrier habitats would be converted to 2,849 acres of beach, dune, supratidal and intertidal habitats (**Table 5-4**). Protection, creation, and nourishment of transitional barrier habitats would enhance and increase, to some undetermined level, aquatic productivity and nutrient transformation functions.

5.12.2.1.2 Indirect Impacts

During periodic renourishment, there would be a localized and short-term decrease in available dissolved oxygen; an increase in turbidity, temperature and biological oxygen demand (BOD). Following renourishment operations (over a 60 – 70 day duration with about 35 days of actual dredging operations), the area would return to ambient conditions and be re-colonized by plankton populations. An increase in the export of dissolved organic compounds and detritus from the created and nourished barrier habitats would benefit local plankton populations by increasing the planktonic food web. Some local plankton populations would be displaced and there would be a long-term loss of some shallow open water habitats in the project area due to construction project features. However, there is an abundance of shallow open water habitat throughout the project area for use by planktonic resources. Renourishment operations on the Caminada Headland would have little, if any impacts, on piping plovers or other shorebirds that utilize the shallow beach waters for foraging for benthic and other organisms.

5.12.2.1.3 Cumulative Impacts

Cumulative impacts to plankton resources of implementing alternative C5/S5 (Recommended Plan/NER Plan) would primarily be associated with the incremental impacts of similar wetland creation, nourishment, and shoreline protection features. Cumulative impacts would be the synergistic effect with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local, and private restoration efforts (**Table 5-4**). Implementing alternative C5/S5 (Recommended Plan/NER Plan) would synergistically interact with these other restoration projects to provide important and essential energy inputs to the planktonic food web throughout coastal Louisiana.

5.12.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.12.2.2.1 Direct Impacts

Direct impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) except existing shallow open water and fragmented barrier habitats would be converted to 2,066 acres of beach, dune, supratidal and intertidal habitats. In addition, there would be no restoration of Shell Island.

5.12.2.2.2 Indirect Impacts

Indirect impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) except there would be no restoration of Shell Island.

5.12.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) except there would be no restoration of Shell Island.

5.13 THREATENED AND ENDANGERED SPECIES

5.13.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on listed (threatened or endangered) species or their critical habitat within the study area.

Existing conditions would persist; listed species would likely continue to be subject to institutional recognition and further regulations. Indirect impacts of not implementing barrier restoration would result in the continued degradation and loss of important and essential fish and wildlife transitional estuarine-marine barrier habitats used by many different fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The continued deterioration and loss of transitional barrier habitats would impact, to some undetermined degree, those listed species that presently utilize the project area including: Gulf sturgeon, green sea turtle, hawksbill sea turtle, Kemp's Ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, piping plover and its critical habitat, and the West Indian manatee. Major threats to the recently de-listed brown pelican including chemical pollutants, colony site erosion, disease and human disturbance (personal communication USFWS, May 11, 2009), would likely continue in the project area threatening this recovering population. Major threats to the piping plover including the loss and degradation of habitat due to development, disturbance by humans and pest, and predation (personal communication USFWS, May 11, 2009) would likely continue. Adverse cumulative impacts on listed species would be offset, to some degree, by the positive impacts of implementing other state and Federal barrier and other restoration projects detailed in **Table 5-3**.

Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill required 19.7 million CY of material dredged primarily from Hewes Point and then placed at various re-handling sites before final construction of protective sand berms thereby primarily impacting sea-turtles. The extent of these impacts are, as of yet, undetermined.

5.13.2 Future With-Project Conditions

5.13.2.1 C5/S5 (Recommended Plan/NER Plan) Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island 5 – One Island with Two Re-nourishments

5.13.2.1.1 Direct Impacts

The Recommended Plan/NER Plan would not impact or otherwise jeopardize the continued existence of any listed species or destroy or adversely modify critical habitat of any listed species with the following exceptions: the threatened piping plover, and piping plover designated critical habitat.

Threatened Piping Plover (*Charadrius melodus*)

The threatened piping plover winters in Louisiana for 8 months to 10 months, from late July until late March or April. Piping plovers regularly use the beach habitat along the Caminada Headland; however, there are no records of piping plovers using the remnant Shell Island. Construction duration of proposed restoration would be approximately 2.5 years, pending local weather conditions.

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland for a total estimated 39 million CY over the 50-year period of analysis. Renourishment material would be placed unconfined at approximately 100 to 300 feet from the existing shoreline in a "feeder berm" thereby allowing longshore transport and wave action to move and redistribute the sediment along the headland both to the east and the west. Hence, proposed restoration activities on the Caminada Headland would likely occur while piping plovers are present. Potential project-induced direct impacts would consist of temporary displacement to nearby suitable habitats and temporary loss of benthic prey species smothered within the project footprint during construction activities. However, there are suitable habitats nearby into which piping plovers can disperse, including

Belle Pass West, the easternmost sand spit of Elmer's Island, Grand Isle, and East Grand Terre Island. Impact from the proposed action would be temporary and would help to stabilize the rapidly retreating and eroding Caminada Headland. Because temporary impacts to the piping plover's forage availability from the Recommended Plan/NER Plan, MVN has determined the Recommended Plan/NER Plan would be likely to adversely affect the piping plover. Early consultation with the USFWS regarding this determination has been initiated, and review of a Biological Assessment (appendix D) for the Recommended Plan/NER Plan as part of early consultation under provisions of the Endangered Species Act of 1073 (87 Stat. 884, as amended; 16 U.S.C 1531 et seq.) by the USFWS is currently underway.

Designated Critical Habitat for the Threatened Piping Plover (*Charadrius melodus*)

On July 10, 2001, the USFWS designated critical habitat for the wintering range of piping plovers and described the primary constituent elements essential for their conservation (**Federal Register** Volume 66, No. 132). Approximately 10.25 miles of the Caminada Headland is located within Unit LA-5 of the piping plover critical habitat designated in Louisiana. The Shell Island reach is not located within designated critical habitat for the piping plover. The primary constituent elements for piping plover critical 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. Designated piping plover critical habitat along the Caminada Headland includes the gulf shoreline extending approximately 6.8 miles east from the east side of Belle Pass bounded on the seaward side by the MLLW (mean low low water) and on the landward side to where densely vegetated habitat, not used by the piping plover begins and where the primary constituent elements no longer occur. This also include s Elmer's Island peninsula where the primary constituent elements occur to MLLW and the gulf shoreline from Elmer's Island to approximately 0.56 mile west of Bayou Thunder Von Trane bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the primary constituent elements no longer occur (Federal Register, Volume 66, No. 132, page 36127).

By choosing to restore the Caminada Headland and Shell Island the MVN understands that there would be the potential for temporary project-induced impacts that may result during construction activities, but our modeling projects indicate that the initial construction and supplemental nourishment impacts will be significantly less than the detrimental impacts of allowing the unique habitat features within the project area to continue to degrade. The MVN has determined that approximately 485 acres (29 acres of dune, 356 acres of supratidal, and 100 acres of gulf intertidal) of critical habitat on the Caminada Headland within designated Unit LA -5 could be temporarily affected by the Recommended Plan/NER Plan. Temporary project induced impacts to designated critical habitat would include construction activities within roosting and foraging habitat and smothering of the benthic community within foraging habitat. Construction duration of proposed restoration would be approximately 2.5 years, pending local weather conditions. Hence, proposed restoration activities on the Caminada Headland would likely occur while piping plovers are present on designated critical wintering grounds.

The temporary project-induced impacts of implementing alternative C5/S5 would be offset by restoration of a total of 2,849 acres including 1,197 acres of dune and supratidal habitat and 1,652 acres of bayside intertidal marsh habitat on the Caminada Headlands and Shell Island. Without this restoration it is estimated, that the shoreline will have rolled back and most of the available habitat within the project area will be gone. Also, though piping plovers are not known to utilize the remnant portions of Shell Island, it is believed that the restoration efforts proposed along Shell Island will restore the barrier islands ability to provide the primary constituent elements necessary for over-wintering piping plovers.

CEMVN understands that though the proposed feeder beach renourishment on the Caminada Headland and the larger Shell Island alternative components of the BBBS project will likely benefit the piping

plover and its critical habitat, the temporary impacts to plover habitat and its critical habitat, will temporarily adversely impact the species. Because of impacts from the Deepwater Horizon and because this project will be occurring concurrently with other restoration projects in the project area we believe the proposed action is *"likely to adversely affect"* the species. A detailed analysis of piping plover their critical habitat can be found in our Biological Assessment in **Appendix D**. Formal coordination has been completed for project components within USACE jurisdiction. The USFWS provided their final Biological Opinion dated December 21, 2011, (see appendix D) and provide the following:

> *Because the Corps does not anticipate conducting any significant changes in the proposed action that would require re-initiation of formal consultation and no significant change has occurred regarding the information used during the preliminary biological opinion, the Service confirms that the September 30, 2011, preliminary biological opinion is now a final biological opinion for the proposed action. We have enclosed a copy of that finalized biological opinion for your convenience.*
>
> *No further ESA consultation with the Service is required for the proposed action. As provided in 50 Cod*[e] *of Federal Regulations (CFR)§402.15, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take (i.e., the 18.42 miles of Gulf shoreline described in the September 30, 2011, biological opinion) is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in the opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instance where the amount or extent of incidental take is exceeded, any operations causing such take shall cease pending reinitiation.*

5.13.2.1.2 Indirect Impacts

Potential project-induced indirect impacts would consist of temporary displacement to nearby suitable habitats and temporary loss of benthic prey species within the project footprint. Renourishment operations would be conducted from 100 to 300 feet from the existing shoreline. Temporary indirect impacts to the piping plover and other species that forage in the intertidal zone would include a reduction in the abundance and diversity of benthic prey species which would be smothered by renourishment sediments as they washed on to the shoreline. Benthic prey species smothered by restoration activities would naturally recolonize the area within 6 months to 2 years post-construction. These impacts would be offset by restoration of a net total of 990 acres of barrier habitats on the Caminada Headland, thereby increasing critical wintering habitat for piping plovers as well as potential foraging and loafing habitat for other shore birds such as terns, gulls, skimmers, and pelicans over the 50 year period of analysis.

5.13.2.1.3 Cumulative Impacts

Compared to the No Acton alternative, cumulative impacts of implementing alternative C5/S5 would be the synergistic effects of restoring a net total of 990 acres of barrier habitats used as critical wintering habitat by piping plover; foraging, loafing, and other habitats by brown pelican and other listed species over the 50-year period of analysis. Construction of the 83,258 lf protective sand berm against the 2010 Deepwater Horizon oil spill required 19.7 million CY of material dredged primarily from Hewes Point and then placed at various re-handling sites before final construction of protective sand berms thereby primarily impacting sea-turtles. The extent of these impacts are as of yet undetermined. Proposed action-related impacts would be in addition to the incremental impacts associated with the restoration of other Louisiana barrier systems used by piping plover, brown pelican and other listed species (see **Table 5-5**).

The net gain in barrier habitats used by many different species of wildlife would be in contrast to the continued long-term significant loss of wildlife habitats that would continue, to varying degrees, for the remaining 251 miles (404 km) of Louisiana barrier shorelines along the gulf.

5.13.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.13.2.2.1 Direct Impacts

Compared to the No Action Alternative, implementing alternative C5 would restore a total of 2,286 acres of important and critical wildlife habitats on the Caminada Headland (**Table 5-4**). There would be no restoration of Shell Island. Direct impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) except Shell Island direct impacts on listed species and their critical habitat resources would be similar to those described under the No Action Alternative.

5.13.2.2.2 Indirect Impacts

Compared to the No Action Alternative, indirect impacts of implementing alternative C5 would be the restoration of a net total of 990 acres of important and critical wildlife habitats on the Caminada Headland (**Table 5-3**). Other indirect impacts to the Caminada Headland would be similar to those described for the Caminada Headland under alternative C5/S5. Indirect impacts of this alternative to Shell Island would be similar to those described under the No Action Alternative.

5.13.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: the synergistic interaction of the effects of implementing the Caminada Headland restoration with a benefit of 990 net acres (0 ha) of important and critical habitats over the 50-year project period of analysis with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-5**. The cumulative impacts to Shell Island would be similar to those described under the No Action Alternative.

5.14 HISTORIC AND CULTURAL RESOURCES

5.14.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative (Future Without-Project Conditions), not implementing coastal barrier system restoration, would have no direct impacts on historic or cultural resources. Existing conditions would persist for proposed restoration of the Caminada Headland and Shell Island as well as to the proposed borrow sites; including Ship Shoal, the near-shore sand bodies and the Mississippi River borrow sites near Nairn, Louisiana.

Under the No Action Alternative (Future Without-Project Conditions), Shell Island has experienced significant erosion and degradation over the past 50 years. Consequently, any archaeological resources and associated context that once may have been on the Shell Island have likely been destroyed. Four archaeological sites were recorded within the project footprint along the Caminada Headland shoreline prior to Hurricanes Katrina and Rita (2005). All four recorded sites, one of which was eligible for inclusion into the National Register of Historic Places, have since been destroyed or lost due to the 2005 hurricanes as well as more recent Hurricanes Gustav and Ike (2008). Indirect impacts of not

implementing proposed coastal barrier system restoration on the Caminada Headland and Shell Island would result in continued coastal barrier land loss, thereby potentially exposing cultural resources and resulting in their damage or destruction. Cumulatively, the continued coastal barrier land loss and resultant damage or destruction of cultural resources and archeological sites would continue not only within the study area, but across the entire Louisiana coastal area.

Under the No Action Alternative (Future Without-Project Conditions), Ship Shoal, a bathymetric feature located offshore central Louisiana, would not be dredged from designated polygons Blocks 12, 13 and 88. While there are no known archaeological sites in these blocks, any potential archaeological sites would remain largely undisturbed from proposed dredging activities. However, direct and indirect impacts to cultural resources in this area would likely continue to result from oil and gas exploration and extraction activities and pipeline construction. Cumulative impacts resulting from the potential loss of cultural resources on Ship Shoal due to oil and gas exploration and extraction activities and pipeline construction on Ship Shoal would be in addition to impacts to cultural resources at other offshore potential sand borrow sites.

Under the No Action Alternative (Future Without-Project Conditions) the Caminada Headland and Shell Island nearshore sand bodies would likely continue to be subjected to natural forces and disruption of the near-shore gulf water bottoms as well as dredging or other sand extraction activities for coastal restoration projects (e.g., CWPPRA projects). In addition, oil and gas exploration and extraction and pipeline construction would likely continue thereby further risking disturbance, damage and potential destruction of any cultural resources in these areas. Cumulative impacts resulting from the potential loss of cultural resources on near shore sand bodies due to likely continued oil and gas exploration and extraction activities, pipeline construction, and dredge borrow activities would be in addition to impacts to cultural resources at other nearshore potential sand borrow sites.

Under the No Action Alternative (Future Without-Project Conditions), the Mississippi River water bottoms would likely continue to be regularly utilized for civil works and other project borrow material as well as subject to navigation maintenance dredging, and effects of annual flooding events. Such activities could likely result in potential direct and indirect impacts resulting in the damage, destruction, loss or obscurity of potentially unknown cultural sites in and along the Mississippi River. Potential impacts to identified cultural resource targets 13, 30, 31, 32 and other known cultural resources in the area would likely be avoided by human activities. However annual flooding events, especially significant flood events, could also damage, destroy, and bury, obscure or even move further downstream potentially unknown cultural sites. An intensive field investigation identified 40 acoustic and 100 magnetic anomalies. At present, none of these anomalies represent significant submerged cultural resources. Analysis of this data indicates the presence of four possible pipelines and two abandoned wells or platforms. These sites should also be avoided. Cumulative impacts to cultural resources within the Mississippi River would include impacts at the proposed Nairn, Louisiana borrow sites as well as the continued use of Mississippi River bottoms as a source for borrow for civil works and other projects, as well as navigation maintenance dredging, and annual flooding events.

5.14.2 Future With-Project Conditions

5.14.2.1.1 Alternative C5/S5 (Recommended Plan/NER Plan): Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.14.2.1.2 Direct Impacts

Alternative C5/S5 (Recommended Plan/NER Plan) would have no direct impacts to cultural resources within the Caminada Headland, Shell Island restoration sites or the proposed Ship Shoal, nearshore gulf borrow sites or the Mississippi River borrow area near Nairn, Louisiana.

Cultural resource investigations for the Caminada Headland yielded four archeological sites during survey investigations. Two of these archeological sites have been destroyed by pipeline construction. An intact shell midden, considered eligible for the National Register of Historic Places, was recorded in the general study area but is located outside of the proposed Caminada Headland restoration footprint. Another cultural site discovered during the 2005 cultural resources survey was considered eligible for the National Register of Historic Places, but has been completely destroyed by recent storms (Hurricanes Gustav and Ike (2008).

Alternative C5/S5 (Recommended Plan/NER Plan) would have no direct impacts to cultural resources on Shell Island, as the cultural integrity of the area has been compromised due to continued coastal land loss.

There are no submerged cultural resources at the proposed borrow areas 12, 13, and 88 on Ship Shoal. Hence, there would be no direct impacts from implementing alternative C5/S5 (Recommended Plan/NER Plan).

Cultural resource surveys of the Mississippi River borrow areas have identified four cultural resource targets (target #13, #30, #31 and #32) that may represent significant submerged cultural resources (tentatively identified as shipwrecks). These targets would be avoided during dredging operations.

Remote sensing surveys are generally highly effective at identifying submerged cultural resources. However, the possibility of encountering an unidentified and unanticipated submerged cultural resource, however unlikely, is always present during construction and dredging activities. In the event that significant cultural resources are encountered in the location of the construction site, work at that location would be halted, and a MVN archeologist and the State Historic Preservation Office (SHPO) would be notified for further consultation. An Unanticipated Discovery Plan will be included in the construction and dredging plans and specifications.

5.14.2.1.3 Indirect Impacts

Indirect impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be the protection of existing cultural resources located further inland on the Caminada Headland area. There would be no indirect impacts on cultural resources on Shell Island as cultural resources that may have been present have lost integrity and have eroded into open water. There are no submerged cultural resources at the proposed borrow areas 12, 13, and 88 on Ship Shoal or at the nearshore Caminada Headland and Empire borrow areas. Hence, there would be no indirect impacts to cultural resources at these offshore. Indirect impacts to cultural resource targets (target #13, #30, #31 and #32) identified in the Mississippi River borrow area would be avoid direct Impacts

5.14.2.1.4 Cumulative Impacts

Cumulative impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would be the additive combination of impacts to cultural resources by this and other Federal, state, local, and private restoration efforts (**table 5-4**). Alternative C5/S5 (Recommended Plan/NER Plan) would work synergistically with other restoration projects to provide critical and essential barrier headlands and islands, which, in turn, would provide some protection to cultural resources that may otherwise be damaged or lost due to coastal land loss.

5.14.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.14.2.2.1 Direct Impacts

The direct impacts to cultural resources would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan). Impacts to Shell Island would be similar to No Action Alternative.

5.14.2.2.2 Indirect Impacts

The indirect impacts to cultural resources would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan). Impacts to Shell Island would be similar to No Action Alternative.

5.14.2.2.3 Cumulative Impacts

The cumulative impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) except the cumulative impacts to Shell Island would be similar to those described under the No Action Alternative.

5.15 SOCIOECONOMIC AND HUMAN RESOURCES

The purpose of this section is to review the direct, indirect, and cumulative impacts on significant economic resources of each restoration alternative, including the Recommended Plan/NER Plan, carried over for detailed analysis compared to taking no Federal action. A comparison of restoration alternatives among significant environmental resources is presented in **Table 3-9**. **Table 5-2** summarizes cumulative impacts of significant socio-economic and human resources. Reference to compliance with Executive Order 12898 regarding environmental justice is described below and in section 8.1.1.11.

5.15.1 Population

5.15.1.1 No Action Alternative (Future Without-Project Conditions)

The project area is remote and uninhabited. Hence, there would be no direct, indirect, or cumulative impacts of the No Action Alternative on human populations. Not implementing barrier restoration features would result in the persistence of existing conditions. The project area is remote and uninhabited.

5.15.1.2 Future With-Project Conditions

5.15.1.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.1.3.1 Direct Impacts:

There is no population residing within the project area, and the Recommended Plan/NER Plan would have no direct effects outside the project area.

5.15.1.3.2 Indirect Impacts:

There is no population residing within the project area, and the Recommended Plan/NER Plan would have no indirect effects outside the project area.

5.15.1.3.3 Cumulative Impacts:

There is no population residing within the project area, and the Recommended Plan/NER Plan would have no cumulative effects outside the project area.

5.15.1.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.1.4.1 Direct Impacts:

There is no population residing within the project area, and alternative C5 would have no direct effect outside the project area.

5.15.1.4.2 Indirect Impacts:

There is no population residing within the project area, and alternative C5 would have no indirect effect outside the project area.

5.15.1.4.3 Cumulative Impacts:

There is no population residing within the project area, and alternative C5 would have no cumulative effect outside the project area.

5.15.2 Infrastructure

5.15.2.1 No Action Alternative (Future Without-Project Conditions)

The project area is remote and uninhabited. Existing infrastructure primarily includes oil and gas pipelines; jetties (Belle Pass and Empire); and along the Caminada Headland near Port Fourchon, the segmented breakwater and cement-filled geotextile and concrete mattress shoreline protection. The effects of continued land loss and degradation would lead to increased costs for maintaining and repairing existing infrastructure.

5.15.2.2 Future With-Project Conditions

5.15.2.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.2.3.1 Direct Impacts:

Implementing this alternative for Caminada Headlands would cover the existing exposed shoreline protection feature (cement-filled geotextile bags and concrete mattress) near Port Fourchon as well as cover over any buried pipelines. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.). Implementing this alternative for Shell Island would cover over any buried pipelines in the protected areas. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.).

5.15.2.3.2 Indirect Impacts:

Implementing this alternative for Caminada Headlands would have an indirect impact on existing infrastructure in the project area by protecting to some undetermined level the Port Fourchon port facility and adjoining fuel storage facilities. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.). Implementing this alternative for Shell Island provides an undetermined indirect level of storm impact reduction protection. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.).

5.15.2.3.3 Cumulative Impacts:

Implementing this alternative for Caminada Headlands would have a cumulative impact on existing infrastructure in the project area by protecting, to some unknown level, the Port Fourchon port facility and adjoining fuel storage facilities. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.). Implementing this alternative for Shell Island would have a cumulative impact on existing infrastructure in the project area by protecting, to some unknown level, the Port Fourchon port facility and adjoining fuel storage facilities. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.).

5.15.2.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.2.4.1 Direct Impacts:

Implementing this alternative would cover the existing exposed shoreline protection feature (cement-filled geotextile bags and concrete mattress) near Port Fourchon as well as cover over any buried pipelines. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.).

5.15.2.4.2 Indirect Impacts:

Implementing this alternative would have an indirect impact on existing infrastructure in the project area by protecting to some undetermined level the Port Fourchon port facility and adjoining fuel storage facilities. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.).

5.15.2.4.3 Cumulative Impacts:

Implementing this alternative would have a cumulative impact on existing infrastructure in the project area by protecting, to some unknown level, the Port Fourchon port facility and adjoining fuel storage facilities. Construction practices would be implemented to avoid and minimize any potential construction-related impacts to existing infrastructure (e.g., pipelines, etc.).

5.15.3 Employment and Income

5.15.3.1 No Action Alternative (Future Without-Project Conditions)

The project area is remote and uninhabited. There is no population within the project area; consequently there would be no direct impacts to employment or income in the project area. However, indirect and cumulative impacts of the No Action Alternative on employment and income would primarily be related to some undetermined declines in commercial and recreational fisheries and oyster leases due to the continued loss and degradation of aquatic and essential fish habitats.

5.15.3.2 Future With-Project Conditions

5.15.3.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.3.3.1 Direct Impacts:

Implementing this alternative would directly impact (fill) several existing oyster leases as outlined in section 5.16.5.

5.15.3.3.2 Indirect Impacts:

Implementing this alternative would provide indirect benefits to commercial and recreational fisheries by increasing the quantity and quality of essential fish habitat necessary for nursery and other aquatic life

functions. In addition this alternative prevent existing oyster leases from being directly exposed to the higher saline waters of the gulf as outlined in section 5.16.5. It would further provide an additional level of protection for commercial and recreational water craft operating on the Empire Waterway.

5.15.3.3.3 Cumulative Impacts:

Implementing this alternative would provide a cumulative effect on the level of protection to existing oyster leases as outlined in section 5.16.5. It would further provide an additional level of protection for commercial and recreational water craft operating on the Empire Waterway.

5.15.3.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.3.4.1 Direct Impacts:

Implementing this alternative would provide a direct effect on the level of protection to existing oyster leases as outlined in section 5.16.5.

5.15.3.4.2 Indirect Impacts:

Implementing this alternative would provide an indirect effect on the level of protection to existing oyster leases as outlined in section 5.16.5.

5.15.3.4.3 Cumulative Impacts:

Implementing this alternative would provide a cumulative effect on the level of protection to existing oyster leases as outlined in section 5.16.5.

5.15.4 Environmental Justice

5.15.4.1 No Action Alternative (Future Without-Project Conditions)

No minority and/or low-income communities have been identified in the study area, per 2000 U.S. Census information and requirements of E.O. 12898 that would be adversely impacted by the No Action Alternative. Therefore, no disproportionately high or adverse human health or environmental effects on minority or low-income populations would occur.

5.15.4.2 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune With Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.2.1 Direct:

Under the Recommended Plan/NER plan, no direct impacts on human health or environmental effects within the study area would occur.

5.15.2.2 Indirect:

Under the Recommended Plan/NER Plan, no indirect impacts on human health or environmental effects within the study area would occur.

5.15.2.3 Cumulative:

There would be no adverse cumulative impacts on minority and/or low-income communities as none have been identified within the study area per 2000 U.S. Census information and requirements of E.O. 12898. Rather, the LCA BBBS would contribute toward achieving and sustaining a coastal ecosystem that would support and protect the environment, local economy and culture of the region.

5.15.5 Commercial Fisheries

5.15.5.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on commercial fisheries. Existing conditions would persist. The continued wetland habitat losses within the study area, combined with widespread coastal wetland loss throughout coastal Louisiana, would contribute to the overall decrease in productivity of Louisiana's coastal fisheries. Louisiana provides more fishery landings than any other state in the conterminous United States (more than 1.1 billion pounds/year), and more than 75 percent of Louisiana's commercially harvested fish and shellfish species are dependent on wetlands (http://lamer.lsu.edu/projects/oceancommotion/facts.htm). Wetland habitat losses in the study area would contribute to the overall decrease in productivity of these fisheries throughout the coastal Louisiana area. For example, menhaden depend upon the estuary for a critical stage in their life cycle.

As much as 16 percent of the nation's fisheries' harvests, including shrimp, crabs, crawfish, oysters, and many finfish, come from Louisiana's coast. (http://lamer.lsu.edu/projects/oceancommotion/facts.htm). The seafood industry would likely suffer significant losses in employment as estuaries that are necessary to produce shrimp, oysters, and other valuable species, continue to erode. Job losses would likely occur in the areas reliant on fishing, harvesting, processing, and shipping of the seafood catch.

The seafood industry would also likely suffer significant losses in employment as natural 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.

5.15.5.2 Future With-Project Conditions

5.15.5.3 Alternative C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.5.3.1 Direct Impacts:

Implementing this alternative would have a short term direct impact on commercial fishing activity within the project area during the period of construction. The seafood industry would have to operate away from

the construction area and would suffer a temporary loss of revenue until the disruption on marine life is abated.

5.15.5.3.2 Indirect Impacts:

Implementing this alternative would provide an indirect impact on localized commercial fishing activity resulting from an increase in the quality and quantity of seafood attracted to an environmentally friendly habitat.

5.15.5.3.3 Cumulative Impacts:

Implementing this alternative would have a cumulative impact of increasing environmentally friendly habitat for seafood development along this area and other restoration project areas. This would result in an increase in seafood production, increased fishing activity and improved employment opportunity for commercial fisheries.

5.15.5.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.5.4.1 Direct Impacts:

Implementing this alternative would have a short term direct impact on commercial fishing activity within the project area during the period of construction. The seafood industry would have to operate away from the construction area and would suffer a temporary loss of revenue until the disruption on marine life is abated.

5.15.5.4.2 Indirect Impacts:

Implementing this alternative would provide an indirect impact on localized commercial fishing activity resulting from an increase in the quality and quantity of seafood attracted to an environmentally friendly habitat.

5.15.5.4.3 Cumulative Impacts:

Implementing this alternative would have a cumulative impact of increasing environmentally friendly habitat for seafood development along this area and other restoration project areas. This would result in an increase in seafood production, increased fishing activity and improved employment opportunity for commercial fisheries.

5.15.6 Oyster Leases

5.15.6.1 The No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on oyster leases (see **Table 5-7** and **Figure 5-12**). Existing conditions would persist. Indirect impacts would include continued coastal barrier land loss and associated increases in salinities making these areas unsuitable for oyster cultivation. Cumulative impacts would be the eventual loss of barrier habitats which, in turn, would result in increased salinity conditions making these areas unsuitable for the viable culture of oysters.

5.15.6.2 Future With-Project Conditions

5.15.6.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.6.3.1 Direct Impacts:

Direct impacts to oyster leases (**Figure 5-12**) would be primarily related to construction activities and would include disruption of water bottoms due to the placement of dredged material. Other direct impacts during construction could include disturbance and/or mortality due to increased turbidity, temperature and biological demand, and decreased dissolved oxygen. The proposed action would impact approximately 904 acres and 24 leases on Shell Island and 170.5 acres and 8 leases on the Caminada Headland.

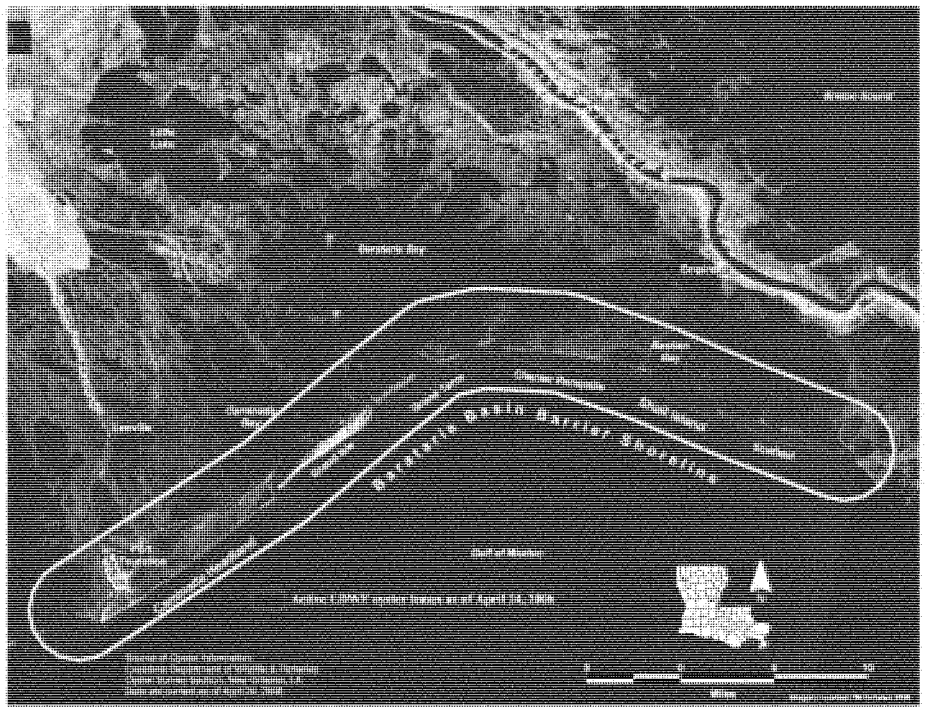


Figure 5-12. Oyster leases (source: http://sonris-www.dnr.state.la.us/www_root/sonris_portal_1.htm).

5.15.6.3.2 Indirect Impacts:

There would be minimal, localized indirect impacts to oyster leases in areas where construction occurs, due to increased turbidity and siltation caused by construction. Barrier restoration of a net total of 1,684 acres would provide important habitat, increase the availability of catabolic products utilized by primary producers which can then be used by oysters and other species (Kilgen and Dugas 1989). Hence, the restoration of barrier habitats in the project area would likely benefit the detritus-based food web of the oyster and thereby increase the local carrying capacity and yields for oyster leases.

5.15.6.3.3 Cumulative Impacts:

Cumulative impacts of this alternative would be the synergistic effect of implementing alternative C5/S5 (Recommended Plan/NER Plan) with a net total of 1,684 acres of barrier habitats and the additive combination of impacts and benefits for overall net acres restored by other Federal, state, local, and private restoration efforts as summarized in **table 5-4**. Louisiana has lost approximately 1,900 square miles of coastal wetland resources, including marsh and barrier islands, since the 1930s (Dunbar et al. 1992; Barras et al. 1994; Barras et al. 2003). Approximately 10 percent of Louisiana's remaining coastal wetlands would be lost at a rate of approximately 6,600 acres per year resulting in an additional net loss of 328,000 acres by 2050 (Barras et al. 2003). The conversion of coastal wetlands to shallow open waters have provided an opportunity for increased habitat for oyster leases. However, the overall oyster lease acreages for the State of Louisiana have continually increased from 1959 to 2001 with the exception of the1979-80 oyster season. Following 2001 the oyster lease acreage totals began to decline with a sharp decrease in 2004 (source (http://oysterweb.dnr.state.la.us/oysterable.htm).

5.15.6.4 Alternative C5: Caminada 5 – Preferred Dune With Expanded Marsh with Re-nourishment

5.15.6.4.1 Direct Impacts:

Direct impacts to oyster leases on Caminada Headland would include disruption of water bottoms due to the placement of dredged material and rocks. Other direct impacts during construction could include disturbance and/or mortality due to increased turbidity, temperature and biological demand, and decreased dissolved oxygen. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.6.4.2 Indirect Impacts:

There would be minimal, localized indirect impacts to oyster leases in areas where construction occurs on the Caminada Headland, due to increased turbidity and siltation caused by construction. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.6.4.3 Cumulative Impacts:

Cumulative impacts of this alternative would affect a relatively small percentage of active leases on the Caminada Headland. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.15.7 Oil, Gas, and Minerals

5.15.7.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on oil, gas or mineral resources. Indirect impacts of not implementing the barrier restoration would result in the continued deterioration of existing conditions.

5.15.7.2 Future With-Project Conditions

5.15.7.3 Alternative C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.7.3.1 Direct Impacts:

Implementing these alternatives would have no direct impact of protecting oil, gas and mineral reserves located in the immediate vicinity.

5.15.7.3.2 Indirect Impacts:

Implementing these alternatives would have the cumulative impact of protecting oil and gas reserves located at Port Fourchon by reducing the impact of coastal deterioration, thereby increasing protection from future storm surges.

5.15.7.3.3 Cumulative Impacts:

Implementing these alternatives would have the cumulative impact of protecting both covered and exposed pipelines by providing an additional layer of soil protection, thereby increasing protection from future storm surges.

5.15.7.4 Alternative C5: Caminada 5 – Preferred Dune With Expanded Marsh with Re-nourishment

5.15.7.4.1 Direct Impacts:

Implementing these alternatives would have the no direct impact of protecting oil, gas and mineral reserves located in the immediate vicinity of the Caminada Headland. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.7.4.2 Indirect Impacts:

Implementing these alternatives would have the cumulative impact of protecting oil and gas reserves located at Port Fourchon by reducing the impact of coastal deterioration, thereby increasing protection from future storm surges. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.7.4.3 Cumulative Impacts:

Implementing these alternatives would have the cumulative impact of protecting both covered and exposed pipelines on the Caminada Headland by providing an additional layer of soil protection, thereby increasing protection from future storm surges. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.15.8 Pipelines

5.15.8.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on pipelines. Indirect impacts of not implementing the barrier restoration would result in the continued deterioration of existing conditions.

5.15.8.2 Future With-Project Conditions

5.15.8.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune With Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.8.3.1 Direct Impacts:

Covering existing pipelines would have the direct impact of covering any existing pipelines in the project areas, providing additional protection against storm surges.

5.15.8.3.2 Indirect Impacts:

Covering existing pipelines would provide some undetermined level of protection for exposed pipelines, and would provide additional protection for all pipelines from storm surges.

5.15.8.3.3 Cumulative Impacts:

Implementing these alternatives would have the cumulative impact of protecting both covered and exposed pipelines by providing an additional layer of soil protection, thereby increasing protection from future storm surges.

5.15.8.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.8.4.1 Direct Impacts:

Covering existing pipelines would have the direct impact of covering any existing pipelines in the Caminada Headland project areas, providing additional protection against storm surges. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.8.4.2 Indirect Impacts:

Covering existing pipelines would provide some undetermined level of protection for exposed pipelines, and would provide additional protection for all pipelines on the Caminada Headland project area from storm surges. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.8.4.3 Cumulative Impacts:

Implementing these alternatives would have the cumulative impact of protecting both covered and exposed pipelines on the Caminada Headland project area by providing an additional layer of soil protection, thereby increasing protection from future storm surges. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.15.9 Navigation

5.15.9.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative would impact navigation on Bayou Lafourche and the Empire Canal as protection of the land mass deteriorates. Continued deterioration would require increased maintenance due to nearby project areas eroding into the channel and Gulf of Mexico. As deterioration continues, shoreline erosion would result in existing jetties becoming unattached to the shoreline, reducing or eliminating their effectiveness.

5.15.9.2 Future With-Project Conditions

5.15.9.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.9.3.1 Direct Impacts:

Implementing this alternative would not likely have any long term direct impact to waterways. However, there would be a short term direct impact due to construction limiting the movements of vessels to Bayou Lafourche and the Empire Canal. No direct impacts anticipated for renourishment of the Caminada Headland.

5.15.9.3.2 Indirect Impacts:

Implementing this alternative would have an indirect impact on commercial and recreational vessel traffic by some undetermined level during construction on the Bayou Lafourche and the Empire Canal.

The Caminada Headland would be renourished with approximately 650,000 CY of maintenance dredged material removed from the Bayou Lafourche navigation channel every 1.5 to 2 years. Over each 10 year period, an estimated 3.9 million CY of material from six dredging cycles (650,000 CY per cycle) will be returned to the headland for a total estimated 39 million CY over the 50-year period of analysis. Maintenance dredged material from the Bayou Lafourche navigation channel is presently being beneficially used for preventing the Belle Pass jetties from being flanked and for maintenance of the integrity of the Gulf shoreline adjacent to the Belle Pass jetties. Use of maintenance dredged material

from Bayou Lafourche for renourishment of the Caminada Headland could result in a shortage of material that might be required to maintain the adjacent Gulf shoreline.

If maintenance dredged material from the Bayou Lafourche navigation channel is not used for renourishment of the Caminada Headland, then the benefits associated with placement of approximately 10 million CY of material over the 50 year period of analysis onto the Caminada Headland would not be realized.

5.15.9.3.3 Cumulative Impacts:

Implementing this alternative would have a cumulative impact on commercial and recreational vessel traffic by some undetermined level during construction on the Bayou Lafourche and the Empire Canal. Cumulative impacts associated with renourishment of the Caminada Headland could include a shortage of dredge material to adequately maintain the Bayou Lafourche navigation channel in the event the Belle Pass jetties are flanked, resulting is possible induced shoaling. If dredge material is not provided for renourishment to the Caminada Headland, then the LCA BBBS project would not meet the calculated benefits associated with 10 million CY of renourishment to the Caminada Headland.

5.15.9.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.9.4.1 Direct Impacts:

Implementing this alternative would not likely have any long term direct impact to waterways. However, there would be a short term direct impact due to construction limiting the movements of vessels to Bayou Lafourche. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.9.4.2 Indirect Impacts:

Implementing this alternative would have an indirect impact on commercial and recreational vessel traffic by some undetermined level during construction on the Bayou Lafourche. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.9.4.3 Cumulative Impacts:

Implementing this alternative would have a cumulative impact on commercial and recreational vessel traffic by some undetermined level during construction on the Bayou Lafourche. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.15.10 Flood Control

5.15.10.1 No Action Alternative (Future Without-Project Conditions)

The project area is remote and uninhabited; there are no flood control levees in the area. The No Action Alternative would result in the persistence of existing trends including the continued degradation of the land area, conversion of existing wetlands to open water habitats, and the continued erosion and sloughing of the shoreline.

5.15.10.2 Future With-Project Conditions

5.15.10.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.10.3.1 Direct Impacts:

Implementing this alternative would have the direct impact of protecting the shoreline from continued degradation of the land area and protecting the landmass from continued erosion and sloughing of the shoreline.

5.15.10.3.2 Indirect Impacts:

Implementing this alternative would have the indirect impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links.

5.15.10.3.3 Cumulative Impacts:

Implementing this alternative would have the cumulative impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links.

5.15.10.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.10.4.1 Direct Impacts:

Implementing this alternative would have the direct impact of protecting the shoreline from continued degradation of the land area and protecting the landmass from continued erosion and sloughing of the shoreline. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.10.4.2 Indirect Impacts:

Implementing this alternative would have the indirect impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.10.4.3 Cumulative Impacts:

Implementing this alternative would have the cumulative impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.15.11 Hurricane Risk Reduction Levees

5.15.11.1 The No Action Alternative (Future Without-Project Conditions)

The project area is remote and uninhabited; there are no hurricane risk reduction levees in the area. The No Action Alternative would result in the persistence of existing trends including the continued degradation of the land area, conversion of existing wetlands to open water habitats, and the continued erosion and sloughing of the shoreline.

5.15.11.2 Future With-Project Conditions

5.15.11.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.11.3.1 Direct Impacts:

Implementing this alternative would have the direct impact of protecting the shoreline from continued degradation of the land area and protecting the landmass from continued erosion and sloughing of the shoreline.

5.15.11.3.2 Indirect Impacts:

Implementing this alternative would have the indirect impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links.

5.15.11.3.3 Cumulative Impacts:

Implementing this alternative would have the cumulative impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links.

5.15.11.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh and with Re-nourishment

5.15.11.4.1 Direct Impacts:

Implementing this alternative would have the direct impact of protecting the shoreline from continued degradation of the land area and protecting the landmass from continued erosion and sloughing of the shoreline. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.11.4.2 Indirect Impacts:

Implementing this alternative would have the cumulative impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave

heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.11.4.3 Cumulative Impacts:

Implementing this alternative would have the cumulative impact of protecting the wetlands and vital land links from storm surges and erosion. While increasing the acreage would not reduce storm surge or wave heights in the area, it would have the effect of lowering storm surge impacts on existing wetlands and land links. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.15.12 Agriculture

5.15.12.1 No Action Alternative (Future Without-Project Conditions)

There are no agricultural activities within or nearby the study area. It is unlikely that any opportunities for agriculture would occur within the study area in the foreseeable future.

5.15.12.2 Future With-Project Conditions — All Alternatives

There are no agricultural activities within or nearby the study area. It is unlikely that any opportunities for agriculture would occur within the study area in the foreseeable future.

5.15.13 Forestry

5.15.13.1 No Action Alternative (Future Without-Project Conditions)

There are no forestry activities within or nearby the study area. It is unlikely that any opportunities for forestry would occur within the study area in the foreseeable future.

5.15.13.2 Future With-Project Conditions — All Alternatives

There are no forestry activities within or nearby the study area. It is unlikely that any opportunities for forestry would occur within the study area in the foreseeable future.

5.15.14 Water Supply

5.15.14.1 No Action Alternative (Future Without-Project Conditions)

There would be no direct, indirect, or cumulative impacts of the No Action Alternative on the water supply as this resource does not exist within the project area. Not implementing barrier restoration features would result in the persistence of existing conditions. The project area is remote and uninhabited.

5.15.14.2 Future With-Project Conditions

5.15.14.3 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh and with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.15.14.3.1 Direct Impacts:

There would be no direct impact on the water supplies in this area.

5.15.14.3.2 Indirect Impacts:

There would be no indirect impact on the water supplies in this area.

5.15.14.3.3 Cumulative Impacts:

There would be no cumulative impact on the water supplies in this area.

5.15.14.4 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.15.14.4.1 Direct Impacts:

There would be no direct impacts on the water supplies in this area. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.15.14.4.2 Indirect Impacts:

There would be no indirect impact on the water supplies in this area. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.15.14.4.3 Cumulative Impacts:

There would be no cumulative impact on the water supplies in this area. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.16 AESTHETIC RESOURCES

5.16.1 No Action Alternative (Future Without-Project Conditions)

The visual complexity surrounding the project area is related to its geomorphic structures including beach, dune, ridge and marsh. All of these elements are critical systems inclusive to the Barataria Basin barrier system. Together, all of these elements provide a pleasing aesthetic view shed to the public.

Without implementation of wetland creation and shoreline protection measures, continued bank line erosion and sloughing of the shoreline and conversion of existing fragmented wetlands to open water habitats would persist. Degradation of the land would convert existing view sheds of marsh, wetland, dune, and beach to more open water views.

Cumulative impacts may include the synergistic effects of the No Action Alternative on aesthetic (visual) resources with the additive combination of similar impacts from wetland loss and degradation throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity, as detailed in **Section 5.1.1 and Table 5-2 and Table 5-4.**

Lafourche/Terrebonne Scenic Byway

This linear viewpoint that delineates the northern portion of the study is located along State Route 1. It is the only road that allows access to (and storm evacuation from) the historical recreational setting that encompasses Grand Isle; thereby it is maintained accordingly. Computer modeling shows that land loss would also not affect this scenic byway or views into the project area.

Port Fourchon Public Beach Parking Area

Computer modeling predicts that land loss would cause this KOP found at the Port Fourchon Beach parking area located at the end of Louisiana Highway 3090 to cease to exist. Panoramic views to the south, southeast, and northwest would most likely be lost. View sheds typical of a beachfront recreational area, foreground views of near-shore breakwaters, back-beach dunes, the occasional shrub line and wetland grasses may also be lost. And, finally there is the potential for loss of the middle ground views of wetland areas broken up by Bay Champagne and small ponds, woody vegetation, and the Gulf of Mexico's marine environment.

5.16.2 Future With-Project Conditions

5.16.2.1.1 C5/S5 (Recommended Plan/NER Plan) Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments Direct Impacts

With the implementation of the Recommended Plan/NER Plan, C5/S5, the restoration of acreage (as prescribed in **Table 5-4**) to the Caminada Headland could greatly increase the visual interests in the area. Improved beach and dunes, mixed with some vegetation and marsh could enhance the intrinsic scenic quality of the drive along Louisiana Highway 1. This mixture of physical environmental elements creates borders and frames for potential views to the Gulf of Mexico and other inland water features which act as the focal point to any given scene.

Shell Island is much more remote and not as visually significant to the public as the Caminada Headland. Visual impacts would be minimal to the public view shed.

5.16.2.1.2 Indirect Impacts

Indirect impacts to aesthetic (visual) resources may include increased traffic volumes along State Route 1 and increased tourism. These increased traffic volumes, while good for the local and state economies, may bring bad tidings for the ecosystem due to increased foot traffic and human interference in the repaired environment.

No Indirect impacts to aesthetic (visual) resources would be expected at the Shell Island (East or West) project area. This is due to the remote nature of the project area.

5.16.2.1.3 Cumulative Impacts

Long term negative impacts to aesthetic (visual) resources would result from the No Action Alternative, but not in the case of the Recommended Plan/NER Plan, C5/S5. The increase in land mass to the Caminada Headlands and Shell Islands East and West would increase visual quality and the potential for long term storm protection to coastal Louisiana. Not to mention some habitat restoration for wildlife and fisheries which also play a vital role in the "living landscape" and provide scale to critical view sheds.

Cumulative impacts could include a shortage of dredge material to adequately maintain the Bayou Lafourche navigation channel in the event the Belle Pass jetties are flanked, resulting is possible induced shoaling. If dredge material is not provided for renourishment to the Caminada Headland, then the LCA BBBS project would not meet the calculated benefits associated with 10 million CY of renourishment to the Caminada Headland. Similar projects across the Louisiana coast and across the nation would have long lasting, positive effects on the visual quality of similar environments.

5.16.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.16.2.2.1 Direct Impacts

Direct impacts to aesthetic (visual) resources in the Caminada Headlands would be similar to those proposed under the Recommended Plan/NER Plan, C5/ S5 plan. Direct impacts to Shell Island would be similar to the No Action Alternative.

5.16.2.2.2 Indirect Impacts

Indirect impacts to aesthetic (visual) resources in the Caminada Headlands would be similar to those proposed under the Recommended Plan/NER Plan, C5/ S5 plan. Indirect impacts to Shell Island would be similar to the No Action Alternative.

5.16.2.2.3 Cumulative Impacts

Cumulative impacts to aesthetic (visual) resources in the Caminada Headlands would be similar to those proposed under the Recommended Plan/NER Plan, C5/S5 plan. Cumulative impacts to Shell Island would be similar to the No Action Alternative.

5.17 RECREATIONAL RESOURCES

5.17.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on recreation resources. Existing conditions would persist. 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 No Action Alternative conditions 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 to 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 and 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).

Without action, the recreation needs identified by the SCORP for the Barataria Basin in general, and the study area in particular 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. Additionally, recreational use of beach areas on the Caminada Headland could decrease in the future due to continued erosion.

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.

5.17.2 Future With-Project Conditions

5.17.2.1 C5/S5 (Recommended Plan/NER Plan): Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments

5.17.2.1.1 Direct Impacts

This alternative would restore Shell Island to a single island that would be similar to the historic single island geomorphic configuration; provide 10-year advanced fill; and would also have a re-nourishment cycle of 20 years with two re-nourishment events over the period of analysis. Continued maintenance of the island would help to ensure its status as a recreation destination.

The primary direct impacts on recreational resources would result from the project area being temporarily unavailable during construction and re-nourishment activities. In addition, there would be a temporary decrease in the quality of recreational opportunities as the wetland creation and nourishment sites re-vegetates, usually within 9 months to 12 months, following completion of construction.

Recreational opportunities in the project area may increase with increased formulation of emergent marsh and other fish and wildlife habitats. An increase in habitat value would likely result in increased fish and wildlife usage of the project area.

Positive long-term benefits would be realized from the deposition of dredged material into shallow open water areas and onto eroding marsh which would become continuous, intermediate marsh. Marsh plants consisting of emergent and/or submergent vegetation would become established, complementing the already existing fish and wildlife habitat and future recreational activities in the area. Recreation fishing opportunities could increase due to the increase in fisheries habitat in the project area.

Restoration of the barrier island habitat would begin the process of returning the recreation visitor days to Caminada and Shell Island (via boat) that have been lost. Volunteer vegetation would become established, through seeds carried in bird droppings. Island restoration would slowly return the estuarine qualities to the edges of the island. The sport fishing success associated with shallow-water estuaries and intertidal areas would begin to re-establish. Land-based recreation including primitive camping, picnicking, bird watching, nature photography, etc., would slowly return. Future storms would continue to impact the island as others have in the past, causing erosion and loss of land.

In all, the Recommended Plan/NER Plan would support and sustain a number of wetland-dependent recreational opportunities, provide for a more stable localized recreation economy, and possibly increase local recreation-related employment and income.

5.17.2.1.2 Indirect Impacts

In the short-term, construction activities, including re-nourishment, would increase turbidity in the project area where work is being performed. This turbidity would disrupt most recreational activity occurring within the immediate vicinity of the area of work; however, these adverse impacts would be temporary and short-lived. In the long-term, areas around the project vicinity could also see an increase in wildlife-dependent recreation activities due to the proliferation of habitat in the project area. Recreation activities dependent upon wetland habitats would be maintained and possibly increased including: hunting, fishing, and bird watching.

With restoration of Shell and Camanada Islands, an increase in acreage would provide increased nesting, brood-rearing, and foraging habitat for resident and migrant avian species. In addition, wetland creation/nourishment would also help to increase and preserve important stopover habitat for neotropical migrants and wintering habitat for waterfowl. Both of these results would provide for an increase in recreational opportunities in fishing, hunting, and wildlife-viewing.

5.17.2.1.3 Cumulative Impacts

Cumulative impacts would be the synergistic interaction of the effects of implementing the Caminada Barrier Headland and Shell Island restoration with a net benefit of 1,684 acres over 50 years with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-4**. Recreational opportunities would be expected to improve due to the cumulative effects of marsh creation projects and other coastal restoration measures in the area of the Recommended Plan/NER Plan. Increased marsh habitat along with increased dune area would increase foraging habitat and provide for improved recreational fishing and hunting. Wildlife viewing should also improve because of the measures identified in **Table 5-4**. Coastal barrier land loss in Louisiana has been addressed, to some degree, by efforts under the CWPPRA program, and the beneficial use of dredged material requirements under Section 307 of the Coastal Zone Management Act of 1972, 16 U.S.C. 1451 *et. Seq.* (**Table 5-4**).

5.17.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.17.2.2.1 Direct Impacts

Compared to the No Action Alternative, implementing alternative C5 would restore a total of 2,066 acres on the Caminada Headland. There would be no restoration of Shell Island. Direct impacts would be similar to those identified for the Recommended Plan/NER Plan, but lesser due to dune and marsh restoration of only the Caminada Headland.

5.17.2.2.2 Indirect Impacts

Indirect impacts would be similar to those described for the Recommended Plan/NER Plan.

5.17.2.2.3 Cumulative Impacts

Cumulative impacts of implementing alternative C5 would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan) with the following exceptions: the synergistic interaction of the effects of implementing the Caminada Headland restoration with a benefit of 990 net acres over the 50-year project period of analysis with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts as summarized in **Table 5-4**. The cumulative impacts to Shell Island would be similar to those described under the No Action Alternative.

5.18 NOISE

5.18.1 No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on noise resources. Existing conditions would persist. 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. Localized and temporary noise impacts, such as commercial and recreational fishing boats and oil and gas exploration activities, would likely continue to affect animals and those humans that utilize the study area.

There would be no direct, indirect, or cumulative impacts of the No Action Alternative on noise. Not implementing wetland creation/nourishment and shoreline protection features would result in the persistence of existing conditions. The project area is a remote and uninhabited marsh. The noise from nearby urban areas has little, if any, impact on the project area. This would be expected to continue in the future.

5.18.2 Future With-Project Conditions

5.18.2.1.1 C5/S5 (Recommended Plan/NER Plan) Caminada Restoration Feature 5 – Preferred Dune with Expanded Marsh with Re-nourishment / Shell Island Restoration Feature 5 – Single Island with 10 year Advanced Fill and 2 Re-nourishments Direct Impacts

Construction activities associated with implementing alternative C5/S5 (Recommended Plan/NER Plan) would temporarily increase the noise level in the project area. However, the project area is remote and unpopulated so the noise level would not affect any nearby human communities. Once construction activities are completed, noise levels would return to pre-construction conditions.

Potential noise impacts concerns may be expected from construction activities, although construction equipment is limited in the level of noise that can be emitted. 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. This section mandates that noise levels emitted from construction equipment be below 90 dB for exposures of eight hours per day or more.

Localized and temporary noise impacts would likely result in wildlife and fishery resources temporarily leaving the project area during construction activities. 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.

5.18.2.1.2 Indirect Impacts

Noise may temporarily cause some local fish and wildlife species to relocate during construction activities. However, indirect impacts due to noise are expected to be localized, temporary, and minor in nature.

5.18.2.1.3 Cumulative Impacts

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. Cumulative impacts would be a synergistic result over and above the additive combination of impacts and benefits of this alternative and other Federal, state, local, and private restoration efforts (**Table 5-4**). Long-term adverse cumulative impacts due to noise levels would not be expected with implementation of alternative C5/S5 (Recommended Plan/NER Plan).

5.18.2.2 Alternative C5: Caminada 5 – Preferred Dune with Expanded Marsh with Re-nourishment

5.18.2.2.1 Direct Impacts

Direct impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan).

5.18.2.2.2 Indirect Impacts

Indirect impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan).

5.18.2.2.3 Cumulative Impacts

Cumulative impacts would be similar to those described for alternative C5/S5 (Recommended Plan/NER Plan).

5.19 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

5.19.1 No Action Alternative (Future Without-Project Conditions)

Previous HTRW studies in the project area have not detected existing Recognized Environmental Conditions (RECs), other than several petroleum pipelines in the area. The probability of HTRW occurrence in the area is low.

Deepwater Horizon April 20, 2010, Oil Spill

The shoreline will be cleaned, using 2011-2012 SCCP Endpoints Criteria, to the level that is acceptable to the USCG and the landowner. A minor amount of residual petroleum product, in the form of Submerged Residue Balls (SRBs) or Submerged Residue Patties (SRPs) could remain within the sub-tidal zone, inter-tidal zone, and supra-tidal zone of the shorelines following final sign off and agreement that removal actions are deemed complete for the affected segments. Any remaining, residual oil would slowly and naturally degrade or attenuate. Tides and wave action could bring additional oil ashore (re-oiling) from deeper water, such as from residual mats remaining in the subtidal zones. Should re-oiling occur within any of these segments and should the product be identified as MC252 oil, the affected segment(s) will follow the process defined in the SCCP, Section 1, Page 5, and will be responded to by the existing response organization and resource infrastructure in each state. The existing infrastructure includes the National Response Center (NRC) Process, as defined in 40 CFR, Part 300.

5.19.2 Future With-Project Conditions

5.19.2.1.1 Direct Impacts

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the study identified several petroleum pipelines in the area, but as long as they are not damaged the potential for direct impacts to the project area from implementation of the C5/S5 (Reeommended Plan/NER Plan) would be low and would likely continue to be low into the future. Otherwise, no Recognized Environmental Conditions RECs) were detected.

The proposed project area overlaps the site of a series of sand berms constructed by the State of Louisiana. This effort should enhance and complement barrier shoreline restoration plans, because additional dredged material would be added to the project vicinity.

The discharge of dredged material into waters of the United States is regulated under the Clean Water Act (CWA). In the absence of a known Hazardous, Toxic, and Radioactive Waste (HTRW) concern, the proposed action would not qualify for an HTRW investigation.

The USACE Engineer Regulation, ER 1165-2-132, Hazardous, Toxic, and Radioactive Waste (HTRW) for Civil Works Projects, states that dredged material and sediments beneath navigable waters proposed for dredging qualify as HTRW only if they are within the boundaries of a site designated by the EPA or a state for a response action (either a removal or a remedial action) under CERCLA, or if they are a part of a National Priority List (NPL) site under CERCLA. (NPL is also known as "Superfund.") None of the reaches proposed for dredging is included in the National Priority List.

Dredged material and sediments beneath the navigable waters proposed for dredging shall be tested and evaluated for their suitability for disposal in accordance with the appropriate guidelines and criteria adopted pursuant to Section 404 of the Clean Water Act and/or Section 103 of the Marine Protection Research and Sanctuaries Act (MPRSA) and supplemented by the US Army Corps of Engineers

Management Strategy for Disposal of Dredged Material: Containment Testing and Controls (or its appropriate updated version), as cited in Title 33, Code of Federal Regulations, Section 336.1.

The method for dredged material testing is specified in the Inland Testing Manual Evaluation of Dredged Material Proposed for Discharge in Waters of the US – Testing Manual (EPA/USACE, 1998) or the Ocean Testing Manual Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual (EPA/USACE, 1991). The potential for the presence of contaminants in the dredged material is determined using the protocols in the Inland Testing Manual or the Ocean Testing Manual.

Based upon a review of the NPL and CERCLA action sites, the probability of encountering HTRW in connection with this project is low. The proposed dredging and beneficial use action does not qualify for an HTRW investigation and is evaluated as a water quality issue (see section on Water Quality).

5.19.2.1.2 Future With Project Conditions – Indirect Impacts

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the potential for indirect impacts by HTRW to the project area from implementation of the C5/S5 (Recommended Plan/NER Plan) would be low and would likely continue to be low into the future.

5.19.2.1.3 Future With Project Conditions – Cumulative Impacts

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the potential for cumulative impacts to the project area from implementation of the C5/S5 (Recommended Plan/NER Plan) would be low and would likely continue to be low into the future.

5.20 AIR QUALITY

5.20.1 The No Action Alternative (Future Without-Project Conditions)

The No Action Alternative, not implementing coastal barrier system restoration, would have no direct impacts on air quality resources. Existing conditions would persist. The institutional recognition of air quality would likely continue with additional regulations. However, air quality throughout the coastal Louisiana area, including the study area, would likely continue to decline into the future. Reasons for the predicted decline include: continued human population growth throughout the general coastal area, further commercialization and industrialization (e.g., oil and gas operations), increased numbers of motor vehicles, and increased emissions from various engines. These impacts would be coupled with the continued loss of coastal wetland vegetation that would no longer be available to remove gaseous pollutants. There would likely be associated increases in respiratory ailments (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 predicts that global warming would also increase some health risks in the gulf coast region (http://www.ucsusa.org/global_environment/global_warming/page.cfm?pageID=973). 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.

5.20.2 Future With-Project Conditions

5.20.2.1.1 Direct Impacts

As required by *Louisiana Administrative Code*, Title 33 (LAC 33:III.1405 B), an air quality applicability determination was made for alternative C5/S5 (Recommended Plan/NER Plan). The air quality determination for alternative C5/S5 (Recommended Plan/NER Plan) considered each separate project feature of the plan for the category of general conformity, in accordance with the Louisiana General Conformity, State Implementation Plan (LDEQ 1994). The air quality determination was calculated, based upon direct and indirect air emissions. Direct emissions include those resulting directly from construction of the Recommended Plan/NER Plan. No other indirect Federal action would likely be required or related to the restoration construction actions. Hence, there would likely be no indirect emissions. Therefore, the air applicability determination analysis would be based upon direct emission for estimated construction hours. The air quality emission analysis for volatile organic compounds (VOC) and nitrous oxide (NO_X) for Shell Island, located in Plaquemines Parish and the Caminada Headland, located primarily in Lafourche Parish, with a small portion located in Jefferson Parish, are presented in **Table 5-9**.

Table 5-9 Air quality determination of volatile organic compounds (VOC) and nitrous oxide (NO_X).

Restoration Feature	VOC (tons)	NO_X (tons)
Shell Island Beach/Dune	162.0	1,997.5
Shell Island Marsh Restoration	24.1	297.6
Caminada Headland Beach/Dune Restoration	123.5	1,519.7
Caminada Headland Marsh Restoration	55.1	678.9
Totals (tons)	**364.7**	**4,493.7**

Compliance with the Clean Air Act has been fully coordinated with the Air Quality Section of the LDEQ (see Section 4.23 Air Quality). As required by Louisiana Administrative Code, Title 33 (LAC 33:III.1405 B), a general conformity determination for air quality is required for projects that affect non-attainment areas (personal communication Mr. Zia Yasoob, Louisiana Department of Environmental Quality). In Louisiana, the non-attainment area currently consists of Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge parishes. However, an air quality determination was made for the Recommended Plan. This included consideration of the Recommended Plan for the category of general conformity, in accordance with the Louisiana General Conformity, State Implementation Plan (LDEQ 1994). 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, State Implementation Plan, section 1405 B.2). The VOC emissions for the Recommended Plan would be classified as de minimus and no further action would be required.

5.20.2.1.2 Future With Project Conditions – Indirect Impacts

Implementing alternative C5/S5 (Recommended Plan/NER Plan) would result in emissions resulting directly from construction of the alternative. No other indirect Federal action would likely be required or related to the restoration construction actions. Hence, there would likely be no indirect emissions. The potential for indirect impacts to air quality to the project area from implementation of alternative C5/S5 (Recommended Plan/NER Plan) would therefore be low and would likely continue to be low into the future. Over the 50-year period of analysis alternative C5/S5 (Recommended Plan/NER Plan) would restore a net total of 1,684 acres that would help to improve local air quality by reducing particulates and gaseous air pollutants.

Nowack et al. (1998) and Currie and Bass (2008) indicate that trees, shrubs and other natural vegetation in urban areas affect air contaminant levels, and by extension 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. Nowack (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. Improvement of air quality would provide positive benefits for humans overall, although this relative difference would be localized and relatively minimal because of the size of the project area and distance from population centers (source: http://www.coloradotrees.org/benefits/Effects%20of%20Urban%20Trees%20on%20Air%20Quality.pdf)

5.20.2.1.3 Future With Project Conditions – Cumulative Impacts

The potential for cumulative impacts to the project area would primarily be related to direct air emissions during construction activities. Hence, cumulative impacts of implementing alternative C5/S5 (Recommended Plan/NER Plan) would therefore be only those related to direct emissions during construction actions and would likely continue to be low into the future.

Potential improvement to air quality would include the synergistic interaction of the effects of implementing alternative C5/S5 (Recommended Plan/NER Plan) with a net total benefit of 1,684 net acres over the 50-year project period of analysis, with the additive combination of impacts and benefits for net acres restored by other Federal, state, local, and private restoration efforts, as summarized in **Table 5-4**.

6.0 PUBLIC INVOLVEMENT, REVIEW AND CONSULTATION

This chapter documents the public involvement and coordination efforts undertaken for the LCA BBBS study. This chapter includes a description of the scoping process, public involvement activities conducted, and the coordination efforts with Federal, state, and local agencies and entities, parishes, and other interested parties (such as Indian Tribes and Nations).

6.1 THE SCOPING PROCESS

A notice of intent (NOI) to prepare a draft EIS for the Louisiana Coastal Area (LCA) – Louisiana, Caminada Headland and Shell Island Restoration Feasibility Study (LCA Caminada-Shell Island Study) was published in the *Federal Register* (volume 70, number 96) on May 19, 2005, and is included in appendix D. The NOI was published to solicit views, comments, and information on resources, study objectives, alternatives, and important features within the study area. This NOI supersedes the NOI published in the *Federal Register* (volume 65, number 83) on April 28, 2000, for the Barrier Shoreline Restoration in Lafourche, Jefferson, and Plaquemines Parishes, Louisiana, a Component of the Louisiana Coastal Area, Louisiana Ecosystem Restoration, Barrier Island Restoration, Marsh Creation, and River Diversion, Barataria Basin Feasibility Study (LCA Barrier Shoreline Restoration Study); and also supersedes the NOI published in the *Federal Register* (volume 65, number 88) on May 5, 2000, regarding the Wetland Restoration and/or Creation in the Barataria Basin, Louisiana, a Component of the Louisiana Coastal Area, Louisiana—Ecosystem Restoration, Barrier Island Restoration, Marsh Creation, and River Diversion, Barataria Basin Feasibility Study (LCA Wetland Restoration Study).

Scoping is not only required by the NEPA, but is also a critical component of an overall public involvement program to solicit input from affected Federal, state, and local agencies, Indian Tribes, interested stakeholders, and the public. 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 EIS. Scoping is a process, not an event or a meeting. It continues throughout the EIS process and may involve meetings, telephone conversations, and/or written comments. Scoping is used to:

1. Identify the affected public and agency concerns;
2. Facilitate an efficient EIS preparation process;
3. Define the issues and alternatives that will be examined in detail in the EIS; and
4. Save time in the overall process by helping to ensure that relevant issues are adequately addressed.

In the development of this feasibility study and integrated EIS, comments acquired from the following scoping meetings were incorporated and are further discussed below:

- Scoping the LCA Barrier Shoreline Restoration Study – April 2000;
- Scoping the LCA Wetland Restoration Study – May 2000; and
- Scoping the LCA Caminada – Shell Island Restoration Feasibility Study – May 2005.

6.1.1 Scoping the LCA Barrier Shoreline Restoration Study – April 2000

An announcement of a public scoping meeting for the LCA Barrier Shoreline Restoration Study was distributed to interested parties in May 2000. The public scoping meeting was held on June 8, 2000, at 7:00 P.M., in the Century Room of the John L. Guidry Stadium, located on Audubon Drive of the Nicholls State University campus, Thibodaux, Louisiana. There were 128 comments expressed at the meeting. An additional three scoping comment letters and two verbal comments were received during the 30-day scoping comment period. The comments received described the public's concerns about the scope of the LCA Study and were documented in a scoping report.

The comments expressed at the scoping meeting, in comment letters, and verbally are summarized below and grouped by EIS subject matter heading. The subject matter typically presented within each EIS subject matter heading is briefly described. Those comments most often expressed by several scoping meeting participants are also identified. The most numerous comments were about project alternatives, followed by environmental consequences, consultation and coordination, affected environment, and purpose and need for action.

6.1.1.1 Scoping Comments Regarding the Purpose and Need for Action

Of the 128 total comments expressed at the scoping meeting, 7 comments related to the purpose and need for the proposed action. These comments were primarily concerns that the proposed action of the study does not include other areas of coastal Louisiana.

6.1.1.2 Scoping Comments Regarding the Alternatives

Of the 128 total comments expressed at the scoping meeting, 97 comments regarding project alternatives were expressed. One of the three comment letters and both verbal comments also expressed concerns related to restoration alternatives.

Some of the major concerns related to the alternatives were about sediment sources. These comments included conducting a thorough search for sediment borrow sources, utilizing material that is currently being dredged from navigation channels, suitability of the sediments for the various habitats to be created, the longevity of placed material, the costs and methods associated with obtaining the sediment, and the costs associated with maintenance.

Frequently mentioned comments were concerns about maximizing the benefits to fish and wildlife, including neotropical migrant birds, endangered species, commercial and recreational fisheries, and oysters. Related to these comments were desires that maritime forests be restored across the study area and that native or non-invasive plants be utilized.

Another area of major concern identified in the comments was quantifying the structural benefits of barrier shoreline restoration, including protection of fisheries, protection of oil and gas infrastructure, storm surge and flood protection, prevention and mitigation of oil spills, and protection of the habitats in the interior of the basin. It was suggested that these items also be considered in the evaluation of the no-action alternative. Often mentioned were concerns about access to and protection of the restored areas after construction, including sanctuary designation, ecotourism, restrictions on construction and other development, future pipeline placement, oyster lease issues, and ownership of created lands. Construction methods and design issues were also frequently mentioned. Concerns were expressed about island configuration, how far out into the gulf will restoration extend, ideal slope design of the shore face for longevity, utilizing innovative technology, methods of transporting sediment, and consideration of hard construction materials (e.g., rock).

6.1.1.3 Scoping Comments Regarding the Affected Environment

Of the 128 total comments expressed at the scoping meeting, 81 comments related to the affected environment. In addition, one of the three comment letters expressed concerns related to the affected environment.

A major area of concern related to the affected environment was the sediment source, which included comments about the location and type of material, current dredging operations, and suitability for the variety of habitats to be created. Comments about pollutants, pathogens, and radioactive material in the sediments were also expressed. Frequently mentioned concerns were about human usage, including recreational and commercial fishing, oyster leases, ecotourism, impacted landowners, and access to islands and passes. Related to this were concerns about the infrastructure in the area, including oil and gas facilities and pipelines.

Another area of concern identified was the tidal prism and the relationship to the flow through existing passes. The role of barrier shorelines in storm surge control and flooding to the interior of the basin were also noted as a concern. Another major comment was fish and wildlife habitat in the area, including neotropical migratory birds, oysters, fish access, endangered species habitat, and type of vegetation. Concerns were expressed about consideration of the "big picture" and such issues as longshore (or alongshore) transport, land loss mechanics, sediment budget, restoration of a natural flood cycle, and designing with natural processes in mind. Related to this were concerns about sustainability and the structural importance of barrier shorelines to the basin.

6.1.1.4 Scoping Comments Regarding the Environmental Consequences

Of the 128 total comments expressed at the scoping meeting, 88 comments were related to the environmental consequences of the proposed action. In addition, one of the three comment letters also expressed concerns related to some aspect of environmental consequences of the proposed action.

Many of the comments on environmental consequences were related to the benefits of an intact barrier shoreline. Many of these comments suggested consideration of benefits for providing habitat for fisheries and wildlife; structural effects in protecting the interior of the basin from storm surges, flooding, and oil spills; protection of oil and gas infrastructure and pipelines; and providing for recreational and commercial fishing, oyster leases, ecotourism, and aesthetics. Concerns were expressed about quantifying the economic value of project benefits to help justify the costs of restoration and for seeking funding sources. In addition, concerns about the longevity and sustainability of the various alternatives were also expressed.

Concerns were expressed regarding the impacts to endangered species, essential fish habitat, fish access, and oysters during restoration construction activities, which also included the effects of non-confined dredged material placement. Concerns were also expressed about the suitability of various types of sediment for the various habitats and the possible release of pollutants, radiation, and pathogens from these sediments. Additionally, there were some concerns about the effects of placement of material on the shoreface.

Concerns were also expressed concerning restriction of access to restored areas by recreational and commercial fishermen; sanctuary designation; and restriction of construction, development, and pipelines from damaging the shoreline after restoration. Other lands right issues included the determination of ownership of restored lands, impacts to landowners, and oyster leases.

Bathymetric concerns and consequences were also expressed, including the effects of closing or restricting passes on the tidal prism, salinity regime, and tidal energy.

6.1.1.5 Scoping Comments Regarding Coordination and Compliance

Of the 128 total comments expressed at the scoping meeting, 84 comments related to coordination and consultation were presented. All three of the comment letters expressed concerns related to coordination and consultation. Four of the scoping meeting comments and two of the letters requested that the general public and/or landowners should be kept informed about the project. One scoping participant expressed concern that the full range of Federal concerns would be considered in the analysis of alternatives. One letter expressed a desire to coordinate at the Federal level with regard to endangered and threatened species, specifically the designation of critical habitat for the piping plover. Concerns about the impacts to fish and wildlife, presence of hazardous materials, and many of the concerns described in the previous sections are also related to consultation and coordination because of required compliance with various laws and regulations and required consultation and coordination with other agencies.

6.1.2 Scoping the LCA Wetland Restoration Study – May 2000

A NOI was published in the *Federal Register* (volume 65, number 88) on May 5, 2000, regarding the Wetland Restoration and/or Creation in the Barataria Basin, Louisiana, a Component of the Louisiana Coastal Area, Louisiana—Ecosystem Restoration, Barrier Island Restoration, Marsh Creation, and River Diversion, Barataria Basin Feasibility Study (LCA Wetland Restoration and Creation Study). An announcement of a public scoping meeting for the study was distributed to interested parties in May 2000. The public scoping meeting was held on June 20, 2000, at 7:00 P.M., in the Student Union Ballroom/Acadia Hall, of the Nicholls State University, located at the Nicholls State University Campus, Thibodaux, Louisiana.

Comments received during the 30-day scoping comment period describe the public's concerns about the scope of the Wetland Restoration and Creation study and were documented in a scoping report. The scoping report summarizes the 44 comments expressed at the public scoping meeting, as well as 2 scoping comment letters and 1 verbal comment received during the scoping comment period.

The 44 comments expressed at the public scoping meeting, the 2 scoping comment letters, and 1 verbal comment are summarized below. Scoping comments are grouped by EIS subject matter heading. Those comments most often expressed by several scoping meeting participants are identified. The most numerous comments were expressed regarding affected environment, followed by project alternatives, environmental consequences, purpose and need for action, and consultation and coordination.

6.1.2.1 Scoping Comments Regarding the Purpose and Need for Action

Ten of the 44 total comments expressed at the scoping meeting related to the purpose and need for the proposed action. These comments were primarily concerns that other areas of coastal Louisiana should be included in this study and prioritizing specific areas for construction.

6.1.2.2 Scoping Comments Regarding the Alternatives

Twenty-four of the 44 comments expressed at the scoping meeting regarded project alternatives. One of the scoping letters and the only verbal comment received expressed concern about project alternatives, as well.

Some of the major concerns related to alternatives were about sediment sources. These included utilizing material that is currently being dredged from navigation channels, the introduction of sediments to the system via natural and man-made means, the transportation of sediment to the placement areas, diversion of sediment from the river, and suggested restrictions to the selection of sediment borrow sources. Frequently mentioned comments related to deleterious effects on existing natural shell beds and deposits. There were also comments suggesting that marsh restoration that would provide protection to human infrastructure should be given priority. The seasonal timing of the construction was also a concern. Also suggested was the use of sheet piling across the entire study area and construction of concrete breakwaters at the barrier island, particularly Grand Isle.

6.1.2.3 Scoping Comments Regarding the Affected Environment

Twenty-seven of the 44 comments expressed at the scoping meeting related to the affected environment. Most of these comments related to the sediment source, either suggesting locations or materials for borrow sources, expressing concerns about potential borrow sources, or making suggestions on prioritizing the construction of the projects. Of particular concern were existing shellfish beds and the potential to disrupt them through the proposed restoration actions. Also of concern were pollution issues, ranging from radiation to pesticides and herbicides. One comment suggested we research the reason for the apparent difference in health between the marshes along Louisiana Highway 1 and marshes farther away from the highway.

6.1.2.4 Scoping Comments Regarding the Environmental Consequences

Seventeen of the 44 comments expressed at the scoping meeting related to the environmental consequences of the proposed action. In addition to pollution issues, concerns were expressed related to the impacts to the oil and gas industry, fisheries, and sediment budgets. Several concerns were related to the impacts of the proposed actions on oysters.

6.1.2.5 Scoping Comments Regarding Coordination and Compliance

Six of the 44 comments expressed at the scoping meeting and one letter comment were related to coordination and consultation. One comment suggested coordination with the Mineral Management Service to waive the mining fee for sediments from Ship Shoal. Two of the comments were related to policy matters concerning oyster leases. The beneficial use of material generated through maintenance dredging was also suggested. Coordination was also suggested with agencies regarding the use of hydrologic and hydrodynamic models to account for projected landscape changes as a result of wetland restoration.

6.1.3 Scoping the LCA Caminada – Shell Island Restoration

Feasibility Study May 2005: A scoping meeting announcement requesting comments regarding the scope of the LCA Caminada-Shell Island Study was mailed to Federal, state, and local agencies; and interested groups and individuals on May 17, 2005. The news release announcing the scoping meetings was provided to 68 media outlets. Information on the public scoping meetings appeared in the following: Houma Courier, June 15, 2005; Times Picayune, June 11, 2005; Plaquemines Gazette, June 10, 2005; New Orleans City Business, no date on the clipping; Breaux Act News Flash, May 26, 2005 and June 14, 2005.

Public scoping meetings were held on:

- June 14, 2005, at the Belle Chasse Auditorium, 8398 Highway 23, Belle Chasse, Louisiana; and
- June 16, 2005, at the Larose Civic Center, 307 East 5th Street, Larose, Louisiana.

The meetings included an open-house forum, question/answer session, and an open scoping comment session. The open house included a series of poster boards regarding the study purpose, study objectives, schedule, and proposed significant resources. The introductory remarks and question and answer session followed the open-house session. During this session, the study's environmental manager and both the USACE and LDNR project managers presented introductory remarks, including the agenda, purpose of the meeting, public involvement under NEPA, a brief history leading to the study, the scope of the analysis, and the intent to prepare a final EIS for restoration of the Caminada Headland and Shell Island. The question and answer portion focused on the handouts and any other general questions, after which there was an opportunity for individuals to present their scoping comments verbally. Transcripts of comments made at the scoping meetings were prepared by a court reporter.

A scoping report summarizes the comments expressed at the public scoping meetings, as well as all other scoping comments received during the comment period beginning May 19, 2005, and ending June 27, 2005. The scoping report also indicated where in the draft EIS individual comments would be addressed. The scoping report was provided to all scoping participants who provided their address, as well as being published on the LCA website, www.lca.gov.

A total of 73 participants signed in for the 2 scoping meetings, with 45 at the Belle Chasse, Louisiana meeting, and 28 at the Larose, Louisiana meeting. A total of 27 multi-part comments were received during the comment period, of which 3 email-scoping comments received were copies of scoping letters. Five individuals expressed comments at the Belle Chase scoping meeting and 6 individuals expressed comments at the Larose scoping meeting. A total of 16 written comments (letter, email, website) were received during the comment period. A summary table of these comments is included in appendix D.

The most numerous comments were expressed regarding the affected environment followed by alternatives; consultation, coordination, and compliance; environmental consequence; and the purpose and need.

6.1.3.1 Scoping Comments Regarding the Purpose and Need for Action

Twenty-nine of the 173 scoping comments related to the purpose and need for the proposed action. Some of the major concerns included the need for restoration of the entire Barataria Basin barrier shoreline and the entire Barataria Basin ecosystem. Other concerns included need for restoration of longshore transport and to maintain barrier islands because they reduce tidal pulses and stabilize the isohaline lines (thereby causing less stress on estuarine species). Several other concerns pointed out the urgent need to act now, timelines for projects should be advanced when possible, and consideration of pipeline slurries to give immediate sediment lift now in addition to utilizing delta processes that take longer periods of time. Concerns were also expressed about cultural needs and to heed the advice of long-term residents of the area; human ecological needs should be considered as they rely upon a healthy and diverse estuary. Other concerns were to consider the destruction of oaks and other vegetation on the cheniere and privately-owned lands; and the importance of shoreline and ridge habitat for birds.

6.1.3.2 Scoping Comments Regarding the Alternatives

Thirty-six of the 173 scoping comments related to the alternatives. Several concerns were expressed regarding aggressive construction of large-scale coastal restoration projects; focus on methods that mimic natural processes; utilize the Mississippi River and its tributaries by mimicking the historic flow of the river; implementing the Third Delta conveyance channel alternative, utilizing a pipeline slurry, and include the backside (landside) of barrier islands for marsh restoration and to establish critical habitat. Other concerns included designing alternatives that provide direct and indirect protection for critical infrastructure; address the rapid erosion and stabilize the remaining subaerial features of Shell Island and the Caminada Headland. Another concern was that all alternatives should reduce the impacts of dredged material disposal to existing emergent marsh, back-barrier marsh, and dune habitat. Other concerns included suggestion that alternatives include means of drainage to avoid salt [water] build-up in areas that could impact salt-intolerant vegetation; what restrictions may be imposed on private landowners' uses of areas that are restored; fill the area to +6 NGVD or +8 NGVD to form a positive protective barrier for lower Plaquemines Parish. Other suggested alternatives included combining several different engineering technologies; use portable galvanized baskets with geotextile liner filled with sand; utilize sediment removed from the Mississippi River by hopper dredges; consider use of nuisance materials such as reclaimed concrete and other materials be used as platforms for rebuilding islands; construct a primary barrier of stone with offshore sands pumped over it.

6.1.3.3 Scoping Comments Regarding the Affected Environment

Forty-three of the 173 scoping comments related to the affected environment. Several concerns were expressed about potential impacts to existing infrastructure and the human ecology; restoration of the entire Barataria Basin ecosystem; and the importance of the different barrier habitats (shoreline, dune, back marsh, and ridges) to fish and wildlife; and concern with potential impacts to essential fish habitat and critical habitat for threatened and endangered species. Other concerns were with placement of hard products, such as rocks or sheet pile into natural systems; potential adverse impacts to borrow sites; minimize the impacts of dredged material disposal to existing emergent marsh, back barrier marsh, and dune habitat; concern for economic development and growth. Other concerns were with quantifying land loss and shoreline retreat rates; consideration of the destruction of oaks and other vegetation on the chenier and privately owned lands. Other concerns included consideration of the functions and values of the Barataria estuary system and the barrier islands; improve water quality; reestablish shorelines of the Empire Canal.

6.1.3.4 Scoping Comments Regarding the Environmental Consequences

Thirty-one of the 173 scoping comments related to the environmental consequences. Several concerns were expressed about maintaining the functions and values of the barrier system; evaluating and quantifying the direct and indirect benefits, impacts and costs of a variety of design templates; impacts on essential fish habitat and critical habitat for threatened and endangered species (e.g., Piping Plover and sea turtles); potential impacts and benefits on marine fishery utilization of wetlands, water bottoms, and water column. Other concerns were with the consequences of impacts from borrowing fill material from offshore; concern with the navigation jetties at Empire and Belle Pass; concern with impacts to water quality and salinity; human and natural resources in this area include people and businesses in the area. Other concerns were with salinity gradients for estuarine fisheries and specifically oyster habitats; bird habitat provided by shoreline and ridges; reducing the impacts of dredged material disposal to existing emergent marsh, back-barrier marsh, and dune habitat. Other concerns were with the fate of existing sand fences and dunes; the destruction of oaks and other vegetation on the chenier.

6.1.3.5 Scoping Comments Regarding the Coordination and Compliance

Thirty-four of the 173 scoping comments related to coordination and compliance. Several concerns were expressed regarding the need for synergy between the LCA and the CWPPRA programs; concern with the availability of CWPPRA funding for barrier shoreline restoration projects at Scofield Island; increased involvement of landowners; and requests to listen to concerns and recommendation of local residents of the area. Other concerns included detailed agency coordination regarding impacts to threatened and endangered species; coordination with NOAA Fisheries regarding EFH; and suggestion to broaden the definition of threatened and endangered species. The Caminada Headland reach falls within Unit LA-5 designated critical habitat for Piping Plovers. Recommendations were made to work closely with the Coastal Zone Management Committees; complete a formal ownership survey to determine ownership boundaries; and protect specific infrastructure such as the LOOP/other pipelines. The EIS should fully describe the importance of the waterbodies and wetlands as nursery and foraging habitats supportive of economically important marine fishery. A recommendation that a qualified biologist be present to inspect the proposed work site during the nesting season to record the presence of undocumented bird nesting colonies. Other concerns were about landowners rights; coordination with the Edward Wisner Donation property to include a beach plan, coordination with the Caillouet Land Corporation; concern with coordination of Restore or Retreat. Other concerns included coordination with the EPA, MMS, NOAA Fisheries, NRCS, and the USFWS; coordination with the Lafourche Coastal Zone Management Administrator; and coordination with the Jefferson Parish Department of Environmental Affairs.

6.2 PUBLIC INVOLVEMENT PROGRAM

A key component in the development of the integrated feasibility study and EIS is implementation of a public outreach and involvement strategy to outline the approach for transmitting information from the PDT to interested members of the public, media outlets, local governments, state partners, and other important decision makers and, as important, receiving and incorporating their comments into the report. This section outlines the public outreach and involvement strategy used by the team.

6.2.1 Goals for Public Outreach and Involvement

The LCA BBBS study and report are built upon previous public outreach and involvement efforts conducted throughout the LCA feasibility study phase, while focusing on the specific problems, needs, and opportunities for the study area. The following goals for public outreach and involvement have been identified:

- Educate the public, stakeholders, and agencies to increase awareness and understanding at a local, regional, and national level.
- Provide and promote effective intra- and inter-agency communication and support for the report preparation teams.
- Gather input from diverse groups to assist in identifying problems, opportunities, potential solutions, and impacts of the various alternatives.
- Provide extensive opportunities for public participation throughout the decision-making process, including discussions of inevitable trade-offs.
- Develop and implement a feedback process to the public concerning how their input has affected decisions such as alternatives development, analysis, and selection of optimum plans.

- Identify and engage public sectors, including stakeholders, public officials, and academia to develop relationships critical to successful execution of the analysis, design, and report preparation phases of the work.
- Provide timely information to the public regarding the team's efforts.
- Establish and/or maintain an active role by project managers in the team's outreach and involvement process.

The report-specific outreach and involvement goals are accomplished through the following process:

1. Identify audiences;
2. Provide educational materials and report specific information to these audiences;
3. Obtain public input, through forums, workshops, public meetings, and other avenues, regarding the development of the LCA BBBS study and report; and
4. Provide feedback to the public as to the course of action taken relative to their input.

6.2.2 Tools to Implement the Public Outreach and Involvement Strategy

6.2.2.1 Public Meetings

Various meetings for public feedback were held during the development of this report. The public outreach and involvement team selected locations for the public hearings. Public hearings held in conjunction with the public review of the draft version of this report, as required by NEPA, were held on July 26, 2011 in Plaquemines Parish and July 28, 2011 in Lafourche Parish. The public outreach and involvement team members coordinated with the PDT to plan and develop presentation materials. The USACE and State of Louisiana public affairs offices coordinated with their respective outreach staff by notifying the media through advisories, news releases, and follow up telephone calls.

6.2.2.2 Targeted Workshops

Throughout the development of the report, opportunities were developed for the public to obtain information through smaller, more interactive venues. Targeted for these workshops were civic and neighborhood associations, academia, environmental groups, coastal zone advisory committees, and non-governmental organizations (NGOs). This format provided optimum two-way communication opportunities – avenues for public information dissemination while enhancing community awareness and understanding. The public outreach and involvement team developed presentation materials tailored to each specific audience.

6.2.2.3 Outreach to public officials and governmental agencies

PDT project managers provided briefings to elected and appointed officials at all levels of government. In addition, report-specific information was provided to State and Federal governmental agencies, including internally at the USACE and State of Louisiana. Tours of project areas were provided as needed and the public outreach and involvement team prepared and delivered materials and briefing packets.

6.2.2.4 Outreach to Stakeholder Groups

Due to the public's high level of interest in hurricane risk reduction and coastal restoration, involving stakeholder groups in decisions was especially important in both the preliminary and final reports. The project delivery and public outreach and involvement teams identified stakeholder groups to focus efforts. Those stakeholder groups were identified as landowners, navigation, oil and gas, local governments, fisheries, Native Americans and Minerals Management Service representatives. The goal of involving these stakeholder groups was to promote long-term relationships and understanding of the report components. This activity involved coordination and preparation of meetings (to include pre- and post-scoping), briefings, and written correspondence with interests outside the USACE and the State of Louisiana. Additionally, several existing groups and committees, such as the Governor's Advisory Commission on Coastal Protection and Restoration, were utilized to expand opportunities for the public to guide and influence the study process. The USACE held meetings with project stakeholders, including:

- Meetings with BTNEP: 2000
- Meeting with Jay Caillouet (landowner): April 11, 2006
- Meeting with the Grand Isle Town Clerk: April 17, 2006
- Meeting with the Sand Management Workshop: April 25, 2006
- Meeting with Wisner Foundation (C. Cathy Norman): May 2, 2006.
- Meeting with Mr. Charles Elmer (landowner): May 15, 2006
- Meeting with Don Morrow and Larry Schmidt of the Trust for Public Land: May 17, 2006
- Meeting with Pipeline Stakeholders: February 26, 2007
- Meeting with Caillouet Land Corporation (landowner): May 22, 2007
- Meeting with Lafourche Parish Coastal Zone Management Committee: August 19, 2008
- Meeting with Cathy Norman, Wisner Foundation (landowner): November 1, 2008
- Meeting with Plaquemines Parish Coastal Zone Management Committee: November 12, 2008
- Meeting with Jefferson Parish Coastal Stakeholders: January 16, 2009.
- Meeting with Ted Falgout, and Simone Theriot, January 29, 2009
- Meeting with Ted Falgout and Al Danos, director of the South Lafourche Beach Development District, June 26, 2009
- Public Hearings on the Draft EIS at Woodland Plantation in Port Sulfur, LA: July 26, 2011.
- Public Hearings on the Draft EIS at South Lafourche High School in Galliano, LA: July 28, 2011.

At these meetings, the project alternatives were discussed and the groups were updated on the project status. The following information and concerns were provided during the stakeholder meetings.

6.2.2.4.1 *Meeting with Jay Caillouet – 618 Canal Blvd. Thibodaux, LA April 11, 2006*

Attending: Fay Lachney, Chris Monnerjahn (USACE MVN); Jennifer Beall, Ken Duffy, Beau Tate, and VJ Marretta (LDNR); and Jay Caillouet, landowner

Chris Monnerjahn explained the objectives of the project and the planning process to Mr. Caillouet. Mr. Caillouet indicated that he is in agreement with concept of project. Two main concerns: reclamation rights and public access.

Mr. Caillouet summarized current conditions and activities at his property. He is giving Port Fourchon a servitude for the boudin bags that were previously placed on his property, and he is giving a maintenance servitude to the Port for the bags. Mr. Caillouet has had discussions with LDNR about placing plant debris from Hurricane Katrina on his property, which would be covered and then planted. The status of this issue was not known at the time of the meeting. Mr. Caillouet has filed a permit application with the USACE for Bay Pass development, including campsites and marina. The area of Bay Pass is north of the project site.

Caillouet Land has filed a reclamation claim to the 1921 shoreline with the State Land Office. The State Land Office claims eroded land up to the mean high water level.

Mr. Caillouet also expressed concerns about public access to the beach. He has had discussions with the Port about a possible pier and restroom area near the end of the highway. Mr. Caillouet indicated that Davie Breaux, Director of Operations of the Greater Lafourche Port Commission, may be the person at the Port who is knowledgeable of these issues.

Caillouet Land also has a permit to put pilings into the water. Mr. Caillouet wants public use of land limited. If the Bay Pass development is approved, Mr. Caillouet would place a security guard at the end of the bridge to limit access only to Bay Pass residents. He also suggested a Wildlife Management area may be a way to reduce unwanted public access to these areas. .

6.2.2.4.2 *Meeting with Ray Santiny – Grand Isle Town Clerk – April 17, 2006*

Attending: Chris Monnerjahn and Fay Lachney (USACE MVN); Jennifer Beall and Greg Grandy (LDNR); and Ray Santiny, Town of Grand Isle.

The meeting was supposed to be with Mayor David Camardelle, but he was in Baton Rouge attending a session of the Legislature. Mr. Santiny was not familiar with the project; however, he did not think that Grand Isle would have any objections. Mr. Santiny said that Mr. Charles Elmer was trying to sell his property and that developers had been looking at the property. Maps were left with Mr. Santiny to give to the mayor. He was told to expect a final report upon completion of the feasibility study.

6.2.2.4.3 *Meeting with Cathy Norman – Edward Wisner Foundation – May 2, 2006*

Attending: Monica Miller (PBS&J), Fay Lachney (USACE MVN), Jennifer Beall, Beau Tate, V.J. Maretta, and Ken Duffy (LDNR), and Cathy Norman (Wisner Foundation).

Ms. Norman described two projects that are underway on the beaches at Wisner Foundation property at this time. The Port cleaned up marsh debris along the beach after Hurricanes Katrina and Rita and buried the storm debris. Marsh debris created by the storm is being used to fill in areas of the marsh that were eroded by the storms. The government agency involved in the

Marsh Debris Dune Restoration Project is the Louisiana Department of Environmental Quality (LDEQ.) Also, bundles of bagasse were placed in washover areas along the beach at the foundation property.

Ms. Norman explained that there are lots of pipelines just west of the Chevron facility. A new 48-inch LOOP pipeline is planned parallel to the existing line.

There have been some releases of hazardous materials in the area around the Chevron facility. The operator of the California Canal is currently under agreement with the EPA to determine whether the contamination can be addressed through natural attenuation. There is an injection well north of the facility on the California Canal. The triangle marsh area west of the facility is not contaminated and the California Canal is being monitored. Ms. Norman does not want the northern part of Fourchon Island along Bayou Barataria (Belle Pass) to be included in the project area. The foundation prefers to keep that area open for commercial development.

Ms. Norman indicated that she is concerned about vehicle access to the beach. The foundation would like to place a gate west of the Chevron facility to prevent vehicle access. Ms. Norman indicated that the foundation is agreeable to the idea of a parking lot and boardwalks. She worries, though, about people parking next to the Chevron facility. People have cut through the fence around the Chevron facility to hunt in the lake next to the tanks. Ms. Norman also recommended the Caillouet property next to Highway 3090 would be the best place for a parking lot. The foundation could accept easements that restrict vehicles. The foundation also would not object to bath houses, as long as maintenance is not the foundation's responsibility. Ms. Norman stated that the Wisner Foundation may not sell any property in fee. The purpose of the foundation's board is to maximize the value of the land.

Ms. Norman expressed concern about liability. Someone attempted to sue the foundation after tripping on a boudin bag. However, the boudin bags are on Caillouet land. If the foundation is sued, it will try to end all public access to its property.

A field trip was set up to view the site. This would include helicopter tours and boat trips of the project areas.

6.2.2.4.4 *Meeting with Charles Elmer – Elmer's Island- May 15, 2006*

Attending: Chris Monnerjahn and Fay Lachney (USACE MVN); Jennifer Beall, V.J. Maretta, Ken Duffy, and Beau Tate (LDNR); Joseph Mole and Edward Rantz (Frilot Partridge); and Charles Elmer (landowner).

This meeting took place at the office of Frilot Partridge, attorneys for Mr. Elmer. Mr. Elmer is currently negotiating with Larry Schmidt of the Trust for Public Land concerning selling his land to the Trust. In turn, the Trust would then possibly sell the land to the State.

The project features were explained to Mr. Elmer and his attorneys.

Mr. Elmer said that he maintained his beach area once or twice a week. Currently, the area is closed. The road and the beach area were breached during the hurricanes. The road is being repaired. Mr. Elmer said that some of the breaches are filling in by themselves.

Draft copies of the easements were provided to Mr. Elmer's attorneys. Mr. Elmer is supportive of the idea of the project, but would prefer to sell his land as opposed to having it encumbered with an easement. He would prefer to have the Trust for Public Lands purchase his property and then have it sold to the State for a park.

Mr. Elmer claims the spit of land on the eastern side of his beach, an area also claimed by the State. Mr. Mole said that he would contact Larry Schmidt of the Trust for Public Land to set up a meeting for the project to be explained to Mr. Schmidt.

6.2.2.4.5 *Meeting with Trust for Public Land – May 17, 2006*

Real Estate and Project Management MVN personnel met with Larry Schmidt and Don Morrow of the Trust for Public Land. This organization was negotiating with Charles Elmer to purchase Elmer's Island on the eastern portion of the Caminada Headland. If the purchase is successful, the Trust for Public Land would then transfer the property to the State of Louisiana. The meeting was informational to ensure that the goals of Trust for Public Land and the LCA BBBS project were not in conflict. It was determined at the meeting that the acquisition of the property by Trust for Public Land would not impact the project.

6.2.2.4.6 *Meeting with Pipeline Stakeholders – February 26, 2007*

Pipeline owners and their representatives that have pipelines located within the project area were invited to an informational meeting at the New Orleans District. The project manager presented the project alternatives and explained that dredged materials would be placed on top of their facilities. The attendees expressed support for the project. All attendees verbally agreed to provide letters of no objection.

6.2.2.4.7 *Meeting with Caillouet Land Corporation – May 22, 2007*

Attendees: Jay Caillouet, Ed Fike, Coastal Environments, Inc., Joan Lanier, Judith Gutierrez, Maurya Kilroy, and Fay Lachney (USACE MVN), Andrew Beall and Beau Tate (LDNR)

Caillouet Land Corporation requested to meet with USACE and LDNR to discuss the project alternatives. Mr. Caillouet again emphasized his support of the project, and his concern that current recreational use was damaging the ecosystem. He is especially concerned about damage caused by vehicles driven on the beach and dunes. He suggested that a parking lot on his land near Louisiana Highway 3090 may help decrease vehicular traffic on the restored project area.

6.2.2.4.8 *Meeting with the Lafourche Parish CZM Committee – August 19, 2008*

The Lafourche Parish Coastal Zone Management committee expressed support for the project and encouraged the Corps to work as quickly as possible due to the importance of and imperative need for restoration of the Caminada Headland. One member was concerned that the project would limit use of the beach for recreation. The project goals were reiterated with emphasis placed on the habitat restoration. The project manager explained the addition of a parking lot and walkways to provide safe access to the beach without damaging the newly created habitats.

6.2.2.4.9 *Meeting with Cathy Norman, Wisner Foundation – November 1, 2008*

Attendees: Greg Grandy, Jerome Zeringue, David Miller, Garrett Graves (Louisiana OCPR), Cathy Norman (Land Manager of the Edward Wisner Property), and Fred Heebe (consultant)

The Louisiana OCPR team discussed the status of the LCA BBBS project and gave the landowner a review of the project and an estimated schedule of milestone project deliverables and dates when those were anticipated to be completed.

6.2.2.4.10 *Meeting with the Plaquemines Parish CZM Committee – November 12, 2008*

The Plaquemines Parish Coastal Zone Management committee expressed support for the project, asking that work begin on reconstruction of Shell Island as soon as possible. Concern was expressed that if the island was not rebuilt soon, then the island would completely disappear.

6.2.2.4.11 *Meeting with Jefferson Parish Coastal Stakeholders – January 16, 2009*

Fay Lachney presented the LCA BBBS Project to the Jefferson Parish Coastal Stakeholders' group, providing a description of the project plan and the tentative schedule. The coastal stakeholders' group expressed support for the LCA BBBS Project.

6.2.2.4.12 *Meeting with Ted Falgout and Simone Theriot – January 29, 2009*

Attendees: Greg Grandy (Louisiana OCPR), Ted Falgout (Port Fourchon Director, member of the Coastal Protection & Restoration Financing Board, Lafourche Parish Coastal Zone Committee and Governor's Advisory Commission on Coastal Protection, Restoration and Conservation), and Simone Theriot (Executive Director of Restore or Retreat, Inc.)

This meeting was requested to discuss the status of the LCA BBBS project. The items discussed included the status of the LCA BBBS project, a review of the project, and an estimated schedule of milestone project deliverables and dates.

6.2.2.4.13 *Meeting with Ted Falgout and Al Danos – June 26, 2009*

Attendees: Fay Lachney, Ted Falgout, and Al Danos (Director of the South Lafourche Beach Development District)

The meeting was held to discuss the possibility of recreational features being added to the LCA BBBS project. Fay Lachney explained that the project was authorized as an ecosystem restoration project and as long as the recreational features did not interfere with the project purpose, it would probably be possible for the South Lafourche Beach Development District to continue to encourage recreation in the area. Mr. Danos explained that the development district would like to build a road from Louisiana Highway 3090 to the area south of Bay Champagne. This would impact the planned marsh creation in the area. Ms. Lachney suggested building the road outside of the project area to the west of Highway 3090 or creating a parking lot outside of the project area to the east of Highway 3090 and building a board walk to access the beach near Bay Champagne. Mr. Danos and Mr. Falgout also would prefer that marsh not be created in Bay Champagne to allow beach goers to swim in either the Gulf of Mexico or Bay Champagne.

6.2.2.4.14 *Public Hearing at Woodland Plantation in Port Sulfur, LA – July 26, 2011*

Fay Lachney presented the draft LCA BBBS Feasibility Study findings and tentative recommendations to the general public in Plaquemines Parish, providing a description of the Recommended Plan. William Klein presented the NEPA requirements and opened the LCA BBBS EIS for the formal 45 day review and comment period. The public expressed support for the LCA BBBS Project in order to save the beach and offered suggestions for dune heights and dredging source locations. Approximately 15 people attended this meeting.

6.2.2.4.15 Public Hearing at South Lafourche High School in Galliano, LA – July 28, 2011

Fay Lachney presented the draft LCA BBBS Feasibility Study findings and tentative recommendations to the general public in Lafourche Parish, providing a description of the Recommended Plan. William Klein presented the NEPA requirements and opened the LCA BBBS EIS for the formal 45 day review and comment period. The public expressed support for the LCA BBBS Project in order to save the beach and also request public access. The South Lafourche Beach Development District submitted a development plan for USACE input however after review it was determined that the plan would impact the planned marsh creation in the area. Approximately 43 people attended this meeting.

6.2.2.5 Publications and Presentation Materials

In addition to conducting scoping meetings and providing a scoping report to interested parties, a variety of other methods were employed to provide information to and solicit comments from the public. Examples of these include the following.

Website – A website for the LCA BBBS project was developed that was linked to the LCA Ecosystem Restoration home page (www.lca.gov). It is constantly maintained and updated to allow information access for the project delivery team and the general public. All publication and presentation materials are accessible from the homepage.

Publications – Materials developed throughout the course of the LCA BBBS study included public notices identifying the purposes and location of workshops and/or meetings, fact sheets, newsletters, etc.

PowerPoint Presentations – A LCA Near-term Ecosystem Restoration presentation was developed for public speaking engagements. Specific LCA BBBS project issue modules were inserted into this presentation. Duplicate copies of the presentation along with suggested text were distributed to all team members and interested stakeholders.

News Releases/Press Kits – News releases were issued at appropriate times throughout the LCA BBBS study and prior to the public workshops and/or meetings to keep the media apprised of activities and issues and to inform the public. A set of informational materials was developed and provided to interested media outlets. Materials consisted of project background information, descriptions of project goals, maps, quotes from leadership about the project and its importance, and other visual reference materials.

Videos – A broadcast quality video about the LCA BBBS project was produced and distributed to libraries, civic groups, educational institutions, and others on request.

Exhibits and Displays – A number of visual tools were needed for public engagements. Large displays for events and small portable displays for speaking engagements were developed for the use at fairs, conferences, and other events. Existing displays were updated as needed.

6.2.2.6 Responsibilities

Implementing the public outreach and involvement plan for the LCA BBBS project was a team effort requiring support from a number of organizational units both at the USACE and the LaCPRA. Although the USACE and the LaCPRA lead the effort, the talents and time of many of the Federal, state, and local agencies involved in the project was necessary to the success of the outreach and involvement plan.

6.3 Institutional Involvement *(NEPA-REQUIRED)*

6.3.1 Study Team

Table 6-1 lists the members of the study team.

Table 6-1. Barataria Basin Barrier Shoreline Restoration Study Team

Preparers of the EIS

NAME	AFFILIATION	DISCIPLINE	SECTION
Ayres, Steven K	USACE-MVN-ED-HE	Hydraulic Engineer	Climate, Offshore Sand Resources, Barrier Systems, Storms & Hurricanes
Blodgett, Edward R	USACE-MVN-ED-HE	Hydraulic Engineer	Climate, Offshore Sand Resources, Barrier Systems, Storms & Hurricanes
Boyce, Mayely L	USACE-MVN-OC	Attorney	Legal Sufficiency & NEPA Compliance
Breaux, Catherine M	U.S. Fish and Wildlife Service	Biologist	Wildlife & Fishery Resources, FWCA Recommendations & Report
Britsch, Louis D	USACE-MVN-ED-FG	Geologist	Geology
Brown, Christopher	USACE-MVN-PM-RP	Biologist	Hazardous, Toxic, & Radioactive Waste, Deepwater Horizon
DeLoach, Pamela A	USACE-MVN-ED	Civil Engineer	Planning & Design, Alternatives
Exnicios, Joan M	USACE-MVN-PM-R	Archeologist	Historic & Cultural Resources, Indian Tribes & Nations
Finley, Heather	Louisiana Department of Wildlife and Fisheries	Biologist	Environmental Impacts, Wildlife & Fishery Resources
Firmin, Bridgett	U.S. Fish and Wildlife Service	Biologist	Threatened & Endangered Species
Glisch, Eric J	USACE-MVN-ED-HE	Environmental Engineer	Water Quality Resources, Salinity Regimes
Haab, Mark E	USACE-MVN-PM-AN	Economist	Socioeconomic & Human Resources
Klein, William P Jr	USACE-MVN-PM-RS	Biology	Environmental Manager
Lachney, Fay V	USACE-MVN-PD-P	Project Management/Planning	Plan formulation, Alternatives
Mach, Rodney F	USACE-MVN-ED-HE	Hydraulic Engineer	Water Quality Resources, Salinity Regimes

Mann, Joseph F	USACE-MVN-PM-AN	Economist	Socioeconomic & Human Resources
Mccaffrey, Kelly P	USACE-MVN-PM-R	Landscape Architect	Aesthetic Resources
Parker, Thomas W	USACE-MVN-PD-RP	Environmental Resource Specialist	Biological Assessment
Perez, Andrew R	USACE-MVN-PD-RN	Recreation Specialist	Recreation Resources
Radford, Richard T	USACE-MVN-PM-RN	Recreation Specialist	Aesthetic Resources
Richardson, Jerica M	USACE-MVN-PM-RN	Archeologist and Environmental Justice	Historic & Cultural Resources, Indian Tribes & Nations
Steyers, Cindy	Natural Resources Conservation Service	Botanist	Environmental Impacts & Vegetation Resources
Stiles, Sandra E	USACE-MVN-PM-RS	Biologist	Threatened & Endangered Species, Biological Assessment
Williams, Patrick	National Marine Fisheries Service	Biologist	Fisheries Resources, Habitat Analysis
Winer, Harley	USACE-MVN-ED-HE	Supervisory Hydraulic Engineer	Climate, Offshore Sand Resources, Barrier Systems, Storms & Hurricanes
OTHER TEAM PARTICIPANTS			
Altman, James	LA Office Of Coastal Protection And Restoration	Manager, Land Section	Real Estate Plan
Axtman, Timothy J	USACE-MVN-PD-P	Project Management/Planning	Plan Formulation
Bacuta, George	USACE-MVN-ED	Civil Engineer	Deepwater Horizon Oil Spill
Beall, Andrew	LA Office Of Coastal Protection And Restoration	Project Management	Planning & Design
Bernard, Edward	USACE-MVN-SS	Safety Officer	Deepwater Horizon Oil Spill
Buras, Honora	Louisiana Department of Natural Resources	Coastal Resources Scientist	Environmental Study Team Co-coordinator, PEIS preparation, Plan Formulation & Alternative Analysis, Benefit Protocols
Coco, Patrick	LA Office Of Coastal Protection And Restoration	Project Design Engineer, Engineering Section	Planning & Design
Constance, Troy G	USACE-MVN-PM-OR	Chief, RPEDS	Planning & Design

Crabtree, Don G	USACE-MVN-RE-E	Appraiser	Gross Appraisal
DuCote, Greg	Louisiana Department of Natural Resources	Coastal Management Division	Planning & Design
Ettinger, John F	U.S. Environmental Protection Agency	Environmental Science and Policy	NEPA Compliance
Frimin, Brigette	USFWS	Endangered Species Coordination	Threatened and Endangered Species
Gosselin, Sean	USACE-MVN-RE	Realty Specialist	Real Estate Plan
Grandy, Gregory	LA Office Of Coastal Protection And Restoration	Project Manager, Project Management Section	Planning & Design
Gutierrez, Judith Y	USACE-MVN-RE-E	Appraisal & Planning Reviewer	Real Estate Plan
Haase, Bren	LA Office Of Coastal Protection And Restoration	Manager, Plan Development Section	Planning & Design
Harris, Jeff	Louisiana Department of Natural Resources	Coastal Consistency	Coastal Consistency
Hicks, Billy	USACE-MVN-PM	Project Management	Planning & Design
Joffrion, Russ	LA Office Of Coastal Protection And Restoration	Project Design Engineer, Engineering Section	Planning & Design
Khalil, Syed	LA Office Of Coastal Protection And Restoration	Geologist	Geology, Offshore Sand Resources, Barrier Systems, Coastal Processes & Hydrology,
Lacy, Robert D	USACE-MVN-PM-AW	Economist	Socioeconomic & Human Resources
Lanier, Joan	USACE-MVN-PM	Project Management/Coastal Restoration	Plan formulation
Leonard, Lisa	USACE-MVN-PM-AW	Economist	Socioeconomic & Human Resources
Llewellyn, Dan	Louisiana Department of Natural Resources	Environmental Restoration and Habitat Development	Planning & Design
Lowe, Robert	USACE-RE-E	Appraisal & Planning	Real Estate Plan
Monnerjahn, Chris	USACE-MVN-PM	Project Management/Coastal Restoration	Plan formulation
Northey, Robert D	USACE-MVN-OC	Attorney	Legal Sufficiency & NEPA Compliance
Parsons, Carol	LA Office Of Coastal Protection And Restoration	LCA Group Coastal Resources Supervisor	Planning & Design
Poff, Michael	Coastal Engineering Consultants, Inc.	Coastal Engineer	Engineering Design

Rhinehart, Kirk	LA Office Of Coastal Protection And Restoration	Administrator, Planning Branch	Planning & Design
Tate, Beau	Louisiana Department of Natural Resources	Project Design Engineer, Coastal Engineering Division	Planning & Design
Thomson, Gordon	Coastal Engineering Consultants, Inc.	Coastal Engineer	Engineering Design

6.4 ADDITIONAL REQUIRED COORDINATION *(NEPA-required)*

This section describes the coordination between Federal, state, parishes, local agencies and entities, Indian Tribes and Nations, and other interested parties. For this study effort, the LCPRA is the 50-50 cost-share partner with the MVN. They have provided a portion of their share as in-kind services, such as in project management, contract management, cultural resources, engineering, real estate support, and report preparation.

6.4.1 Federal Agencies

The following Federal agencies were coordinated with during the course of this study:

- U.S. Environmental Protection Agency (EPA)
- Gulf of Mexico Program
- U.S. Coast Guard (USCG)
- U.S. Department of Transportation (DOT) and Energy (DOE)
- U.S. Department of Agriculture (USDA)
  - Natural Resources Conservation Service (NRCS)
  - Forest Service (USDA Forest Service)
- U.S. Department of Commerce (DOC)
  - National Marine Fisheries Service (NOAA Fisheries)
- U.S. Department of the Interior (DOI)
  - Fish and Wildlife Service (USFWS)
  - U.S. Geological Survey (USGS)
  - Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE)
  - National Park Service (NPS)

6.4.2 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 (LDWF)
- Louisiana Department of Transportation and Development (LDOTD)

- Louisiana Department of Environmental Quality (LDEQ)
- Louisiana Coastal Protection and Restoration Authority (LaCPRA)
- Louisiana State Historic Preservation Officer (SHPO)

6.4.3 Parishes

The following parishes were coordinated with during the course of this study:

- Jefferson
- Lafourche
- Plaquemines

6.4.4 Indian Tribes and Nations

There are no federally recognized Indian tribes or nations within or nearby the study area. Hence, no Indian tribes or nations were coordinated with during the course of this study.

6.4.5 Interested Parties

The following groups 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
- Wisner Foundation
- Landowners
- Trust for Public Land

6.5 REPORT RECIPIENTS *(NEPA-required)*

The Louisiana Coastal Area Barataria Basin Barrier Shoreline Restoration Draft Integrated Construction Report and Draft Environmental Impact Statement will be 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 available upon request from the U.S. Army Corps of Engineers at the following address:

U.S. Army Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, Louisiana 70160-0267

6.6 PUBLIC VIEWS AND RESPONSES *(NEPA-required)*

In accordance with the NEPA, the MVN issued a Notice of Availability inviting public comment on the draft report. During the 45-day comment period, at least 2 public meetings requesting comments on the draft report were held. Following the comment period, the MVN will prepare responses to all substantive comments received on the draft. All registered comment meeting participants, as well as those providing written comments, will be provided a copy of the Final Integrated Construction Report and Final Environmental Impact Statement. In addition, the final report will be posted on the study website located at http://www.lca.gov.

7.0 COORDINATION AND COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS*(NEPA-Required)

This chapter documents the coordination and compliance efforts regarding statutory authorities including: environmental laws, regulations, Executive Orders, policies, rules, and guidance. Consistency of the Recommended Plan with other Louisiana coastal restoration efforts is also described.

7.1 ENVIRONMENTAL COORDINATION AND COMPLIANCE

Following completion of the integrated LCA BBBS Final Construction Report and SEIS, the Assistant Secretary of the Army for Civil Works (ASA-CW) will issue a written Record of Decision (ROD) concerning the Recommended Plan. The ROD will be issued within a framework of laws, regulations, Executive Orders, policies, rules, and other guidance. These authorities establish regulatory compliance standards for environmental resources pertaining directly to USACE management of water resources development projects, or provide planning guidance for the management of environmental resources. Relevant Federal statutory authorities and Executive Orders are listed in table 7-1 and relevant State of Louisiana statutory authorities are listed in table 7-2. Full compliance with statutory authorities will be accomplished upon review of the LCA BBBS Final Construction Report and SEIS by appropriate agencies and the public and the signing of a ROD.

As mentioned in section 1.2.2.2, the Corps has requested the following agencies to be a Cooperating Agency (as defined under 40 CFR 1501.6) for this study: Louisiana Department of Environmental Quality (LDEQ), Louisiana Coastal Protection and Restoration Authority (LaCPRA), Louisiana Department of Wildlife and Fisheries (LDWF), Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE), National Marine Fisheries Service (NMFS), Natural Resources Conservation Service (NRCS), U.S. Environmental Protection Agency (USEPA), U.S. Fish and Wildlife Service (USFWS), and the U.S. Geological Survey (USGS).

7.1.1 Clean Water Act– Section 401 Water Quality

Under provisions of the Clean Water Act, any project that involves placing dredged or fill material in waters of the United States or wetlands or mechanized clearing of wetlands needs a water quality certification from the LDEQ, Office of Environmental Services. Water Quality Certification (WQC 110830-01/AI 101235/CER 20110007) was granted by the LDEQ on September 30, 2011.

7.1.2 Clean Water Act – Section 404(b)(1)

The USACE is responsible for administering regulations under Section 404(b)(1) of the Clean Water Act. Potential project-related impacts subject to these regulations have been evaluated as in compliance with Section 404(b)(1) of the Clean Water Act (see appendix D).

Table 7-1
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 of 1940,
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 7-2 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

7.1.3 Coastal Zone Management Act of 1972

Section 307 (16 U.S.C. 1456(c)(1)(A)) of the Coastal Zone Management Act of 1972 directs Federal agencies proposing activities or development projects (including civil work activities), whether within or outside the coastal zone, to assure that those activities or projects are consistent, to the maximum extent practicable, with the approved state coastal zone management program. A Consistency Determination was provided with the Draft Integrated Report (see appendix D) and was submitted to the LDNR for consistency review. Implementation of the Recommended Plan is considered consistent, to the maximum extent practicable, with the approved Louisiana state coastal management program. By letter dated September 13, 2011, the LDNR, Office of Coastal Management indicated that the project (C20110034), as proposed in the Consistency Determination, is consistent with the Louisiana Coastal Resource Program (LCRP) of the proposed action.

7.1.4 Fish and Wildlife Coordination Act Report

The USFWS has been a cooperating agency and collaborative partner throughout the study process, contributing to the documentation and analysis of potential impacts by the various alternatives. The April 30, 2009, Fish and Wildlife Coordination Act Report (FWCAR), the August 5, 2010 and the December 8, 2010 supplements and the December 22, 2011 final FWCAR are included in appendix D.

In their December 22, 2011 final FWCAR for the LCA BBBS Study, the USFWS concurred with the findings of this study. The final FWCAR recommendations state:

> *The Service is pleased to see the increase of sediment and the addition of renourishment to the Caminada Headland and the single island alternative plus renourishment for Shell Island and agree that those additional features would result in greater overall benefits. The Service feels the new TSP represents a significant gain in habitat for fish and wildlife resources over the project life. In fact with the changes to the TSP two of our previous FWCA report recommendations have been resolved. The Service believes that the impact analysis and recommendations (presented below) provided in our April 2009, August 5, 2010, and June 3, 2011 FWCA Report 11 and Supplemental Reports continue to remain valid with the addition of the first recommendation and the removal of the two recommendations mentioned above.*

1. *The Service, NMFS, and LDWF should be provided an opportunity to review and submit recommendations on future detailed planning reports and the draft plans and specifications on the Barataria Basin Barrier Shoreline Restoration Project addressed in this report.*

2. *Coordination should continue with the Service and NMFS on detailed contract specifications to avoid and minimize potential impacts to piping plover and their critical habitat, manatees, pallid sturgeon, and sea turtles.*

3. *Avoid adverse impacts to nesting seabird colonies through careful design project features and timing of construction. 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, exact dates may vary within this window depending on species present). Prior to any such work, surveys should be conducted by qualified personnel during the colonial seabird nesting season to determine the presence and location of any such colonies. In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.*

4. *If the proposed project has not been constructed within 1 year or if changes are made to the proposed project, the Corps should re-initiate Endangered Species Act consultation with the Service.*

5. *The newly created barrier headland/island and back-barrier marsh, as well as the surrounding habitats that may be indirectly benefited by long-shore transport and sediment overwash, should be monitored over the project life for effectiveness and the results should be provided to all resource agencies. Development of those monitoring plans should be coordinated with all natural resource agencies.*

6. *All containment features should be breached or degraded, if necessary to restore tidal connectivity, once the marsh creation/nourishment areas have at least 80% coverage of emergent vegetation.*

7. *Identification of additional borrow sites should be coordinated with the Service and other natural resource agencies.*"

Under provisions of the NEPA, ESA, and the FWCAR, and because they are integral components of the administrative record, this report includes the draft FWCAR (see appendix D); the coordination letter from the USFWS listing threatened and endangered species within the study area (see appendix D); the draft Biological Assessment describing potential impacts on threatened and endangered species (see appendix D); and the May 9, 2005, letter affirming the USFWS participation as a cooperating agency (40 CFR 1501.6) (see appendix D).

7.1.5 Threatened and Endangered Species Act

Compliance with the Threatened and Endangered Species Act has been coordinated with the USFWS and NMFS for those species under their respective jurisdictions. A Biological Assessment has been prepared, which documents the potential impacts of implementing the Recommended Plan on the piping plover and its critical habitat (see appendix D). A supplement to the Biological Assessment has also been prepared discussing potential impacts of renourishment of the Caminada Headland (see Appendix D). The USACE has coordinated with the USFWS and the NMFS regarding potential impacts of the Recommended Plan to listed species and their critical habitat.

Formal coordination has been completed for project components within USACE jurisdiction. The USFWS provided their final Biological Opinion dated December 21, 2011, (see appendix D) and provide the following:

> *Because the Corps does not anticipate conducting any significant changes in the proposed action that would require re-initiation of formal consultation and no significant change has occurred regarding the information used during the preliminary biological opinion, the Service confirms that the September 30, 2011, preliminary biological opinion is now a final biological opinion for the proposed action. We have enclosed a copy of that finalized biological opinion for your convenience.*
>
> *No further ESA consultation with the Service is required for the proposed action. As provided in 50 Cod*[e] *of Federal Regulations (CFR)§402.15, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take (i.e., the 18.42 miles of Gulf shoreline described in the September 30, 2011, biological opinion) is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in the opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instance where the amount or extent of incidental take is exceeded, any operations causing such take shall cease pending reinitiation.*

However, the BOEMRE will be conducting formal consultation for permitted sand mining operations within Federal waters. The USACE will comply with all permit conditions determined by BOEMRE. The USACE anticipates that BOEMRE coordination for use of Federal sand resources along the OCS will be completed during PED phase.

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 USACE 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 Recommended Plan. See also section 4.15 "Threatened and Endangered Species", and section 5.13 "Threatened and Endangered Species" of this report.

7.1.5.1 Louisiana State Threatened and Endangered Species and Rare and Unique Habitats Coordination

The MVN reviewed the database maintained by the Louisiana Natural Heritage Program, part of the LDWF that provides the most recent listing and locations for threatened and endangered species and rare unique habitats within the State of Louisiana. The Recommended Plan would not adversely impact threatened or endangered species or rare and unique habitat. The Recommended Plan would increase the available barrier shoreline, islands, and headland habitats as well as salt marsh habitats for use by these species. The Recommended Plan would restore degraded areas, making them more suitable to colonization by estuarine submergent vascular vegetation, coastal mangroves, coastal dune grassland, and coastal dune shrub thicket (see also section 4.9.2 "Rare, Unique, and Imperiled Vegetative Communities").

7.1.6 Magnuson-Stevens Fishery Conservation and Management Act of 1996 (Essential Fish Habitat)

The MVN has coordinated with the NMFS, which is a cooperating agency in the study process, and that agency's experts on various marine organisms, as well as Essential Fish Habitat (EFH). Analysis of potential impacts of the Recommended Plan on EFH is described in section 4.12 "Essential Fish Habitat".

7.1.7 Clean Air Act – Air Quality Determination

Compliance with the Clean Air Act has been fully coordinated with the Air Quality Section of the LDEQ (see Section 4.23 Air Quality). As required by Louisiana Administrative Code, Title 33 (LAC 33:III.1405 B), a general conformity determination for air quality is required for projects that affect non-attainment areas (personal communication Mr. Zia Yasoob, Louisiana Department of Environmental Quality). In Louisiana, the non-attainment area currently consists of Ascension, East Baton Rouge, Iberville, Livingston, and West Baton Rouge parishes. However, an air quality determination was made for the Recommended Plan. This included consideration of the Recommended Plan for the category of general conformity, in accordance with the Louisiana General Conformity, State Implementation Plan (LDEQ 1994).

An air quality determination has been calculated, based upon direct and indirect air emissions. 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 was based upon direct emission for estimated construction hours. 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, State Implementation Plan, section 1405 B.2). The VOC emissions for the Recommended Plan would be classified as de minimus and no further action would be required.

7.1.8 Historic and Cultural Resources

In compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, and 36CFR 800, Federal agencies are required to identify and consider potential effects that their undertakings might have on significant historic properties, districts, sites, buildings, structures, or objects that are included in or eligible for inclusion in the National Register. Additionally, a Federal agency shall consult with any tribe that attached religious and cultural significance to such properties. Agencies shall afford the State Historic Preservation Officer (SHPO) and tribes reasonable opportunity to comment before decisions are made. Accordingly, the Recommended Plan has been coordinated with the SHPO and tribes. Coordination letters received from the SHPO are included in appendix D. The LCA BBBS Final Integrated Construction Report and FEIS will be provided to the SHPO and tribes, as well as other interested parties for comment.

In accordance with ER 1105-2-100, Appendix C, paragraph C-4(d)(5)(d)(2), the U.S. Army Corps of Engineers (USACE) elected to fulfill its obligations under Section 106 of the National Historic Preservation Act of 1966, as amended, through the execution and implementation of a Programmatic Agreement. In consultation with the Advisory Council on Historic Preservation (ACHP), Louisiana State Historic Preservation Officer (SHPO), Indian tribes, representatives of local governments, and other consulting parties, the USACE developed a Programmatic Agreement among the USACE, Coastal Protection and Restoration Authority of Louisiana, SHPO, and ACHP, pursuant to 36 CFR § 800.14(b)(1), executed July 29, 2010. The Programmatic Agreement establishes the procedures for consultation, identification of historic properties, assessment and resolution of adverse effects.

The MVN has received SHPO concurrence for the following LCA projects. Please see appendix D, for copies of letters:

1. Caminada Headland Restoration Project (October 18, 2007) (July 24, 2009).
2. Mississippi River Sand Borrow Sites (June 11, 2008).
3. Caminada Headlands Borrow Area for LCA (September 20, 2007).
4. Ship Shoal OCS Blocks 12, 13, and 88 (May 15, 2008) and;
5. Shell Island for placement of dredge material (March 20, 2008)

7.1.9 Farmland Protection Policy Act

The purpose of the Farmland Protection Policy Act is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. The Farmland Protection Policy Act ensures, to the maximum extent practicable, that Federal programs are administered in a manner that is compatible with state, local, and private programs to protect farmland. The NRCS is the agency primarily responsible for implementation of the Farmland Protection Policy Act. Under the Farmland Protection Policy Act, the NRCS is to provide technical assistance to Federal agencies, state and local governments, tribes, or nonprofit organizations that desire to develop farmland protection programs and policies. The NRCS has been a cooperating agency (40 CFR 1501.6) in the study process with experts on various soils, vegetation, and agriculture aspects contributing to the documentation and analysis of potential impacts.

AD-1006, "Farmland Conversion Impact Rating," the form used by Federal agencies that wish to convert farmland to nonagricultural uses, has been completed (see appendix D) and has been submitted to the NRCS. There are no farmlands within the study area. Hence, there would be no unnecessary or irreversible conversion of farmland to non-agricultural uses.

7.1.10 Executive Order 13186 – Migratory Bird Habitat Protection

Executive Order 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.

7.1.11 Executive Order 12898 – Environmental Justice

Concern with environmental justice (EJ) issues 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 Executive Order 12898 regarding Federal actions to address EJ issues 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.

Executive Order 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.

Potential EJ issues have been considered throughout the entire study process, from study initiation through project implementation and monitoring. As part of the NEPA process, the planning development team held 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.

The MVN is committed to ensuring that any potential environmental justice issues are addressed as the study proceeds. There would be no potential EJ issues from implementing the Recommended Plan. However, the MVN continues to encourage any interested parties to inform personnel of potential EJ concerns.

7.1.12 Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646)

All real estate interests acquired for construction of the Recommended Plan would 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 (see appendix C) outlines the proposed acquisition plan for the Recommended Plan.

7.1.13 Executive Order 13112 – Invasive Species

On February 3, 1999, Executive Order 13112 was signed to prevent the introduction of invasive species, 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 Executive Order 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 Recommended Plan is consistent with Executive Order 13112 to the extent practicable and permitted by law and subject to the availability of appropriations, and within Administration budgetary limits. The Recommended Plan would use relevant programs and authorities to prevent the introduction of invasive species and would not authorize, fund, or carry out actions likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, the USACE 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 would be taken in conjunction with the actions.

8.0 AREAS OF CONTROVERSY AND RECOMMENDATIONS

8.1 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

There is public support for the construction of structures to attempt to decrease erosion due to storm surge on the Caminada Headland near Port Fourchon. Placement of terminal groins would retain sediment on Caminada Headland while breakwaters would reduce the wave energy and reduce the amount of erosion. While the impact from breakwaters may appear to be positive as reduced erosion rates along portions of the shorelines could enhance project performance, these benefits could be offset by significant adverse impacts that could result from the interruption of longshore sediment transport. This interference with sediment transport processes could increase the rates of erosion and shoreline retreat to adjacent reaches of the barrier shoreline. Once breaches have occurred and marsh is exposed, erosion rates increase. The BBBS team deems that the most appropriate approach to restoration projects should be to mimic natural environmental processes and structures. Rock breakwaters do not mimic or reflect natural environmental features or processes in coastal Louisiana. Hard, immobile structures are fundamentally inconsistent with the soft and highly dynamic nature of the coastal system.

Fourchon Beach, located on the Caminada Headland at the terminus of Louisiana Highway 3090, is a local recreation spot. There have been differing opinions between the landowners and the public regarding access to the beach areas. While the shoreline and the beach area south of Bay Champagne are claimed as state lands by the State of Louisiana, access is available only by crossing private property. There has been considerable conflict between the landowners and the public over access to the beach, especially concerning vehicle access on the beach. While the landowners allow pedestrian access, pilings have been placed to prevent vehicle access. Consequently, beach goers are forced to recreate only in areas near the terminus of Highway 3090. To provide vehicle access to other areas of the beach, the South Lafourche Beach Development District (SLBDD) would like to build a road from Highway 3090 to the beach area at Bay Champagne. The preferred location of the road would impact the marsh creation area planned between Bay Champagne and Highway 3090. The SLBDD also does not want marsh created in the Bay area, leaving this area available to beach visitors. There are very few beaches in Louisiana that can be accessed by vehicles, severely limiting the public's access to the seashore. However, vehicular traffic on the beach would be incompatible with the ecosystem goals and objectives of the BBBS project and the attainment of the project benefits. This conflict is a microcosm of the larger issue of whether private landowners should benefit from the use of public restoration funds, and whether, due to the use of public funds, the public should have access to restored lands.

There is also controversy resulting from the competing goals of the economic, hurricane and storm damage risk reduction, and restoration special interest groups. Some parties are primarily concerned with hurricane and storm damage risk reduction and shoreline erosion. Other groups are primarily interested in environmental restoration, especially restoration of the Caminada Headland beach, dune, and marsh ecosystems. Some interested parties are primarily concerned with the economic goals such as recreation and oil and gas interests in the Port Fourchon area. Consequently, the ecosystem restoration goals of the LCA BBBS to restore the Caminada Headland barrier shoreline, dune, and marsh habitats and associated essential fish and wildlife species are seen by these other

groups as being incomplete because they do not include economic or hurricane and storm damage risk reduction measures.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time. The impacts of the oil spill as well as the various emergency actions taken to address oil spill impacts (e.g., use of oil dispersants, creation of sand berms, use of Hesco baskets, rip-rap, sheet piling and other actions) could potentially impact USACE water resources projects and studies within the Louisiana coastal area, including the BBBS project. Potential impacts could include factors such as changes to existing, future-without, and future-with-project conditions, as well as increased project costs and implementation delays. The USACE will continue to monitor and closely coordinate with other Federal and state resource agencies and local sponsors in determining how to best address any potential problems associated with the oil spill that may adversely impact project implementation. Supplemental planning and environmental documentation may be required as information becomes available. If at any time petroleum or crude oil is discovered on project lands, all efforts will be taken to seek clean up by the responsible parties, pursuant to the Oil Pollution Act of 1990 (33 U.S.C. 2701 et seq.).

The USACE, New Orleans District Regulatory Branch has considered and responded to approximately 58 emergency permits related to the Deepwater Horizon oil spill and are described in **Chapter 5, Table 5-1.** Of potential impacts to the LCA BBBS are several permits that have constructed protective berms, Hesco baskets, rip-rap, bulkheads, and concrete fill to close gaps and washover areas along the Caminada Headland. In addition, the State of Louisiana is permitted to dredge and fill to construct six sand berm reaches along the shoreline of the Chandeleur Islands/Breton National Wildlife Refuge westward to Baptiste Collette Bayou and along the seaward shoreline of Timbalier Island eastward to Sandy Pont. Material to construct the berms would be dredged from Ship Shoal, South Pelto, the Mississippi River Offshore Disposal Site, Pass a Loutre, St. Bernard Shoal and Hewes Point. Emergency permits have the following clause that provides for removing, relocating or altering permitted structures if necessary and upon due notice from the Corps. The clause would pertain to future actions by the United States, such as proposed Louisiana Coastal Area restoration projects:

The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee shall be required upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

As is evident from the numerous ongoing actions, the dynamic nature of the impacts associated with the Deepwater Horizon oil spill will likely require additional consideration in the near future for USACE Civil Works projects.

8.2 RECOMMENDATIONS

8.2.1 Description of the Recommended Plan

The tentatively selected plan is a combination of Caminada Headland Alternative 5 and Shell Island Alternative 5. The initial construction of the barrier shorelines will create or

restore 2,849 acres of beach, dune, and marsh habitats. The fully funded cost of the project, excluding operations and maintenance, is estimated to be $448,351,000. The estimated cost exceeds the authorization. Additional authorization from Congress would be required to implement construction of this project.

8.2.1.1 Caminada Headland

The Recommended Plan proposes a dune height of +7 feet NAVD88 with a dune width of 290 feet. It also proposes a landward beach and dune component in order to maximize acreage and longevity. The landward and seaward slopes would be set 20 horizontal to 1 vertical. The marsh fill is proposed on the landward side of the dune at an elevation of +2.0 feet NAVD88. Approximately 880 acres of beach/dune and 1,186 acres of marsh would be restored or created, resulting in a total of 2,066 acres. The existing 1,431 acres (454 acres of beach/dune and 977 acres of marsh), which are severely degraded, will be restored, and 635 acres (426 acres of beach/dune and 209 acres of marsh) will be created. Fill quantities for the dune and marsh fills would be 5.1 million and 5.36 million cubic yards, respectively. For the dune area, the material would be pumped from the dredge to the beach. The material would then be worked on the beach by bulldozers and front-end loaders. Points of direct access to the project area are Louisiana Highway 3090 and a beach road at Elmer's Island on the eastern end. For the marsh area, the material would be pumped from the offshore borrow site. The dune would serve as the southern dike for the marsh fill. Additional dikes would be constructed around the remaining perimeter. These operations would be completed in a manner that would minimize turbidity of the water at the dredge site and the discharge site.

Approximately 71,500 feet of sand fencing would be installed. The sand fences would be porous barriers that would reduce wind speed along the coast such that sand being transported by the wind accumulates on the downwind side of the fence. The sand fences would promote deposition of windblown sand, create dune features, reduce trampling of existing dunes by beach visitors, and protect vegetative plantings. Vegetative plantings would include a variety of native species. The recommended planting density is no greater than 8-foot centers.

The borrow area identified for the beach/dune restoration is Ship Shoal, a large submerged sand body in the Gulf of Mexico located offshore in south-central Louisiana. The shoal is about 31 miles long and 7 miles wide, lying in water depths of 9 feet to 30 feet. Preliminary studies have shown it is the remaining seaward shoal from one of the older, abandoned Mississippi River deltas. It is composed of well-graded quartz sand and is suitable for use in restoring the Caminada Headland since its grain size is similar to the sand found on the headland. The sediment is to originate from South Pelto, Blocks 12 and 13, which is approximately 40 miles from the project site. The borrow site for the marsh restoration would be located approximately 1.5 miles south of the central portion of the Caminada Headland, and 4.7 miles southwest of Caminada Pass. The estimated cost of construction, including contingencies, supervision and administration, real estate, and preconstruction engineering and design (PED), is $223,526,000 (October 2011). The estimated duration of construction is 936 days. It is estimated that the duration of plantings would be 750 days over a 3-year period.

The Recommended Plan will include renourishment of the Caminada Headland with 3.9 million cubic yards of sand every 10 years. USACE operations and maintenance dredging of the Bayou Lafourche, Louisiana (Belle Pass) navigation project yields on

average approximately 650,000 cubic yards of material every 1.5 to 2 years. This material will be placed in the littoral drift south of Bayou Moreau where the long shore transport of material splits going east and west. The material will be placed, allowing the long shore transport and wave action to move and place the sediment along the headland. Over each 10 year period, an estimated 3.9 million cubic yards of material will be returned to the headland, exceeding the sediment lost from the headland due to longshore transport. This renourishment is part of the non-Federal sponsor's operations and maintenance requirements. The non-Federal sponsor will pay the incremental cost of beneficially using this material over the federal standard. The estimated incremental cost of the renourishment is $7.35 million per dredging event. Under the intermediate relative sea level rise, the Target Year (TY) 50 acreage is estimated to be 2,064 acres; under the historic relative sea level rise scenario, the TY 50 acreage is estimated to be 2,122 acres.

The renouishment will create a feeder beach along the nodal zone of the Caminada Headland. The nodal point is a "hot spot" due to bifurcation of the sediment transport, thus it breaches more frequently than other locations on the Headland. By placing the material at the nodal point, the entire Headland will benefit by reducing breaching. However, should an area of the headland be in danger of breaching, sediment would be placed near the breach to supplement the existing sediment.

The WVA for the Caminada Headland was calculated assuming renourishment of 2 mcy of maintenance dredged material from Bayou Lafourche over a ten year period (see Tables 5-4). This calculation is similar to the benefit determination used in the LCA Ecosystem Restoration Study (USACE 2004). However, recent Corps policy on sustainability (CECW-MVD Memo dated October 7, 2011, Policy Guidance Request for Addressing Sustainability of Ecosystem Restoration Projects in Louisiana) required additional analysis and modeling. In order for this project to comply with these policies and be sustainable, additional dredged material from the Bayou Lafourche navigation project would be needed for renourishment of the Caminada Headland.

On average, approximately 650,000 cy of material is dredged from the Belle Pass reach of Bayou Lafourche approximately every 1.5 to 2 years, and would result in an estimated renourishment of the Caminada Headland of 3.9 mcy every ten years, slightly more than the 3.8 mcy lost over the ten year time period. Overall project costs were determined utilizing the costs associated with 3.9 mcy for renourishment; while the stated benefits (as described in Table 5-4) utilized 2 mcy for renourishment. The changes resulted in a more conservative calculation of benefits. Utilizing 3.9 mcy for renourishment on the Caminada Headland, whose WVA results are undetermined, are estimated to increase the project benefits, thus meeting the sustainability requirements of Corps policy.

Consequently, the acres and AAHUs developed under the WVA utilizing 2 mcy for renourishment (see Tables 5-2, 5-4; and reported throughout Chapter 5) under-report the total benefits in acres that would accrue utilizing the 3.9 mcy of renourishment. Hence, the net acres reported throughout this chapter, Chapter 3, and the abstract vary from the net acres reported in Chapter 5. This increase in material would not impact the selection of the National Environmental Restoration (NER) or recommended plan.

For example, the total net acres for the Caminada Headland reported in Table 5-4 (990 net acres) were determined utilizing 2 mcy of renourishment material in contrast to net acres for the Caminada Headland presented in Table 3-9 (High RSLR: 1,736; BBBS RSLR: 1,929; Intermediate RSLR: 2,064; and Low RSLR: 2,122). Similarly total project net acres (both Caminada Headland and Shell Island) calculated using 2 mcy renourishment is 1,684 net acres in contrast to 2,728 total net acres calculated using 3.9 mcy renourishment.

8.2.1.2. Shell Island

The Recommended Plan will restore the Shell Island reach as one island, similar to its pre-Hurricane Bob (1979) condition. The island would include shoreface, dune, and marsh platform features.

The landward edge of the dune would be located seaward of the existing shoreline. The west end would be terminated approximately 0.5 mile before Grand Bayou. It is anticipated that the closure of Coupe Bob would return the tidal prism to its pre-1979 path—flowing through Grand Bayou, with Grand Bayou increasing in size in response to the altered tidal flow pattern. The planned western end is close to the western limit of Shell Island that was observed in 1973, prior to the opening of Coupe Bob. The proposed island follows the shortest and shallowest route across Coupe Bob. The east end of the island would then follow the remnants of Shell Island East, but has a concave shape towards land. This would be required to maintain a smooth shoreline. The eastern end of the island would be located near the Empire Waterway. The constructed dune would have a uniform width of 189 feet along the length of the restored barrier island.

Louisiana barrier islands have typical widths in the region of 1,000 feet to 1,500 feet wide from the gulf shoreline to the bayward limit of the marsh. A uniform marsh width of 735 feet was chosen to construct an island that is approximately 1,240 feet wide following equilibration of the shoreline fill. The fill source for dike construction is located within the marsh fill footprint where the existing bathymetry is relatively shallow (less than -2.0 feet).

However, in deeper water (bathymetry below -3.0 feet), it is not feasible to construct the marsh section with only marsh sediments, as the marsh would settle too rapidly and nonuniformly to perform its intended purpose effectively. Instead it is recommended to construct a sand base across Coupe Bob, at -3.0 feet, using shoreline fill material. The marsh can then be constructed on top of this base, which would reduce settlement of the marsh material. A second option is to install a geotextile tube for containment of the marsh fill where the -3 feet NAVD88 sand base is constructed. The geotextile tube could be filled with sand from the sand base. This option was used for the development of the Recommended Plan.

It is estimated that 5.6 million cubic yards of shoreline fill would be required to construct 317 acres of shoreline/dune area (area above +2 feet, NAVD88). Approximately 2.1 million cubic yards of marsh fill would be required to construct 466 acres of marsh. The

existing 386 degraded acres (56 acres of beach/dune and 330 acres of marsh) will be restored while 397 acres will be created (261 acres of beach/dune and 136 acres of marsh.)

Shell Island would be re-nourished 20 years and 40 years after initial construction to the original template of 317 beach/dune acres. The marsh fill would also be re-nourished to its original construction template at this time interval. Approximately 1.5 million cubic yards of beach fill would be required for re-nourishment cycles in years 20 and 40. In year 20, approximately 907,200 cubic yards of marsh fill would be required and in year 40, 604,700 cubic yards would be required for re-nourishment. The estimated cost of the renourishment in year 20 is $63.3 million and $60.9 million in year 40. Under the intermediate relative sea level rise, the TY 50 acreage is estimated to be 855 acres; under the historic relative sea level rise scenario, the TY 50 acreage is estimated to be 919 acres.

The borrow source for the dune/beach would be a large sand deposit near Nairn in the Mississippi River between mile markers 32 and 34, approximately 11 miles north of the project area. The borrow site is located in a river meander where greater sediment thickness is anticipated due to the presence of relict (vertically stacked) sand bars. USACE boring data indicates sand thickness of at least 70 feet. Based on samples obtained from vibracores, the sand grain size is comparable to the sand at the project site. The dredged material would be pumped from the Mississippi River via pipeline. The borrow source for the marsh restoration would be the Empire deposit, approximately 1.5 miles from the Empire Jetties. Water depths in the borrow area are from 16 feet to 20 feet. The borrow area occupies about 207 acres and total mixed sediment volumes range from 5.5 million to 6.6 million cubic yards for 15 foot and 20 foot cut depths, respectively. The sedimentary characteristics indicate a silt content of about 40 percent, a clay content of about 22 percent and sand content of about 38 percent. The estimated construction cost, including contingencies, supervision and administration, real estate, and PED is $203,437,000 (October 2011). It is estimated that duration for construction would be 787 days. It is estimated that the duration for the plantings would be 360 days over a period of 3 years.

8.2.2 Recommended Component of Construction

Additional authorization will be requested to implement the construction of the NER. However, because the NER cannot be constructed within the maximum project cost as authorized by WRDA 2007, a subset of the NER, Caminada Headland Alternative 5, was selected as the recommended component of construction. The recommended component of construction represents an implementable and separable element of the NER plan, is cost effective and incrementally justified, and within the cost and scope of the current authorization.

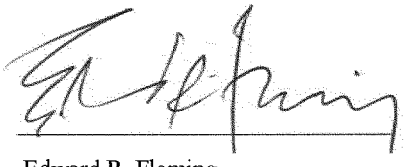
8.3 District Engineer's Recommendation

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 BBBS Restoration Study effort. Based upon the sum of this information, I am recommending for implementation of the BBBS project the NER Plan presented in this report. The NER Plan includes the construction components for ecosystem restoration that help address 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, facilitate longshore transport of sand resources, provide infrastructure protection, and make progress towards a more sustainable ecosystem. I recommend that the Director of the Civil Works Program approve the recommended BBBS project identified in this study for implementation.

Additionally, I recommend that the recommended component of construction, the Caminada Headland Alternative 5, be implemented under the existing authority provided in Section 7006(c)(1)(C) of WRDA 2007. Caminada Headland Alternative 5 is an implementable increment of the NER plan, and is within the cost and scope of the WRDA authorization.

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.



Edward R. Fleming
Colonel, US Army
District Engineer

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9.2 GLOSSARY

Acceptability	Adequate to satisfy a need, requirement, or standard. One of the USACE 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 involved 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.
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.
Anadromous	Ascending rivers from the sea from breeding.
Anoxia	Absence of oxygen
Anthropogenic	Caused by human activity.
Average Annual Habitat Unit (AAHU)	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.
Benefits	Valuation of positive performance measures.
Benthic	Living on or in sea, lake, or stream bottoms
Biomass	The total mass of living matter (plant and animal) within a given unit of environmental area
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.
	There are several sections of this Act which pertain to regulating impacts to wetlands. The discharge of

Clean Water Act Section 404 (b) (1)	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 objectives across the entire Louisiana Coast.
Comprehensive Plan	Same as coast wide Plan.
Congressional Authorization	Authorization for implementation of a project subject to approval of the project feasibility-level decision document by the Assistant Secretary of the Army for Civil Works.
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.
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.
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	The repeating pattern of delta development, progression, and abandonment. As sediments are deposited at the mouth of the distributary channels, the delta progresses seaward. The main channel then switches to a new course with a shorter reach to the depositional basin. Abandoned delta lobes decrease in elevation due to continued subsidence and sediment compaction, resulting in retreat of the shoreline. Abandoned lobes may be partially or wholly covered by new lobes during later deltaic cycles.
Deltaic Deposits	Mud and sand deposited at the mouth of the river.
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)
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.
Dredged material embankments (Spoil Banks, Side-cast Banks, Excavated Material Banks)	Dredged material removed from canals and piled in a linear mound along the edge of the canals.
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 conditions or function.
Effectiveness	Having an intended or expected effect. On 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.
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.
Enhance	To augment or increase/heighten the existing state of an area
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 of 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).
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 anaylsis.
Feature	A constructible increment of an alternative plan.
Final Array	The final grouping of the most effective plans from which a final recommendation can be made.
Foreshore Dikes	An embankment of earth and rock built to prevent floods or erosion; that were built in the area of a shore that lies between the average high tide mark and the average low tide mark.
Fresh Marsh	Intertidal herbaceous plant community typically found in the area of the estuary with salinity ranging from 0-3 ppt.
Furbearer	An animal whose skin is covered with fur (mammal), especially fur that is commercially valuable, such as muskrat, nutria, and mink
Geomorphic	Related to the geological surface configuration.
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 mash or swamp to open water.
Habitat Units (HU's)	Represent a numerical combination of quality (HSI) and quantity (acres) existing t any given point in time. The HU's 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 in AAHUs between the two scenarios represents the net benefit attributable to the project in terms of habitat quantity and quality.
Hazardous, Toxic, and Radioactive Waste (HTRW)	Wastes that contain toxic constituents, or that may cause hazardous chemical reactions, including explosive or flammable materials, or radioactive wastes, which, improperly managed may present a hazard to human health or the environment
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 movements on the earths 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 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 communication 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	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.
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.
Locally Preferred Plan (LPP)	Alternative plan preferred by local sponsor if other than the Recommended Plan.
Maintain	To keep an existing state
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
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 FEIS 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 that "Goals," describing how to achieve the desired targets.
Organic	Composed of or derived from living things
Oscillations	Fluctuation 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
Planning Scale	Planning term that reflects the degree to which environmental processes would be restored or reestablished, and the resulting ecosystem and landscape changes that would be expected over the next 50 years. This uppermost scale is referred to as "Increase." No net loss of ecosystem function is "Maintain." Reducing the projected rate of loss of function is
Post-larval	Stage in an animals 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.
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.
Province	A major division of the coastal area 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
Rebuild	To some extent build back a structure/landform that had once existed.
Reduce	To diminish the rate or speed of a process
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 an approximation of its condition or function prior to disturbance by modifying conditions responsible for the loss of change; re-establish the function and structure of that ecosystem
Saline Marshes	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 final 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 canals.
Shoaling	The shallowing of an open-water area through deposition of sediments.
Social	Relating to human society and its modes of organization.
Socioeconomic	Involving both social and economic factors.
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 Native American sites and other archaeological/historic sites
Stillstand	A period of time when sea level did not change
Storm Overwash	The process by which sand is transported 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.
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 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
Target	A desired ecosystem state that meets an objective or set of objectives
Terrestrial Habitat	The land area or environment where an organism lives; as distinct from water or air habitats.
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
Upland	A general term for non-wetland elevated land above low areas along streams or between hills.
Water Resources 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	A bill passed by Congress that provides authorization and/or appropriation for projects related to the conservation and development of water and related resources.

9.3 ACRONYMS

AAHU	Average Annual Habitat Unit
ACHP	Advisory Council on Historic Preservation
ACM	Articulated Concrete Mat Preservation
AEAM	Adaptive Environmental Assessment and Management
ARS	Local Rate of Subsidence
ASA (CW)	Assistant Secretary of the Army (Civil Works)
ATR	Agency Technical Review
BA	Biological Assessment
BAT	Best Available Technology Economically Achievable
BBBS	Barataria Basin Barrier Shoreline Restoration Study
BCT	Best Conventional Pollutant Control Technology
BMP	Best Management Practices
BPD	Barrels Per Day
BRM	Brackish Marsh
BTNEP	Barataria-Terrebonne National Estuary Program
BTU	British Thermal Units
BU	Benefits Units
CDP	Census Designated Places
CE/IC	Cost Effectiveness and Incremental Cost
CE/ICA	Cost Effectiveness and Incremental Cost Analysis
CELSS	Coastal Ecological Landscape Spatial Simulation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CFS	Cubic Foot Per Second
CIAP	Coastal Impact Assistance Program
Coast 2050 Plan	Coast 2050-Toward a Sustainable Coastal Louisiana Report
COM	Compaction Fraction
CP	Conceptual Plan
CRT	Coastal Restoration Team
CSVR	Contents-to-Structure Value Ratio
CWA	Clean Water Act
CWPPRA	Coastal Wetlands Planning, Protection Restoration Act
CY	Cubic Yards
CYR	Cubic Yards Per Year
D	Water Depth
Dbl	Decibels
DD	Decision Documents
DEQ	Department of Environmental Quality
DM	Decision Makers
DO	Dissolved Oxygen

E&D	Engineering and Design
EIS	Environmental Impact Statement
EMAP	Environmental Monitoring and Assessment Program
EP	Engineering Pamphlet
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
FDES	Flood Damage Estimation System
FDT	Framework Development Team
FEMA	Department of Homeland Security- Federal Emergency Management Agency
FHWA	Federal Highway Administration
FPG	Federal Principles Group
FCSA	Feasibility Cost Share Agreement
ft	Feet
FTL	Functional Team Leader
FWA	Future With The Alternative
FWCAR	Fish and Wildlife Coordination Act Report
FWO	Future Without Project
FY	Fiscal Year
GIWW	Gulf Intracoastal Waterway
GIS	Geographic Information System
H&H	Hydrology and Hydraulics
HEP	Habitat Evaluation Procedures
HIS	Habitat Suitability Index
HSIQL	Habitat Suitability Index That Reflects Quality of Habitat
HTRW	Hazardous, Toxic, or Radioactive Waste
HQU	Habitat Quality Units
IHNC	Inner Harbor Navigation Canal
INT	Interspersion
IPT	Interdisciplinary Planning Team
IWR	Institute for Water Resources
KOP	Key Observation Point
LACPR	Louisiana Coastal Protection and Restoration
LCA	Louisiana Coastal Area
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development
LDWF	Louisiana Department of Wildlife and Fisheries
LERRD	Land, Easements, Rights of Way, Relocation, and Disposal
LOCPR	Louisiana Office of Coastal Protection and Restoration
LPP	Locally Preferred Plan
LSU	Louisiana State University
MCACES	Microcomputer Aided Cost Estimating System
MCFS	Marsh Creation Feasibility Study

MLG	Mean Low Gulf
MPH	Miles Per Hour
MPO	Metropolitan Planning Organization
MR&T	Mississippi River and Tributaries
MRC	Mississippi River Commission
MR-GO	Mississippi River Gulf Outlet
MS4s	Municipal Separate Storm Sewer Systems
NAAQS	National Ambient Air Quality Standards
NE	Northeast
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NG	Natural Gas
NGO	Non-Government Organization
NGVD	National Geodetic Vertical Datum (NAVD)
NHPA	National Historic Preservation Act
NMFS	Department of Commerce – National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NRCS	Department of Agriculture- Natural Resources Conservation Service
NRHP	National Register of Historic Places
NTRC	National Technical Review Committee
NW	North West
NWR	National Wildlife Refuge
OMRR&R	Operating, Maintaining, Repairing, Replacing and Rehabilitating
OSI	Overall Suitability Index
O&M	Operations and Maintenance
OPEC	Organization of Petroleum Exporting Countries
P&G	Principles & Guidelines
PBMO	Plan that Best Meets Objectives
PDT	Project Delivery Team
PED	Preconstruction, Engineering, and Design
PEIS	Programmatic Environmental Impact Statement
PIERS	Port Import Export Reporting Service
PIR	Project Implementation Report
PMT	Project Management Team
PPA	Project Partnership Agreement
PPM	Parts Per Million
PPT	Parts Per Thousand

Q	Discharge
RET	Retention Fraction
RP	Recommended Plan
RR	Railroad
RSLR	Relative Sea Level Rise
RV	Recreational Vehicle
RWG	Regional Work Group
S&A	Supervision and Administration
SAV	Submerged Aquatic Vegetation
SELA	Southeast Louisiana
SHPO	State Historic Preservation Officer
SL	Sediment Load
SLU	Southeastern Louisiana University
SPR	Strategic Petroleum Reserve
SS	Scrub Shrub
SUB	Local Subsidence Amount
SW	Southwest
SWPP	Storm Water Pollution Prevention Plan
TMDL	Total Maximum Daily Limit
TSP	Tentatively Selected Plan
TVA	Tennessee Valley Authority
TY	Target Year
ULL	University of Louisiana at Lafayette
UNO	University of New Orleans
UPL	Upland
USACE	United States Corps of Engineers
USACE-MVD	United States Corps of Engineers – Mississippi Valley Division
USACE-MVN	United States Corps of Engineers – New Orleans District
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
USFWS	Department of the Interior- U.S. Fish and Wildlife Service
USGS	Department of the Interior – United State Geological Survey
VE	Value Engineering
VOC	Volatile Organic Compounds
VT	Vertical Team
WCSC	Waterborne Commerce Statistics Center
WRDA	Water Resource Development Act
WRU	Water Resource Units
WVA	Wetlands Value Assessment
WW	Waterway

9.4 INDEX

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