LOUISIANA COASTAL AREA (LCA)
ECOSYSTEM RESTORATION STUDY

Volume VI of VI

Final Integrated Feasibility Study and Supplemental Environmental Impact Statement

for the

Medium Diversion at White Ditch Plaquemines Parish Louisiana

September 2010

U.S. Army Corps of Engineers
New Orleans District

Coastal Protection and
Restoration Authority

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The responsible lead Federal agency for this study is the U.S. Army Corps of Engineers – Mississippi Valley, New Orleans District (CEMVN). The non-Federal sponsor for the study is Coastal Protection and Restoration Authority (CPRA). This report is a combined feasibility report and environmental impact statement complying with requirements of the U.S. Army Corps of Engineers (USACE) and the Council of Environmental Quality (CEQ), and is intended to reduce duplication and paperwork. An asterisk (*) in the table of contents notes paragraphs that are required for National Environmental Policy Act (NEPA) compliance.

September 2010

U.S. Army Corps of Engineers
New Orleans District

Coastal Protection and
Restoration Authority

This report contains six volumes.

You are at **Volume VI**, which is the Medium Diversion at White Ditch Final Integrated Feasibility Study Report and Supplemental Environmental Impact Statement.

Volume I:	Summary
Volume II:	Amite River Diversion Canal Modification
Volume III:	Convey Atchafalaya to Northern Terrebonne Marshes / Multipurpose Operation of the Houma Navigation Lock
Volume IV:	Small Diversion at Convent / Blind River
Volume V:	Terrebonne Basin Barrier Shoreline Restoration
Volume VI:	Medium Diversion at White Ditch

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FINAL
INTEGRATED FEASIBILITY STUDY AND SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
Louisiana Coastal Area (LCA), Louisiana
Medium Diversion at White Ditch
Plaquemines Parish, Louisiana

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

ABSTRACT: Four of 12 alternative plans were considered in detail: Alternative 1 would implement a 5,000 cubic feet per second (cfs) maximum diversion and outfall management features; Alternative 2 would implement a 10,000 cfs maximum diversion; Alternative 3 would implement a 15,000 cfs maximum diversion.

Alternative 4 is the Recommended Plan and would implement a 35,000 cubic feet per second maximum diversion with associated outfall management features. This project would provide a source of river sediment, freshwater and nutrients to the River aux Chenes subbasin and other nearby portions of the upper Breton Sound Basin, to restore and protect marsh soils and vegetation and maintain a functional salinity regime. The project would be expected to benefit approximately 98,000 acres of wildlife and fisheries habitat in this portion of the Breton Sound Basin. The fully funded cost of the Recommended Plan is estimated to be $387,620,000. Currently, the annual operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) costs are estimated at $1,467,836. OMRR&R costs are the responsibility of the non-Federal sponsor. These costs can be found in Tables 3.15 and 3.16 of the main report. Information presented in the LCA Main Report, Final Programmatic Environmental Impact Statement (EIS), and supporting volumes and appendices are incorporated by reference in this Final Integrated Feasibility Study with Supplemental EIS.

Comments: Please send comments or questions on this Final Supplemental Environmental Impact Statement (SEIS) to the U.S. Army Corps of Engineers, New Orleans District, Attention: Andrew D. MacInnes, P.O. Box 60267, New Orleans, LA 70160-0267. Telephone: (504) 862-1062; Fax (504) 862-1892. The official Closing Date before Federal Action can occur on this project will be 30 days from the date on which the Notice of Availability of this Final Integrated Feasibility/SEIS appeared in the *Federal Register*.

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Project Photographs of the White Ditch Study Area

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Executive Summary

ES.1 Summary Introduction and Study Information

Title VII of the Water Resources Development Act (WRDA) 2007 authorizes the Louisiana Coastal Area (LCA) ecosystem restoration program. Included within that authority are requirements for comprehensive coastal restoration planning, program governance, a Science and Technology Program, a program for the beneficial use of dredged material, feasibility studies for restoration plans, project modification investigations, and restoration project construction, in addition to other program elements. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005.

This report is an integrated Feasibility Study and Supplemental Environmental Impact Statement (SEIS) conducted for the Medium Diversion at White Ditch (MDWD) project. This report fulfills the reporting requirement to Congress of Section 7006(e)(3), which directs the Secretary of the Army to submit feasibility reports on the six projects included in that section by December 31, 2008, and authorizes implementation of the projects provided a favorable Chief of Engineers' Report is completed no later than December 31, 2010.

ES.2 Problems, Need for, Opportunities, and Objectives of Action for the MDWD Project

The altered supply and distribution of freshwater, lack of sediments, marsh subsidence and human development in the White Ditch area have resulted in rapid loss of marsh habitat in the MDWD project area over the past century. Various human activities have resulted in degraded and unbalanced distribution of freshwater, brackish, and saltwater marsh habitats. Further, the degradation of the existing marshes has made them more vulnerable to the range of Gulf storm events; extreme and seasonal, resulting in accelerated degradation, and altered hydrology changed salinity regimes. The threat of increasing relative sea level rise is compounding these problems.

Wetlands in the project area are deteriorating for several reasons: 1) subsidence, 2) lack of sediment and nutrient deposition, 3) erosion via tidal exchange, 4) channelization, 5) saltwater intrusion and 6) lack of freshwater. Recent hurricanes and tropical storms have also caused significant damage to the project area. These activities have resulted in the loss of several thousand acres of solid, vegetated marsh. It is expected that the project area will lose thousands of acres of marsh over the 50-year planning horizon. Deterioration will continue and the system is vulnerable to complete collapse unless preventative measures are taken.

Based on the available data and the outcome of public scoping meetings, a series of potential desired futures exists that require consideration by the study team, sponsor, collaborating agencies and citizens. Early in the planning process a Desired Future Condition was identified as a no net loss of marsh acres consistent with LCA Planning Goal 2. It should be noted that no net loss was what the Project Delivery Team (PDT) felt was achievable and desirable given the uncertainty associated with sea level rise and the constraints of time and availability of information.

Study goals, objectives, and constraints were developed to comply with the study authority and to respond to study area problems and opportunities. In consultation with the non-Federal sponsor and other interested parties, Goals and Objectives were developed in the first quarter of 2009. They are:

Goals and Objectives

Overarching System Goal	Objective
Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them by reversing the trend of degradation and deterioration to the area between the Mississippi River and the River aux Chenes ridges, so as to contribute towards achieving and sustaining a larger coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the economy and well-being of the nation.	A. Maintain the current area of marsh habitat, of all types (41,206 acres), that provide life requisite habitat conditions for native coastal marsh fish and wildlife. B. Restore adequate freshwater and nutrient inputs into the project area such that sustainable areas of fresh, intermediate, brackish and saline marsh are present and existing areas of marsh acres are maintained. C. Restore sediment inputs into the project area equivalent to an average of approximately 1,300,000 cubic yards of sediment per year.

ES.3 Alternatives

Management measures were developed to address study area problems and to capitalize upon study area opportunities. Management measures were derived from a variety of sources including prior studies, the NEPA public scoping process, and the multidisciplinary, interagency project delivery team (IPDT).

The development of *alternative plans* is described extensively in Chapter 3. Multiple structural measures and management measures were assessed. Five diversion locations were considered. These were repeatedly screened to develop the final array.

The alternatives in the Final Array are:

No Action (Future Without-Project Conditions). Over a 50-year period of analysis, if nothing were done, we would see significant losses of all marsh types throughout the study area. More major storms could accelerate this loss. As a result open-water habitats would continue to grow allowing for further intrusion of saltwater into the marsh.

Alternative 1 – 5,000 cfs diversion at Location 3. This alternative involves construction of a structure capable of diverting up to 5,000 cfs consisting of three 15-ft x 15-ft box culverts. Additionally, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater, nutrient and sediments. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area. The diversion would be operated fully open only during March and April and run at up to 1,000 cfs for the rest of the year.

Alternative 2 – 10,000 cfs Max Diversion at Location 3. This alternative involves construction of a structure capable of diverting up to 10,000 cfs consisting of three 15-ft x 15-ft box culverts. Additionally, 32 acres of ridge and terrace creation, 176 acres of marsh creation utilizing dredged material from an adjacent 167 acres of canal being reconfigured to convey freshwater, nutrient and sediments. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area. The diversion would be operated fully open only during March and April and run at up to 1,000 cfs for the rest of the year.

Alternative 3 – 15,000 cfs Max Diversion at Location 3. This alternative involves construction of a structure capable of diverting up to 15,000 cfs consisting of ten 15-ft x 15-ft box culverts. Additionally, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal being reconfigured to convey freshwater, nutrient and sediments. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area. The diversion would be operated fully open only during March and April and run at up to 1,000 cfs for the rest of the year.

Alternative 4 – 35,000 cfs Max Diversion (Recommended Plan) at Location 3. This alternative involves construction of a structure capable of diverting up to 35,000 cfs consisting of ten 15-ft x 15-ft box culverts. Additionally, 31 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal being reconfigured to convey freshwater, nutrient and sediments. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area. The diversion would be operated fully open only during March and April and run at up to 1,000 cfs for the rest of the year.

Desired Future Condition

The desired future condition established early on in study development was to achieve “no net loss” of marsh acres at the end of the 50-year period of analysis. While it was desirable to maximize the acres of marsh, it was uncertain if that was possible given the various physical and operational constraints. The ERDC-SAND2 model is an engineering spreadsheet that predicts sedimentation in a wetland system. The ERDC-SAND2 model assessed sediment dispersal and was used to generate land creation outputs for the MDWD project area. The ERDC-SAND2 model outputs along with the hydraulic engineering model outputs are the key components in the WVA, which is used to generate habitat units. Based on the ERDC-SAND2 results, Alternative 4 provided the most net acres at the end of period of analysis. By implementing Alternative 4, it is possible that the study area could see a return to historic marsh acreages. Finally, the IC/CE analysis of the final array of alternatives utilized WVA benefits based in part on an operation regime of Open Diversion during March–April with a 1,000 cfs maintenance flow the remainder of the year. Alternative 4 is the most capable at achieving no net loss. Alternative 3 also has the potential to achieve no net loss but requires longer pulse durations. Longer pulse duration was viewed by the PDT and stakeholders as less acceptable.

Relative Sea Level Rise and Sustainability

An analysis of the high sea level rise scenario was conducted utilizing the ERDC-SAND2 model. The model was used to determine whether a net loss or gain of marsh acreage would occur assuming a high sea level rise scenario. Alternative 4 was the most effective at countering the effects of high sea level rise. Alternative 4 could maintain marsh acreage out to approximately year 20 of the analysis which was then quickly followed by a sharp decline and eventual collapse of the marsh and near total conversion to open water. This result was based on the March–April Pulse plus a 1,000 cfs maintenance flow the rest of the year. It should be noted however, that in the event high sea level rise becomes a reality, Alternative 4 alone has the capability (assuming an open diversion) to divert large enough quantities of freshwater, nutrients and sediments to overcome high sea level rise. While not publicly acceptable at present, if the collapse of the marsh within the study areas was imminent, then having the ability to respond accordingly with a year round open diversion would be critical. Alternative 4 is the only alternative capable of providing a sustainable solution to the high sea level rise scenario

Recommendation of the Recommended Plan

The interagency team recommends Alternative Plan 4 (Location 3 – 35,000 cfs) as the Recommended Plan. This alternative best meets the study objectives, is the most flexible, and has the most robust sustainable capability against relative sea level rise over the length of the 50-year planning horizon. Alternative Plan 4 has a primary operating regime of a maximum 35,000 cfs pulse during March–April with a maximum 1,000 cfs maintenance flow throughout the remainder of the 12-month cycle (May–February). The pulse regime was chosen because it capitalizes on sediment availability while minimizing adverse effects to socioeconomic resources. It mimics a natural hydrologic regime.

Alternative 4 meets the four evaluation criteria of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. Alternative 4 provides the most robust capability for adapting to future risk and uncertainty. Alternative 4 provides the most flexible management of operations to respond to sea level rise. Based on the ERDC-SAND2 results, Alternative 4 provides the most net acres at the end of period of analysis and it is possible that the study area could see a return to historic marsh acreages. The current cost is $361,606,000, the total first cost of construction is $365,201,000, and the fully funded project cost is $387,620,000. It would result in restoration of natural deltaic processes within the study area. In cooperation with the USFWS, NOAA, and the State of Louisiana, the Corps has planned and would design a project that serves the needs of the nation.

NER Plan

The NER plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. Alternative 4 Location 3 – 35,000 cfs, based on all considerations is the NER plan. The NER Plan is supported by the non-Federal sponsor and therefore no locally preferred plan is identified. Additionally, based on the evaluation conducted as part of this EIS, it has been determined that Alternative 4 Location 3 – 35,000 cfs, is the environmentally preferable alternative.

ES.4 Affected Environment

This chapter describes the climate, geomorphic and physiographic setting, and the historic and existing conditions for important resources.

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 following sections discuss historic and existing conditions of each important resource occurring within the project area.

Location and Climate

The MDWD project study area is located in LCA Subprovince 1, and comprises part of the Breton Sound hydrologic basin in Plaquemines Parish, Louisiana. Plaquemines Parish is located within the Central Gulf Coastal Plain in southeastern coastal Louisiana. The parish encompasses the current delta of the Mississippi River, which was built up from alluvial silt deposited over centuries when the river was levee-free and overflowed its banks. Elevations range from sea level along the Gulf Coast, to approximately +15 feet above sea level along levee ridges. The project area is located within the Mississippi River Deltaic Plain, with the Mississippi River acting as the primary influence on geomorphic processes in the delta region. The boundary of the project study area encompasses over 98,000 acres of intermediate to brackish intertidal wetland habitats. The climate of the project area is subtropical marine with long humid summers and short moderate winters.

Significant Resources

Significant Resources considered within the development of this Feasibility Report with Integrated SEIS included soils; coastal vegetation; wildlife; fisheries; plankton; benthos; essential fish habitat (EFH); threatened and endangered species; hydrology (including flow and water levels, and sediment); water quality; recreation; public lands; cultural and historic resources; aesthetics; air quality; socioeconomic and human resources (including population; infrastructure; employment and income; navigation; oil, gas, and utilities; pipelines; commercial fisheries; oyster leases; and flood control and hurricane protection). In addition, the characterization of noise and hazardous, toxic, and radioactive waste (HTRW) in the project area are presented.

ES.5 Environmental Consequences

This chapter describes the potential environmental consequences of implementing alternative plans considered for freshwater diversion and marsh restoration in the project study area. The following analysis compares the No Action Alternative to four alternatives carried over for detailed analysis: Alternative Plans 1, 2, 3, and 4. Alternative 4 is the Recommended Plan. Alternatives developed and evaluated in this study are described in Chapter 3. A comparison of the direct, indirect, and cumulative impacts for wetland creation and enhancement is presented. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

No Action Alternative (Future Without Project Conditions)

Direct

The No Action Alternative would have a direct impact on the area between the Mississippi River and River aux Chenes through the continuation of existing degradation of marsh. The absence of a supply of freshwater, sediment, and nutrients combined with the ongoing pressures of wind and wave action, storm surges, and human activities has severely eroded marsh soils and reduced the ability of the project area to maintain a balance of emergent wetland and shallow water. The project area would continue to be isolated from natural riverine processes. No opportunities for beneficial use of dredged material for construction features would occur.

Existing vegetation resources in the project footprint would continue to degrade and convert to intermediate marsh. Wildlife habitat would continue to degrade and switch. The project area is recognized as an important and productive fisheries nursery habitat, and conversion to open water would reduce availability of this habitat. Juvenile fish and invertebrates are important food sources for migratory birds, such as wading birds and waterfowl.

There would be no direct impacts to population and housing, minority populations, infrastructure, tax revenues and property values in the vicinity of the proposed Phoenix diversion site from the No Action Alternative.

Indirect

Without implementation of the proposed diversion, no increase in input of sediment, freshwater and nutrients to the project area would occur. This would result in the persistence of existing conditions including continued erosion of marsh soils, and continued fragmentation and conversion of existing intermediate, brackish and saline marsh to shallow open-water habitats. Both man-induced and natural processes would contribute to the continued loss of vegetated habitats, including: continued erosion and subsidence, increased saltwater intrusion, increased water velocities, and increased herbivory. Over the next 50 years, approximately 13,750 acres of emergent marsh is projected to be lost, and it is likely that all remaining remnants of bottomland hardwood vegetation would disappear over the same period.

Continued conversion of emergent marsh to open water is expected to have long-term adverse impacts to many fish species that depend on estuarine wetlands. The abundances of aquatic organisms would decrease. The reduction in emergent wetlands would also result in shifts in predator/prey relationships, a decline in fishery productivity, and reduced recreational fishing opportunities. The loss and deterioration of transitional wetland habitats over time could continue to indirectly affect, to an undetermined degree, all Threatened and Endangered species that may potentially utilize the Breton Sound basin including.

In terms of Socioeconomics, there would be no indirect impacts to population and housing, human health, minority or low-income populations, business and industry, traffic and transportation, public facilities and services, infrastructure, tax revenues and property, community and regional growth, land use socioeconomics, water use and supply, or manmade resources. However, there would be indirect impacts to important Socioeconomic natural resources due to no action. Indirect impacts on natural resources and commercial fisheries would occur as a result of continuing loss of emergent wetland and increase in shallow open water. There would be a shift in the populations of fishes and invertebrates, with more saline-dominated species replacing freshwater species. Over the 50-year planning horizon, habitat for many commercial fishery species would likewise decline, leading to a net loss in fisheries population size and diversity. Without implementation of the proposed diversion, indirect impacts on oyster leases would occur as a result of continuing loss of emergent wetland and increase in shallow open water. This would likely result in a shift in oyster population toward the middle and upper reaches of the estuary. At the same time, currently productive oyster leases in the lower portions of the project area would likely degrade in time as salinity shifts above the optimal. Over the 50-year planning horizon, optimal habitat for oyster production would likewise decline, leading to a net loss in oyster lease productivity and harvest.

Alternative 1 – 5,000 cfs max Diversion, Alternative 2 – 10,000 cfs max Diversion, and Alternative 3 – 15,000 cfs max Diversion

The adverse Direct, Indirect, and Cumulative impacts associated with Alternative 1, Alternative 2, and Alternative 3 would be similar to those presented for Alternative 4. The reason for this is that most adverse impacts are associated with construction activities, which would be relatively equivalent regardless of alternative size. Other negative impacts would be associated with freshening of the basin and would be relatively equivalent regardless of alternative size.

Positive Direct, Indirect, and Cumulative impacts associated with Alternative 1, Alternative 2, and Alternative 3 would not equal those provided by Alternative 4. This alternative best meets the study objectives, is the most flexible, is the most robust, and has the most sustainable capability against relative sea level rise over the length of the 50-year planning horizon. It would result in restoration of natural deltaic processes within the study area. Alternative 1, Alternative 2, and Alternative 3 would not fully satisfy the Goal and Objectives of the project.

Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

Direct

Construction of the 35,000 cfs maximum diversion would directly impact approximately 640 acres in the intermediate zone (277 acres of marsh and 363 acres of shallow open water). Approximately 223 acres of marsh and shallow water area would be excavated to enlarge the outfall channel for the structure. This excavated material would be placed on organic marsh soils and aquatic substrates to create approximately 31 acres of ridges lining the outfall channels, and 385 acres of created marsh in locations adjacent to the outfall channels.

The direct impact to hydrology of Alternative 4 would be increased water levels and flows within the project area while the structure is being operated. During operations, Mississippi River water would flow through natural and man-made channels. This would increase the availability of freshwater, sediments, and nutrients. The sediments in the waters would be available to help restore areas of open water that were historically marsh. The areas that would receive the most potential benefits from the sediments would be the open water areas that are adjacent to Bayou Garelle. It is believed that it would be a sufficient amount to keep up with the current rate of marsh loss and have the potential for restoring the marsh back to its historic condition.

Under the 35,000 cfs diversion, no direct impacts to water use and supply or groundwater would occur. However, it could cause short-term adverse impacts to water quality. These impacts would be minimized through best management practices (BMPs). Direct impacts to ambient air quality would be temporary and localized. Construction activities would temporarily cause minor increases in noise levels.

Under the 35,000 cfs diversion alternative, the existing benthic communities in the footprint of the proposed construction and dredging activities would be lost. However, following construction, benthic organisms would likely recolonize aquatic habitats in the project area, and the enhancement of freshwater marsh habitat by the diversion should be beneficial to numerous benthic species. Construction of the 35,000 cfs alternative is expected to have minor short-term impacts to fisheries resources in the immediate vicinity of the outfall management features. Following construction, displaced fish would likely return to the project area. Direct impacts to EFH would include the disturbance and displacement of managed species in the construction footprint. Construction of the proposed diversion and associated outfall management features would not jeopardize the continued existence of any listed species or destroy or adversely modify critical habitat. Construction of the 35,000 cfs diversion alternative and associated outfall management features would not be expected to adversely affect archaeological sites.

In terms of Socioeconomics, there would be no long-term adverse direct impacts to population and housing, human health, minority or low-income populations, business and industry, traffic and transportation, public facilities and services, infrastructure, tax revenues and property, community and regional growth, agriculture; forestry; public lands; water use and supply; navigation, oil, gas, and utilities; flood control and hurricane protection; fisheries; and oyster leases. Any short-term impacts would be minor and inconsequential.

Indirect

Indirect beneficial impacts of implementing the 35,000 cfs max diversion would include the expected restoration of approximately 20,315 net cumulative acres of emergent marsh soils by year 50 following construction of the project. Indirect impacts to hydrology would be the inundation of lands while the structure is being operated. Lands that would not normally be inundated during the period would become submerged. However, with this submergence there would be an opportunity for the lands to collect beneficial sediments that are being carried by the diverted Mississippi River water, thus renewing historic deltaic processes. Increased sediment introduction into the project area would result in the "filling-in" of open water areas adjacent to Bayou Garelle.

Increased flows from the diversion would also result in changes to the salinity levels in the Breton Sound Basin. Flows of freshwater would result in lower salinities across the project area, and beyond River aux Chenes. These lower salinities would remain for approximately a 3-month period following peak flows from the diversion. No indirect impacts to water use and supply or groundwater would occur. There could be both positive and negative effects to water quality. Creation and protection of emergent wetlands would help to improve local air quality by reducing particulates and gaseous air pollutants. Indirect impacts due to noise are expected to be localized, temporary, and minor in nature. Operation would indirectly provide an inflow of freshwater, sediments and nutrients to the project area and redistribute sediments along existing and created BLH ridges during pulses. An increase in all land types in the project area is expected to occur with this alternative. Additionally, the ERDC-SAND Model land loss calculations conducted in support of the WVA assessment of proposed diversion alternatives projected that the 35,000 cfs diversion would produce an overall gain in land acreage to approximately 59,902 acres by year 50 after project implementation. Operation of the 35,000 cfs diversion is anticipated to result in an increase in SAV coverage in the fresh, intermediate, and brackish zones as a consequence of delivery of nutrients and sediments throughout the project area

There is potential for entrainment of larval and young-of-year (YOY) fish into the marsh and open water of the project area, including individual specimens of federally listed species such as the pallid sturgeon. However, no critical habitat for pallid sturgeon has been identified in the vicinity of the White Ditch project area. While there is a potential for individuals of the species to be adversely affected by entrainment during operation of the diversion, the proposed project is not considered likely to jeopardize the continued existence of pallid sturgeon in the lower Mississippi River.

In terms of Socioeconomics, there would be no distinguishable adverse indirect impacts to population and housing, human health, minority or low-income populations, business and industry, traffic and transportation, public facilities and services, infrastructure, tax revenues and property, community and regional growth, land use socioeconomics, water use and supply, community cohesion, or manmade resources. In the long term the continued existence of these wetlands would benefit, to some undetermined level, local employment in wetland-dependent jobs such as commercial and recreational fisheries, alligator farming, hunting and fishing guide services, and ecotourism; as well as provide benefits for supporting economic activities such as marinas, bait and tackle shops, and others.

Diversion of river sediment and water with this operating plan is unlikely to substantially increase the potential for sedimentation and shoaling in the Mississippi River downstream of the diversion, or to require additional or increased dredging over the 50-year planning horizon. Indirect effects within the project area resulting from operation of Alternative 4 would include increased water levels within interior distributaries such as River aux Chenes and Bayou Garelle, and increased inundation of low-lying lands, particularly when the diversion is operated at maximum capacity. These hydrologic alterations are expected to distribute and deposit river sediments throughout the project area. No significant adverse effects on existing Federal or non-Federal levees are expected to result from implementation of this alternative.

Over the 50-year planning horizon, implementation of Alternative 4 is expected to have large-scale benefits for commercial fisheries and shellfish operations by restoring and preserving marsh and critical nursery habitat in the project area. Without project implementation most marsh in the project area will be lost based on current rates of loss. Although the long-term, large-scale outlook of implementation would be positive, there would be unavoidable impacts to certain natural resources in the project area. Alternative 4 would have indirect impacts on commercial fisheries by affecting the location of target species. Changes in salinity levels in the project area as a result of project operation could change the distribution of fish and shellfish species based on their salinity tolerance. No broad system-level change in species density, assemblage, or numbers would be expected. Changes in fisheries distribution could impact commercial fishing patterns and locations. There is also a potential for some indirect impact on commercial seafood processing facilities located on the West Bank of Plaquemines Parish if Alternative 4 is implemented. Indirect impacts to oyster leases around this diversion site if Alternative 4 is implemented could include increased rate of mortality and decrease in productivity in oyster leases located closest to the diversion site. This could result in a loss of revenue for commercial oyster harvesters on those leases.

Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative with the added combination of similar wetland degradation and wetland loss impacts throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. The Caernarvon Diversion does freshen the White Ditch project area, albeit to an unknown extent, and could potentially impact patterns in and near the study area, but would not likely the study area. The proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch could have impacts on the project area, but conclusive details as to those extents are not available at this time. Other diversions along the Mississippi River would collectively have impacts on Mississippi River stages and possibly sediment and nutrient loads available to the Breton Sound Basin.

ES.6 Public Involvement

A project kick-off meeting was held on December 12, 2008, and a public scoping meeting was organized and hosted in accordance with NEPA on February 5, 2009. A scoping meeting announcement requesting comments on the scope of the MDWD Study was mailed to Federal, State, and local agencies; and interested groups and individuals on January 7, 2009. The media advisory announcing the scoping meeting was provided to 350 media outlets. The open house session provided attendees with an opportunity to visit a series of poster stations staffed by project team members and subject matter experts regarding the following topics: the LCA plan, the NEPA process and milestones, an overview of the study and its goals and objectives, as well as maps of the study area. Approximately 26 people attended the MDWD scoping meeting. A total of 16 multi-part comments were received during the comment period, of which one was received via e-mail and two were copies of letters. Fourteen individuals expressed comments at the scoping meeting. A total of three written comments (letter, email, web site) were received during the comment period. The comments were categorized according to their applicability to the SEIS.

ES.7 Coordination and Compliance

Coordination and compliance efforts were conducted regarding statutory authorities. These include environmental laws, regulations, executive orders, policies, rules, and guidance such as the U.S. Fish and Wildlife Coordination Act, Clean Water Act – Section 401 Water Quality and Section 404(b)(1), Coastal Zone Management Act of 1972, Magnuson-Stevens Fishery Conservation and Management Act of 1996, and the Magnuson-Stevens Act Reauthorization of 2006 (Essential Fish Habitat), Clean Air Act, National Historic Preservation Act of 1966, Farmland Protection Policy Act, Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Louisiana State Rare, Threatened, and Endangered Species, and Natural Communities Coordination, and Executive Orders 13186,12898, and 13112. Full compliance with statutory authorities will be accomplished upon review of the integrated feasibility study and environmental impact statement by appropriate agencies and the public and the signing of a ROD.

ES.8 Areas of Controversy and Unresolved Issues

During the scoping meeting and throughout the alternative identification and evaluation a number of issues have been raised regarding diversions in general and those under consideration in the study area. Every effort has been made to address these concerns and clearly identify the impacts, both beneficial and detrimental of the alternatives considered. Through public review of the document, most of these issues were clarified and resolved. However, it is also likely that if construction and operation of the Recommended Plan were to occur, then these issues would continue to be raised. They are summarized as follows:

- Joint operation of the proposed White Ditch Diversion with the existing Caernarvon Diversion would be key to maintaining the condition of the overall Breton Sound ecosystem. These two projects should not be operated independently of one another. Modeling results and monitoring data suggests that Caernarvon has the ability to substantially freshen the Breton Sound even without freshwater inputs from another source. In order for Breton Sound salinities to rebound after the March–April pulse from the White Ditch Diversion, flow from Caernarvon would have to be closely controlled. This will mean a change to the current operational plan. It will be crucial that future modeling during PED for White Ditch and during Feasibility for the LCA

Modification to Caernarvon investigate joint operation. The LCA 4 Modification to Caernarvon will consider and account for the proposed Medium Diversion at White Ditch project during its analysis. Additionally the existing and proposed operational plans for both White Ditch and Caernarvon are subject to refinement based on any newly acquired data. If significant changes are required, these would be properly disclosed to the public through the NEPA process.

- Potential negative impacts to oysters from over-freshening of the basin. An evaluation of the impacts to the salinity regimes in the study area was conducted and the areas most important to commercial oyster harvesting could experience significant changes as a result of the project, especially if an unfavorable operational regime is implemented. During the PED phase, detailed and extensive aquatic modeling using the fisheries modeling software will be used to thoroughly evaluate the potential impacts to fisheries resources, including commercially important species such as oysters. These results could assist in further refinement of the proposed operational regime.
- Converting the estuary to fresh/intermediate marsh. Fresh and intermediate marsh types are an important habitat type in coastal areas and specifically the study area. The loss of these areas has diminished the ecological integrity of the study area. The restoration of fresh and intermediate marsh types will not exceed historic trends and is not expected to displace significant areas of brackish or saline marsh. Additionally the Recommended Plan has the potential to create new areas of brackish and saline marsh through restoration of the functional processes that create and sustain them.
- Creating 'flotant' marsh that is not anchored and provides no surge protection. The short duration of the pulse (March–April) operating regime has the potential to saturate existing marsh. However, due to the relatively short pulsing season, significant habitat switching is not expected to occur.
- Direct sediment delivery with dredging from the river. The cost of this approach would be excessive. While building marsh directly would have an immediate benefit, it would not restore the processes needed to sustain marsh within the study area.
- Impacts to pallid sturgeon. At this time, surveys are being conducted to determine whether pallid sturgeon are present and if the Recommended Plan will impact the species. Preliminary indications are that the species is not present; however, the USFWS has not yet made a formal determination. That information will be available before a public review draft of the report is completed.
- Creating access and/or land-use problems for private landowners. The Recommended Plan will have immediate impacts in the area being considered for the location of the structure. Access during construction may be limited but this would be temporary.
- Did we pick the best spot on the river to capture sediment? Based on the available information, the supply of sediment at the Phoenix location would be adequate to meet the goals and objectives of the project and operational requirements of the structure. The information used to predict project benefits in the ERDC-Sand2 Model came from data obtained from the Belle Chasse station, which represented the longest continuous dataset from a nearby location. When comparing the ERDC-Sand2 Model inputs to data that have been collected within the project area itself, it is seen that the programs estimates are conservative. Data collected by the USGS in the outfall canal of the existing White Ditch Siphon suggests that more sediment is available to enter

into the project area than represented by the Belle Chasse Data. Using the Belle Chasse Data, it is expected that the Recommended Plan will deliver approximately 16,600 tons of sediment per day into the project area during the March–April Pulse. Using the USGS sediment loads and the same pulse operation, approximately 17,900 tons of sediment per day could enter the project area. This results in a potential 8% increase in sediment loads from what are currently being projected.

Current research being done by the University of Texas in conjunction with the State of Louisiana also suggests that there will be further increased sediment concentrations specifically at the Phoenix site. The Phoenix location of the Recommended Plan was selected because there is a "back-current" in flows on the Mississippi River. This will enhance the amount of sediment available in the area of the diversion as the back-current will continually pull sediments into the diversion.

Additional analysis will be conducted during PED to determine the best orientation and placement of the structure within close proximity of its presently proposed location. The project would not move from the Phoenix location.

- Relative Sea-Level Rise (RSLR). Extensive consideration of RSLR occurred during formulation. Further, the impacts of the moderate and high sea-level rise scenarios on the Recommended Plan were evaluated but it should be noted that no evaluated alternative is able to entirely offset the high rate of sea-level rise.
- Induced shoaling effects and other effects to the navigation/shipping industry. No impacts are expected to the day-to-day activities of the navigation/shipping industry. A qualitative analysis of induced shoaling effects is included in Appendix N. Further analysis is recommended during design to accurately assess and minimize, through the diversion structure design, potential impacts.
- The Recommended Plan for this project exceeds the cost authorization presented in the 2004 LCA Report. The District Commander recommends seeking additional authorization in order to construct the Recommended/NER plan; however, the need to request additional authorization has the potential to impact the project construction schedule.
- Fishery modeling and habitat change modeling will be performed during the PED phase. The cost and schedule for this will be incorporated into the PMP being developed by the USACE for the PED Phase. At this time, a SOW is being developed as part of the Donaldsonville to the Gulf project to look at various models and develop a white paper on the best use of them. The intent of these models is to support adaptive management of this project.
- If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.
- The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time (September 2010). 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 MDWD 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 Deepwater Horizon Oil spill can be found in several governmental sources. The USFWS Situation Report for August 2, 2010 (http://www.fws.gov/home/dhoilspill/pdfs/MondayAugust22010.pdf) indicates the following environmental-related Deepwater Horizon oil spill information: 563 personnel are actively engaged in the response, working to protect wildlife and their habitats, including 36 national wildlife refuges. They are also assessing the damage from the oil spill in preparation for the work that will be needed to restore the Gulf of Mexico. Some 1,643 visibly oiled birds have been collected alive by the U.S. Fish and Wildlife Service, the states and our partners in response to the Deepwater Horizon oil spill. Of those, 594 birds have been rehabilitated and released. Another 1,451 visibly oiled birds have been collected dead. Aerial operations over Louisiana observed an oil sheen covering 300 acres in the northeastern portion of Barataria Bay. A heavily oiled coastline covering about one-half mile was found at Bayou Chalond and heavy oil and tar balls were observed on landfall east of Point-Au-Fer and along Timbalier Island. Beached bird surveys were conducted in Texas, Louisiana, Mississippi, Alabama and Florida. Aerial missions are scheduled for Southwest Pass, Chandeleur Islands, Biloxi Marsh, Barataria Bay, Terrebonne, Marsh Islands, Atchafalaya Delta, Point-Au-Fer and Timbalier Bay.

- Overall number of personnel responding: approximately 30,100
- Total vessels responding: more than 4,500
- Total boom deployed: more than 2,155 miles
- Boom available: more than 856 miles
- Oily water recovered: more than 34.7 million gallons
- Estimated 11.14 million gallons of oil burned
- Estimated total of more than 1.84 million gallons of dispersant used including:
  - Estimated more than 1.07 million gallons surface dispersant used
  - Estimated more than 771,000 gallons of sub-sea dispersant used:
- Estimated approximately 632 miles of Gulf Coast shoreline is currently oiled-approximately 365 miles in Louisiana, 111 miles in Mississippi, 68 miles in Alabama, and 88 miles in Florida.

The USACE, New Orleans District Regulatory Branch, has considered and responded to approximately 55 emergency permits related to the Deepwater Horizon oil spill. 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. 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.

ES.9 Conclusions and Recommendations

The Recommended Plan will restore degraded marsh habitat and impaired deltaic processes that sustain them between the Mississippi River and River aux Chenes. This will be accomplished by reconnecting the study area to the supplies of freshwater, nutrients and sediment that have been isolated within the Mississippi River by the MR&T levee. These benefits are represented by the 13,355 Average Annual Habitat Units expected from the NER plan at an estimated fully funded cost of $387,620,000 (Appendix L). When compared to the FWOP in 50 years, the Recommended Plan yields a Net Increase of approximately 35,000 acres under the current rate of sea level rise. The Recommended Plan is the plan that best meets the Louisiana Coastal Area goals and objectives as well as those identified for the study area in partnership with the State of Louisiana. The Recommended Plan is also the plan that best meets the P&G's four criteria of completeness, effectiveness, efficiency, and acceptability, as well as the Environmental Operating Principles of environmental sustainability, interdependence, balance and synergy, accountability, knowledge, respect, and assessing and mitigating cumulative impacts.

The District Commander has considered all the significant aspects of this study including the environmental, social, and economic effects, the engineering feasibility, and the comments received from other resource agencies, the Non-Federal Sponsors, and the public and has determined that the Recommended Plan presented in this report is in the overall public interest and a justified expenditure of Federal funds.

1.0 STUDY INFORMATION

1.1 STUDY AUTHORITY

Title VII of the Water Resources Development Act (WRDA) 2007 authorizes the Louisiana Coastal Area (LCA) ecosystem restoration program. Included within that authority are requirements for comprehensive coastal restoration planning, program governance, a Science and Technology Program, a program for the beneficial use of dredged material, feasibility studies for restoration plans, project modification investigations, and restoration project construction, in addition to other program elements. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005.

SEC. 7003. LOUISIANA COASTAL AREA.

(a) IN GENERAL.-The Secretary may carry out a program for ecosystem restoration, Louisiana Coastal Area, Louisiana, substantially in accordance with the report of the Chief of Engineers, dated January 31, 2005.

(b) PRIORITIES.—

(1) IN GENERAL.—In carrying out the program under subsection a), the Secretary shall give priority to—

(A) any portion of the program identified in the report described in subsection (a) as a critical restoration feature;

(B) any Mississippi River diversion project that—

(i) will protect a major population area of the Pontchartrain, Pearl, Breton Sound, Barataria, or Terrebonne basins; and

(ii) will produce an environmental benefit to the coastal Louisiana ecosystem;

(C) any barrier island, or barrier shoreline, project that—

(i) will be carried out in conjunction with a Mississippi River diversion project; and

(ii) will protect a major population area;

(D) any project that will reduce storm surge and prevent or reduce the risk of loss of human life and the risk to public safety; and

(E) a project to physically modify the Mississippi River-Gulf Outlet and to restore the areas affected by the Mississippi River-Gulf Outlet in accordance with the comprehensive plan to be developed under section 7002(a) and consistent with sections 7006(c)(1)(A) and 7013.

Under the 2007 WRDA Section 7006, the LCA program has authority for feasibility-level reports of six near-term critical restoration features. The excerpt below from WRDA outlines the project authority for this report for the Medium Diversion at White Ditch project:

SEC. 7006. CONSTRUCTION.

(3) PROJECTS SUBJECT TO REPORTS.—

(A) FEASIBILITY REPORTS.—Not later than December 31, 2008, the Secretary shall submit to Congress feasibility reports on the following projects referred to in the restoration plan:

(i) Multipurpose Operation of Houma Navigation Lock at a total cost of $18,100,000.

(ii) Terrebonne Basin Barrier Shoreline Restoration at a total cost of $124,600,000.

(iii) Small Diversion at Convent/Blind River at a total cost of $88,000,000.

(iv) Amite River Diversion Canal Modification at a total cost of $5,600,000.

(v) Medium Diversion at White's Ditch at a total cost of $86,100,000.

(vi) Convey Atchafalaya River Water to Northern Terrebonne Marshes at a total cost of $221,200,000.

(B) CONSTRUCTION.—The Secretary may carry out the projects under subparagraph (A) substantially in accordance with the plans and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed by not later than December 31, 2010.

(4) CONSTRUCTION.—No appropriations shall be made to construct any project under this subsection if the report under paragraph (2) or paragraph (3), as the case may be, has not been approved by resolutions adopted by the Committee on Environment and Public Works of the Senate.

This report is an integrated Feasibility Study and Supplemental Environmental Impact Statement (SEIS) conducted for the Medium Diversion at White Ditch (MDWD) project. This report fulfills the reporting requirement to Congress of Section 7006(e)(3), which directs the Secretary of the Army to submit feasibility reports on the six projects included in that section by December 31, 2008, and authorizes implementation of the projects provided a favorable Chief of Engineer's Report is completed no later than December 31, 2010.

1.2 PURPOSE AND SCOPE

In November 2008, the U.S. Army Corps of Engineers (USACE) and the State of Louisiana represented through the Coastal Protection and Restoration Authority (CPRA), executed a single Feasibility Cost-Share Agreement (FCSA) covering six LCA near-term plan elements listed in Section 7006(e) of the Water Resources Development Act (WRDA), 2007. The six features will each go through a separate feasibility analysis and environmental compliance review culminating in a single master feasibility document. The cost-share during this feasibility phase is 50% Federal and 50% Non-Federal in total. However, the individual elements have been divided so that each entity has lead responsibility for preparing three of the six report components. This means that at the end of the feasibility phase the total cost will be shared on a 50/50 basis, yet for work on each individual element during the feasibility phase the ratio of funds expended by either the Federal or non-Federal sponsor will be higher depending upon their level of responsibility. Although three of the projects will be lead by state teams, each individual feasibility component will be conducted and written to meet USACE planning and technical standards for a feasibility level document.

This document serves as the Final Feasibility Report for the LCA MDWD project. This project was identified as a Near-term Critical Restoration Feature Recommended for Study and Future Congressional Authorization in the LCA Main Report dated January 21, 2005. In November 2007, WRDA passed, authorizing this and other projects from the LCA Main Report. The MDWD feasibility study is anticipated to result in a Chief's Report containing a Recommended Plan to construct a Mississippi River diversion in the vicinity of White Ditch for the purposes of introducing freshwater, sediments, and nutrients into the study area.

1.3 STUDY AREA

The MDWD project study area is located in LCA Subprovince 1 in the Breton Sound hydrologic basin in Plaquemines Parish, Louisiana (Figure 1.1). The boundary of the project encompasses over 98,000 acres of intermediate to brackish intertidal wetland habitats. The study area boundary follows distinct landscape features beginning in the north with the confluence of the non-Federal back levee and the Forty-Arpent canal, extending along the non-Federal back levee, the Mississippi River levee, the Federal back levee and along the left descending natural bank of the Mississippi River to the west; past American Bay, California Bay, and through Breton Sound, near Bay Gardene to the south; into and along River aux Chenes to the east, and back to the point of beginning. The area has been significantly impacted by recent tropical storms and hurricanes and is currently isolated from the effects of the Caernarvon freshwater diversion, located at the northern end of the Breton Sound basin.

There are two discreet project locations that will be considered for the purposes of the feasibility study: The area along the Mississippi River where a freshwater diversion structure might be located; and the project area that could be influenced and benefited by the diverted freshwater. The footprint of both of these areas will be dependent upon the overall size and capacity of the diversion structure recommended in the report.

The area of interest where a diversion structure could be located occurs on the left descending bank of the Mississippi River, between Bertrandville to the north (river mile 69) and the community of Davant to the south (river mile 51). An area of particular interest for this study is the stretch between White Ditch (river mile 64.4) and Phoenix (river mile 59.7). This 4.7-mile stretch is unique in that there is no hurricane protection levee (back levee) on the marsh side that protects existing homes and infrastructure from elevated water levels (tidal or storm surge). The Mississippi River levee is the only flood protection structure that keeps river water from entering the project study area. This situation minimizes the amount of infrastructure that could be affected by construction of a diversion structure and allows for a broader array of measures to be considered in addressing problems in the project area. The project study area has been heavily influenced by both man-made and natural processes. Channel construction, subsidence, erosion, saltwater intrusion, and storm-related damages have all significantly altered the natural environment, causing extensive losses of wetland habitats.

1.4 HISTORY OF INVESTIGATION

The MDWD feasibility study is designed to address coastal restoration problems and opportunities in the project area based on guidance from the LCA Ecosystem Restoration Study completed in 2004. The LCA effort identified numerous projects that were classified by immediacy of need in order to prioritize efforts undertaken to eventually achieve Congressional appropriation for construction. An additional nine projects are identified in WRDA 2007 section 7006 and all projects are scheduled to be included in a Chief's Report to be completed by 31 December 2010.

Given the magnitude of Louisiana's coastal land losses and ecosystem degradation, it has become apparent that a systematic approach involving larger projects to restore natural geomorphic structures and processes, working in concert with smaller projects, will be required to effectively deal with a physical problem of such large proportions (LCA 2004).

A siphon capable of diverting Mississippi River water up to 250 cubic feet per second (cfs) currently exists at White Ditch. It was constructed in 1963 to improve oyster and muskrat habitats, but has not been operated since 1991 except for brief modeling studies and other temporary durations. In addition to the LCA authority, both the State-developed Louisiana Comprehensive Master Plan for a Sustainable Coast and the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program have diversion projects identified for further evaluation at White Ditch.

1.5 PRIOR REPORTS AND EXISTING PROJECTS

A number of prior water resources development efforts have been identified as relevant to the MDWD study. Prominent existing efforts are detailed in Sections 1.5.1, 1.5.2, 1.5.3, 1.5.4, and Attachment B. The relevance of these reports is reflected in Table 1.1.

1.5.1 Federal

Several comprehensive planning efforts have significance to the MDWD Feasibility Study, including the Coast 2050 Plan; LCA Ecosystem Restoration Study; Louisiana's Comprehensive Master Plan for a Sustainable Coast; and the LACPR technical report. These comprehensive planning efforts are described below.

Coast 2050 Plan, 1999. In 1998, Federal and State agencies, local governments, academia, numerous non-governmental groups, and private citizens participated in developing the Coast 2050 Plan, a conceptual plan for restoration of the Louisiana coast. The Plan was a direct outgrowth of lessons learned from implementation of restoration projects through the CWPPRA and other programs, and reflected a growing recognition that a more comprehensive "systemic" approach to restoring coastal wetlands was needed. The Plan formed the basis for the May 1999 905(b) reconnaissance report that preceded the LCA Ecosystem Restoration Study that recommended the MDWD project.

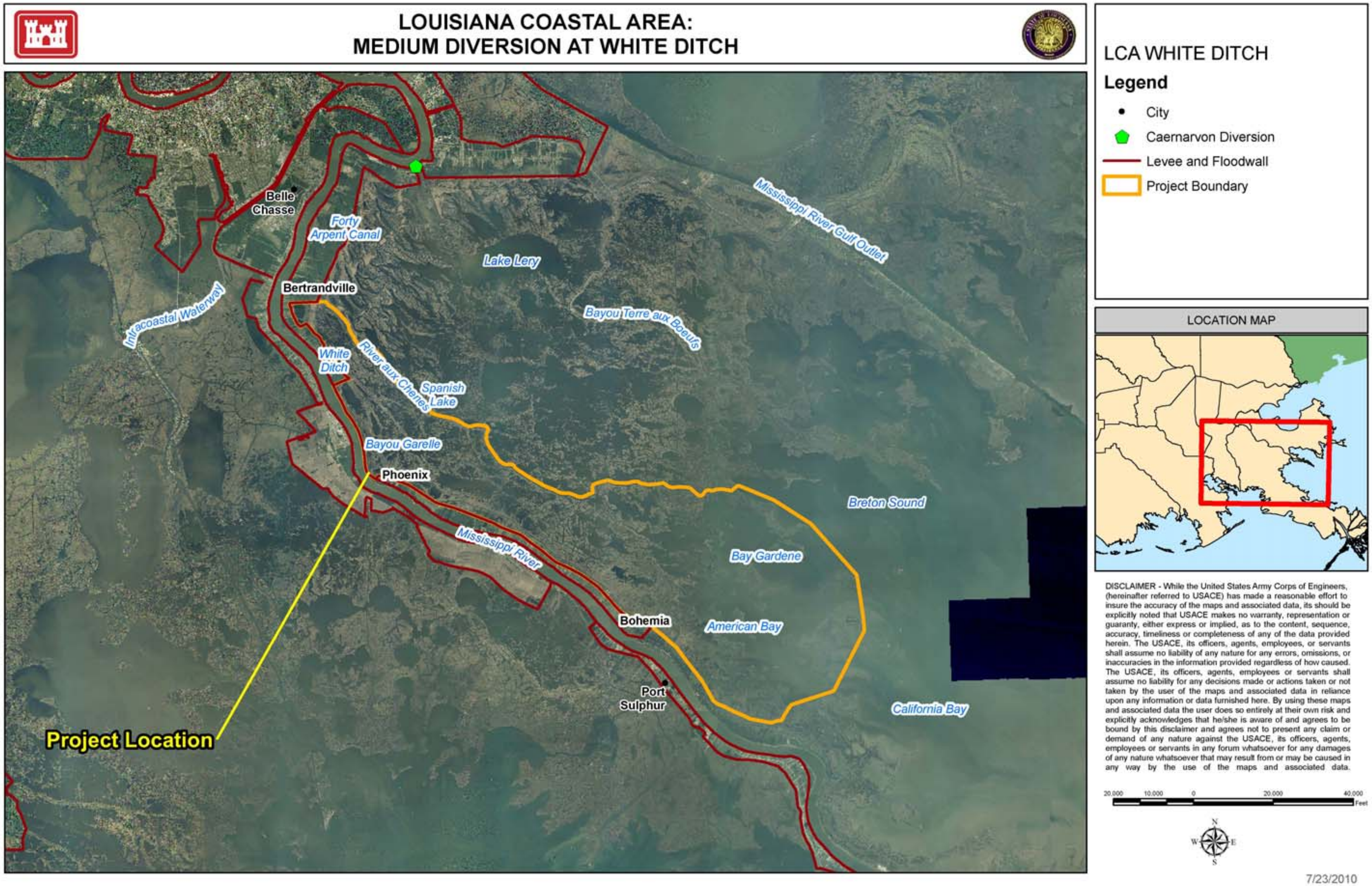

Figure 1.1: Study Area Map

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Table 1.1: Relevance of Prior Studies, Reports, Programs, and Water Projects to the MDWD Feasibility Study

Prior Studies, Reports, Programs, and Water Projects	**Relevance to Medium Diversion at White Ditch**				
	Data Source	**Consistency**	**Structural Measurements**	**Non-Structural Measures**	**Future Without Project Condition**
Mississippi River and Tributaries (MR&T), 1928	X	X	X		
New Orleans to Venice, Louisiana Hurricane Protection, 1962	X	X	X		
Hydrologic and Geologic Studies of Coastal Louisiana, LSU 1973	X				X
Deep-Draft Access to the Ports of New Orleans and Baton Rouge, Louisiana, 1981		X			
Louisiana’s Eroding Coastline: Recommendations for Protection, EPA 1982	X	X	X	X	X
Mississippi Deltaic Plain Region Ecological Characterization, USFWS 1982	X				X
Proceedings of the Conference on Coastal Erosion and Wetland Modification in Louisiana: Causes, Consequences, and Options, 1982	X				X
Mississippi and Louisiana Estuarine Areas, 1984	X				X
Louisiana Coastal Area, Hurricane Protection, 1988 (Draft)	X	X			
Louisiana Coastal Wetlands Conservation, Restoration and Management Act, Act 6 1989	X	X			X
The Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA), 1990	X	X	X	X	X
White’s Ditch Diversion Siphon – Outfall Management Plan Feasibility Report (1992)	X		X	X	X
An Environmental- Economic Blueprint for Restoring the Louisianan Coastal Zone: The State Plan for the Wetlands Conservation and Restoration Authority, 1994	X	X	X	X	X
A White Paper- The State of Louisiana’s Policy for Coastal Restoration Activities, 1995	X	X			X
Coast 2050, 1999	X	X	X	X	X
Mississippi River Sediment, Nutrient and Freshwater Redistribution Feasibility Study, 2000	X				X
LCA Ecosystem Restoration Study, 2004	X	X	X	X	X
Act 8 of the First Extraordinary Session of 2005		X			
Drawing Louisiana’s New Map: Addressing Land Loss in Coastal Louisiana, 2006	X				X
Louisiana’s Comprehensive Master Plan for a Sustainable Coast, 2007	X	X	X	X	X

Table 1.1, concluded

Prior Studies, Reports, Programs, and Water Projects	Relevance to Medium Diversion at White Ditch				
	Data Source	Consistency	Structural Measurements	Non-Structural Measures	Future Without Project Condition
Louisiana Coastal Protection and Restoration (LACPR), 2009	X	X	X	X	X
Bonnet Carré Spillway	X	X	X	X	
CWPPRA Projects Constructed or Authorized for Design	X	X	X	X	X
Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS)	X	X	X	X	
Various Environmental Assessments (EAs) Prepared by the USACE	X	X	X	X	X

Louisiana Coastal Area (LCA), 2004. In 2000, the USACE and State of Louisiana initiated the Louisiana Coastal Area Ecosystem Restoration Study to address Louisiana's severe coastal land loss problem. The goal of LCA is to achieve and sustain a coastal ecosystem that can support and protect the environment, economy, and culture of coastal Louisiana and thus, contribute to the economy and well-being of the nation. The LCA study focused on "lessons learned" from previous Louisiana coastal restoration efforts, the Coast 2050 restoration strategies, and the best available science and technology to develop a plan addressing the most critical coastal ecological needs. This study recommended the MDWD project.

Louisiana's Comprehensive Master Plan for a Sustainable Coast, 2007. The Louisiana Legislature, through Act 8 of the First Extraordinary Session of the 2005 Louisiana Legislature, established the Coastal Protection and Restoration Authority (CPRA) to develop, implement, make reports on, and provide oversight for a comprehensive coastal protection master plan and annual coastal protection plans. A diversion at White Ditch is identified as a restoration concept for restoring natural processes in the Delta Plain and maintaining critical landscape features.

Louisiana Coastal Protection and Restoration (LACPR), 2009. The Louisiana Coastal Protection and Restoration technical report includes analysis and design for coastal restoration and "Category 5" hurricane risk reduction. The USACE submitted a Preliminary Technical Report to Congress in July 2006 and a draft final report is now in Independent External Peer Review. The LACPR report identifies the MDWD area as a key location for marsh creation though it does not recommend a Mississippi River diversion in the area.

Prior Studies, Reports, and Projects

In addition to the comprehensive planning efforts described above, the studies, reports, and projects listed in Table 1.1 have been identified as potentially relevant to the MDWD study. A brief description of relevant prior studies and reports and National Environmental Policy Act (NEPA) documents is provided below.

Related Laws and Programs

Over the past three decades, both the Federal Government and the State of Louisiana have established policies and programs that are intended to halt and reverse the loss of coastal wetlands and to restore and enhance ecosystem function.

Federal Laws and Programs

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

The task force is also required to prepare an annual Project Priority List (PPL). CWPPRA provides funds annually for coastal restoration planning and the construction of coastal protection and restoration projects. As of April 2009, 146 active CWPPRA projects have been approved, 77 have been constructed, 17 are under construction, and 30 have been de-authorized or transferred to other programs. The CWPPRA program anticipates receiving $84 million in Federal funds for Fiscal Year 2009 (FY 2009). The CWPPRA program has authorized the White Ditch Resurrection and Outfall Management project for Phase I funding as part of PPL-14.

1.5.2 State

Coastal resource management in Louisiana formally evolved once Louisiana adopted and began participating in the Federal Coastal Zone Management (CZM) program in 1978. Shortly thereafter, the State developed a coastal zone management plan. One of the primary objectives of this plan was to ensure that future development activities within the coastal area would be accomplished with the greatest benefit and the least amount of environmental damage. The Plaquemines Parish Government operates its own CZM program in accordance with State and Federal regulations and adheres to the policy of minimizing environmental damages from approved projects. Any final MDWD project recommendations must be in compliance with the Parish and State CZM program.

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

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

Act 8 of the First Extraordinary Session of 2005. In November 2005, Act 8 of the First Extraordinary Session of 2005 created the CPRA and charged it with coordinating the efforts of local, State, and Federal agencies to achieve long-term and comprehensive coastal protection and restoration. The CPRA created a Master Plan to integrate what had previously been discrete areas of activity: flood control and wetland restoration. The Master Plan identifies a diversion at White Ditch in several of its concept alternatives.

1.5.3 Local

Non-governmental organizations (NGOs) have also participated in various coastal restoration projects. Public and private parties involved in wetlands preservation or restoration activities in coastal Louisiana include Coastal America, Corporate Wetlands Restoration Partnership, Gulf Coast Joint Venture, Audubon Society, National Fish and Wildlife Foundation, The Nature Conservancy, and the National Wildlife Federation. These efforts are primarily concerned with preservation. The restoration activities of these organizations may support the overall goals of the MDWD project; however, these efforts are small in scale and will not appreciably influence plan formulation.

The Lake Pontchartrain Basin Foundation (LPBF) and the Coalition to Restore Coastal Louisiana (CRCL) are both active and prominent NGOs that have taken an interest in the development of the MDWD study. The LPBF has developed several plans that rely on alternatives that could be constructed in the White Ditch area.

- Multiple Lines of Defense Strategy
- Pontchartrain Coastal Lines of Defense Plan
- Comprehensive Habitat Management Plan

Public scoping comments were also received from both organizations that propose a large spillway-type structure that is capable of delivering significant amounts of freshwater and sediments to the project area (see Appendix A).

Related Water Projects

Several existing and authorized navigation, river flood control, hurricane storm surge risk reduction and coastal restoration projects are related to the MDWD Feasibility Study. These projects are briefly described below.

River Flood Control Projects

Mississippi River and Tributaries (MR&T), 1928. The MR&T is a comprehensive project for flood control on the lower Mississippi River below Cape Girardeau, Missouri. The MR&T has four major elements: levees, floodways, channel improvement and stabilization, and tributary basin improvements.

The MR&T system controls and confines the river system before it reaches the coastal area. Any location for a diversion from the Mississippi River in the vicinity of White Ditch will be situated on the MR&T levee.

Bonnet Carré Spillway, 1931. The Bonnet Carré Spillway is located at the site of an old crevasse, and contains a flood control structure at the Mississippi River that was completed in 1931. The facility is designed to convey a maximum of 250,000 cfs of floodwater to Lake Pontchartrain to relieve flood conditions downstream. The spillway could serve as a guide in the design of the MDWD project and this concept was submitted for consideration during the public scoping process.

Hurricane Storm Surge Risk Reduction Projects

Greater New Orleans Hurricane and Storm Damage Risk Reduction System. The Hurricane and Storm Damage Risk Reduction System (HSDRRS) for Greater New Orleans consists of more than 200 projects forming a comprehensive system of levees, floodwalls, gates, internal drainage and pumping stations and other structures, integrated into a single system designed to reduce the risk of hurricane and storm damage to the Greater New Orleans area. It is located in southeastern Louisiana and includes all or a portion of six parishes: Jefferson, Orleans, St. Bernard, St. Charles, Lafourche and Plaquemines. The HSDRRS is integrated with the Mississippi River flood system along the main stem of the Mississippi River which protects against riverine flooding. The HSDRRS is designed to perform as an integrated system when completed.

Coastal Restoration Projects

Bonnet Carré Freshwater Diversion. In the 1984 *Mississippi and Louisiana Estuarine Areas: Freshwater Diversion at Lake Pontchartrain Basin and Mississippi Sound* feasibility study, various alternative locations were considered for diverting river water into the Basin at Bonnet Carré and Violet, both alone and in combination with other diversions. The diversion at Bonnet Carré was selected as the preferred alternative, largely due to cost considerations. The Assistant Secretary of the Army for Civil Works [ASA(CW)] transmitted the final feasibility report and Environmental Impact Statement (EIS) to Congress in September 1989. The Design Memorandum was submitted to USACE headquarters in October 1990, approved in November 1991, and the ASA(CW) concurred in January 1993. An Environmental Assessment (EA) evaluating water quality impacts to Lake Pontchartrain was developed following a re-assessment of the project, and a Finding of No Significant Impact (FONSI) was signed in July 1996. The State of Louisiana replied to USACE in July 1996, declining to participate further in the project due to concerns about adverse impacts to water quality in Lake Pontchartrain.

Davis Pond Freshwater Diversion. The Davis Pond diversion structure is located on the west bank of St. Charles Parish and is capable of diverting up to 10,650 cfs of Mississippi River water into a large ponding area to help control salinity levels in the Barataria Bay hydrologic basin. Construction of the project began in 1997 and it began operations in 2002. The project was authorized by the Flood Control Act of 1965 and modified by WRDA in 1974, 1986, and 1996. The Davis Pond project, like Caernarvon, fits within the MDWD authorized project capacity of 5,000 to 15,000 cfs. Davis Pond is currently experiencing design modifications that could serve as a reference in designing the MDWD project.

Caernarvon Freshwater Diversion and Outfall Management. The *Freshwater Diversion to the Barataria and Breton Sound Basins* report and subsequent technical appendices (USACE 1984), recommended diverting Mississippi River water into the Breton Sound Basin near Caernarvon to increase habitat quality and improve fish and wildlife resources. The Caernarvon Freshwater Diversion was completed in 1991 with a design discharge of 8,000 cfs. Since its construction, the Caernarvon structure has been operated as a salinity control measure. The design and operation of this project served as a reference for development of the MDWD project.

The Water Resources Development Act of 2007, Section 7006(e)(1)(C), authorized a study to identify changes in the operation of the Caernarvon project to increase wetland creation and restoration outputs for this structure. The introduction of additional freshwater would facilitate organic and sediment deposition, improve biological productivity, and prevent further deterioration of the marshes. The present structure, constructed in 1991, can divert up to 8,000 cfs of freshwater; however, the actual amount of diverted flow depends on a detailed annual operational plan which correlates with projected river stages and hunting/migrating seasons. The proposed restoration feature study would assess changes in the operation of the Caernarvon project to increase wetland creation and restoration outputs for this structure. Modified operation of this structure would allow an increase in the freshwater introduction rate, perhaps 5,000 cfs (178 cms) on average, to accommodate the wetland building function of the system. This study would identify any changes to this feature's operation that would increase restoration outputs. The proposed project will also investigate the economical effects of commercial fisheries and the environmental impacts of aquatic wildlife and vegetation due to the possible deviating operational schedule. A Chief of Engineers report is scheduled for completion by November 2011.

Bertrandville Siphon. The Bertrandville Siphon project was recently authorized for Phase I engineering and design under the CWPPRA program in January 2009. This project is located to the north of the MDWD project on the eastbank of Plaquemines Parish and proposes to construct a siphon to divert water from the Mississippi River into surrounding wetlands. The capacity of the structure is proposed at 1,000 cfs and it is under development by the USEPA and the State of Louisiana.

Naomi Siphon and Outfall Management. The Naomi Siphon and Outfall Management project is comprised of two separable elements: the siphon, which is capable of diverting up to 2,100 cfs; and hydrologic control features consisting of two fixed crest rock weirs to retain sediments in the system and help prevent saltwater intrusion into the project area. The siphon was completed in 1992 and the outfall management features were completed in 2002. Although this project is located on the westbank of Plaquemines Parish, its location is near where the MDWD could be located. The Naomi Siphon could serve as a guide for design and implementation of the MDWD project.

White Ditch Resurrection and Outfall Management. A siphon built in 1963 at White Ditch to deliver freshwater for oyster and muskrat habitat has ceased operation due to age and various other complications. The rehabilitation or replacement of the existing siphon at White Ditch and the construction of an additional siphon of similar size is proposed through CWPPRA. Phase I engineering and design funds have been appropriated and the NRCS and the State of Louisiana are developing project details. The project's proposed strategies also include installing a water control structure in the White Ditch outfall channel at the junction with River aux Chenes to force water into interior marshes. The MDWD project team and NRCS are coordinating the development of both projects.

West Pointe à la Hache Siphon and Outfall Management. The existing siphon consists of eight 72-inch siphon tubes capable of diverting up to 2,144 cfs of freshwater from the Mississippi River into the ~17,000 acre project area. Outfall management measures consist of earthen plugs, rock weirs, and spoil bank maintenance. The project area is suffering from significant loss of wetland habitat due to a variety of factors including subsidence, the absence of freshwater and sediments, canal dredging, and saltwater intrusion. Construction of the project features will help to re-establish *Spartina patens*, the target plant species, in the project area. This project is located on the westbank of the Mississippi River in Plaquemines Parish and could serve as a guide for design of the MDWD project.

Bohemia Mississippi River Reintroduction. The Bohemia Mississippi River Reintroduction project was authorized for Phase I engineering and design funding under the CWPPRA program in October 2007. This project seeks to connect an existing canal to the Mississippi River allowing up to 10,000 cfs to flow through the uncontrolled diversion. A gap would be cut through the natural bank of the River and maintenance dredging would take place in the canal to facilitate the increased flow of freshwater. The project is located south of the MDWD project on the eastbank of the Mississippi River in Plaquemines Parish and could be used as a reference source for data and design considerations.

Bayou Lamoque Freshwater Diversion. Two large freshwater diversion structures are located at Bayou Lamoque on the eastbank of the Mississippi River in Plaquemines Parish: one built in 1955 capable of diverting 4,000 cfs of river water and one built in 1978 capable of diverting 8,000 cfs. These structures were operated periodically by the Louisiana Department of Wildlife and Fisheries (LDWF) until 1994. Neither structure is officially managed because of repair and operation issues and the lack of an interagency management plan. Improvements to the structures were proposed through CWPPRA, and are currently being developed with Coastal Impact Assistance Program (CIAP) funding. The structures could be used as a data and design reference in developing the MDWD project.

Delta Building Diversion North of Fort St. Philip. The wetlands in the area are deteriorating from erosion, subsidence, and insufficient sediment input. Some delta building is occurring in the downstream end of the project area from Mississippi River overbank flow. However, most of the project area is deteriorating from a lack of sediment. The proximity of open, shallow, estuarine water to the Mississippi River, coupled with the low level of development and infrastructure at this site, presents a rare opportunity to construct a sediment diversion project for a reasonable construction cost. The size of the diversion channel was designed to allow enough sediment through to create about 624 acres of marsh over the project life. This project has significantly increased sediment input into the benefited wetlands through the diversion of about 2,500–5,000 cfs of Mississippi River water. This project could serve as a guide for design and operation for the MDWD.

Benney's Bay Sediment Diversion. The objective of the project is to restore vegetated wetlands in an area that is currently shallow open water. The project would divert sediments in an effort to create, nourish, and maintain approximately 5,828 acres of fresh to intermediate marsh in the Benney's Bay area over the 20-year project life. The project consists of a conveyance channel for the large-scale diversion of water and sediments from the river. The conveyance channel would be constructed in two phases: (1) construction of an initial channel with an average discharge of 20,000 cfs; (2) after a period of intensive monitoring, enlargement of the channel to a 50,000 cfs discharge. Material from the construction of the channel would be used to create wetlands in the diversion outfall area. This project is currently being designed. This project could serve as a guide for design of the MDWD.

West Bay Diversion. The diversion site is located on the west bank of the Mississippi River, in Plaquemines Parish, Louisiana, 4.7 miles above Head of Passes. The project diverts Mississippi River water and sediments into West Bay. The project consists of a conveyance channel for the large-scale diversion of sediments from the river. Material from the construction of the initial channel was used to create wetlands in the diversion outfall area. This project could serve as a guide for design of the MDWD despite recent developments by the CWPPRA Task Force that mandate its closure in 2011 due to negative induced shoaling effects on a nearby anchorage area.

Myrtle Grove Diversion. The 2004 LCA Ecosystem Restoration study considered diversions of various sizes (5,000 cfs, 15,000 cfs, 38,000 cfs with sediment enrichment, 75,000 cfs with sediment enrichment, and 150,000 cfs with sediment enrichment) at Myrtle Grove for inclusion in the near-term restoration plan. The 2005 Report of the Chief of Engineers recommended that a diversion with a capacity between 2,500 and 15,000 cfs with dedicated dredging be authorized for construction at Myrtle Grove contingent upon approval of a feasibility level of detail report by the Secretary of the Army. The project was authorized for construction contingent on preparation of a construction report in section 7006(c) of the WRDA 2007. A diversion at Myrtle Grove was approved for study under the CWPPRA program in 2001 and deauthorized in 2008. The State of Louisiana has continued to conduct hydrologic modeling of the proposed diversion. The diversion would provide additional sediment and nutrients to nourish highly degraded existing fresh to brackish wetlands in shallow open-water areas of mid- and lower Barataria Basin. Dedicated dredging (from the Mississippi River) at the rate of approximately 2 million cubic yards/year for several years with the new structure would provide for the projected creation of up to 19,700 acres of new wetlands over the project life. The LCA White Ditch team has coordinated modeling of the White Ditch diversion with the state's Myrtle Grove modeling team because the two diversions may be located across from one another on the Mississippi River. A feasibility study on the Myrtle Grove diversion was initiated under the LCA program in July 2010.

Existing Studies

A summary of studies and analyses performed on other projects is described in Table 1.2 and shown on Figure 1.2. Information gleaned from these studies was used as a basis for determining measurable metrics in the project objectives and for ensuring assumptions made regarding inputs to the hydraulic model and the ERDC-SAND2 model were sound. Not all studies listed in the table played a significant role in project development, but they were considered and applied where appropriate.

1.6 PLANNING PROCESS AND REPORT ORGANIZATION

The Medium Diversion at White Ditch project follows the USACE's six-step planning process specified in Engineering Regulation (ER) 1105-2-100. The planning process identifies and responds to problems and opportunities associated with the Federal objective and specified State and local concerns. This integrated report includes elements of both the planning process and sections specific to the NEPA review of the project.

The chapter headings and order in this report generally follow the outline of the required NEPA documentation for an EIS. Chapters of the report relate to the six steps of the planning process in ER 1105-2-100 as follows:

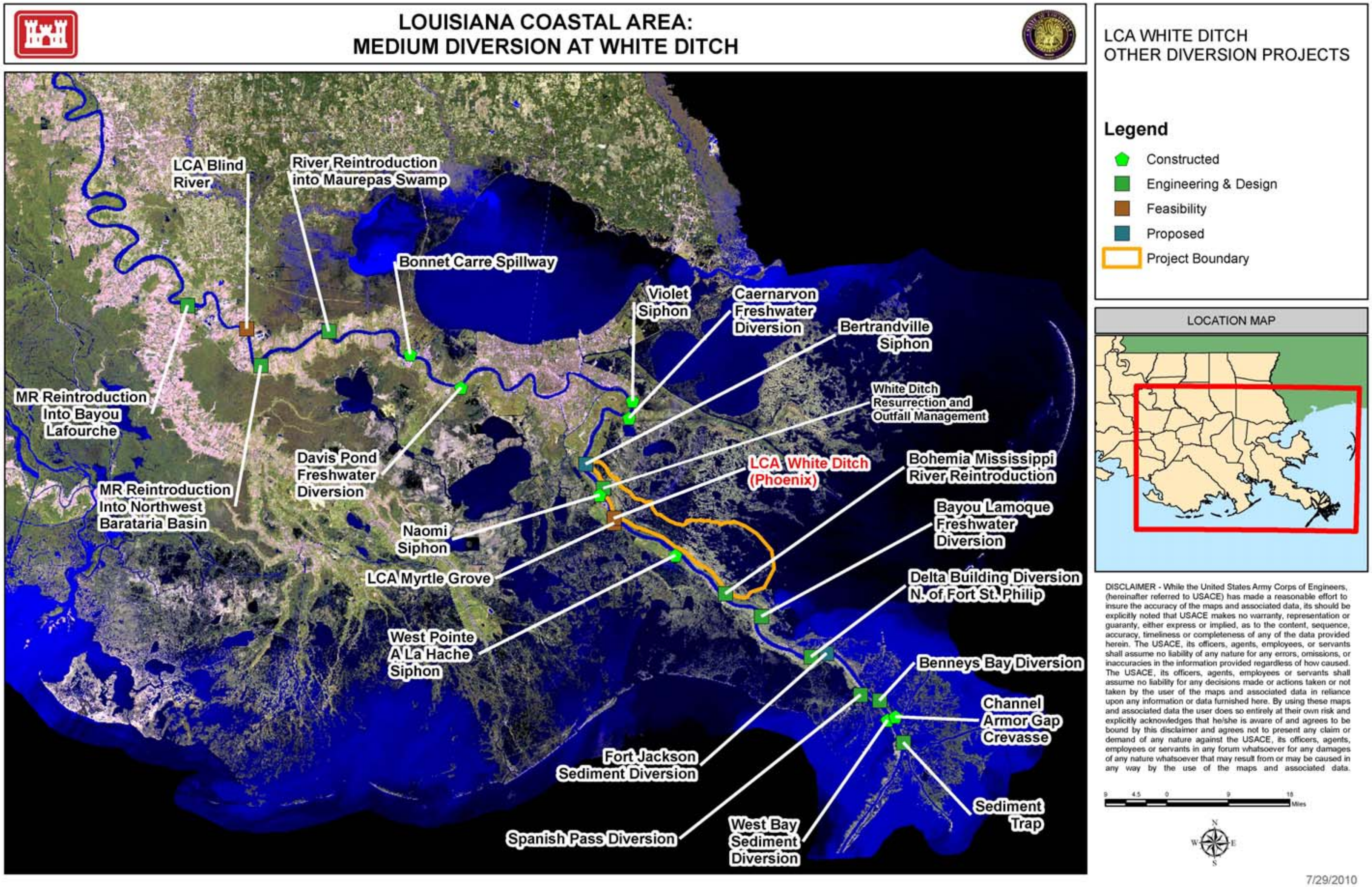

Figure 1.2: Other Diversion Projects

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Table 1.2: Related Studies That Played a Role in MDWD Project Development

Study Name	Study Focus	Relevant Information	How Used?
River Diversions and Shoaling (Letter, Jr. et al.)	Mississippi River	Examines the effects of how freshwater and sediment diversions affect shoaling rates and subsequent dredging in the lower Mississippi River.	This study was referenced as a supplement to the qualitative shoaling analysis (Appendix N).
Defining Restoration Targets for Water Depth and Salinity in Wind-Dominated Spartina Patens Coastal Marshes (Nyman, et al.)	South-central and southwest Louisiana intermediate marshes	Discusses the effects of predicted vs. observed water levels and salinities on the productivity of marshes dominated by Spartina patens.	This study was considered in conjunction with the MDWD pulsing scheme and maintenance flow scenarios.
The Decline in the Suspended Load of the Lower Mississippi River and its Influence on Adjacent Wetlands (Kesel)	Lower Mississippi River and the Mississippi River Delta	Analyzes the relatively recent trends of decreasing sediment loads in the Mississippi River due to factors such as reservoir construction upriver and land-use changes.	Data was considered as inputs were determined for use in ERDC-SAND2 model runs.
The Effect of Environmental Forcing on the Suspended Sediment Within the Naomi Wetlands as Reflected in Turbidity Data (McGraw)	Marshes surrounding the Naomi Siphon	Analyzes the forcing functions that affect the input and distribution of sediment in a system from a freshwater diversion.	Data was used to consider outfall channel and management arrangements as well as pulsing strategies.
Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study (CWPPRA)	Mississippi River Deltaic Plain and tributaries	Evaluates numerous diversion structures and locations in addition to sediment and nutrient load in the Mississippi River.	This study was used both in developing an array of diversion alternatives and the qualitative shoaling analysis (Appendix N).
Pulsed River Flooding Effects on Sediment Deposition in Breton Sound Estuary, Louisiana (Wheelock)	Upper Breton Sound estuary and Caernarvon diversion	Sediment accretion rates were documented at and around the diversion structure and analysis looked at how to operate diversions to capture as much sediment as possible.	The study was used to assess input assumptions for the ERDC-SAND2 model, consider different pulsing techniques, and distribute flows throughout the study area.
Abatement of Wetland Loss in Louisiana Through Diversions of Mississippi River Water Using Siphons (Roberts et al.)	Central River aux Chenes sub-area of the Breton Sound basin	The existing White Ditch siphon was studied to determine sediment accretion rates and spatial distribution of introduced sediments.	Study was referenced for known sediment loads in the Mississippi River, pulsing schemes, and outfall channel arrangements.
Current and Historical Sediment Loads in the Lower Mississippi River (Thorne et al.)	Lower Mississippi River	Observed sediment loads (with variability) in the Mississippi River were documented for current and historic trends.	The study was considered as a source of sediment inputs, capacity needs for land-building, and when to focus pulsing events.

Table 1.2, cont'd

Study Name	Study Focus	Relevant Information	How Used?
The Impacts of Pulsed Reintroduction of River Water on a Mississippi Delta Coastal Basin (Day et al.)	Upper Breton Sound estuary and Caernarvon diversion	Relates the importance of diversion discharge timing, over-marsh sheet flow, and water distribution to maximize effectiveness.	The study was used to assess input assumptions for the ERDC-SAND2 model, consider different pulsing techniques, and distribute flows throughout the study area.
The Use of Large Water and Sediment Diversions in the Lower Mississippi River (Louisiana) for Coastal Restoration (Allison et al.)	Lower Mississippi River	Focuses on river-side mechanics including analyzing sediment loads and the importance of structure location for maximizing restoration opportunities.	Data utilized in coordination with Myrtle Grove diversion development, sediment suspension in the river and diversion potential.
Sediment Discharge into a Subsiding Louisiana Deltaic Estuary Through a Mississippi River Diversion (Snedden et al.)	Upper Breton Sound Estuary and Caernarvon diversion	Report stresses the importance of timing pulsed diversions to maximize sediment introduction and also examines the distribution of sediments within the system.	Study was considered in conjunction with proposed pulsing operations and design of the distribution network.

Chapter 2: Need For and Objectives of Action. This chapter addresses the first step in the planning process. In the first step of the planning process, the study area problems and opportunities are defined in addition to the constraints, goals, and objectives. An initial statement of problems and opportunities was developed for the 2004 LCA report which reflected the priorities and preferences of the Federal Government, non-Federal sponsor, and other stakeholders. This report presents an updated problem identification that includes enhanced understanding of the process and problems of the study area.

Chapter 3: Alternatives. The third chapter of this report addresses the third, fifth, and sixth steps in the planning process. Step three of the planning process is the formulation of alternative plans. During this step, the plans developed in the 2004 LCA report were reevaluated. The fifth step in the planning process addresses comparisons of the alternative plans with emphasis on the outputs and affects each alternative. During the sixth step of the planning process, the selection of the Recommended Plan is made based upon the comparison of the alternative plans.

Chapter 4: Affected Environment. The fourth chapter of this report addresses the second step of the planning process which requires an inventory and forecast of resources within the study area. The inventory and forecast of the study area provides the without project condition and is the basis of comparison for the alternatives.

Chapter 5: Environmental Consequences. The fifth chapter of this report covers the fourth step of the planning process which evaluates the effects of the proposed alternative plans in terms of ecosystem benefits. The evaluation criteria are based on the overall goals and objectives of the LCA program and specific planning objectives and purposes of the near-term critical restoration projects recommended in the 2005 Chief of Engineer's Report.

1.7 USACE CAMPAIGN PLAN

The USACE has developed a Campaign Plan with a mission to "provide vital public engineering services in peace and war to strengthen our nation's security energize the economy and reduce risk from disasters." This Campaign plan is shaping USACE command priorities, focusing transformation initiatives, measuring and guiding progress, and helping the USACE adapt to the needs of the future.

USACE Campaign Plan Goals and Objectives Summary

- Goal 1: Deliver USACE support to combat, stability and disaster operations through forward deployed and reach back capabilities.
  - Objective 1a: USACE is ready, responsive and reliable in delivering high performance, all hazard, contingency mission execution in a world-wide theater of operations.
  - Objective 1b: Prepare Theater Engineer Commands (TEC) to support Combatant Commanders throughout the spectrum of operations.
  - Objective 1c: Establish human resources and family support programs that promote readiness and quality of life.
  - Objective 1d: Institutionalize USACE capabilities in interagency policy and doctrine.

- Goal 2: Deliver enduring and essential water resource solutions through collaboration with partners and stakeholders.
  - Objective 2a: Deliver integrated, sustainable, water resources solutions.
  - Objective 2b: Implement collaborative approaches to effectively solve water resource problems.
  - Objective 2c: Implement Streamlined and Transparent Regulatory Processes to Sustain Aquatic Resources.
  - Objective 2d: Enable Gulf Coast recovery.

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

- Goal 4: Build and cultivate a competent, disciplined, and resilient team equipped to deliver high quality solutions.
  - Objective 4a: Identify, develop, maintain, and strengthen technical competencies in selected Communities of Practice (CoP).
  - Objective 4b: Communicate strategically and transparently.

- Objective 4c: Standardize business processes.
- Objective 4d: Establish tools and systems to get the right people in the right jobs, then develop and retain this highly skilled workforce.

This project addresses two points of the USACE Campaign Plan. The second goal of the USACE Campaign Plan is addressed by this project since it is an element of the LCA ecosystem restoration plan on the Gulf Coast. This project also addresses the third goal through the application of the planning process to formulate, analyze, and evaluate alternative designs in pursuit of a sustainable, environmentally beneficial, and cost-effective ecosystem restoration design.

2.0 NEED FOR AND OBJECTIVES OF ACTION

2.1 NATIONAL OBJECTIVES

The USACE planning process is based on the economic and environmental Principals and Guidelines (P&G) promulgated in 1983. The P&G provide for development of reasonable plans that are responsive to National, State, and local concerns. Planning project benefits are quantified in this process as national economic development (NED) output, national ecosystem restoration (NER) output, or a combination of NED/NER output.

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

Ecosystem restoration is one of the primary goals of the USACE Civil Works Program. The USACE objective in ecosystem restoration planning is to contribute to NER. NER contributions include increases in the net quantity and/or quality of desired ecosystem resources. NER measurements are changes in ecological resource quality as a function of improvement in habitat quality and/or quantity. The units are expressed quantitatively in physical units or indexes that are not based on monetary units. Net changes are measured in the study area and in the rest of the nation. Single-purpose ecosystem restoration plans shall be formulated and evaluated in terms of their net contributions to increases in NER output. Multipurpose plans that include ecosystem restoration shall contribute to both NED outputs and NER outputs. For multipurpose projects, a plan that trades off NED and NER benefits to maximize the sum of net contributions to NED and NER is usually recommended.

NED and NER contributions were considered in the alternatives analysis for this project. However, under Title VII of WRDA 2007, any project or separable project element under LCA may be justified by the environmental benefits alone and economic justification is not required if the Secretary determines that the project or activity is cost-effective. This exemption does not apply for any project that is not predominately related to the protection, preservation, and restoration of the coastal Louisiana ecosystem.

2.2 SIGNIFICANCE OF THE MDWD PROJECT AREA

The benefits of ecosystem restoration and protection projects are difficult to measure in monetary terms. When determining Federal interest, it is important that the significance of the resources being studied for restoration by clearly identified. Under Title VII of WRDA 2007, any project or separable project element under LCA may be justified by the environmental benefits alone and economic justification is not required if the Secretary determines that the project or activity is cost-effective. The USACE's P&G defines significance in terms of institutional, public, and technical recognition of the resources. For years, the Federal Government, the State of Louisiana and other agencies have been engaged in activities that clearly demonstrate the institutional, public, and technical recognition of the resources of the MDWD project area.

Institutional

The formal recognition of coastal Louisiana in laws, adopted plans, and other policy statements of public agencies and private groups illustrate the significance of the Breton Sound Basin to a variety of institutions. At the Federal level, the MDWD project area's importance as an environmental and economic resource has long been recognized by congressional action and through the activities of several agencies. The U.S. Congress recognized the significance of coastal Louisiana by the passage of the CWPPRA (PL-101-646, Title III, CWPPRA), which provided authorization and funding for the Louisiana Coastal Wetlands Conservation and Restoration Task Force to begin actions to curtail wetland losses. Table 2.1 is a list of CWPPRA projects in the Breton Sound Basin.

Table 2.1: CWPPRA's Restoration Projects in the Breton Sound Basin

PPL	Number	Agency	Project Name
2	BS-03a	NRCS	Caernarvon Diversion Outfall Management
10	BS-10	COE	Delta Building Diversion North of Fort St. Philip
10	BS-11	USFWS	Delta Management at Fort St. Philip
14	BS-12	NRCS	White Ditch Diversion Restoration and Outfall Management
15	BS-13	COE	Bayou Lamoque Freshwater Diversion (Transferred to CIAP)
17	BS-15	EPA	Bohemia Mississippi River Reintroduction
17	BS-16	USFWS	Caernarvon Outfall Management/Lake Lery Shoreline Restoration
18	BS-18	EPA	Bertrandville Siphon

While CWPPRA is an ongoing program, it is comprised of relatively small projects that only partially restore the coastal ecosystem, and has proven that given the magnitude of Louisiana's coastal land losses and ecosystem degradation, a systematic approach involving larger projects, working in concert with smaller projects is necessary to reverse the trend of degradation and restore coastal wetlands in Louisiana. Congress reaffirmed the significance of coastal Louisiana by authorizing the LCA Program through Title VII of the WRDA (Public Law 110-114). The MDWD project is specifically categorized as a near-term critical project. This conditional authorization and accelerated schedule to ensure swift action, demonstrates the importance and necessity of taking immediate and bold measures to reduce the rate of degradation that has been allowed to progress in coastal Louisiana for decades. The FY 2011 presidential budget for the USACE provides $35.6 million for Gulf Coast restoration, including $19 million for wetlands construction projects and $16.6 million for wetlands pre-construction studies. The FY 2011 presidential budget for the USFWS provides $5 million for Gulf Coast restoration.

Public

Coastal Louisiana is significant based on wide public recognition of the environmental resources present in the coastal wetlands. Louisiana's coastal wetlands and barrier island systems enhance protection of an internationally significant commercial-industrial complex from the destructive forces of storm-driven waves and tides. Population for Plaquemines Parish, location of the MDWD study area, was estimated at approximately 21,540 in 2007 (U.S. Census Bureau, 2009). Between 60% and 70% of Louisiana's population lives within 50 miles of the coast. Louisiana's coast is a "working coast," supporting critical infrastructure such as highways, ports, pipelines and navigational waterways of national economic significance. Without coastal restoration, people and businesses that power the nation will be forced to retreat from coastal Louisiana, resulting in severe economic consequences to the nation.

Excluding Alaska, Louisiana produced the nation's highest commercial marine fish landings (about $343 million) excluding mollusk landings such as clams, oysters, and scallops (NMFS 2003). The State of Louisiana also leases thousands of sites throughout the basin for the production and harvesting of oysters. Data from the USFWS show expenditures on recreational fishing (trips and equipment) in Louisiana to be nearly $703 million, and hunting expenditures were $446 million for 2001 (USFWS, 2002).

Technical

Numerous scientific analyses and evaluations of the MDWD project area have documented its significant ecological resources. 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. While many studies have been conducted to identify the major contributing factors (e.g., Boesch et al., 1994; Turner 1997; Penland et al., 2000), most studies agree that land loss and the degradation of the coastal ecosystem are the result of both natural and human induced factors, producing conditions where wetland vegetation can no longer survive and wetlands are lost. The natural processes of subsidence, saltwater intrusion, and erosion of wetlands, and the human effects of river levee construction and the oil and gas industry, have caused major impacts to the Breton Sound Basin in recent decades. The two major wetland problems resulting from the natural processes and human intervention in this basin are sediment deprivation and saltwater intrusion.

The MDWD project area contains an extraordinary diversity of habitats that range from narrow natural levees to expanses of forested swamps and freshwater, intermediate, brackish, and saline marshes. Taken as a whole, the unique habitats of wetland areas and the Gulf of Mexico, with their hydrological connections to each other, and migratory routes of birds, fish and other species, combine to place the coastal wetlands of the project area among the nation's most productive and important natural assets. In human terms, these coastal wetlands have been a center for culturally diverse social development.

The commercial harvest of alligator eggs is important economically in the basin. The alligator population in the Breton Sound estuary is surveyed annually by the LDWF via aerial nest inventories conducted in late June or early July after nesting is complete.

Approximately 70 percent of all waterfowl that migrate through the U.S. use the Mississippi and Central flyways, which are located directly over (within) the MDWD project area. With over 5 million birds wintering in Louisiana, the Louisiana coastal wetlands are a crucial habitat to these birds, as well as to neo-tropical migratory songbirds and other avian species that use them as crucial stopover habitat. These economic and habitat values, which are protected and supported by the coastal wetlands of Louisiana, and the MDWD project area specifically, are significant on a national level.

2.3 PUBLIC CONCERNS

A number of public concerns have been identified during the course of the study. Initial concerns were expressed in the study authorization. Additional input was received through coordination with the sponsor, coordination with other agencies*, public review of draft and interim products*, *and through workshops* and public meetings. A discussion of public involvement is included in Chapter 6, Public

Involvement, Review and Consultation. The public concerns that are related to the establishment of planning objectives and planning constraints are:

- Potential negative effects from the diversion on oyster habitats
- Potential negative effects from the diversion on alligator egg collecting
- Potential negative effects from the diversion on the proliferation of invasive species
- Potential negative effects from the diversion on the Mississippi River shipping and navigation industry
- Excessive changes in the salinity gradient that converts existing estuarine habitats into purely freshwater and intermediate types
- Making the project area more susceptible to storm surge by creating ‘flotant’ marsh
- Not having a rigorous and comprehensive operational scheme
- Proliferating the range and extent of invasive species (water hyacinth)
- Increasing costs associated with maintenance dredging in the Mississippi River due to induced shoaling effects
- Uncertainty about effects of the diversion on commercial and recreational fisheries species
- Coordinating the operational scheme with the Myrtle Grove diversion that could be located directly across from the White Ditch diversion location

2.4 PROBLEMS, NEEDS, AND OPPORTUNITIES

The first step in the planning process is the identification of problems and opportunities. Problems are undesirable, negative conditions that the study will address. Opportunities are desirable conditions that could be achieved in the future. Study area problems and opportunities were drawn from prior comprehensive planning studies and from public input and interagency information exchange.

System-wide problems and opportunities were used to identify and define more geographically specific problems and opportunities throughout the study area. Through the NEPA public scoping process, the study team solicited input on problems and opportunities from members of the public, government resource agencies, and other stakeholders. A discussion of general study area problems and opportunities follows.

2.4.1 General Problem Statement

The altered supply and distribution of freshwater, lack of sediments, marsh subsidence and human development in the MDWD area have resulted in degraded and unbalanced distribution of freshwater, brackish, and saltwater marsh habitats. Further, the degradation of the existing marshes has made them more vulnerable to the range of Gulf storm events; extreme and seasonal, resulting in accelerated degradation, altered hydrology changed salinity regimes.

Installation of the existing White Ditch diversion siphon was completed in 1963 with the objective of enhancing muskrat and oyster habitat. In the absence of an outfall management plan, the surrounding marsh received limited benefits from the diverted river water. Two 50-inch steel pipes divert water from the Mississippi River through the White Ditch, into the Belair Canal and then into the River aux Chenes, where it continues south and out of the project area. Usage of the siphons was abandoned for many years and they degraded into a non-usable condition. The siphons were recently refurbished and water was diverted into White Ditch as part of research efforts.

Wetlands in the project area are deteriorating for several reasons: 1) subsidence, 2) lack of sediment and nutrient deposition, 3) erosion via tidal exchange, 4) channelization, 5) saltwater intrusion, 6) lack of freshwater, and 7) sea level rise. Recent hurricanes and tropical storms have also caused significant damage to the project area. These activities have resulted in the loss of several thousand acres of solid, vegetated marsh. Deterioration will continue unless preventative measures are taken.

Along the Louisiana coast, both changes in water level and changes in land elevation are occurring. Relative sea level change is the term applied to the difference between the change in eustatic sea level and the change in land elevation (also referred to as relative subsidence). Land elevations decrease due to subsidence from compaction and consolidation of sediments, faulting, and groundwater depletion, and increase due to sediment accretion from riverine and littoral sources as well as organic deposition from vegetation. For most of coastal Louisiana, sediment accretion is insufficient to offset subsidence, so land elevations are decreasing. Taking into account changes in land elevation and water levels, the average rate of relative sea level change along coastal Louisiana is currently estimated to be between 3.4 to 3.9 feet/century (1.03 and 1.19 meters/century).

In the absence of supplemental freshwater and sediment from the Mississippi River, subsidence, sea-level rise, wave erosion, and saltwater intrusion will continue to be problems. Protection and enhancement of this area are dependent on providing a hydrologic and sediment regime that minimizes the physiological stress to wetland vegetation from saltwater intrusion and tidal energy and is conducive to the retention of locally provided freshwater and sediments

The historic hydrology of the project area indicates that the current course of the Mississippi River has remained the same for the last 700 years and has directly influenced the development of the entire area. The project area is located on the east side of the Mississippi River and was formed between two natural levee ridge systems, River aux Chenes on the east and the Mississippi River on the west. There are also two unnamed bayou ridges found within the project area. These ridges formed along the old natural bayous which were distributary channels for the Mississippi River. These natural bayous once carried sediments and nutrients into the project area during high river stages when the natural ridges were seasonally overtopped.

In the historical setting, floodwater from the river would recede and sediments and nutrients would be deposited in the inter-distributary basins located between ridges. During normal or low river stages, the ridges along the distributary channels served like levees and buffered the basin areas from the daily tidal influence. This buffering effect created a low energy freshwater environment in the inter-distributary basins, forming deep organic soils. Drainage to the area was provided by a high water event breaching the River aux Chenes ridge in the southern part of the project area. This event caused the development of the Bayou Garelle tributary channel.

The present day hydrology of the project area has been altered and no longer functions in a historically natural pattern. Historically, water moved very slowly through the system. Freshwater slowly exited the system through meandering pathways in the marsh and saltwater was slow to intrude. Presently, changes in the marsh allow water to rapidly pass through the system and saltwater is able to quickly intrude. The hydrologic balance within the marsh has been disturbed due to the following man-made changes:

1. The Mississippi River can no longer overflow its banks into the project area due to the Mississippi River protection levee. This has eliminated the introduction of freshwater from the river and disrupted natural sediment deposition patterns.
2. Channels have been dredged through natural ridges, which have increased drainage and tidal exchange and exposed the soil to erosive forces.

2.4.2 Study Area Opportunities

Opportunities exist to naturalize the distribution of freshwater and sediments, improve hydrologic distribution of freshwater, improve topographic diversity, reduce the negative impacts of Gulf storm events and inhibit invasive species.

- Freshwater Supply – Re-introduction of freshwater supplies is an opportunity to restore a degraded and impaired deltaic forming process. Further, freshwater introduction has the potential to balance the altered salinity regime, improve the viability of freshwater marsh plant life and therefore restore fish and wildlife habitats.
- Hydraulic Distribution – Human induced habitat fragmentation (canals) has resulted in a degraded condition whereby the limited existing freshwater supplies are directed towards River aux Chenes and into the Gulf. Opportunities exist to improve the internal distribution of freshwater to restore and improve the sustainability of freshwater marsh habitats.
- Sediment Supply and Distribution – The lack of sediments from the Mississippi River has accelerated the degradation of all marsh types. Opportunities exist to re-introduce sediments from the river and use on site sediments displaced by Gulf storm events to create new marsh area. Based on the available survey data, the average depth of open water in the study area is 2 feet, with approximately 1 foot of soil structure above water required to support healthy marsh. This total of 3 feet of soil structure is assumed to be needed to support healthy marsh in the future.
- Topographic Diversity – As the freshwater marshes in the area degrade, niche habitats on ridges are lost, particularly forest resources such as oaks. Opportunities exist to restore ridge type features with both sediment introduction and targeted placement of materials.
- Sustainability – As marsh degradation has accelerated, seasonal Gulf events have a magnified impact on the remaining marsh areas. Opportunities exist through freshwater supply and distribution and sediment supply and distribution to create a healthier marsh which will be more resistant to the normal range of Gulf events.
- Invasive Species – Hyacinth is a common invasive species in the Breton Sound Basin. Freshwater introduction has the potential to improve conditions for its growth. Opportunities exist to control this incursion through effective diversion flexible management, prescribed burns of marsh grass and chemical control.

2.4.3 Desired Future Conditions

In order to more clearly articulate restoration goals and objectives for the project and understand how they fit into the large coastal system and the knowledge gained through the 2004 LCA Study; it is useful to outline potential desired future ecological conditions. Desired future conditions represent the restoration need of the project area. The restoration need in the case of White Ditch is the difference between a fully functioning and sustainable marsh community and the future habitat conditions (future without project). As an "ideal" ecological condition is difficult to determine for the project area due to a lack of reference conditions, the desired future condition is somewhat conceptual and reflects the value of the resource placed upon it by stakeholders. Project objectives will be refined based on the desired future. Finally, it is a useful way of establishing the upper bounds to restoration goals, objectives, and ultimately alternatives.

Based on the available data and the outcome of public scoping meetings, a series of potential desired futures exists that require consideration by the study team, sponsor, collaborating agencies and citizens. Figure 2.1 illustrates five potential desired future conditions. They are:

- **Louisiana Coastal Area Study (2004) 1**: Increase of marsh acres 50% over no net loss.
- **Louisiana Coastal Area Study (2004) 2**: Maintain no net loss of marsh acres.
- **Louisiana Coastal Area Study (2004) 3**: Reduce loss rate by 50%.
- **Desired Future 1**: Historic Condition (1985).
- **Desired Future 2**: Other proposed target?

At this time a Desired Future Condition has been identified as a no net loss of marsh acres consistent with LCA 2. It should be noted that no-net-loss was what the Project Delivery Team (PDT) felt was achievable and desirable given the uncertainty associated with sea level rise and the constraints of time and availability of information. Given the severe loss of marsh from over the last 25 years exceeding the current marsh areas would be beneficial to both the project area but also the larger ecosystem of the Breton Sound. The annual loss rate of marsh of 274.5 acres per year is equivalent to approximately 1.3 million cubic yards of sediment. The 1.3 million cubic yards figure is the quantity of sediment required to offset the loss of 274.5 acres per year. Based on the available survey data, the average depth of open water in the study area is 2 feet with approximately 1 foot of soil structure above water required to support healthy marsh. This total of 3 feet of soil structure is assumed to be needed to support healthy marsh in the future. The 1.3 million cubic yards figure is the volume of sediment needed to fill the 274.5 acres to an average depth of 3 feet.

2.5 PLANNING OBJECTIVES

Study goals, objectives, and constraints were developed to comply with the study authority and to respond to study area problems and opportunities.

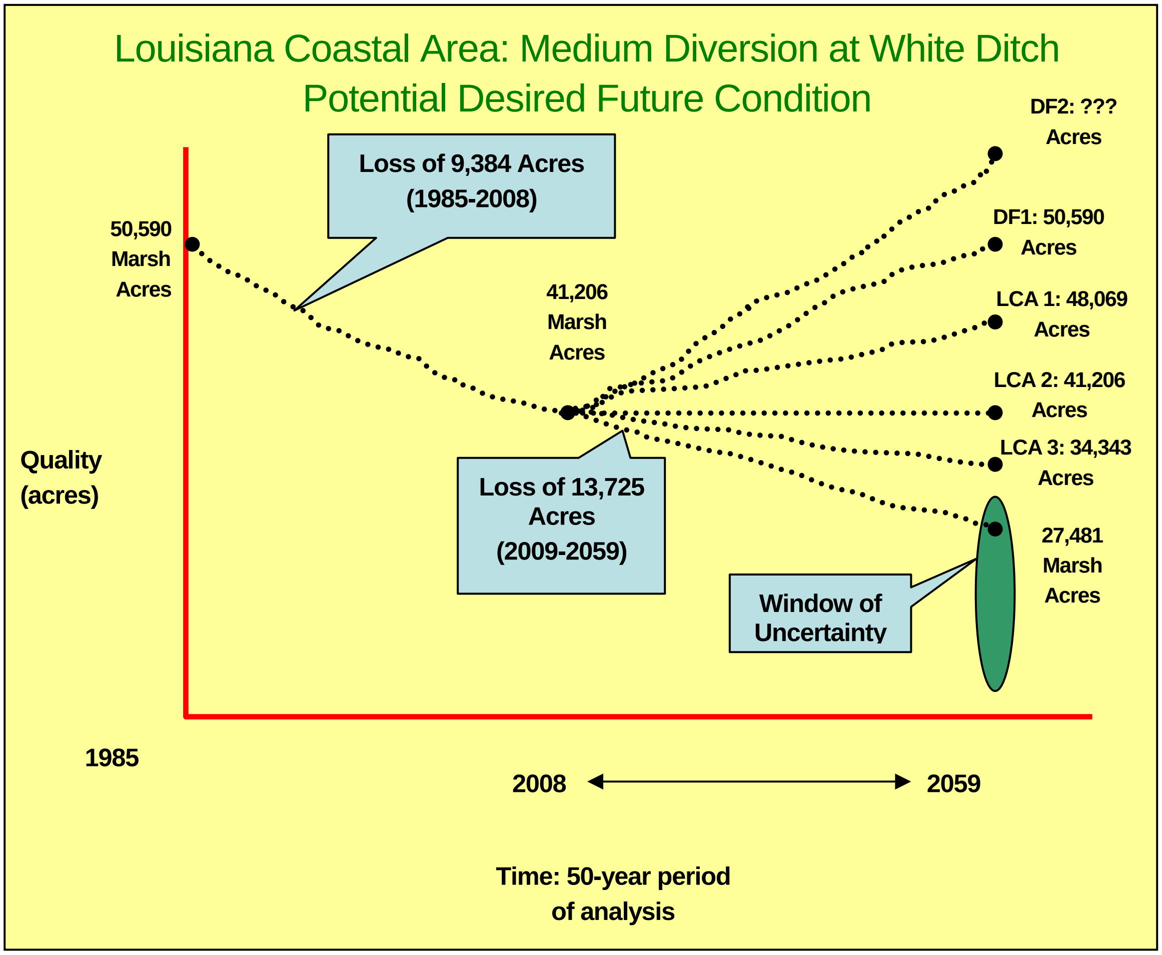

Figure 2.1: Potential Desired Future Condition

2.5.1 Goals and Objectives

In consultation with the non-Federal sponsor and other interested parties, Goals and Objectives were developed in the first quarter of 2009. They are:

Table 2.2: Goals and Objectives

Overarching System Goal	Objective
Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them by reversing the trend of degradation and deterioration to the area between the Mississippi River and the River aux Chenes ridges, so as to contribute towards achieving and sustaining a larger coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the economy and well-being of the nation.	A. Maintain the current area of marsh habitat, of all types (41,206 acres) that provide life requisite habitat conditions for native coastal marsh fish and wildlife. B. Restore adequate freshwater and nutrient inputs into the project area such that sustainable areas of fresh, intermediate, brackish and saline marsh are present and existing areas of marsh acres are maintained. C. Restore sediment inputs into the project area equivalent to an average of approximately 1,300,000 cubic yards of sediment per year.

2.6 PLANNING CONSTRAINTS

Development and evaluation of restoration alternatives for the proposed project are constrained by a number of factors. These factors are generally divided into two categories:

- Project design constraints- Limitations to the scope and functionality of specific project features because of issues regarding project effects on other projects or infrastructure in the study area; and
- Ecosystem constraints- Constraints imposed upon the project design by existing conditions within the study area's ecosystem.

These categories and their constituent constraints are discussed separately below.

Project Design Constraints. Identified project design constraints for the MDWD project include the following:

- The current authorization identifies a 5,000–15,000 cfs diversion with the ultimate size to be determined by the PDT. The 2004 LCA report determined based on limited information, a medium diversion would be sufficient to meet the goals and objectives of the overall LCA project. Existing conditions may have changed and we will investigate all reasonable alternatives for achieving the goals and objectives, even if they include larger diversions.
- Flood Damage Protection – The MDWD restoration measures must accomplish its goals while avoiding and/or minimizing significant impacts to the existing level of flood protection.
- Drainage Infrastructure – The current arrangement of canals and water bodies would likely need to be altered to support the goals of the project. The project should permit reasonable access to the local waterways for all prospective users.
- General Infrastructure – A State highway and several local roads, as well as a few residences are found in the study area. Adverse effects to the existing infrastructure will be minimized to the extent practicable. Numerous gas and oil pipelines exist that are not mapped and may limit the design or restrict the use of some potential restoration measures. The risk and uncertainty associated with any project feature must be evaluated as it relates to buried utilities.
- Potential impacts such as induced shoaling or increased Operations and Maintenance of the authorized Mississippi River Navigation Project should be avoided but if necessary mitigation measures and costs will be evaluated and included as part of the Recommended Plan.

Ecosystem Constraints. Identified ecosystem constraints for the MDWD project included the following:

- It may be likely that the restoration of marsh habitats may still not occur fast enough to compensate for the losses due to Gulf storm events and potential sea level rise.
- Water Quality – Planning objectives of the proposed project include the introduction of water and sediments from the Mississippi River. Restoration measures cannot introduce water, nutrient or sediment flows that would violate established state water quality standards.
- Pallid Sturgeon – In 2008 the Bonnet Carré Diversion, north of New Orleans was opened for the first time in 15 years. A number of pallid sturgeons were entrained in the diversion. At this time it

is not known if pallid sturgeons are in the lower river near the MDWD study area. Monitoring will need to be done to determine its presence and if so this will need to be coordinated closely with USFWS.

- River aux Chenes – River aux Chenes, while disconnected from the Mississippi River, still conveys flows from the Breton Sound Basin to the Gulf. Overtopping of the natural levees or banks of the River aux Chenes from a diversion could potentially result in loss of those diversion flows to the Gulf. This effect could serve as an upper constraint on the size of flows that can be diverted. Further Hydrology and Hydraulic modeling will need to be done to better understand these conditions.
- Estuarine Access – Diversion features need to be designed to allow the continuance of ecologically important exchanges of water, nutrients, food sources and fish between the project area and River aux Chenes, as well as navigation access, while achieving project objectives for marsh restoration.

3.0 ALTERNATIVES

3.1 PLAN FORMULATION RATIONALE

3.1.1 Plan Formulation Rationale

Alternatives for the proposed action were formulated in consideration of study area problems and opportunities, as well as study goals, objectives and constraints. As specified in ER 1105-2-100, four criteria were considered during alternative plan screening: completeness, effectiveness, efficiency, and acceptability.

3.1.2 Plan Formulation Criteria

3.1.2.1 Completeness

Completeness is the extent that an alternative provides and accounts for all investments and actions required to ensure the planned output is achieved. These criteria may require that an alternative consider the relationship of the plan to other public and private plans if those plans affect the outcome of the project. Completeness also includes consideration of real estate issues, O&M, monitoring, and sponsorship factors. Adaptive management plans formulated to address project uncertainties also have to be considered.

3.1.2.2 Effectiveness

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

3.1.2.3 Efficiency

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

3.1.2.4 Acceptability

A plan must be acceptable to Federal, state, and local government in terms of applicable laws, regulation, and public policy. The project should have evidence of broad-based public support and be acceptable to the non-Federal cost sharing partner.

3.1.3 Environmental Operating Principles

In 2002, the USACE formalized a set of Environmental Operating Principles applicable to decision-making in all programs. The principles are consistent with NEPA; the Army Strategy for the Environment; other environmental statutes, and the WRDAs that govern USACE activities. The Environmental Operating Principles inform the plan formulation process and are integrated into all project management processes. Alternatives were formulated for this project consistent with the Environmental Operating Principles.

The USACE Environmental Operating Principles are:

- Strive to achieve environmental sustainability, and recognize that an environment maintained in a healthy, diverse, and sustainable condition is necessary to support life;
- Recognize the interdependence of life and the physical environment, and proactively consider environmental consequences of USACE programs and act accordingly in all appropriate circumstances;
- Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another;
- Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems;
- Seek ways and means to assess and mitigate cumulative impacts to the environment and bring systems approaches to the full life cycle of our processes and work;
- Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work; and
- 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.

3.1.4 White Ditch Study Area Land Loss

The loss of coastal marsh within the White Ditch study area has been profound. The data available and shown in Table 3.1 depicts habitat change over time from the earliest time period of 1956 through 2008 including the aftermath of the 2005 hurricanes that affected the study area. From 1956 to 2008, approximately 12,762 marsh acres of all types have been converted to open water.

This loss of marsh habitat is accounted for in a variety of one time or short term events and the alteration of systemic marsh building processes. These contributors to marsh conversion include:

- Gas and Oil Pipeline Construction
- Extreme 2005 Gulf Storm Events
- Altered Deltaic Process
  - Subsidence
  - Diminished Sediment Inputs
  - Diminished Fresh Water Inputs
  - Diminished Nutrient Inputs
- Sea Level Rise

Table 3.1: Study Area, Medium Diversion at White Ditch

Date	Julian	Data	Land Area (acres)	Water (acres)	Total (acres)	Land Area (mi^2)	Water (mi^2)	Total (mi^2)	% Land	% Water
1956	1956.8	habitat	53,968	44,361	98,329	84.3	69.3	153.6	54.9%	45.1%
1978	1978.8	habitat	46,904	51,425	98,329	73.3	80.4	153.6	47.7%	52.3%
1/9/1985	1985.0	TM	50,590	47,739	98,329	79.0	74.6	153.6	51.4%	48.6%
1/28/1988	1988.1	TM	50,792	47,537	98,329	79.4	74.3	153.6	51.7%	48.3%
1988	1988.8	habitat	47,202	51,127	98,329	73.8	79.9	153.6	48.0%	52.0%
11/1/1990	1990.8	TM	47,114	51,215	98,329	73.6	80.0	153.6	47.9%	52.1%
2/24/1998	1998.2	TM	47,996	50,333	98,329	75.0	78.6	153.6	48.8%	51.2%
11/18/1999	1999.9	TM	45,407	52,922	98,329	70.9	82.7	153.6	46.2%	53.8%
10/1/2000	2000.8	TM LCA Desktop	46,325	52,004	98,329	72.4	81.3	153.6	47.1%	52.9%
10/30/2001	2001.8	TM	45,829	52,500	98,329	71.6	82.0	153.6	46.6%	53.4%
2/27/2002	2002.2	TM	46,728	51,601	98,329	73.0	80.6	153.6	47.5%	52.5%
11/7/2004	2004.9	TM	45,538	52,791	98,329	71.2	82.5	153.6	46.3%	53.7%
10/25/2005	2005.8	TM	40,831	57,498	98,329	63.8	89.8	153.6	41.5%	58.5%
10/28/2006	2006.8	TM	42,057	56,272	98,329	65.7	87.9	153.6	42.8%	57.2%
10/1/2008	2008.8	TM	41,206	57,123	98,329	64.4	89.3	153.6	41.9%	58.1%

The short time frame events include large oil and gas pipeline construction during the 1950s and 1960s. Also, the 2005 hurricane season proved devastating in both the intensity of the storm and the storm track of Katrina through the Breton Sound Basin. Alterations in the deltaic processes that build and sustain marsh are primarily related to the disruption of freshwater, nutrient and sediment inputs that result from the isolation of the study area from the Mississippi River. Sea level rise also has contributed to the loss of marsh habitat to open water. The marsh loss in 2005 compared to historic areas of loss is illustrated in Figure 3.1. The map depicts areas converted from marsh to open water from 1956–2005, not inclusive of Hurricane Katrina. The areas in red indicate those areas of marsh lost to open water as a result of Hurricane Katrina.

In consultation with the U.S. Geological Survey (USGS) and taking into consideration the quality of the available data sets, the loss rates were calculated for the period 1985–2008. With respect to the older data (1956 and 1978), there are issues with using those data points quantitatively in calculating land loss rates. These issues relate primarily to the consistency of data collection methodology and classification of landscape features. They can be looked at qualitatively in terms of what the trends are for an area, but should not be used in calculating the slope of the land loss line. Figure 3.2 shows the 1985–2008 loss rates.

3.1.5 Future Study Area Loss Rates

The future loss rate for the study area is what the PDT in partnership with the sponsor and the public have set goals and objectives against and have measured action alternatives against to determine relative benefits. However, it is important to discuss the assumptions, risk and uncertainty involved with predicting the future rate of marsh conversion to open water.

The available information indicates that a continued loss rate of approximately 274.5 acres +/- per year throughout the 50-year period of analysis would be reasonable. This would yield a loss of an additional 13,725 acres of marsh of various types to open water within the study area. Figure 3.3 illustrates both the historic loss rate and extrapolates that decline out to the end of our period of analysis. The result is 27,481 acres of marsh of all types remaining compared to the 2008 measure of 41,206 acres, or a 33.3% decline in marsh acres.

In Figure 3.3 this concept is expressed as a window of uncertainty.

The two major areas of uncertainty related to the future without project condition are hurricane and storm damage and sea level rise. Seasonal hurricanes and storm damages are reflected in the proposed loss rate as they reflect the inclusion of these events in the historic average. Large catastrophic events similar to Katrina are not included in the future without project condition for the following reasons:

- A storm of the magnitude of Katrina equates to a 425-year storm. While there is always a probability in any given year that a damaging storm of this magnitude could occur, for the period of analysis it is not included.

- One reason the damage to the study area from Katrina was so extensive is the storm track maximized the storm surge into the study area. It is unlikely that another storm would take the same track through the study area during the period of analysis.

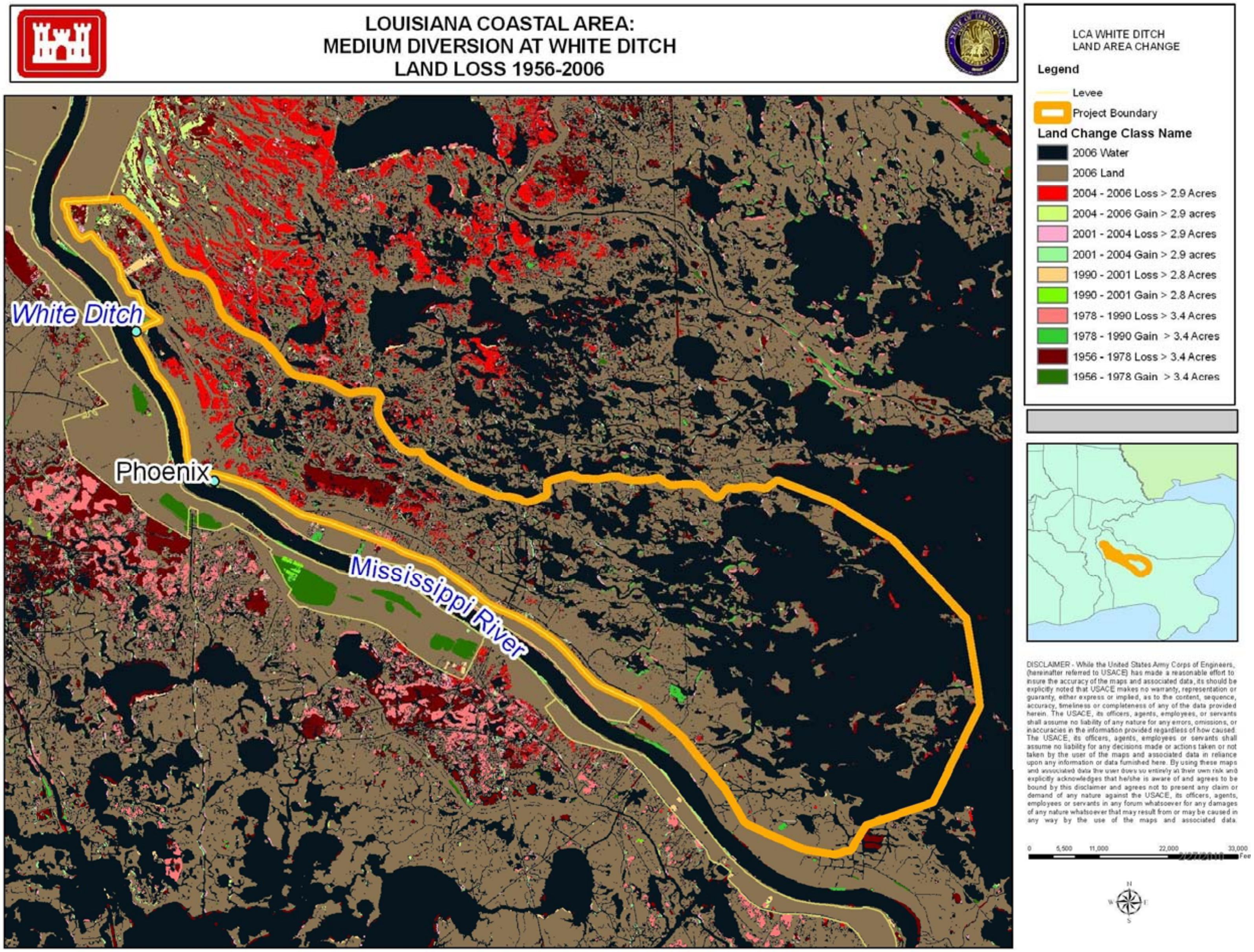

Figure 3.1: Land Area Change in Coastal Louisiana after the 2005 Hurricanes (1956–2005) (USGS)

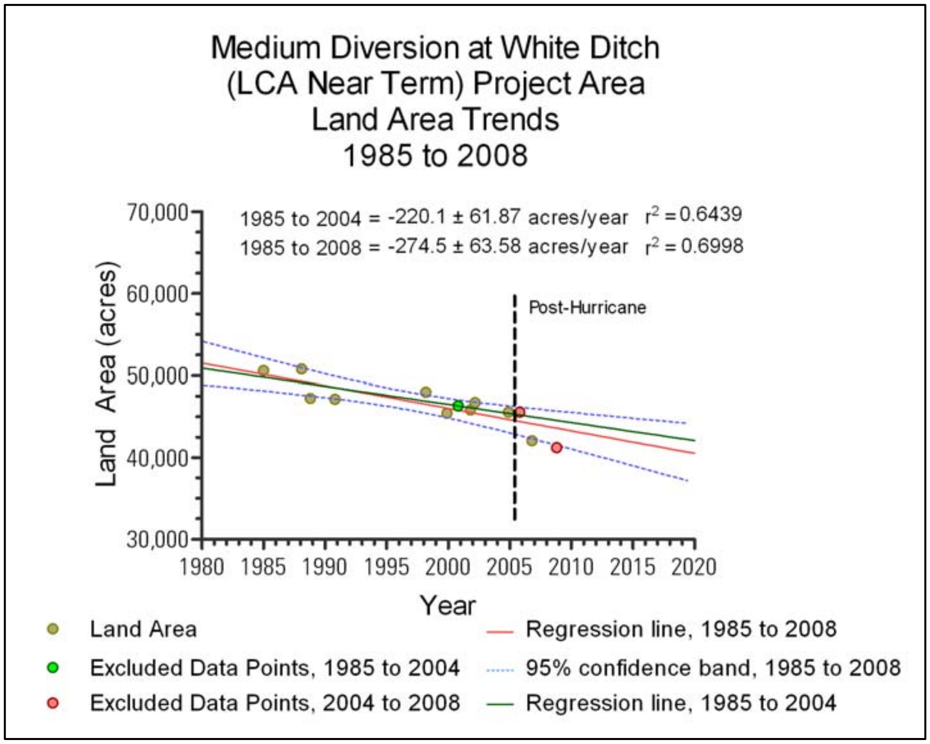

Figure 3.2: Land Area Trends

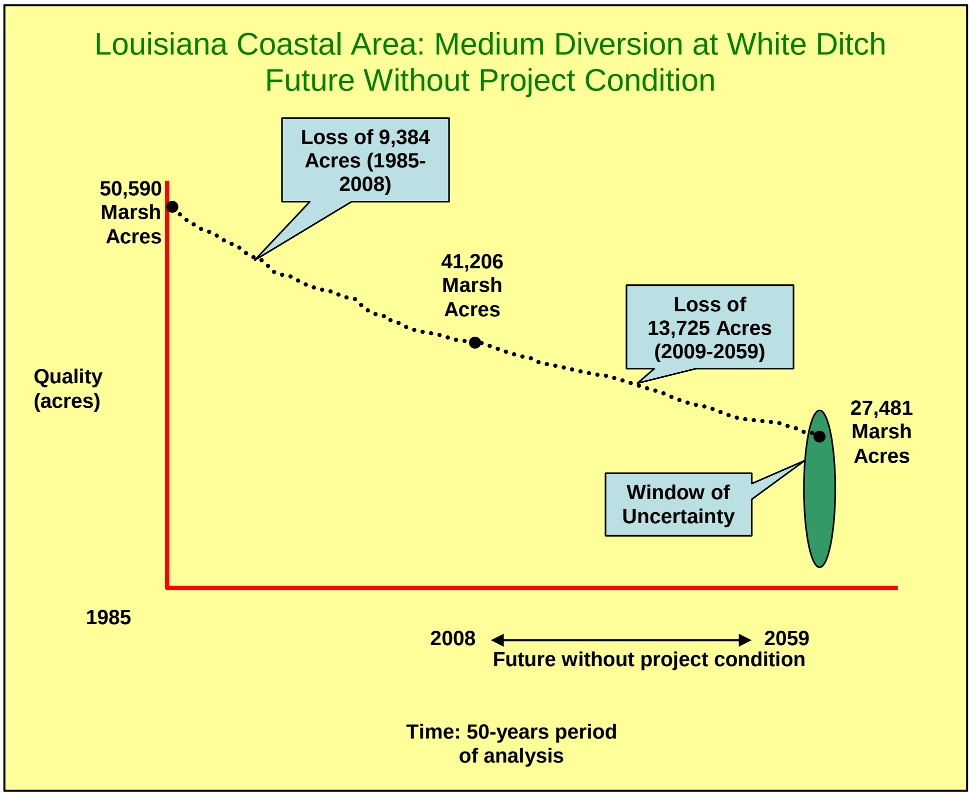

Figure 3.3: Future Without-Project Condition

USACE guidance on sea level rise is found in EC1165-2-211 which directs the consideration of three different scenarios for sea level rise into the planning process. A regional historic rate for the study area has been determined to be 10.2 millimeters per year (mm/yr) or 1.8 feet over the 50-year period of analysis. This is based on the historic average and is already reflected in the 274.5 acres +/- loss rate, which is also based on historic trends. Intermediate and high rates of sea level rise are projected to be 2.3 and 3.7 feet, respectively. The average elevation of marsh within the study area ranges from 1 to 3 feet with exceptions being remnant ridges and terraces. The inclusion of the intermediate scenarios (2.3 feet) and the high sea level rise scenario (3.7 feet) results in a significant decline in marsh habitat of all types. The high rate of sea level rise would likely result in a total collapse of the marsh habitat within the study area. To reflect this uncertainty the impacts of the high rate sea level rise scenario on the future without project condition are shown on in Figure 3.4

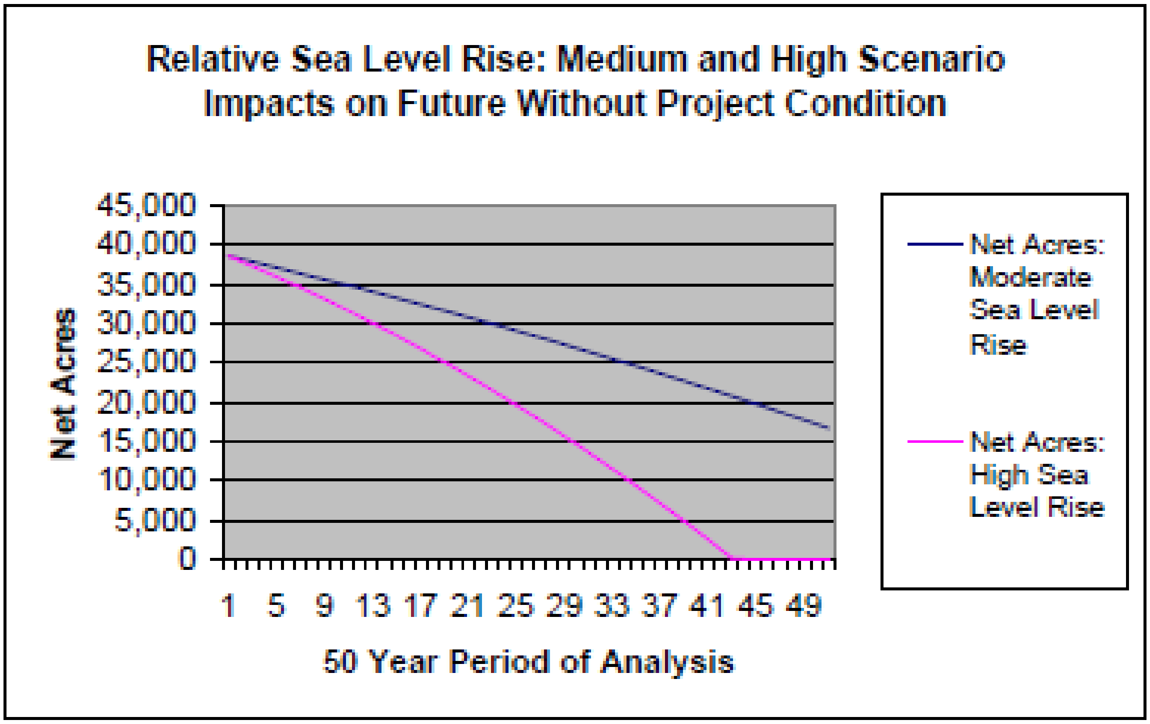

Figure 3.4: Relative Sea Level Rise: Medium and High Scenario Impacts on Future Without-Project Condition

3.2 MANAGEMENT MEASURES

3.2.1 Value Engineering Study

A Value Engineering (VE) workshop was conducted on May 18–22, 2009, for the U.S. Army Corps of Engineers (USACE), New Orleans District, by Value Management Strategies, Inc. The subject of the study was a group of three Louisiana Coastal Area (LCA) ecological restoration projects: Small Diversion at Convent/Blind River, Amite River Diversion Canal Modification, and Medium Diversion at White Ditch. This study was conducted at the Feasibility Scoping Report/Preliminary Draft EIS, an early stage of project development, and as such is the beginning of plan formulation.

VE Study Results

The VE team developed alternative concepts that are intended to assist the USACE in better formulating plans to carry forward into the next phase of project development. These recommendations are categorized per subject project, as well as those that pertain to general plan formulation.

Major findings of the workshop are summarized as follows:

Presently, loss of area in the marsh allows water to rapidly pass through the system and saltwater is able to quickly intrude. The absence of an outfall management plan related to the White Ditch diversion siphon results in the surrounding marsh receiving limited benefits from the diverted river water. Also, the lack of marsh-forming sediments from the Mississippi River has accelerated the degradation of all marsh types. Sediment needs in the project area are extensive and plan strategies that increase diversion flows to provide required sediment transport may not be sufficient to provide the necessary sediment. Key VE alternatives identified to address these issues are as follows:

- Design diversion structures to maximize sediment introduction
- Optimize quantity of freshwater diverted at White Ditch in combination with other proposed diversion projects
- Construct diversion structure approximately 7 miles south of Phoenix
- Construct a combination spillway with capacity controls to medium diversion levels
- Install sediment introduction system into White Ditch diversion structure
- Optimize flow conveyance in White Ditch
- Identify and incorporate impacts effects of subsidence due to fluid withdrawal into project analysis

General/Plan Formulation

- Develop Plan Strategies that account for much higher levels of global sea level (GSL) rise
- Provide clarification and address the Water Resources Development Act of 2007 (WRDA 2007) regarding specified authorized funding limits and the extent of planning development of LCA projects

Many of these comments and recommendations were adopted and considered by the MDWD PDT during alternative formulations process. The Recommended Plan incorporates most of the suggestions developed by the VE team.

3.2.2 Development of Management Measures

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

Before alternative plans were formulated, the first step taken was to identify general locations and categories of potential improvements that would satisfy the goals and objectives established previously. The process began with several discussions concerning the management goals and objectives discussed in the previous section. This yields an array of *general measures* from which *specific measures* were developed. The formulation of these specific measures involved an assessment of the measures as to whether they met the goals and objectives of the study and how likely they were to produce measurable habitat benefits. This is a subjective process requiring further trade-off analysis and habitat evaluation procedures of alternative plans; however, the depth of professional experience and first-hand management knowledge by many members of the team was invaluable in defining specific measures.

Finally, during this process, several specific measures were screened for a variety of reasons. They are not included as specific measures but are described in the screening section below, along with the necessary justification for their elimination from consideration. Upon finalization of specific measures, alternatives were developed through combinations of specific measures. This development of *alternative plans* is described in 3.3 and 3.4.

3.2.3 Description of Management Measures

As each potential category of measures was developed, a corresponding list of criteria related to each potential measure was also developed. Below are listed the categories of actions to adequately address the ecosystem objectives. Measures are loosely defined in five categories that seek to address deficiencies in or unbalanced deltaic forming processes. They are:

F – Freshwater Supply

F1) Uncontrolled Diversion (Levee Removal)
F2) Uncontrolled Diversion (Large Spillway)
F3) Uncontrolled Diversion (Multiple Spillways)
F4) Gated Diversion Structure (Single)
F5) Gated Diversion Structure (Multiple)
F6) Siphon (Large Multiple)
F7) Siphon (Medium Multiple)
F8) Siphon (Small Multiple)

H – Hydraulic Distribution

H1) Culverts and/or Weirs
H2) Canal Reconfiguration
H3) Construct New Canals
H4) Modify Existing Ridges to Redistribute Flow

S – Sediment Supply and Distribution

S1) Canal Dredging and Placement
S2) Dredging and Placement of local Mississippi River Sediments

S3) Importation and Placement of Regional Sediments
S4) Construct Seed Wetlands

P – Protection and Sustainability (Existing Marshes)

P1) Barrier Islands
P2) Rock Dikes
P3) Construct Ridges
P4) Construct Terraces

I- Invasive Species Management

I1) Prescribed Burning
I2) Chemical Control

3.2.3.1 Freshwater Supply

The 2004 LCA Study identified reduction of freshwater inputs to coastal marsh areas as a critical impediment to higher functioning and quality marsh habitats. The disconnect between riverine freshwater sources and the adjacent floodplain marshes has allowed saltwater to intrude into historically freshwater habitat types. The salinity intrusion damages existing vegetation which then dies or begins conversion to saltwater tolerant species. This transition weakens the soil structure and makes it vulnerable to seasonal Gulf storm events. This category of measures includes both controlled and uncontrolled introduction of freshwater to the MDWD area. Potential measures include removing portions of the MR&T levee not required for flood damage reduction, variously sized spillways in the existing MR&T levee, gated diversion structures, and siphons or pumps.

3.2.3.2 Hydraulic Distribution

Existing canal configurations, storm damage and a generally fragmented landscape impede the effective distribution of existing and planned freshwater within the site. This category of measures includes culverts within existing ridges, notched weirs in existing canals, canal reconfiguration or construction of new canals and modifying existing ridges to redistribute freshwater flows within the MDWD area.

3.2.3.3 Sediment Supply and Distribution

Sediment deposition is as least as important as freshwater supply and distribution. In the current configuration, the availability of sediments has been completely eliminated from the project site. While it is likely that the MDWD area would be in a stage of natural degradation, the unavailability of riverine sediments has accelerated this process, resulting in large-scale subsidence and land loss from Gulf storm events. The reintroduction of freshwater discussed above will provide necessary seasonal sediment inputs required for a more sustainable marsh area. However, the large sediment depositional events that historically occurred with an unconfined Mississippi River could be difficult to replicate, despite their importance to marsh creation and sustainability. Further, opportunities exist to strategically place sediment in order to capture what may be introduced along with supplies of freshwater. This category of measures includes dredging existing canals and beneficial placement of material, dredging and placement of Mississippi River sediments, importing and placement of regional sediment resources, and the construction of seed wetlands.

3.2.3.4 Protection (Existing Marshes)

As the MDWD area has degraded, the effects of seasonal and extreme Gulf storm events has led to large scale land loss, particularly since 2005. Opportunities exist to create structures that provide not only habitats similar to barrier islands present in other areas of the Louisiana coast but also to provide protection to the MDWD study area from storm events while other long term measures such as freshwater and sediment reintroduction and distribution take effect. This category of measures includes construction of barrier islands, rock shoreline protection, restoration of historical ridges and associated terraces.

3.2.3.5 Invasive Species Management

Hyacinth is a common invasive species in the Breton Sound Basin. Freshwater introduction has the potential to improve conditions for its growth. Hyacinth can out-compete native marsh grasses for resources resulting in conversion to a monoculture. Measures have been considered to control the proliferation of invasive species that could result from sustained freshwater introduction.

Specific Measures

Management measures that were carried forward for further evaluation are consistent with Administration budget policy, specific USACE policies for ecosystem restoration, and Federal laws, regulations, and Executive Orders.

Reflecting the criteria outlined above and the constraints present at the project site, specific measures were developed within the broad categories of potential measures. These measures are intended to satisfy the objectives and reach the goals of the project study (see Section 2.5.1)

3.2.3.6 Freshwater Supply

- **F1** *Uncontrolled Diversion (MR&T Levee Removal)* – The current MR&T levee between White Ditch and Phoenix, Louisiana, is approximately 4.7 miles in length and provides protection from the river to the community of Carlisle, though there is very little existing infrastructure or developed area. Portions of the levee could be removed to provide a constant connection to the Mississippi River and the corresponding ranges of flood events. The size of the diversion would need to be determined based on hydraulic criteria and the potential biological response to the freshwater diversion. Other considerations include the need to bridge Louisiana State Highway 39 (LA 39) over any created gap in levee protection.
- **F2** *Uncontrolled Diversion (Large Spillway)* – Based on hydraulic and biologic analysis, a large spillway that would convey certain Mississippi River flows into the study area could be constructed on the MR&T levee. A minimum flood frequency of 0.5 would be a starting point for analysis. Other considerations include the need to bridge any potential gap in levee protection for LA 39. Also, the non-Federal back-levee that protects the communities of Belair and Bertrandville to the north would need to be raised because the potential for induced flooding exists with the measure. Finally, the likelihood of the navigation channel migrating during large flood events through the levee opening could increase. A risk analysis would need to be conducted and an adequate structural response would need to be incorporated.
- **F3** *Uncontrolled Diversion (Multiple Spillways)* – A single diversion presents limitations on freshwater distribution within the project site. This measure involves construction of several

small spillways placed along the 4.7-mile length of the MR&T levee to better distribute incoming freshwater. The individual spillways could also be notched or sized differently to allow a variety of flows into the site.

- **F4** *Gated Diversion Structure (Single)* – This measure features a single structure with gates that pass flows ranging from 5,000 to 100,000 cfs. The gates could be electrically controlled similar to Caernarvon. Another option would be a stop log type structure with several bays similar to the Bonnet Carré structure. Stop logs could be placed or removed with truck mounted winches.
- **F5** *Gated Diversion Structure (Multiple)* – A single gated diversion presents limitations on freshwater distribution within the project site. Multiple gated structures that collectively pass 5,000 to 100,000 cfs could be more effective at distributing freshwater throughout the project site.
- **F6** *Siphon (Large Multiple)* – A siphon is a continuous tube that would allow freshwater to drain from the Mississippi River through the MR&T levee into the MDWD area. The flow being driven only by the difference in hydrostatic pressure between the river side and the study area without any need for pumping. Currently, a siphon capable of diverting water up to 250 cfs exists at White Ditch. It was constructed in 1963 by the Parish and the NRCS to improve oyster and muskrat habitats, but has not been operated since 1991 except for brief episodes. To achieve a minimum diversion of 5,000 cfs several large siphons could be required to achieve the desired flow rates.
- **F7** *Siphon (Medium Multiple)* – Several smaller siphons could be constructed in combination with other freshwater measures to achieve the desired cfs.
- **F8** *Siphon (Small Multiple)* – Several smaller siphons could be constructed in combination with other freshwater measures to achieve the desired cfs.

3.2.3.7 Hydraulic Distribution

- **H1** *Culverts and/or Weirs* – Due to storm events and canal construction many areas of existing marsh do not receive adequate distribution of existing freshwater resources. Culverts would be placed, based on existing conditions and alternative hydraulic modeling, to allow for a more even distribution of freshwater throughout the site. Weirs could also be placed in existing waterways to help direct the flow of freshwater and sediments to target areas.
- **H2** *Canal Reconfiguration* – Existing canals for gas, oil and utilities have the effect of fragmenting the marshes and altering the distribution of existing freshwater. This results in degraded areas becoming more susceptible to saltwater intrusion and Gulf storm damage. Existing canals could be altered to better redistribute flows. These alterations could include cutting spoil banks to facilitate sheet flow, filling of abandoned canals and creation of distributaries.
- **H3** *Construct New Canals* – Where appropriate and in conjunction with other measures, new canals could but cut to facilitate freshwater dispersion to degraded freshwater areas.
- **H4** *Modify Existing Ridges to Redistribute Flow* – Remnant historical ridges serve a vital purpose in creating niche habitats for tree species. They also present an opportunity to direct freshwater inputs from proposed diversions. Existing ridges near proposed freshwater sources could be restored to more historical dimensions. The restored ridges would also act to channel introduced sediments to areas needing nourishment.

3.2.3.8 Sediment Supply and Distribution

- **S1** *Canal Dredging and Placement* – Canals that are still needed to support commerce but that have filled in due to storm surge could be dredged to improve their ability to circulate freshwater. The dredged material would be placed in adjacent marshes where pockets of open water exist, thereby decreasing marsh fragmentation and increasing overall marsh acreage.
- **S2** *Dredging and Placement of local Mississippi River Sediments* – Diversion of freshwater does provide opportunities to introduce sediment. However the decades of isolation from wetland forming river flows has resulted in a significant deficit in sediments. This measure entails large scale importation of suitable riverine sediments from dredging nearby Mississippi River reaches. Dredging and placement could be both mechanical and hydraulic. Additionally innovative dredging and placement technologies tested in 2004 could be used to place material in sensitive marsh habitats. These include concrete pumps on floating platforms and conveyor belts.
- ***S3*** *Importation and Placement of Regional Sediments* – The loss of land within the Breton Sound Basin and in particular the MDWD study area has been dramatic. The large quantities of sediment required for a holistic restoration of marsh habitats in the area could justify large scale importation of sediment from areas other than the immediate MDWD reach of the Mississippi River. It is possible to make use of USACE New Orleans District (MVN) channel maintenance material for beneficial use as well as long range transport of suitable sediments from USACE Mississippi Valley Division (MVD) ecosystem projects that are being dredged from critical backwater habitats and where removing the sediment from a given donor study area is preferable in ecosystem terms to placement on site. Placement could be both mechanical and hydraulic. Additionally innovative dredging and placement technologies tested in 2004 could be used to place material in sensitive marsh habitats. These include concrete pumps on floating platforms and conveyor belts.
- **S4** *Construction of Seed Wetlands* – Certain areas that will be subject to increased sediment load from freshwater introduction could be constructed to create immediate marsh habitat while being configured to trap additional sediments from freshwater diversions. An example would be a perched wetland with an elevated perimeter and transitional (habitat) interior. As water levels fluctuate sediments would become trapped in the center and drop out, resulting in marsh creation.

3.2.3.9 Protection (Existing Marshes)

- **P1** *Barrier Islands* – Currently, a complex of barrier islands exists on the extreme south-east of the Breton Sound basin that is being addressed through other efforts. However, the MDWD area and Breton Sound in general have reached a point where the marsh is no longer able to recover from seasonal storm events due to saltwater intrusion and conversion of marsh to open water. A series of smaller constructed barrier islands aligned along high probability hurricane tracks and on the south-east edge of the study area would serve to disrupt storm surge and damage to project features. In addition to the habitat value of the barrier islands they would provide protection of the study area over the long term (>50 years), while freshwater and sediment measures restore the marshes themselves and make them more resilient to Gulf storm damage.
- **P2** *Rock Dikes* – Areas of existing high quality marsh could be made more resilient to seasonal Gulf events by construction of rock shoreline protection.

Table 3.2: Summary of the Problems, Opportunities, Goals, Objectives and Measures to this Point in the Planning Process

Problems and Opportunities	Overarching System Goal	Objective	Potential General Measures
Problem: The altered supply and distribution of freshwater, lack of sediments, marsh subsidence and human development in the White Ditch area have resulted in a degraded and unbalanced distribution of freshwater, brackish and saltwater marsh habitats. Further, the degradation of the existing marshes has made them more vulnerable to the range of Gulf storm events; extreme and seasonal, resulting in accelerated degradation, altered hydrology changed salinity regimes. Opportunities: Opportunities exist to naturalize the distribution of freshwater and sediments, improve hydrologic distribution of freshwater, improve topographic diversity, reduce the negative impacts of Gulf storm events and inhibit invasive species.	Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them by reversing the trend of degradation and deterioration to the area between the Mississippi River and the River aux Chenes ridges, so as to contribute towards achieving and sustaining a larger coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the economy and well-being of the nation.	A. Maintain the current area of marsh habitat, of all types (41,206 acres) that provide life requisite habitat conditions for native coastal marsh fish and wildlife. B. Restore adequate freshwater and nutrient inputs into the project area such that sustainable areas of fresh, intermediate, brackish and saline marsh are present and existing areas of marsh acres are maintained. C. Restore sediment inputs into the project area equivalent to an average of approximately 1,300,000 cubic yards of sediment per year.	**F1)** Uncontrolled Diversion (Levee Removal) **F2)** Uncontrolled Diversion (Large Spillway) **F3)** Uncontrolled Diversion (Multiple Spillways) **F4)** Gated Diversion Structure (Single) **F5)** Gated Diversion Structure (Multiple) **F6)** Siphon (Large Multiple) **F7)** Siphon (Medium Multiple) **F8)** Siphon (Small Multiple) **H1)** Culverts **H2)** Canal Reconfiguration **H3)** Construct New Canals **H4)** Modify Existing Ridges to Redistribute Flow **S1)** Canal Dredging and Placement **S2)** Dredging and Placement of local Mississippi River Sediments **S3)** Importation and Placement of Regional Sediments **S4)** Construct Seed Wetlands **P1)** Barrier Islands **P2)** Rock Dikes **P3)** Construct Ridges **P4)** Construct Terraces **I1)** Prescribed Burns **I2)** Chemical Control

- **P3** *Construct Ridges* – In areas where historical ridges have been degraded due to Gulf storm damage or subsidence, new ridges could be constructed using local sediments. The short term sustainability of such features can be enhanced with practices such as stone-toe protection or construction utilizing geo-textile fabrics (textile tubes). Stone-toe protection is a practice whereby rock is placed along the active erosion line (toe) of a bankline, thereby inhibiting undercutting of the bank. Long-term sustainability is dependent on other measures to build healthy marshes through freshwater and sediment supplies.
- **P4** *Construct Terraces* – Terraces could be constructed in open-water habitats to help trap sediments that move through the area.

3.2.3.10 Invasive Species Management

- **I1** *Prescribed Burning* – Fire is a natural disturbance regime in coastal marshes. Habitat fragmentation has limited the effectiveness of this regime at controlling invasive plant species. Prescribed burns at locations susceptible for non-native species invasion will control the species and improve the overall health of the marsh habitat.
- **I2** *Chemical Control* – In areas where hyacinth is dominant or the spatial extent is small and isolated, chemical means may be employed to control invasive species. These measures would be likely combined with other measures to improve overall habitat quality.

3.2.4 Screening / Evaluation of Alternative Plans

Screening of measures is a process whereby various criteria are evaluated to better characterize a specific measure and the likelihood that it can achieve cost effective restoration. The outcome of this process can result in specific measures being dropped from further consideration. Reasons (screening criteria) for elimination of specific measures can include:

- Objectives Supported – Each measure can support some or all of the ecosystem objectives. Those that support more objectives represent more holistic solutions.
- Timeframe for Marsh Creation – Measures have variable timeframes for creating acres of marsh habitat; some immediate, others long term.
- Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) – The complexity and cost of operations and maintenance of measures was discussed.
- Lands, Easements, Rights-of-Way, Relocations of Utilities or Other Existing Structures, and Disposal Areas (LERRDs) – While acquisition of LERRDs is a sponsor responsibility, the likelihood that the lands can be acquired or that impacts to oil, gas, oyster and alligator leases generate excessive costs or risks must be considered.
- Navigation – Measures that have the potential to introduce navigational hazards or increased Operation and Maintenance (O&M) costs were identified.
- Flooding – Measures that increase base and flood event water elevations on the existing Mississippi River & Tributaries levee or the non-Federal back-levee were identified. Measures that would require significant raising of the non-Federal back levee were also identified.

A workshop was held in April 2009 with the sponsor and other resource managers to screen the preliminary list of specific measures. Appendix L also provides additional information. The table below details measures that were eliminated from further consideration and why.

3.2.5 Alternative Plans not Carried Forward for Further Analysis

Table 3.3: Specific Measures Screened from Further Consideration

Category	Specific Measure	Symbol	Justification for Elimination from Further Consideration
Freshwater Supply	Uncontrolled Diversion (Levee Removal)	**F1**	Uncontrolled diversions would not allow for targeted management of water inflows to account for seasonal variation. Also, as the flows on the Mississippi River are highly altered this measure would not fulfill the objective of naturalizing freshwater and nutrient flow into the study area. This alternative would not allow flexibility needed for cooperative management with other existing and future diversion projects in the region. The cost to relocate or elevate the State highway would be high. This measure would necessitate at a minimum the raising of the non-Federal back levee to the north of MDWD and possibly require the raising of the back levee protecting Phoenix.
	Uncontrolled Diversion (Large Spillway)	**F2**	Uncontrolled diversions would not allow for targeted management of water inflows to account for seasonal variation. Also, as the flows on the Mississippi River are highly altered this measure would not fulfill the objective of naturalizing freshwater and nutrient flow into the study area. This alternative would not allow flexibility needed for cooperative management with other existing and future diversion projects in the region. The cost to relocate or elevate the State highway would be high.
	Uncontrolled Diversion (Multiple Spillways)	**F3**	Uncontrolled diversions would not allow for targeted management of water inflows to account for seasonal variation. Also, as the flows on the Mississippi River are highly altered this measure would not fulfill the objective of naturalizing freshwater and nutrient flow into the study area. This alternative would not allow flexibility needed for cooperative management with other existing and future diversion projects in the region. The cost to relocate or elevate the State highway would be high.
	Controlled Diversion (Single Gates)	**F4**	Engineering analysis concluded that a single gate structure would be inadequate to pass the minimum flows necessary to meet project goals and objectives.

Table 3.3, cont'd

Category	Specific Measure	Symbol	Justification for Elimination from Further Consideration
	Siphon (Large Multiple	**F6**	The use of large siphons was evaluated. The first cost of construction and O&M costs were higher than comparably sized (CFS) gated box culverts, while the habitat benefits were identical. Further discussion and analysis can be found in the Engineering Appendix.
	Siphon (Medium)	**F7**	The use of medium siphons was evaluated. The first cost of construction and O&M costs were higher than comparably sized (CFS) gated box culverts, while the habitat benefits were identical. Further discussion and analysis can be found in the Engineering Appendix.
	Siphon (Small-Multiple)	**F8**	The use of small siphons (less than 1,000 cfs) would require multiple crossing of the MR&T levee, the State highway and utilities. The operation of numerous (>5) sites would pose operation and maintenance issues for the sponsor. The need to cut multiple new outfall canals through healthy marsh to distribute freshwater is undesirable.
Hydraulic Distribution	Construct New Canals	**H3**	Construction of new canals would require cutting through existing healthy marsh and result in immediate loss of wetlands in the study area. It would also result in additional habitat fragmentation. The distribution of freshwater throughout the site can be achieved through other measures. These types of measures are envisioned as stand-alone new canals and distinct from an outfall canal necessary to move water directly from the diversion structure.
Sediment Supply and Distribution	Dredge and Place Mississippi River Sediments	**S2**	Upon further analysis it was determined that the diversion structures themselves were far more efficient at capturing needed sediments for marsh creation.
	Importation of Regional Sediments	**S3**	Upon further analysis it was determined that the diversion structures themselves were far more efficient at capturing needed sediments for marsh creation.
	Construct Seed Wetlands	**S4**	After further discussion and engineering analysis this measure was effectively combined with measure S1 for each of the final array of diversion alternatives.

Table 3.3, cont'd

Category	Specific Measure	Symbol	Justification for Elimination from Further Consideration
Protection	Barrier Islands	**P1**	Based on costs and efforts associated with recent projects, the level of effort to construct barrier islands as part of the MDWD project would likely be cost prohibitive, especially in light of the primary goal of the project. This is primarily due to the large amount of construction and associated material that would likely be required to effectively accomplish this task. This measure alone would not accomplish the goals of the project and could impair the ability to implement other necessary associated measures.
Invasive Species Management	Prescribed Burning	**I1**	After further discussion among the state and Federal resource managers, it was concluded that burning, though practiced widely for marsh vegetation propagation, was ineffective as a tool for controlling the spread of invasive species. (Will be considered as future adaptive management actions where determined necessary and appropriate).
	Chemical Control	**I2**	Large scale application of chemicals could have as much detrimental effect to healthy marsh as to invasive species. Further, the use of chemicals to control invasive species could present problems when applied over large swaths of private property. (Will be considered as future adaptive management actions where determined necessary and appropriate).

3.3 PRELIMINARY ALTERNATIVE PLANS

3.3.1 Development of Alternative Plans

Alternative plans are combinations of management measures that collectively meet study goals and objectives within the defined study constraints. Alternative plans are assembled and compared against one another using performance outputs and costs. Alternative plans and their component management measures will be assessed relative to the objective of National Ecosystem Restoration (NER). As alternative plans are evaluated, implementation roles for other Federal and non-Federal agencies will be considered and developed in detail for the Recommended Plan.

Alternatives were developed that combine the best measures to provide a broad range of alternatives. All of the action alternatives have freshwater diversions as the base option with additional measures added as more data became available in later stages of the feasibility study. Based on discussions with the sponsor and a study team review of goals and objectives the following conceptual alternatives have been defined:

1. **Conceptual White Ditch (CWD) 1: No Action.** Over a 50-year period of analysis, if nothing were done, we would see significant losses of all marsh types throughout the study area. More major storms could accelerate this loss. As a result open-water habitats would continue to grow allowing for further intrusion of saltwater into the marsh.
2. **CWD 2: LCA Plan**. This alternative involves construction of a 15,000 cfs maximum diversion structure. No other measures would be evaluated as part of this alternative. The need for a managed diversion was previously established as part of the screening of uncontrolled diversion measures. Therefore the design would allow for control of freshwater and sediment delivery (based on flow) at a 5,000 cfs minimum.
3. **CWD3: LCA Plan Enhanced**. This alternative involves construction of a 15,000 cfs maximum diversion structure. The design would allow for control of freshwater and sediment delivery (based on flow) at a 5,000 cfs minimum. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S), and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.
4. **CWD4: 45,000 CFS Freshwater Diversion.** This alternative involves construction of a structure capable of diverting up to 45,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S), and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.
5. **CWD5: 75,000 CFS Freshwater Diversion.** This alternative involves construction of a structure capable of diverting up 75,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.
6. **CWD6: 100,000 CFS Freshwater Diversion.** This alternative involves construction of a structure capable of diverting up to 100,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

After defining the desired future condition, following the feasibility scoping meeting, the objectives for the project were refined. The freshwater, sediment and nutrient requirements needed to maintain existing acres of marsh habitat while improving the distribution of marsh types, necessitated a reevaluation of all large diversion (>15,000 cfs) alternatives. Additionally, the Diversion Project at Myrtle Grove on the opposite bank of the Mississippi River completed hydraulic evaluation of the same range of diversions (45k, 75k and 100k) and identified significant issues with impacts to MR&T and back levees; a situation very similar to the White Ditch study area. Table 3.4 below lists the alternatives eliminated from further consideration and why.

Table 3.4: Conceptual Alternatives Screened from Further Consideration

Alternative	Symbol	Justification for Elimination from Further Consideration
45,000 CFS Freshwater Diversion.	**CWD5**	Significant impacts were identified at Myrtle Grove in evaluating the 45,000 diversion option. Sustained water levels in excess of 3 feet were identified. Similar water levels could be expected within the White Ditch project site. These sustained water depths indicate the need for toe armoring of significant portions of the levee system as well as the potential to raise non-Federal back levees. Finally, an important design criterion was the desire for all diversions not to exceed the natural levees of River aux Chenes. When this occurs, freshwater and nutrients discharge to the Gulf via River aux Chenes and their benefits are lost.
75,000 CFS Freshwater Diversion.	**CWD5**	Significant impacts were identified at Myrtle Grove in evaluating the 75,000 diversion option. Sustained water levels in excess of 3 feet were identified. Similar water levels could be expected within the White Ditch project site. These sustained water depths indicate the need for toe armoring of significant portions of the levee system as well as the potential to raise non-Federal back levees. Finally, an important design criterion was the desire for all diversions not to exceed the natural levees of River aux Chenes. When this occurs, freshwater and nutrients discharge to the Gulf via River aux Chenes and their benefits are lost.
100,000 CFS Freshwater Diversion.	**CWD6**	Significant impacts were identified at Myrtle Grove in evaluating the 100,000 diversion option. Sustained water levels in excess of 3.5 feet were identified. Similar water levels could be expected within the White Ditch project site. These sustained water depths indicate the need for toe armoring of significant portions of the levee system as well as the potential to raise non-Federal back levees. Finally, an important design criterion was the desire for all diversions not to exceed the natural levees of River aux Chenes. When this occurs, freshwater and nutrients discharge to the Gulf via River aux Chenes and their benefits are lost.

Ecohydraulic modeling of the project alternatives was utilized to compare the effects of one alternative to another. Modeling of this type is a difficult and computationally intensive analysis. For a detailed description of the methodology and results of the analysis, see Appendix L. The initial screening of alternatives was conducted to narrow down the number of alternatives to be run for the WVA Analysis based on time constraints. These simulations were setup to examine a hypothetical spring pulse period and allow for the comparison of results between all 660 runs. Each simulation was to run for a 1-month duration with “maximum” flows from the proposed new diversion as well as from the existing Caernarvon diversion (8,000 cfs). By assuming maximum flow from Caernarvon, it was possible to examine the potential extremity of events. Other parameters were as follows:

- Average spring (March–May) tidal conditions.
- Average spring (March–May) wind forcing conditions for Plaquemines Parish, Louisiana.
- Average spring (March–May) rainfall inputs.
- An average evaporation constant of 5 mm/day.
- Starting salinity over the entire grid of 7 ppt.

The results of this round of modeling clearly demonstrated that any diversion alternative will greatly freshen the project area, particularly if the diversion is operated in conjunction with Caernarvon. The smaller diversions freshen the sound more slowly, but are just as effective as the larger diversions. Other conclusions that were drawn from this initial modeling are that the larger diversions, 70,000 cfs and 100,000 cfs, will overtop the River Aux Chenes ridge.

After the screening of the larger-sized diversions, it was decided by the PDT that in order for a full array of alternatives to be evaluated, a diversion that went beyond the 2005 LCA report description was needed. Since the original concepts for an alternative over the 2005 15,000 cfs project (45,000–100,000 cfs) proved unacceptable, the PDT developed and discussed a 30,000 cfs diversion because it was the next logical increment up from 15,000 cfs that did not encounter the problems with the 45,000 cfs or larger diversions. As we progressed through our hydrology and hydraulics assessment we developed a minimum operating condition for all of the structures such that they could operate at design flows at any time during a typical year with a minimum of 1 foot of head differential on the Mississippi River which is an average low stage. The structure design for the 15,000 cfs diversion (ten 15-x-15-foot box culverts) is physically capable of passing a maximum flow of 35,000 cfs based on a 7-foot head differential on the Mississippi River which is an average yearly stage. Further, H&H modeling determined that 35,000 cfs was the maximum diversion that would not exceed River aux Chenes natural levees. Therefore a 35,000 cfs diversion alternative was developed for both locations 2 and 3. See Appendix L for additional information on the H&H analysis.

3.3.2 Location for Diversion Structure(s)

The various conceptual alternatives are all centered on diversion structures as the primary means by which wetland forming processes are restored. The location of one or multiple diversion structures within the study area is a critical piece to quantifying the benefits of various increments of diversion size ranging from 5,000 to 35,000 cfs. The remaining non-diversion measures formulated in Section 3.2 were then combined and optimized based on the variety of diversion sizes and locations to most effectively and efficiently distribute diverted freshwater, nutrients and sediments so as to maximize marsh creation.

Preliminary investigations identified five potential locations for diversion structures. These areas are shown on Figure 3.5

Negative and positive aspects of each of these sites are evaluated based on best professional judgment and an evaluation of known and collected data.

Location 1

Location 1 is at the north end of the White Ditch study area. It is a populated residential area interspersed with orchards, pastures, and bottomland hardwoods. The west border is the Mississippi River and MR&T levee and the east border is the Plaquemines Parish non-Federal back levee. The distance between the MR&T levee and the back levee ranges from approximately 1,900 to 2,700 feet.

The Value Engineering Study team suggested this as a potential location for a diversion structure. This area was identified because it is located on a point bar of the Mississippi River giving it greater potential to deliver sediment into the study area. This location would provide the greatest benefit to the extreme northern end of the study area.

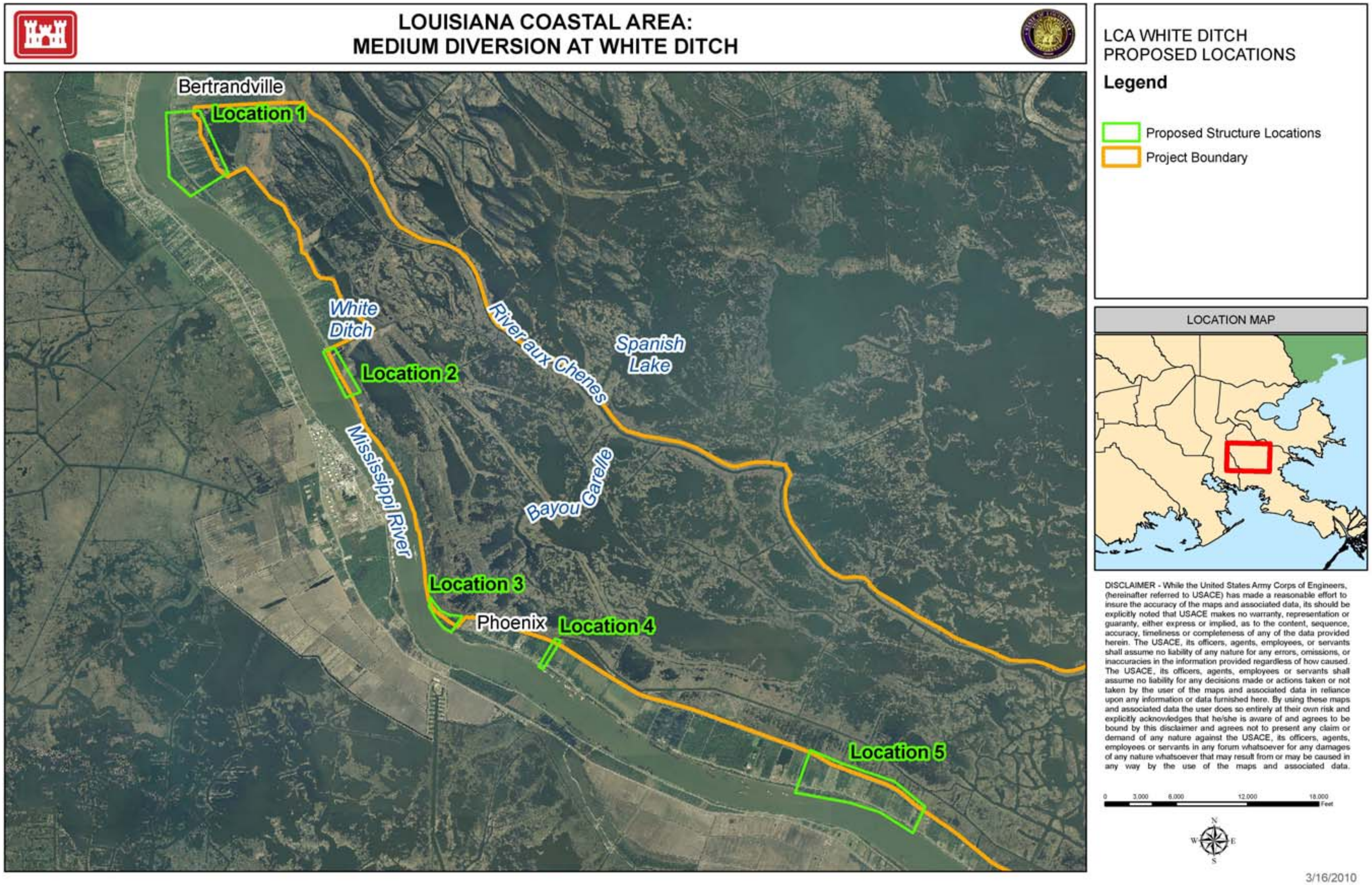

Figure 3.5: Potential Diversion Structure Locations

Benefits of this location include:

- It would deliver benefits to the northern section of the study area.

Drawbacks of this location include:

- The presence of a back levee introduces additional construction challenges and costs. Flood protection measures such as coffer dams would have to be maintained on two levees instead of one during construction. Water would have to be transported approximately 2,000 feet in pipes or culverts to reach the marsh.
- It would be difficult to convey sediment, freshwater, and nutrients to the southeast portion study area. Therefore, it would be difficult to satisfy the goals and objectives throughout the entire study area. An alternative at this location would likely not be independently viable.
- The vast majority of water and sediments introduced at this location would travel into the Forty Arpent Canal and away from the study area. It would be difficult to prevent this because the canal is not a natural feature and does not have a spoil terrace to restrict overland flow. It is likely that potential benefits would never be maximized due to the difficulty in maintaining water in the system.
- Due to the proximity of River aux Chenes, less flow would be required to exceed the riverbank compared to a diversion that was located further away. If less flow is allowed into the study area, less sediment and nutrients would be put into the system.
- Location 1 contains private development between the MR&T levee and the back levee. Construction at this location would require removal of homes and relocations would likely be necessary. There is one potential area in location 1 that would not impact homes, but would require clearing of approximately 30 acres of bottomland forest.

Location 2

Location 2 is at the existing siphons at White Ditch. There are no residences in the potential construction footprint. There are several small recreational buildings and an electrical substation nearby. Additionally, several oil/gas pipelines run through the diversion study area. The length of this location runs from the existing White Ditch down the MR&T levee for 9,000 feet. It is considered a good location for sediment.

Benefits of this location include:

- The most important characteristic of this site is the lack of a back levee. The absence of a back levee simplifies construction efforts and minimizes construction costs.
- There are existing internal infrastructure features, such as channels and levees, which could be modified to convey diverted water within the marsh.
- The location is centrally located within the overall study area. It could independently provide environmental benefits and meet project objectives throughout the study area. An alternative at this location would be independently viable.

- There are minimal residences to impact and potentially no relocations would be necessary. Real estate issues would be substantially less complicated compared to other areas because there are very few land owners to acquire ROEs from.

Drawbacks of this location include:

- There could be a need to elevate an existing electrical substation within this location.
- There are a few residences in the vicinity of the location that might need to be elevated

Location 3

Location 3 is just north of Phoenix, Louisiana. There are no known structures within the footprint of this area. It runs from the junction of the MR&T levee and the Federal back levee to a point approximately 9,200 feet north on the MR&T levee. The White Ditch Value Engineering team identified this area as a good location to intake sediment because it is on a point bar. Point bars are locations where sediments drop out of the water column and settle. It is centrally located within the study area and could yield benefits to the north and south.

Benefits of this location include:

- The most important characteristic of this site is the lack of a back levee. The absence of a back levee would greatly simplify construction and would minimize construction costs.
- There are existing internal features, such as channels, ridges, and historic distributaries, which could be used to convey diverted water within the marsh.
- The location is centrally located within the overall study area. It could provide environmental benefits and meet project objectives throughout most of the study area, rather than just in a specific section.
- There are no residences to directly impact and no relocations would be necessary. Real estate issues would be substantially less complicated compared to other areas because there are very few land owners to acquire ROEs from.

Drawbacks of this location include:

- There is not an existing channel to directly convey diverted flows.
- There are a few residences in the vicinity of the location that would likely need to be elevated.
- Marsh would have to be excavated to create the outfall channel.

Location 4

Location 4 is in the central portion of the White Ditch study area. It is near commercial and residential areas. The distance between the MR&T levee and the Federal back levee is approximately 2,200 feet. The White Ditch Engineering team identified this area as a good location to intake sediment because it is near a channel crossing in the river. It is centrally located within the study area and could yield benefits to the north and south.

Benefits of this location include:

- The location is centrally located within the overall study area. It could provide environmental benefits and meet project objectives throughout most of the study area, rather than just in a specific section.
- The location is centrally located within the overall study area. It could provide environmental benefits and meet project objectives throughout most of the study area, rather than just in a specific section.
- There are existing internal infrastructure features, such as channels and levees, which could be used to convey diverted water within the marsh.

Drawbacks of this location include:

- The presence of a back levee introduces additional construction challenges and costs. Flood protection measures such as coffer dams would have to be maintained on two levees instead of one during construction. Water would have to be transported approximately 2,200 feet in pipes or culverts to reach the marsh.
- The existing canal between the levees would need to be widened to convey appropriate flows. Numerous oil and natural gas lines on the bottom of the channel could create difficulties in dredging.
- There is an anchorage area on the Mississippi River side of this location that might have to be relocated.
- Location 4 contains some private development between the MR&T levee and the back levee. Construction at this location might require removal of homes, depending upon the configuration of the outfall canal.

Location 5

Location 5 is located in the central portion of the White Ditch study area between Phoenix and Pointe à la Hache, Louisiana. It is a populated residential and business area with multiple land owners. The distance between the MR&T levee and the Federal back levee ranges from approximately 1,800 to 2,900 feet. This area was recommended for consideration in the Value Engineering Study. It was identified as a good location to intake sediment and deliver environmental benefits to the southern end of the study area.

Benefits of this location include:

- There are existing internal infrastructure features, such as channels and levees, which could be used to convey diverted water.
- There are existing internal infrastructure features, such as channels and levees, which could be used to convey diverted water.

Drawbacks of this location include:

- The presence of a back levee introduces additional construction challenges and costs. Flood protection measures such as coffer dams would have to be maintained on two levees instead of one during construction. Water would have to be transported up to 2,900 feet in pipes or culverts to reach the marsh.

- The location contains a substantial amount of private development. Construction at this location could require removal of homes and relocations might be necessary.
- It would be difficult to convey sediment, freshwater, and nutrients to the northwest portion study area. Therefore, it would be difficult to meet objectives for entire study area. An alternative at this location would likely not be independently viable.

Discussion and Conclusions

A screening process was used to determine which of the locations were most suitable for further evaluation in combination with increments of diversion size. Criteria evaluated include:

- Back Levee Cost: Several locations would need to cross residential areas with back levees. The cost of crossing two levees would be high.
- Lack of Beneficial Sediment: Certain locations have high sediment load along the Mississippi River and would be better suited for capturing river sediments.
- Hydrology and Hydraulics: The flow of water to the Gulf in a north-west to south-east fashion indicates that diversion located towards the lower “downstream” end of the project sites would be less effective at distributing the requisite freshwater, sediment and nutrients. See Appendix H for additional information on Hydrology and Hydraulics.
- Infrastructure Cost: All locations have infrastructure in addition to the levees. Locations that have higher densities of infrastructure relative to one another and therefore higher relocation costs were identified.
- Capacity Limitation: Not all locations are able to accommodate the full range of diversion structure capacities.
- New Outfall Canals: Locations that would require new outfall canal construction as opposed to those locations with existing outfall available were identified.

Table 3.5 aligns the locations with the criteria that limit the sites overall suitability as a location for diversion.

Table 3.5: Diversion Location Screening

Louisiana Coastal Area: Medium Diversion at White Ditch Diversion Location Matrix					
	Back Levee Cost	H&H	Infrastructure Cost	Capacity Limitations	New Outfall Canals
Location					
1	X		X	X	X
2					
3					X
4	X	X	X	X	
5	X	X	X	X	X

There are numerous disadvantages to placing alternatives at Locations 1, 4, or 5. Most of these disadvantages are directly related to the existence of a back levee. From an engineering standpoint, these sites are more complicated for construction and would be more costly to construct. The distance between the MR&T and back levee at these locations averages around 2,000 feet. Long trenches would need to be excavated to a depth of ~20 feet between the two levees. Once excavated, this distance would need to be spanned by concrete box culverts or pipes to carry water from the river to the marsh. Long-term O&M of these features would be difficult. Coffer dams would have to be constructed on the MR&T and the back levee.

By comparison, Locations 2 and 3 do not have a back levee and therefore lack the engineering disadvantages associated with 1, 4, and 5. Water and sediment could move directly from the river into the marsh through a box culvert structure beneath the MR&T levee, which would be approximately 350 feet. Only one coffer dam would have to be constructed. Diversions at Locations 2 or 3 would be much simpler to construct and less costly than at Locations 1, 4, and 5.

Locations 2 and 3 also have the advantage of being centrally located and directly adjacent to much of the most degraded marsh within the project boundary. These locations could independently provide positive influences on most of the study area. Location 4 is also centrally located and could provide benefits to most of the study area. However, locations 1 and 5 are at the fringe of the area of severe degradation. It would be very difficult for either site to independently provide benefits to the entire study area.

Because of the back levee and the protection it provides, Locations 1, 4, and 5 have numerous real estate and relocation concerns. There are several homes, businesses, and farms at each of these locations. Removal and relocations of homes and businesses would be unavoidable. By comparison, Locations 2 and 3 have minimal real estate concerns. There are far fewer landowners and very few homes or business in the footprint of either. The few impacts that potentially exist would be indirect.

In summation, no justifiable reason exists to continue consideration of any area outside of the 4.7-mile stretch between White Ditch and Phoenix where there is no back levee. It is believed that the goals and objectives of the project can be fully and effectively addressed from Location 2 and 3. Locations 1, 4, and 5 have been removed from further consideration.

3.3.3 Description of Alternative Plans

The remaining conceptual alternatives from Section 3.3.1 have been integrated with the remaining suitable locations for diversion structures to yield an array of alternatives that meet the goals and objectives of the project and are likely to restore the impaired deltaic processes. The alternatives are:

1. **White Ditch (WD) 1: No Action.** Over a 50-year period of analysis, if nothing were done, we would see significant losses of all marsh types throughout the study area. More major storms could accelerate this loss. As a result open-water habitats would continue to grow allowing for further intrusion of saltwater into the marsh.

2. **White Ditch (WD) 2: Location 2 – 5,000 cfs.** This alternative involves construction of a structure capable of diverting up to 5,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S), and protection and sustainability (P) will be refined to

improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

3. **White Ditch (WD) 3: Location 2 – 10,000 cfs.** This alternative involves construction of a structure capable of diverting up to 10,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

4. **White Ditch (WD) 4: Location 2 – 15,000 cfs.** This alternative involves construction of a structure capable of diverting up to 15,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

5. **White Ditch (WD) 5: Location 2 – 35,000 cfs.** This alternative involves construction of a structure capable of diverting up to 35,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

6. **White Ditch (WD) 6: Location 3 – 5,000 cfs.** This alternative involves construction of a structure capable of diverting up to 5,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

7. **White Ditch (WD) 7: Location 3 – 10,000 cfs.** This alternative involves construction of a structure capable of diverting up to 10,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

8. **White Ditch (WD) 8: Location 3 – 15,000 cfs.** This alternative involves construction of a structure capable of diverting up to 15,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

9. **White Ditch (WD) 9: Location 3 – 35,000 cfs.** This alternative involves construction of a structure capable of diverting up to 35,000 cfs. Additionally, once the preliminary freshwater and sediment supply benefits of the structure are determined, measures from the hydraulic distribution (H), sediment supply & distribution (S) and protection and sustainability (P) will be refined to improve beneficial distribution of freshwater and sediments to create and restore marsh habitat and improve its sustainability.

3.3.4 Screening / Evaluation of Alternative Plans

3.3.4.1 The ERDC-SAND2 Model

The ERDC-SAND2 model was originally known as the Boustany Model. The Boustany Model was developed for evaluating the marsh creation potential. ERDC modified and refined the Boustany model to specifically measure the marsh creation potential of diversion structures. The modified version became known as the SAND model. The SAND was refined further and became the SAND2. The ERDC-SAND2 model was the tool used by the MDWD team to predict changes in marsh acreages for all alternatives over a 50 year planning horizon. It is an ecohydraulic engineering model specifically designed to assess the effectiveness of potential diversion projects on restoration of land in the coastal marsh. The ERDC-SAND2 model is fundamentally based on three processes impacting marsh accretion:

1) Historical land loss rates are applied to account for marsh loss due to all negatively impacting system processes (e.g. sea level rise, compaction, subsidence, etc.) along with background processes existing prior to the diversion operation (e.g. marsh nutrient cycling, net tidal and groundwater inputs, etc.).

2) Inorganic benefits of flow diversion from the addition of sediment.

3) Organic benefits of flow diversion due to plant growth, mortality, and burial stimulated by addition of the limiting nutrient (nitrogen).

The model applies these processes to assess Future With Project (FWP) and Future Without Project (FWOP) conditions for alternative comparison. Since the FWOP condition is without diversion, FWOP marsh acreage is a function of land loss only. The model processes these categories and projects acres of marsh within a specified project area. With some slight modifications, the model can also project acreages with accelerated sea level rise rates. More extensive information concerning the ERDC-SAND2 model can be found in Appendix L.

The outputs (net and average annual acres) from the ERDC-SAND2 model became a key component of the WVA ecosystem model. A defined operating plan had yet to be evaluated, so three such operating schemes were proposed to begin to characterize the potential range of benefits of various operating regimes for each diversion and the ability of each alternative to achieve the goals and objectives of the project. The Open Diversion reflects the upper threshold in terms of potential impacts. The other two regimes focus on maximizing sediment capture during the highest sediment load in the River based on available information. They are:

- Open Diversion Year Round
- A March 1–May 30 Maximum Pulse with no Maintenance Flow
- A March only pulse with a 1,000 cfs Monthly Maintenance Flow

Finally, the likelihood existed that these large diversion alternatives may have impacts beyond the immediate study area. Therefore the ERDC-SAND2 Model was run on the original study area as well as the entire Breton Sound Basin. The Institute for Water Resources (IWR) Planning Suite was used for the analysis.

Table 3.6 displays the costs and net acres of marsh created at the end of the 50-year period of analysis in order to compare alternatives that can achieve no net loss of marsh acres. The most cost effective alternatives and operating schemes that achieve a no net loss or desired future condition are highlighted in green. The desired future condition would be equivalent to the current marsh acres (2009) of 41,206. The Location 3 – 10,000 cfs alternative achieves this at the end of the period of analysis only for the year round open diversion operating regime. It does this more cost effectively than the same size diversion at Location 2. The Location 3 – 15,000 alternative achieves the desired future condition at the end of the period of analysis for the year round open diversion and the March–May Pulse. It does this more cost effectively than the same size diversion at Location 2. The Location 3 – 35,000 alternative achieves the desired future condition at the end of the period of analysis for all three operating regimes and more cost effectively than the same size diversion at Location 2. The 35,000 cfs diversion also achieves a no net loss of marsh within the expanded Breton Sound Basin if operated at full capacity year round.

It should be noted that the major difference in cost between Location 2 alternatives and Location 3 is the length of conveyance channels needed to move freshwater, nutrients and sediments. While Location 2 has an existing conveyance channel (White Ditch) Hydrologic and Hydraulic modeling indicated that it requires considerably more dredging and placement of material to make it effective at moving diversion flows to the majority of the study area. Location 3, while it does involve dredging of new conveyance channels, they are much shorter and more efficient at distributing diversion flows of freshwater, nutrients and sediments. A complete discussion of this can be found in the Engineering Appendix L.

Table 3.6: LCA: White Ditch Incremental Cost/Cost Effectiveness Step 1a

Alternative	Total First Cost*	Annualized Cost**	**Operating Regimes Gross/Net Acres (Original Study Area) Year 50** Original Study area - Open Diversion	Original Study area - March–May Pulse	Original Study area - March Pulse + 1,000 CFS	**Operating Regimes Gross Acres (Expanded Study Area) Year 50** Expanded Study area Open Diversion	Expanded Study area March–May Pulse
Location 2 - 5,000 CFS Box	$181,800,000	$9,013,128	35,241/ –5,965	32,676/ –8,530	34,484/ –6,722	69,251	64,481
Location 2 - 10,000 CFS Box	$230,000,000	$11,402,748	43,448/ 2,242	38,071/ –3,135	36,318/ –4,888	80,924	70,298
Location 2 - 15,000 CFS Box	$398,600,000	$19,761,458	51,445/ 10,239	43,327/ 2,121	38,111/ –3,095	92,668	76,099
Location 2 - 35,000 CFS Box	$493,400,000	$24,461,373	76,174/ 34,968	59,670/ 18,464	44,364/ 3,155	139,965	98,909
Location 3 - 5,000 CFS Box	$140,600,000	$6,970,549	35,241/ –5,965	32,676/ –8,530	34,484/ –6,722	69,251	64,481
Location 3 - 10,000 CFS Box	$165,000,000	$8,180,232	**43,448/ 2,242**	38,071/ –3,135	36,318/ –4,888	80,924	70,298
Location 3 - 15,000 CFS Box	$229,400,000	$11,373,001	**51,445/ 10,239**	**43,327/ 2,121**	38,111/ –3,095	92,668	76,099
Location 3 - 35,000 CFS Box	$334,800,000	$16,598,435	**76,174/ 34,968**	**59,670/ 18,464**	**44,364/ 3,155**	**139,965**	98,909

*Excludes Real Estate and O&MRRR

**FY 2010 Discount Rate 4 3/8%

Table 3.7: LCA: White Ditch Incremental Cost/Cost Effectiveness Step 1b

	Incremental Cost/Cost Effectiveness Analysis Open Operation				**Incremental Cost/Cost Effectiveness Analysis March–May Pulse**			
Alternative	Open Diversion (Average Annual Acres)	Incremental Cost	Incremental Acres	Incremental Cost per Acre	Mar–May Pulse (Average Annual Acres)	Incremental Cost	Incremental Acres	Incremental Cost per Acre
Location 2 - 5,000 CFS Box	5,276				2,715			
Location 2 - 10,000 CFS Box	11,553		Non-Cost Effective Plans		5,853		Non-Cost Effective Plans	
Location 2 - 15,000 CFS Box	17,860				8,984			
Location 2 - 35,000 CFS Box	42,731				21,282			
Location 3 - 5,000 CFS Box	5,276	$6,970,549	5,276	$1,321	2,715	$6,970,549	2,715	$2,567
Location 3 - 10,000 CFS Box	11,553	$1,209,683	6,277	$193	5,853	$1,209,683	3,138	$385
Location 3 - 15,000 CFS Box	17,860	$10,163,318	11,583	$877	8,984	$10,163,318	5,846	$1,739
Location 3 - 35,000 CFS Box	**42,731**	**$6,435,117**	**31,148**	**$207**	**21,282**	**$6,435,117**	**15,436**	**$417**

*Excludes Real Estate and O&MRRR

**Discount Rate 4 3/8%

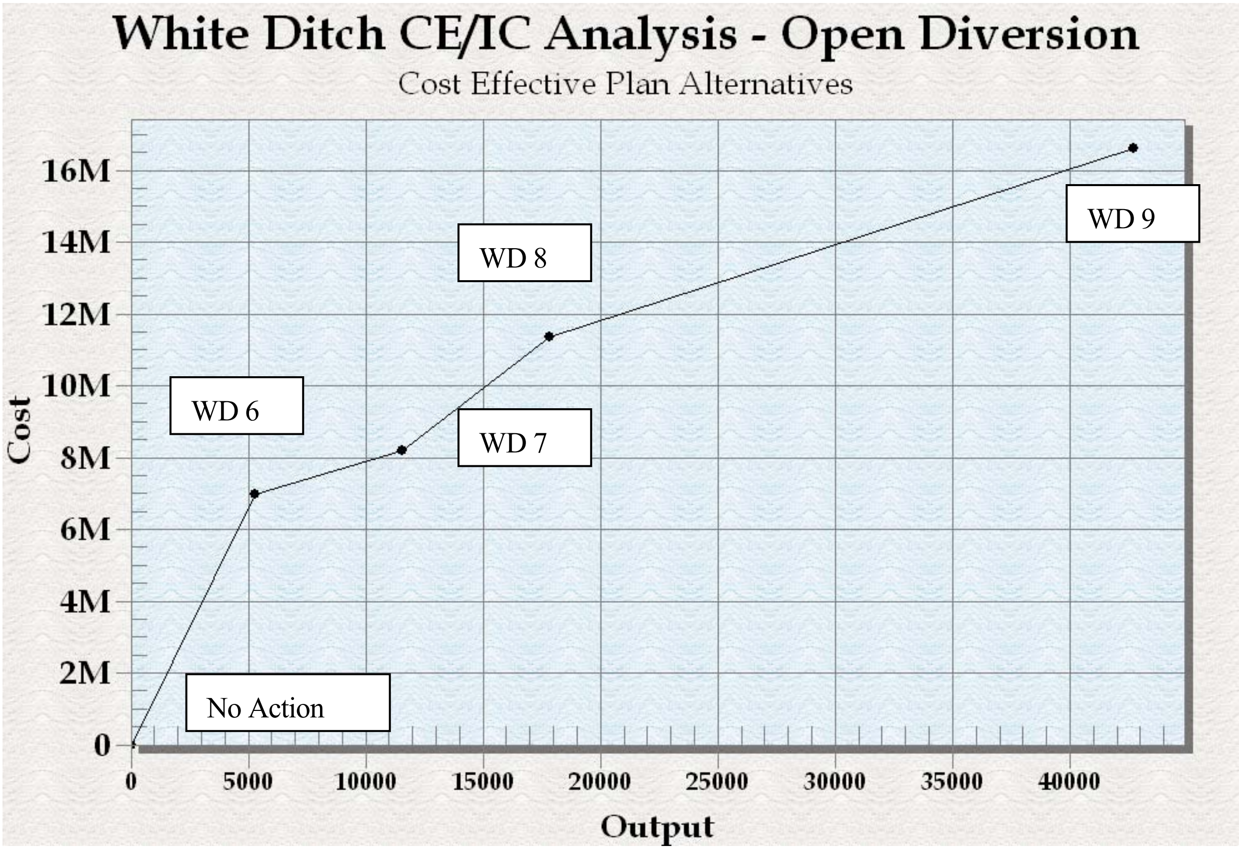

Figure 3.6: White Ditch CE/IC Analysis—Open Diversion

3.3.4.2 CE/IC Analysis

In order to refine the preliminary alternatives further, a two-step Cost Effectiveness & Incremental Cost (CE/IC) Analysis was utilized. The first step used preliminary cost estimates developed for each action alternative and outputs from the ERDC-SAND2 model. Table 3.7 displays the CE/IC analysis of the action alternatives. Average Annual Acres of Marsh is compared against the annualized first cost of the action alternatives. Average Annual Acres of Marsh produced by each size of diversion structure is the same for each location. All of the alternatives at location 2 were not cost effective while the 5, 10 and 15 thousand cfs diversions at location 3 were found to be cost effective. The 35,000 cfs diversion was considered a best buy.

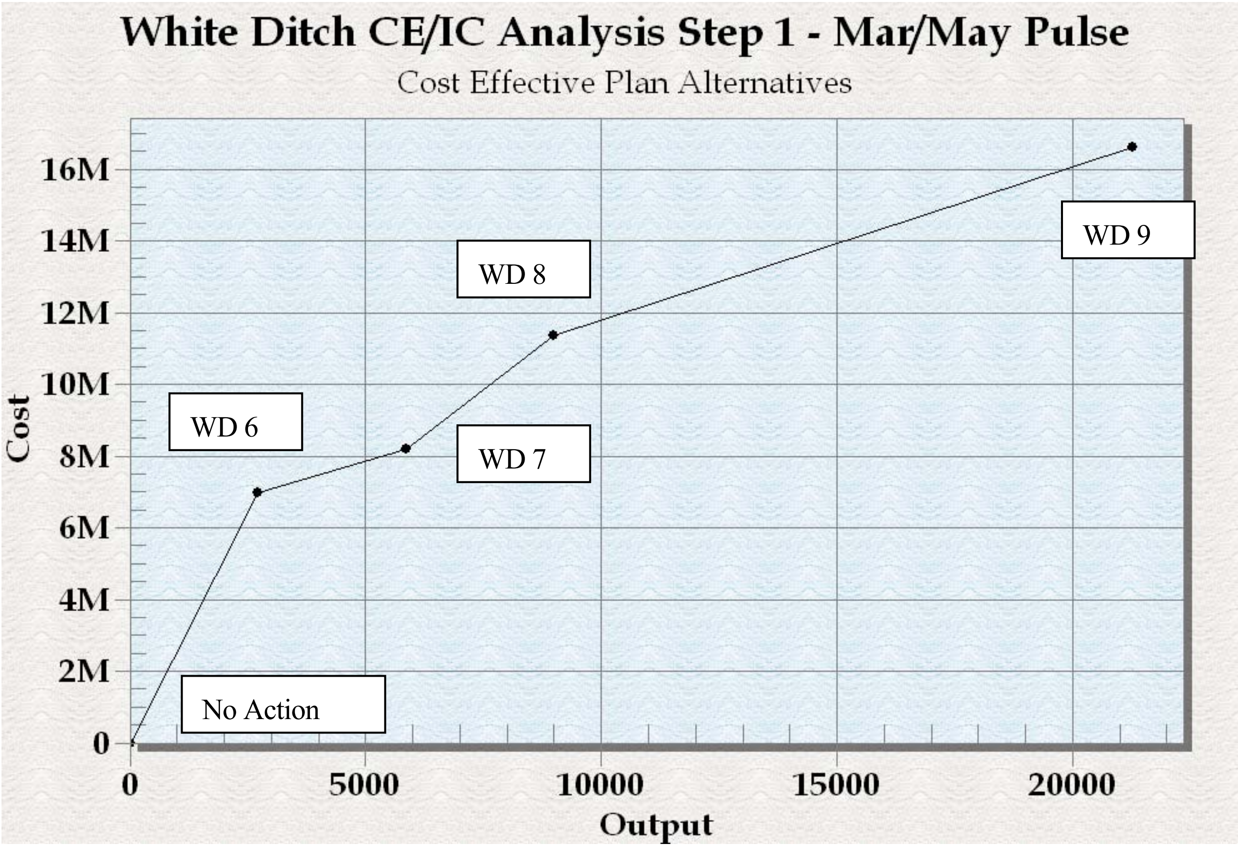

Figure 3.7: White Ditch CE/IC Analysis Step 1—March–May Pulse

3.3.5 Alternative Plans not Carried for Further Analysis

Based on the above analysis, it was determined that the following alternatives would not be further evaluated:

- White Ditch (WD) 2: Location 2 – 5,000 cfs
- White Ditch (WD) 3: Location 2 – 10,000 cfs
- White Ditch (WD) 4: Location 2 – 15,000 cfs
- White Ditch (WD) 5: Location 2 – 35,000 cfs

3.4 FINAL ARRAY OF ALTERNATIVES

3.4.1 No Action (Future Without Project Conditions)

No Action. The future without project condition for White Ditch will continue to see declines in overall wetland acres of all types (Figure 3.8). The current altered deltaic process will result in the lack of freshwater, nutrients and sediments in the project are that are critical to sustain existing marsh and build additional areas. Overall the study area is expected to see an average loss of 274.5 acres of marsh per year. This land loss will, during the 50-year period of analysis, result in a further loss of 13,725 acres of marsh from the 2009 acreage of 41,206.

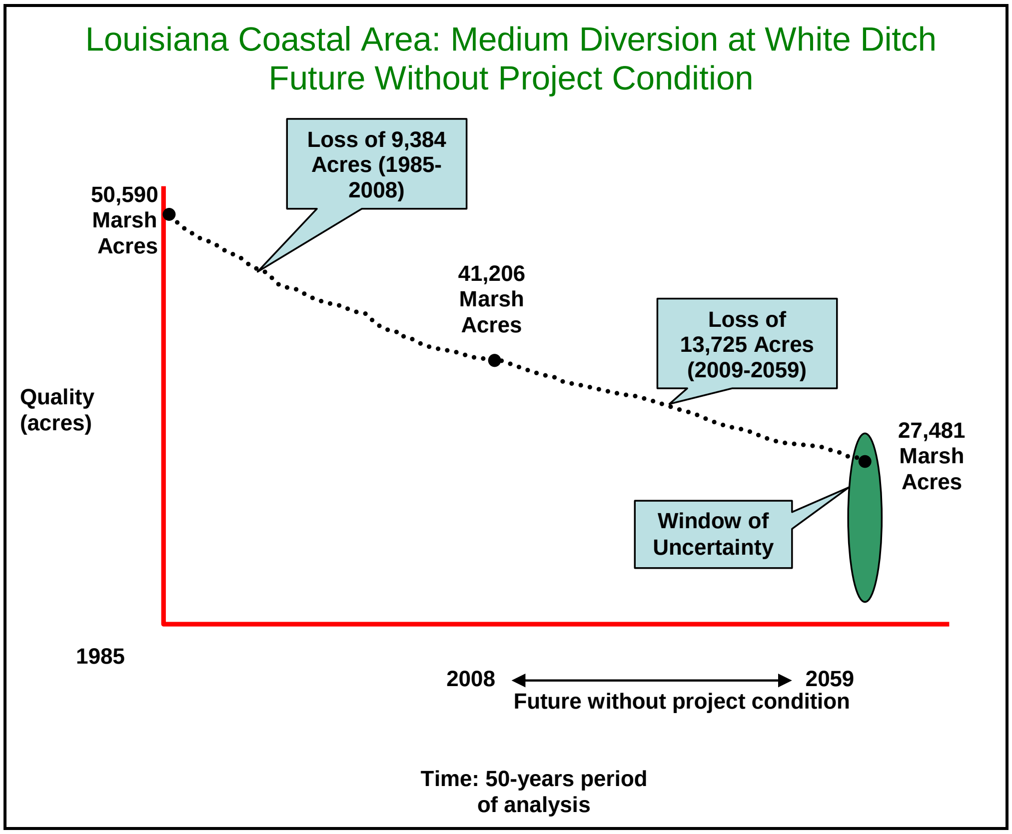

Figure 3.8: LCA: Medium Diversion at White Ditch Future Without Project Condition

Waterbodies would grow larger and wave erosion would accelerate causing further land loss, making remaining marsh lands in the project area and the larger Breton Sound Basin more vulnerable to tropical storms. The Future Without Project Condition will likely see the existing marsh persist with minimal circulation of water, nutrients, and sediment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the marsh ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to inundate plant communities, which would ultimately lead to substantial losses. The study area will likely see additional saltwater intrusion and conversion of the remaining intermediate and brackish marsh to saline marsh types with the associated salt-tolerant or marine fauna.

The remaining marsh acreage of 27,481 does not account for any losses that may be incurred by moderate or high rates of sea level rise. Figure 3.9 below depicts the impacts of both the moderate and high rates of sea level rise on the project area.

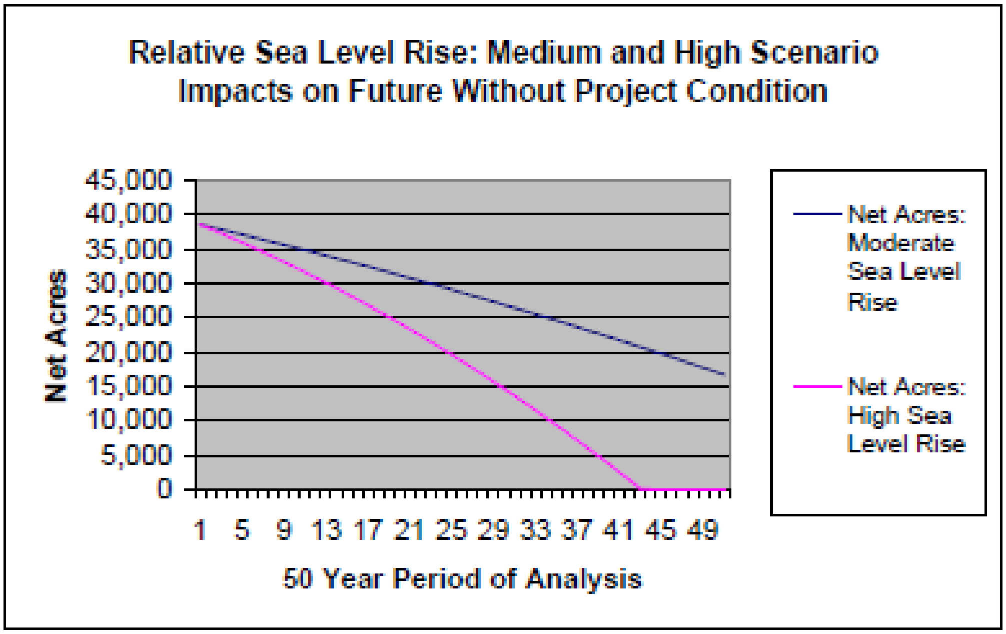

Figure 3.9: Relative Sea Level Rise: Medium and High Scenario Impacts on Future Without Project Condition

Marsh acres are the result of a variety of physical structure and functions within the larger ecosystem. Some of these components include soils and waterbottoms, sediment, subsidence, salinity, riparian vegetation, benthics and fishery resources. Summaries of the future without project condition for these resources are below with more details provided in Section 4.

Soils and Waterbottoms. No direct alteration of soils or substrate would occur under the No Action Alternative and associated water management features. No conversion of prime or unique farmland would occur, and the No Action Alternative would have no direct impact on these resources.

The indirect impacts of the No Action Alternative, would be that the existing patterns of soil erosion and land loss would continue into the future. Organic soils in the project area would not be able to maintain their elevations due to subsidence, decreased plant productivity, wave erosion, and relative sea level rise. 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 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. In the future, if no actions are taken to restore and protect marsh habitat within the project area, any prime and unique farmland that remains outside of the protection of existing Federal and non-Federal back levees would continue to be subject to further degradation and possible loss.

Sedimentation and Erosion. The No Action Alternative (i.e., not implementing a sediment and freshwater diversion in the White Ditch Study Area) would have a direct impact on sedimentation or erosion within the area between the Mississippi River and River aux Chenes through the continuation of existing degradation of marsh. The absence of a supply of freshwater, sediment, and nutrients combined with the ongoing pressures of wind and wave action, storm surges, and human activities has severely eroded marsh soils and reduced the ability of the project area to maintain a balance of emergent wetland and shallow water.

Indirect impacts of the No Action Alternative, not implementing the diversion, are the persistence of existing conditions. Consequences would include further degradation of the existing marsh from saltwater intrusion due to short circuited hydrologic processes present in the basin; as well as the continued lack of sediments, nutrients, and freshwater River aux Chenes and the Mississippi River. With the absences of these features, the marsh would not be able to sustain itself against subsidence and prolonged inundation from sea level rise. The No Action Alternative would cause the existing marsh to persist with minimal circulation of water, nutrients, and sediment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the marsh ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to inundate plant communities, which would ultimately lead to substantial losses.

Subsidence. The Future Without Project Condition will likely see the existing marsh to persist with minimal circulation of water, nutrients, and sediment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the marsh ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to inundate plant communities, which would ultimately lead to substantial losses.

Salinity. Under the No Action Alternative, no direct impacts to salinity levels of the Mississippi River or the White Ditch project area would occur.

Indirect impacts of not implementing restoration features would result in the persistence of existing conditions for the Mississippi River and continued degradation of the White Ditch project area.

Vegetation Resources. Direct impacts under the No Action Alternative, no construction of diversion structure or associated outfall management features would occur, and no BLH would be cleared or filled by construction activities. No opportunities for beneficial use of dredged material for construction features would occur. Existing BLH in the project footprint would continue to degrade and convert to intermediate marsh. No direct impacts to existing wetland vegetation resulting from construction of the proposed diversion and associated features would occur. No opportunities for beneficial reuse of marsh soil and substrate excavated for construction would be realized. No direct impacts to Submerged Aquatic Vegetation (SAV) would occur. Baseline SAV coverage was estimated at approximately 15% of open water areas in the vicinity of the proposed construction footprint (25% in the overall project area). Existing SAV in the project footprint would continue to degrade and die off as increased salinities enter the study area and marsh continues to decrease in acreage.

Without implementation of the proposed diversion, no input of sediment, freshwater and nutrients to the project area would occur. This would result in indirect impacts including the continued erosion of marsh soils and continued fragmentation and conversion of BLH to intermediate and brackish marsh habitats. Both man-made and natural processes would contribute to the continued loss of vegetated habitats, including: continued erosion and subsidence, increased saltwater intrusion, and increased water velocities. Over the next 50 years, the remaining BLH species in the Study Area would experience continued subsidence, sea level rise, and salinity increases. The BLH would eventually diminish and convert to marsh. Over the next 50 years, approximately 13,750 acres of emergent marsh is projected to be lost, and it is likely that all remaining remnants of bottomland hardwood vegetation would disappear over the same period. Over the next 50 years, SAV is projected to be reduced from the estimated baseline of 25% of open water areas to approximately 15% as the area deteriorates.

Benthics. The Future Without Project Condition will likely see marine (saltwater) influences continue to take hold and convert freshwater wetlands into intermediate, brackish, and saline marsh. As freshwater inputs continue to decline and allow marine influences to predominate over riverine influence, salinity levels rise, resulting in the conversion of low-lying vegetated areas to open water and the redistribution of marine sediment. These actions eventually lead to conditions that expedite interior marsh loss and the benthic community and benthic processes would shift from that of an estuarine community to a more open water marine community. Over the long term, without renewed inputs of freshwater, sediment, and nutrients to restore and maintain emergent marsh habitat, the project area is likely to convert from a predominately estuarine habitat to a predominately marine habitat. The benthic community that supports the estuarine system processes would be adversely affected by the reduction and eventual loss of this habitat.

Essential Fish Habitat. The No Action Alternative (no construction of river diversion structure or associated outfall management features) would have no direct impact on Essential Fish Habitat (EFH).

Indirect impacts of not implementing wetland creation/nourishment and shoreline protection features would result in the persistence of existing conditions resulting in the conversion of categories of EFH, such as estuarine marsh and SAV, to marine water column and mud, sand, or shell substrates is expected to continue. Over time, the No Action Alternative would result in the conversion of an estimated 13,724 acres of emergent marsh to open water. Substantial decreases in the quality of EFH in the project area would reduce the area's ability to support federally managed species.

3.4.2 Alternative 1 – 5,000 cfs diversion

Location 3 – 5,000 cfs. This alternative involves construction of a structure capable of diverting up to 5,000 cfs consisting of three 15-ft x 15-ft box culverts. Additionally, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater, nutrient and sediments (Figure 3.10).

The locations of secondary features, such as notched weirs, were determined from best professional judgment. Notched weirs are rock structures designed to increase the retention time of the diverted water within the project area by restricting flow into the River Aux Chenes. Hydraulic modeling clearly demonstrated that River aux Chenes drains the project area and that once water enters it is quickly carried away from the desired benefit area. Major outfalls into River aux Chenes would be restricted in order to retain water in the benefit area and create a greater retention time. A greater retention time would allow for more sediment to fall in the project area versus being lost to River Aux Chenes. Placing notched weirs in outfall canals would create a smaller cross-section and result in smaller outflow capacity from the project area into River Aux Chenes. Notched weirs were chosen because they would not restrict navigational traffic, nor would they restrict the ingress/egress of aquatic organisms. The structures would be constructed of 400-pound rip rap with a geotextile and geogrid bedding. A typical cross-section of a notched weir and plans showing their potential locations can be found in Section L7.5.

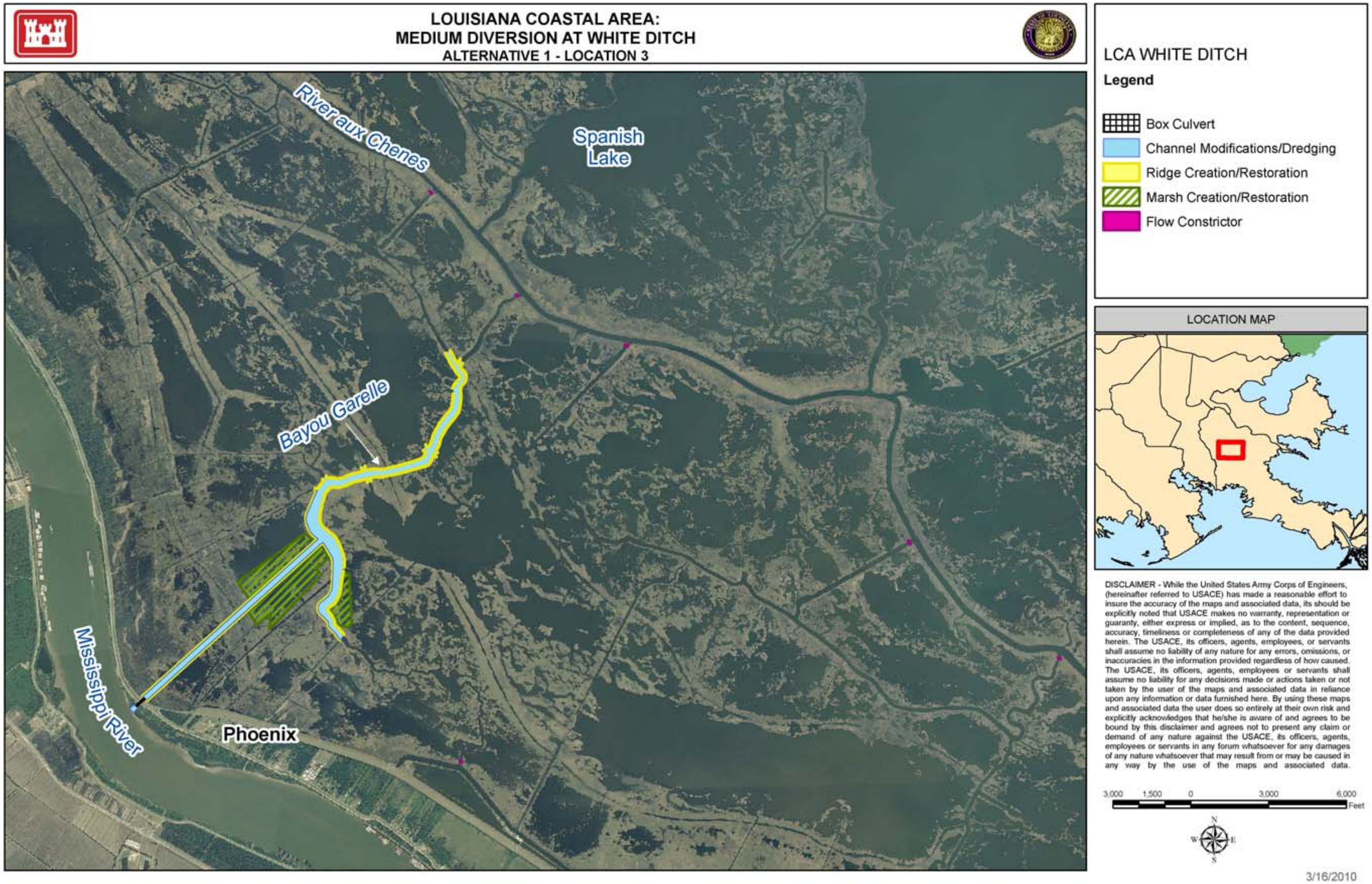

Figure 3.10: Alternative 1 – Location 3

3.4.3 Alternative 2 – 10,000 cfs Max Diversion

Location 3 – 10,000 cfs. This alternative involves construction of a structure capable of diverting up to 10,000 cfs consisting of three 15-ft x 15-ft box culverts. Additionally, 32 acres of ridge and terrace creation, 176 acres of marsh creation utilizing dredged material from an adjacent 167 acres of canal being reconfigured to convey freshwater, nutrient and sediments (Figure 3.11).

The locations of secondary features, such as notched weirs, were determined from best professional judgment. Notched weirs are rock structures designed to increase the retention time of the diverted water within the project area by restricting flow into the River Aux Chenes. Hydraulic modeling clearly demonstrated that River aux Chenes drains the project area and that once water enters it is quickly carried away from the desired benefit area. Major outfalls into River aux Chenes would be restricted in order to retain water in the benefit area and create a greater retention time. A greater retention time would allow for more sediment to fall in the project area versus being lost to River Aux Chenes. Placing notched weirs in outfall canals would create a smaller cross-section and result in smaller outflow capacity from the project area into River Aux Chenes. Notched weirs were chosen because they would not restrict navigational traffic, nor would they restrict the ingress/egress of aquatic organisms. The structures would be constructed of 400-pound rip rap with a geotextile and geogrid bedding. A typical cross-section of a notched weir and plans showing their potential locations can be found in Section L7.5.

3.4.4 Alternative 3 – 15,000 cfs Max Diversion

Location 3 – 15,000 cfs. This alternative involves construction of a structure capable of diverting up to 15,000 cfs consisting of ten 15-ft x 15-ft box culverts. Additionally, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal being reconfigured to convey freshwater, nutrient and sediments (Figure 3.12).

The locations of secondary features, such as notched weirs, were determined from best professional judgment. Notched weirs are rock structures designed to increase the retention time of the diverted water within the project area by restricting flow into the River Aux Chenes. Hydraulic modeling clearly demonstrated that River aux Chenes drains the project area and that once water enters it is quickly carried away from the desired benefit area. Major outfalls into River aux Chenes would be restricted in order to retain water in the benefit area and create a greater retention time. A greater retention time would allow for more sediment to fall in the project area versus being lost to River Aux Chenes. Placing notched weirs in outfall canals would create a smaller cross-section and result in smaller outflow capacity from the project area into River Aux Chenes. Notched weirs were chosen because they would not restrict navigational traffic, nor would they restrict the ingress/egress of aquatic organisms. The structures would be constructed of 400-pound rip rap with a geotextile and geogrid bedding. A typical cross-section of a notched weir and plans showing their potential locations can be found in Section L7.5.

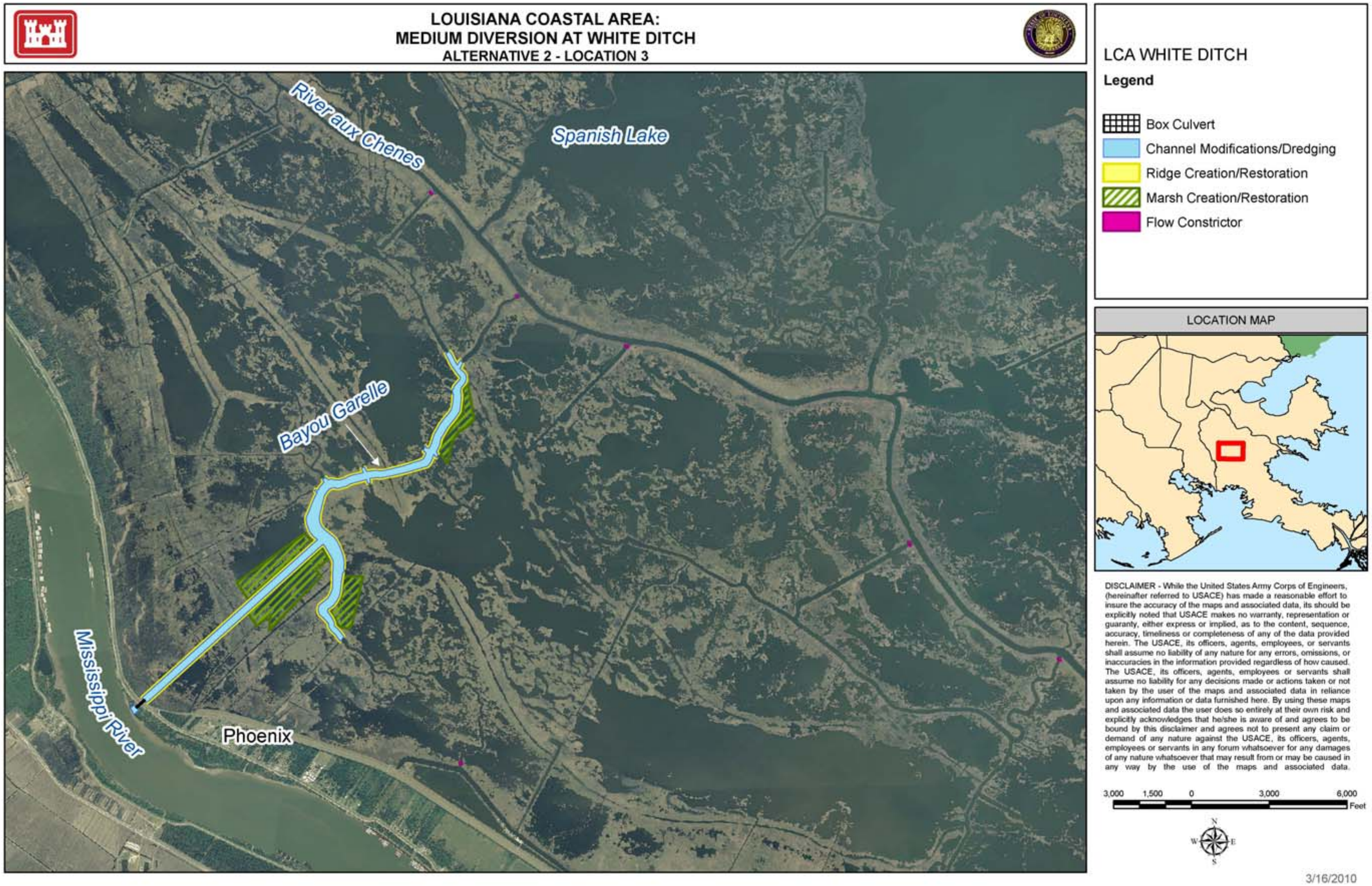

Figure 3.11: Alternative 2 – Location 3

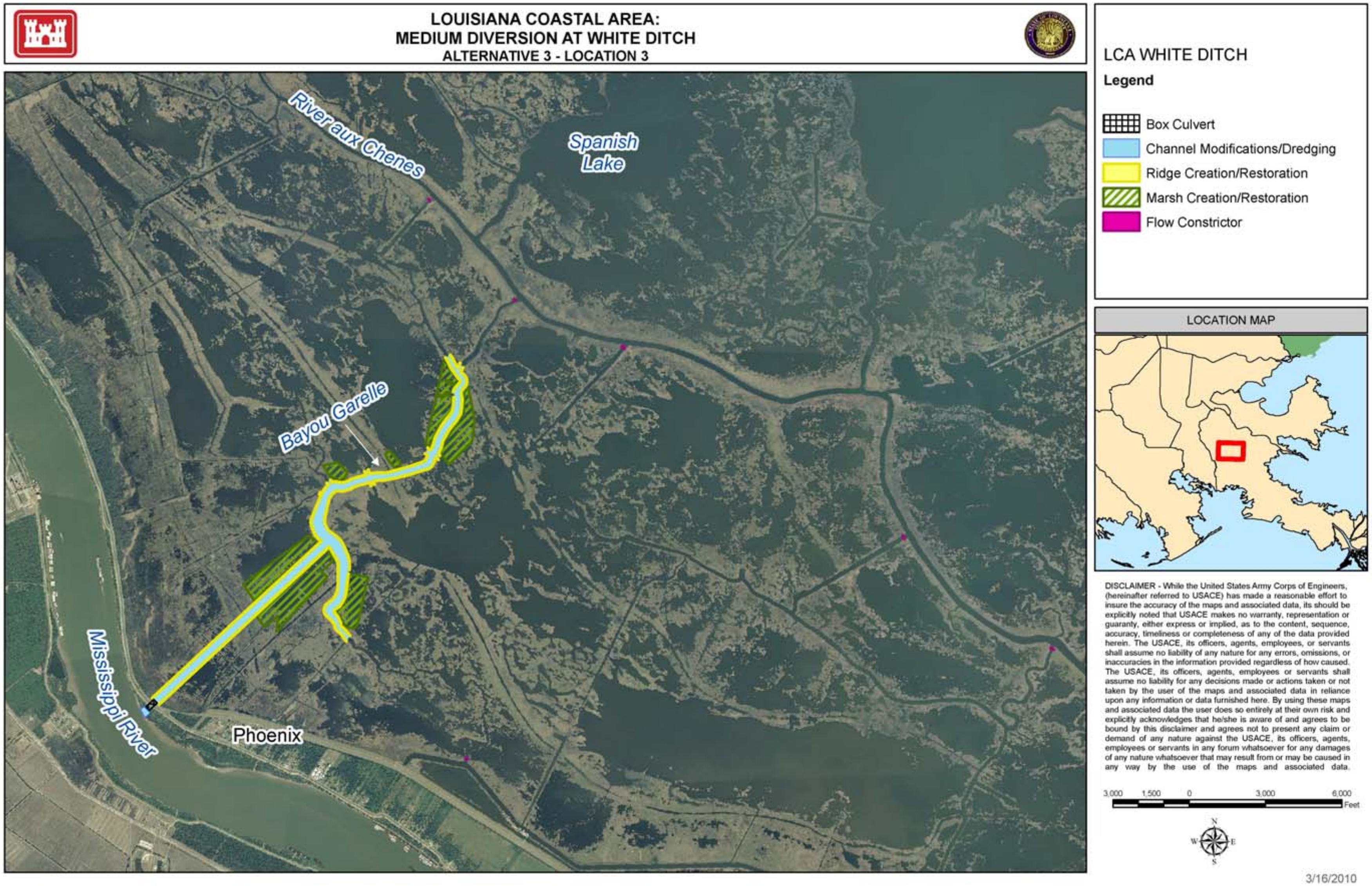

Figure 3.12: Alternative 3 – Location 3

3.4.5 Alternative 4 – 35,000 cfs Max Diversion (Recommended Plan)

Location 3 – 35,000 cfs. This alternative involves construction of a structure capable of diverting up to 35,000 cfs consisting of ten 15-ft x 15-ft box culverts. Additionally, 31 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal being reconfigured to convey freshwater, nutrient and sediments (Figure 3.13).

The locations of secondary features, such as notched weirs, were determined from best professional judgment. Notched weirs are rock structures designed to increase the retention time of the diverted water within the project area by restricting flow into the River Aux Chenes. Hydraulic modeling clearly demonstrated that River aux Chenes drains the project area and that once water enters it is quickly carried away from the desired benefit area. Major outfalls into River aux Chenes would be restricted in order to retain water in the benefit area and create a greater retention time. A greater retention time would allow for more sediment to fall in the project area versus being lost to River Aux Chenes. Placing notched weirs in outfall canals would create a smaller cross-section and result in smaller outflow capacity from the project area into River Aux Chenes. Notched weirs were chosen because they would not restrict navigational traffic, nor would they restrict the ingress/egress of aquatic organisms. The structures would be constructed of 400-pound rip rap with a geotextile and geogrid bedding. A typical cross-section of a notched weir and plans showing their potential locations can be found in Section L7.5.

3.5 COMPARISON OF ALTERNATIVE PLANS

This section describes the alternative plans and the process used to determine the potential costs, habitat benefits, incremental cost/cost effectiveness, and other factors leading to a recommended plan. Once the final array was determined, a second round of ecohydraulic modeling was conducted. These runs analyzed how salinities would encroach back into the Breton Sound with “maintenance” flows coming from the proposed diversion (1,000 cfs) and Caernarvon (800 cfs). For these runs, simulations started following the final results of the initial screening of alternatives using the salinities that were estimated there. These results fed into the WVA analysis. These simulations were for a 3-month period with the following parameters:

- Average summer (June–August) tidal conditions.
- Average summer (June–August) wind forcing conditions for Plaquemines Parish, Louisiana.
- Average summer (June–August) rainfall inputs.
- An average evaporation constant of 5 mm/day.

3.5.1 Incremental Cost/Cost Effectiveness Analysis Process.

Cost effectiveness analysis was used to determine what project features should be built, based on habitat benefits (outputs) that meet the goals and objectives of the project and at the same time are the most cost effective. The Corps has incorporated cost effectiveness analysis into its planning process for all ecosystem restoration planning efforts. A cost effectiveness analysis is conducted to ensure that least cost

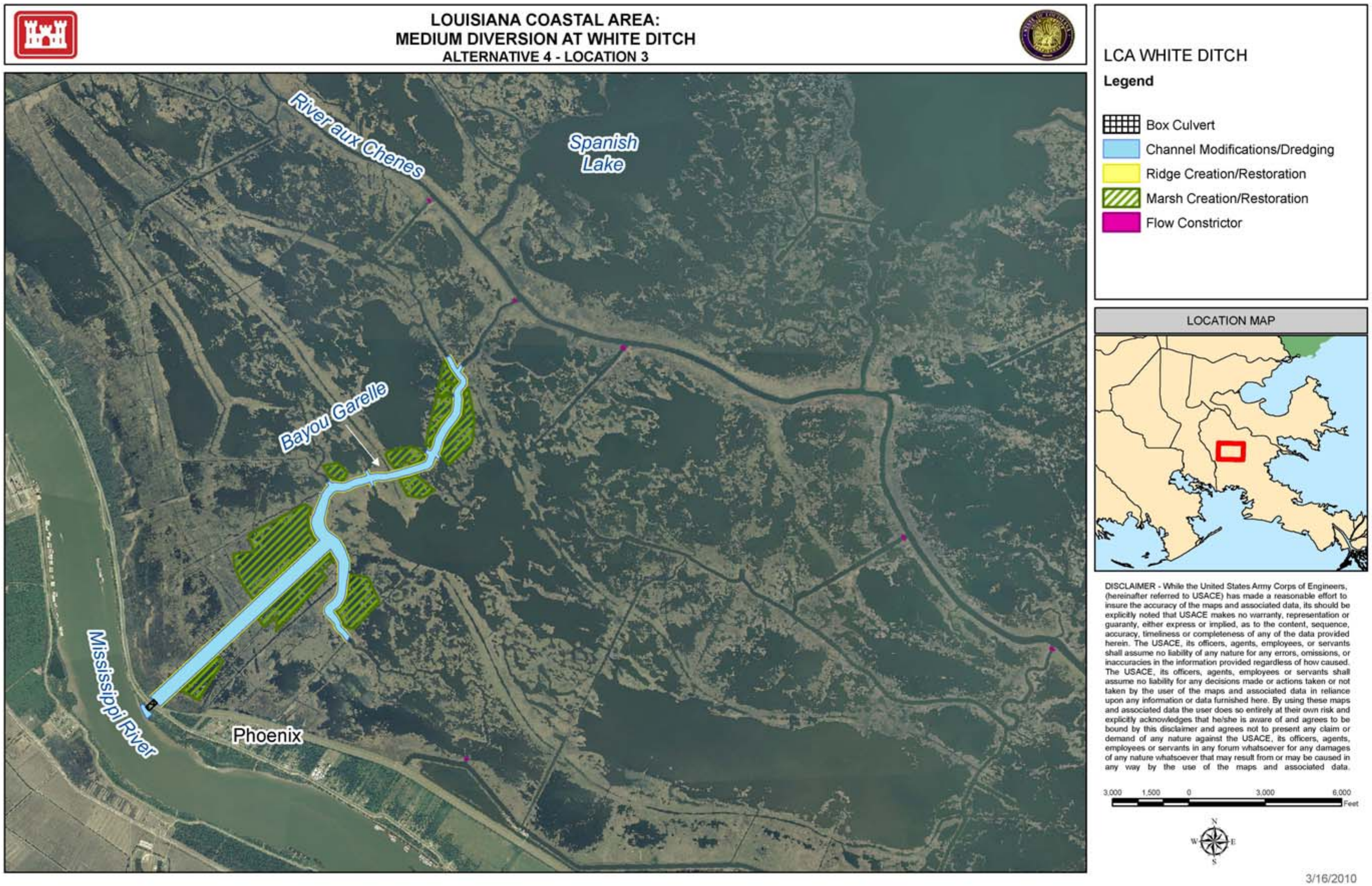

Figure 3.13: Alternative 4 – Location 3

alternatives are identified for various levels of output. After the cost effectiveness of the alternatives has been established, incremental cost analysis is conducted to reveal and evaluate changes in cost for increasing levels of environmental output.

Cost effectiveness and incremental analysis is a three step procedure: (1) calculate the environmental outputs of each alternative; (2) determine a cost estimate for each alternative; (3) combine the alternatives to evaluate the best overall project alternative based on habitat benefits and cost. While cost and environmental outputs are necessary factors, other factors such as the ability to construct, schedule, likelihood to achieve projected results, immeasurable environmental benefits, ancillary benefits etc., are very important in deciding on the preferred alternative.

Environmental outputs were calculated as Average Annual Habitat Units (AAHUs). The annualized costs were calculated by applying a 4-3/8% annual interest rate to the construction costs over the 50-year period of analysis. What is described below is the second step of the process introduced in Section 3.3.4 above.

3.5.2 Wetland Value Assessment (WVA)

The Wetland Value Assessment (WVA) methodology is a quantitative habitat-based assessment methodology developed for use in determining wetland benefits of project proposals submitted for funding under the CWPPRA. The WVA quantifies changes in fish and wildlife habitat quality and quantity that are expected to result from a proposed wetland restoration project. The results of the WVA, measured in Average Annual Habitat Units (AAHUs), can be combined with cost data to provide a measure of the effectiveness of a proposed project in terms of annualized cost per AAHU gained. In addition, the WVA methodology provides an estimate of the number of acres benefited or enhanced by the project and the net acres of habitat protected/restored. See Appendix B for a complete description of the WVA and its application to this project.

The WVA was developed in 1991 by the Environmental Work Group (EnvWG) assembled under the Planning and Evaluation Subcommittee of the CWPPRA Technical Committee; the EnvWG includes members from each agency represented on the CWPPRA Task Force and members of the Academic Assistance Subcommittee. The WVA was designed to be applied, to the greatest extent possible, using only existing or readily obtainable data. The WVA models have been revised several times since they were developed in 1991. WVA has been used to evaluate 50–60 projects CWPPRA coastal restoration projects over the last 2 years. WVA has also been used to evaluate proposed impacts for approximately 200 permit applications and 30–40 mitigation areas. For these reasons, and because it was developed specifically for use in Louisiana coastal environments, this methodology was selected for use in evaluating MDWD and other LCA projects.

The WVA is a modification of the Habitat Evaluation Procedures (HEP) developed by the USFWS (USFWS 1980). 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. A notable difference exists between the two methodologies, however, in that HEP generally uses a species-oriented approach, whereas the WVA utilizes a community approach.

The WVA has been developed for application to several habitat types along the Louisiana coast and community models have been developed for fresh marsh, intermediate marsh, brackish marsh, saline marsh, fresh swamp, barrier islands, and barrier headlands. Two other habitat assessment models for bottomland hardwoods and coastal chenier/ridge habitat were developed outside of the CWPPRA arena and are periodically used by the EnvWG. A WVA Procedural Manual was prepared by the EnvWG to provide guidance to project planners in the use of the various community models.

Habitat types impacted by construction of the MDWD outfall management features (channel enlargement, marsh creation, and ridge creation) are intermediate marsh and open water in the intermediate salinity zone. Habitat types impacted by operation of the MDWD are intermediate, brackish, and saline marsh, and open water in the intermediate, brackish, and saline zones. Project implementation will create two habitat types found historically but not currently present in the impacted area: fresh marsh and ridge. Consequently, the WVA assessment for MDWD utilized community models for fresh/intermediate marsh, brackish marsh, saline marsh, and coastal chenier/ridge habitat.

WVA Model Certification

The WVA model is completing model certification in accordance with EC 1105-2-407, May 2005 Planning Models Improvement Program:

Model Certification. The model has undergone external review which is documented in the July 8, 2009, Draft Model Certification Review Report for the Wetland Value Assessment Models prepared by the Battelle Memorial Institute for the U.S. Army Corps of Engineers, Ecosystem Planning Center of Expertise. The WVA revision documentation and spreadsheets have been submitted to the ECO-PCX. The ECO-PCX has reviewed the revisions and will forward a recommendation to certify the model for use in the LCA projects.

Since the WVA was still in the process of being certified, the projects using the WVA model were required to respond to specific comments related to the ongoing certification process and the use of WVA on the specific project. The specific comments and responses for the WVA as it relates to the LCA-MDWD Modification project can be found in Appendix K. Based on satisfactory responses to these comments, Planning Center of Expertise for Ecosystem Restoration has cleared the WVA model for use in evaluating the alternatives considered in this report.

WVA Concept

The WVA operates under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland habitat type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated or expressed through the use of community models developed specifically for each habitat type. Each model consists of 1) a list of variables that are considered important in characterizing fish and wildlife habitat, 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Index) and different variable values, and 3) a mathematical formula that combines the Suitability Index for each variable into a single value for habitat quality; that single value is referred to as the Habitat Suitability Index, or HSI. The output of each model (the HSI) is assumed to have a linear relationship with the suitability of a coastal wetland system in providing fish and wildlife habitat.

The WVA models have been developed for determining the suitability of Louisiana coastal wetlands in providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. The models have been designed to function at a community level and therefore attempt to define an optimum combination of habitat conditions for common fish and wildlife species utilizing a given habitat type. Earlier attempts to capture other wetland functions and values such as storm-surge protection, flood water storage, water quality functions, and nutrient import/export were abandoned due to the difficulty in defining unified model relationships and meaningful model outputs for such a variety of wetland benefits. However, the ability of a Louisiana coastal wetland to provide those functions and values may be generally assumed to be positively correlated with fish and wildlife habitat quality as predicted through the WVA.

Community Model Variable Selection

Habitat variables considered appropriate for describing habitat quality in each wetland type were selected according to the following criteria:

- The condition described by the variable had to be important in characterizing fish and wildlife habitat quality in the wetland type under consideration;
- Values had to be easily estimated and predicted based on existing or readily obtainable data (e.g., aerial photography, habitat classification data, water quality monitoring stations, interviews with knowledgeable individuals, etc.); and
- The variable had to be sensitive to the types of changes expected to be brought about by typical wetland restoration projects proposed under the CWPPRA.

The marsh community models used in the WVA assessment for the MDWD (fresh/intermediate, brackish, and saline) all utilize the same habitat variables. These are: 1) percent of wetland (marsh) covered by emergent vegetation; 2) percent of open water covered by submerged and floating-leaved aquatic vegetation; 3) Marsh edge and interspersion with open water; 4) percent of open water less than or equal to 1.5 feet deep in relation to marsh surface; 5) salinity; and 6) aquatic organism access. Baseline values assigned to these variables are listed and explained in the WVA Assessment appendix (pages 17–74) included with the USFWS Coordination Act Report attached to this document as Appendix B.

Suitability Index Graphs

A suitability index graph is a graphical representation of how fish and wildlife habitat quality or "suitability" of a given habitat type is predicted to change as values of the given variable change, and allows the model user to numerically describe, through a Suitability Index, the habitat quality of a wetland area for any variable value. Each Suitability Index ranges from 0.1 to 1.0, with 1.0 representing the optimal condition for the variable in question. Suitability Index (SI) graphs were constructed for each variable. While the three marsh community models used for the MDWD utilize the same six variables, the suitability graphs for each variable differ according to the marsh community type (fresh/intermediate, brackish, or saline).

Habitat Suitability Index Formula

The final step in model development was to construct a mathematical formula that combines all Suitability Indices into a single Habitat Suitability Index value. Because the Suitability Indices range from 0.1 to 1.0, the HSI also ranges from 0.1 to 1.0, and is a numerical representation of the overall or "composite" habitat quality of the particular wetland area being evaluated. The HSI formula defines the aggregation of Suitability Indices in a manner unique to each wetland type depending on how the formula is constructed.

Within an HSI formula, any Suitability Index can be weighted by various means to increase the power or "importance" of that variable relative to the other variables in determining the HSI. Additionally, two or more variables can be grouped together into subgroups to further isolate variables for weighting.

Benefit Assessment

The net benefits of a proposed project are estimated by predicting future habitat conditions under two scenarios: future without-project and future with-project. Specifically, predictions are made as to how the model variables will change through time under the two scenarios. Through that process, HSIs are established for baseline (pre-project) conditions and for future without- and future with-project scenarios for selected "target years" throughout the expected life of the project. Those HSIs are then multiplied by the study area acreage at each target year to arrive at Habitat Units (HUs). Habitat Units represent a numerical combination of quality (HSI) and quantity (acres) existing at any given point in time. The HUs resulting from the future without- and future with-project scenarios are annualized, averaged over the project life, to determine 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. The starting point for the WVA 50-year period of analysis was assumed to be 2015 based upon the current schedule to complete Plans & Specifications and Construction. This 2015 date differs slightly from the 2009 used in the previous iterations of the planning process. While the starting point of the analysis has changes between steps (2015 compared to 2009) the entire final array of alternatives was evaluated on equal terms and therefore the comparison of alternatives and their respective benefits is valid.

The WVA assessment for the MDWD utilized habitat and land-water data generated by the USGS for the project area, aerial photography, monitoring and hydrodynamic modeling data (for salinity) and also used field survey data collected for WVAs recently conducted for other, smaller CWPPRA projects within and adjacent to the MDWD project area. Separate WVA analyses were conducted for each marsh type and each diversion size alternative, and for each outfall management feature type. Target year 0 (TY0) was assumed to be 2015. The WVA analyses conducted for the future-without-project (FWOP) condition used two target years: 1 (TY1) and 50 (TY50) to assess changes in the project area over the 50-year planning horizon. Analyses of the future-with-project (FWP) condition also used TY1 and TY50, but added a target year 5 (TY5) within the 50-year planning horizon. TY5 was used in the FWP analyses because review of hydrodynamic modeling outputs projecting salinities indicated that a portion of the intermediate marsh area would transition to fresh marsh within a few years following the start of project operation. More-detailed information concerning data sources, variable assumptions, anticipated habitat changes, and performance of the diversion alternatives over time is presented in an appendix to the USFWS Coordination Act Report at Appendix B.

MDWD Summary

Following the multiple operating regimes analyzed as part of Step 1 described previously, an optimal operating regime was established based on the best available supplies of freshwater, nutrients and sediments while avoiding the negative impacts of open diversions on the public, oyster and alligator resources. A March–April Open Pulse with a 1,000 cfs maintenance flow the rest of the year would achieve these ends. The WVA values for the MDWD project are summarized below:

Table 3.8: Direct Footprint Acreage Impacts

	Ridge Creation	Marsh Creation	Channel Enlargement
Alternative 1: Location 3 – 5,000 cfs Diversion	32	139	153
Alternative 2: Location 3 – 10,000 cfs Diversion	32	176	167
Alternative 3: Location 3 – 15,000 cfs Diversion	32	235	182
Alternative 4: Location 3 – 35,000 cfs Diversion	31	385	223

Table 3.9: Benefits Summary*

Outfall Management Features				
Feature	**5,000 cfs**	**10,000 cfs**	**15,000 cfs**	**35,000 cfs**
Marsh Creation	54.59	72.52	92.19	155.20
Channel Enlargement	-15.99	-19.08	-21.89	-31.25
Ridge Footprint	-11.33	-11.33	-11.33	-11.37
Ridge Creation	28.24	28.24	28.24	27.36
Net AAHUs	**55.51**	**70.35**	**87.21**	**139.94**
Diversion Benefits				
Marsh Type	**5,000 cfs**	**10,000 cfs**	**15,000 cfs**	**35,000 cfs**
Fresh/Intermediate	3,505.05	3,862.13	5,650.28	8,802.11
Brackish	1,359.93	1,655.31	1,656.16	3,965.54
Saline	276.26	347.78	347.97	447.42
Net AAHUs	**5,141.24**	**5,865.22**	**7,654.41**	**13,215.07**
Total Net AAHUs	**5,196.75**	**5,935.57**	**7,741.62**	**13,355.01**

* The WVAs were updated during the review process. The updated AAHUs and acres are in Appendix B. There was no significant change in these values.

Table 3.10: Acreage Summary

MDWD Final Array of Alternatives		
	WVA AAHUs March–April Open + 1,000 cfs Maintenance Flow Year 0 = 2015	Gross/Net Acres March–April Open + 1,000 cfs Maintenance Flow Year 0 = 2015 No Net Loss Acres = 39,587
Location 3 – 5,000 cfs	5,197	35,638 / –3,949
Location 3 – 10,000 cfs	5,936	40,419 / 562
Location 3 – 15,000 cfs	7,742	45,046 / 5,459
Location 3 – 35,000 cfs	13,355	59,902 / 20,315

Note: The WVA assessment was updated during the review process. The updated AAHUs and acres affected can be found in Appendix B. There was no significant change in these values as a result of the update.

Cost Estimates for Habitat Improvement Measures

Rough cost estimates were developed to conduct the cost effectiveness and incremental cost analysis of the various alternative plans. Items included in the first cost construction estimated are mobilization, dredging, placement, demobilization, contingency, Engineering and Design during Construction (EDC), Supervision & Administration (S&A), Real Estate and Operations and Maintenance. Table 3.11 summarizes the costs associated with each alternative plan. Following selection of the Recommended Plan, the design will be refined and a feasibility level cost estimate prepared. Therefore, the cost of the Recommended Plan may differ from the numbers used during IC/CE analysis. Further details can be found in the Engineering and Cost Appendices (Appendix L).

Table 3.11: LCA: White Ditch Cost Estimates

Alternative	Total First Cost*	Annualized O&MRRR	Annualized First Cost**	**Total Annualized Cost**
Location 3 – 5,000 CFS Box	$152,900,000	$781,804	$7,580,348	$8,362,152
Location 3 – 10,000 CFS Box	$174,200,000	$871,463	$8,636,342	$9,507,805
Location 3 – 15,000 CFS Box	$241,700,000	$1,131,044	$11,982,801	$13,113,845
Location 3 – 35,000 CFS Box	$329,300,000	$1,467,836	$16,325,760	$17,793,596

*Includes Real Estate
**FY 2010 Discount Rate 4-3/8%

3.5.3 Results of the Incremental Cost/Cost Effectiveness Analysis

The analyses showed that alternative plans 1, 2, 3, and 4 are cost effective. Aside from the No Action Alternative, Alternative 4 exhibited the lowest cost per Unit of all alternatives, $1,332 per AAHU. Alternative 3 exhibited the highest cost per Unit at $1,694 per AAHU.

Table 3.12: White Ditch Incremental Cost/Cost Effectiveness Step 2

Alternative	Total Annualized Cost	WVA AAHU	Average Cost per AAHU
Location 3 – 5,000 CFS Box	$8,362,152	5,197	$1,609
Location 3 – 10,000 CFS Box	$9,507,805	5,936	$1,602
Location 3 – 15,000 CFS Box	$13,113,845	7,742	$1,694
Location 3 – 35,000 CFS Box	$17,793,596	13,355	$1,332

* Includes Real Estate
** Discount Rate 4⅜%

Overall, alternative 4 was considered a best buy plan. However, as the plans are linear in benefits and costs, a CE/IC analysis was conducted on all of the alternatives. These plans provide the greatest increase in benefits for the least increase in cost.

The No Action Alternative (FWOP) is cost effective; however, it provides no improvement in habitat quality resulting in steep declines in marsh. Alternative plan 1 provides 5,197 AAHUs over and above the No Action Alternative (FWOP) at an annualized incremental cost of $8,362,152 (tables 3.12 and 3.13). Alternative plan 2 provides 739 additional AAHUs, at an annualized incremental cost of $1,145,653. Alternative plan 3 provides 1,806 additional AAHUs, at an annualized incremental cost of $3,606,040. Alternative Plan 4 provides 5,613 additional AAHUs at an annualized incremental cost of $4,679,752. Alternative 4 has the lowest incremental cost per AAHU of $834.

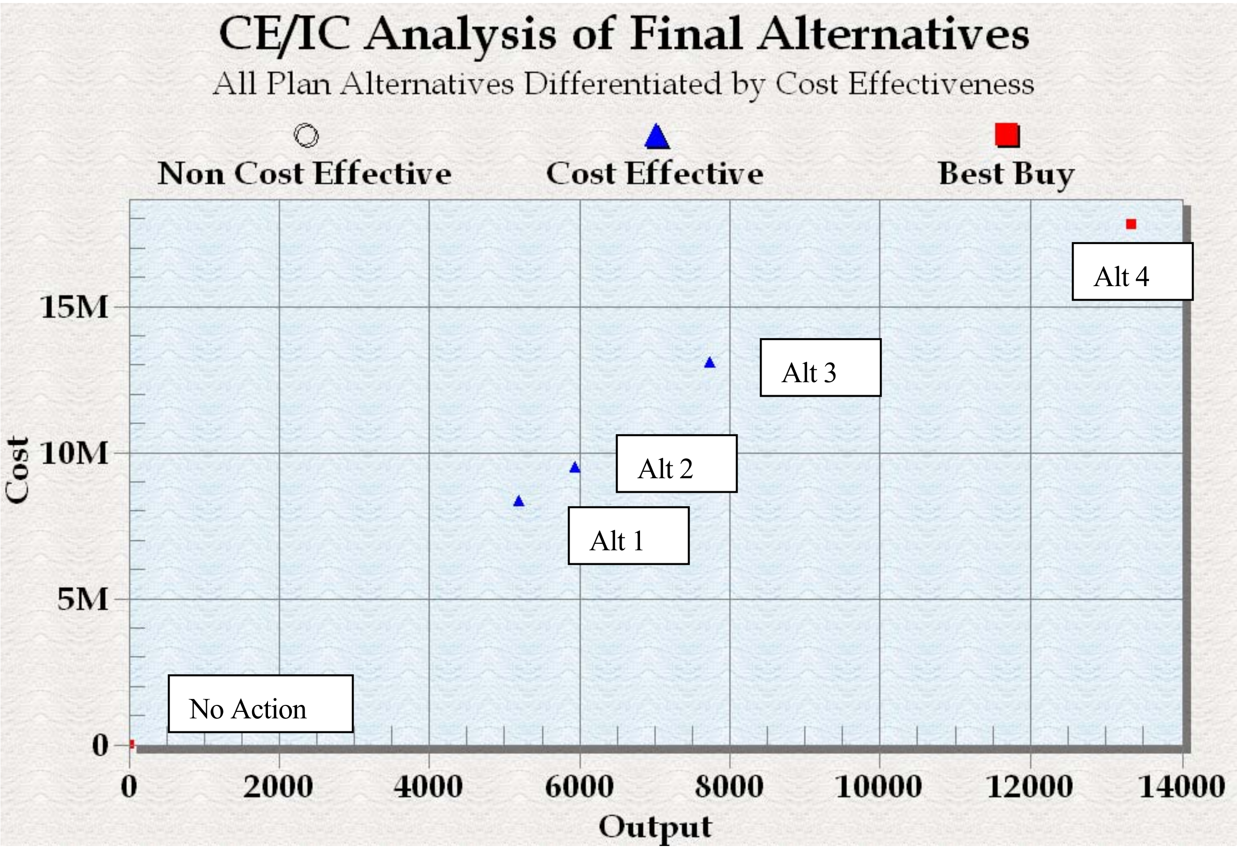

Figure 3.14: CE/IC Analysis of Final Alternatives

Table 3.13: White Ditch Incremental Cost/Cost Effectiveness Step 2

Alternative	Total Annualized Cost	WVA AAHU	Incremental Cost/Cost Effectiveness Analysis of Cost Effective Plans: Incremental Cost	Incremental AAHU	Incremental Cost per AAHU
Location 3 – 5,000 CFS Box	$8,362,152	5,197	$8,362,152	5,197	$1,609
Location 3 – 10,000 CFS Box	$9,507,805	5,936	$1,145,653	739	$1,550
Location 3 – 15,000 CFS Box	$13,113,845	7,742	$3,606,040	1,806	$1,997
Location 3 – 35,000 CFS Box	$17,793,596	13,355	$4,679.752	5,613	$834

* Includes Real Estate
** Discount Rate 4⅜%

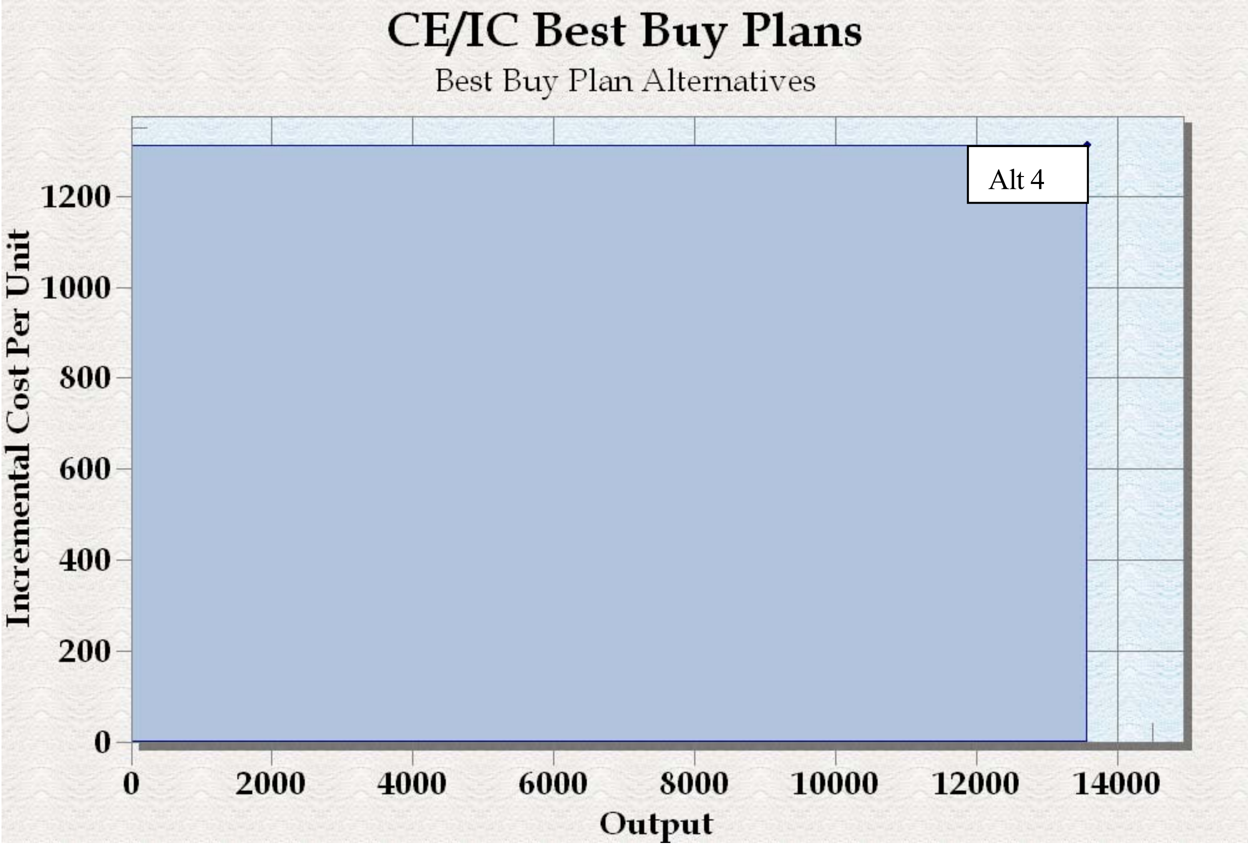

Figure 3.15: CE/IC Best Buy Plans

3.5.4 Other Factors

As part of the process to determine whether additional increments of ecosystem investment are worth the cost, other factors were considered.

3.5.4.1 Recreational Benefits

The primary purpose of the White Ditch Study is to determine a cost effective ecosystem restoration plan, however there are potential ancillary benefits to recreation. Recreation benefits are not being claimed to justify the project but are useful in discerning among the final alternatives. A complete analysis can be found in the Recreation Benefits Analysis Annex to Appendix K.

Given that the study area has 90,109 unit days per year and that each unit day is valued at $8.99, the total annual monetary value of the recreational resource that would be affected by the White Ditch project is $810,256. Given that the likelihood at success with fishing will increase and that environmental factors will improve over time if the proposed project is implemented, the total annual monetary value of the recreational resource will increase in the future compared to the annual monetary value of the recreational resource should the proposed project not be implemented.

To better understand the economic impact of the proposed project on recreation, the analysis considered effects over a 50-year period. The analysis uses the Federal discount rate for 2009 of 4 3/8%. The following table summarizes the potential net present value of recreational resources for each alternative.

Table 3.14: Net Increase in Recreation Benefits

	Without Project	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Net Present Value of Benefits over 50 years	$0	$1,206,000	$1,278,000	$1,421,000	$853,000
Annualized Benefits	$0	$57,284	$60,704	$67,496	$40,517

3.5.4.2 Desired Future Condition

The desired future established early on in the study was to achieve a no net loss of marsh acres at the end of the 50-year period of analysis. While it was desirable to maximize the acres of marsh, it was uncertain if that was possible given the various physical and operational constraints. The outputs of the ERDC-SAND2 model are one of the key components in the WVA. Based on the ERDC-SAND2 results, Alternative 4 provided the most net acres at the end of period of analysis. It is possible that the study area could see a return to historic marsh acreages. Finally, the IC/CE analysis of the final array of alternatives utilized WVA benefits based in part on an operation regime of Open Diversion during March–April with a 1,000 cfs maintenance flow the remainder of the year. As can be seen in the figure below, under a variety of operating regimes, Alternative 4 is the most capable at achieving no net loss.

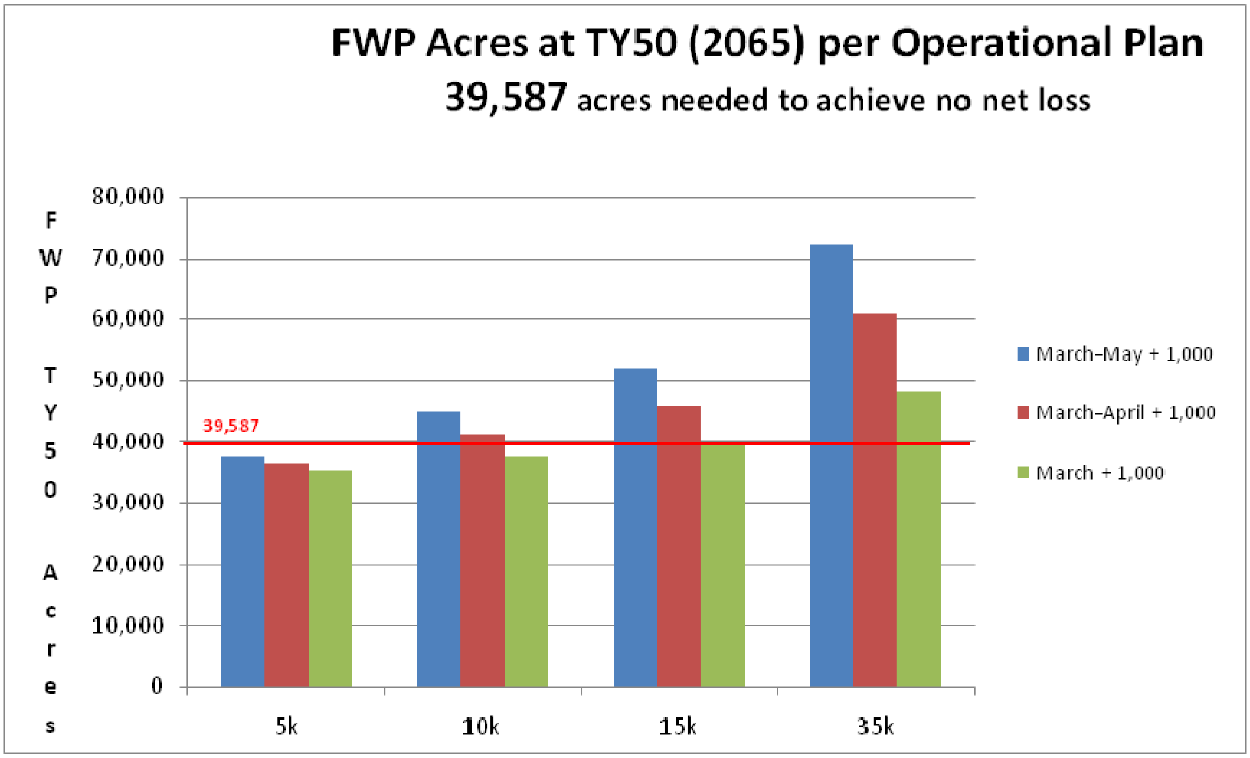

Figure 3.16: FWP Acres at TY50 per Operational Plan

3.5.4.3 Relative Sea Level Rise

An analysis of the high sea level rise scenario was conducted utilizing the ERDC-SAND2 model. The model was used to determine whether a net loss or gain of marsh acreage would occur assuming a high sea level rise scenario. Alternative 4 was the most effective at countering the effects of high sea level rise. Alternative 4 could maintain marsh acreage out to approximately year 20 of the analysis which was then quickly followed by a sharp decline and eventual collapse of the marsh and near total conversion to open water. This result was based on the March–April Pulse plus a 1,000 cfs maintenance flow the rest of the year. Tables 3.15 and 3.16 display these details. It should be noted however, that in the event high sea level rise becomes a reality, Alternative 4 alone has the capability (assuming an open diversion) to divert large enough quantities of freshwater, nutrients and sediments to overcome high sea level rise. Longer term pulses of freshwater may result in large scale habitat switching to predominately freshwater types. Further, long term freshwater pulses can saturate marsh vegetation and soils such that they are less resilient to storm surge from seasonal events resulting in marsh displacement and conversion to open water. There is strong public feeling that the prolonged operation of Caernarvon prior to Katrina contributed to the severe loss of marsh. While not publicly acceptable at present (due to the anticipated negative consequences of over-freshening the basin), if the collapse of the marsh within the study areas was imminent, then having the ability to respond accordingly with a year round open diversion would be critical.

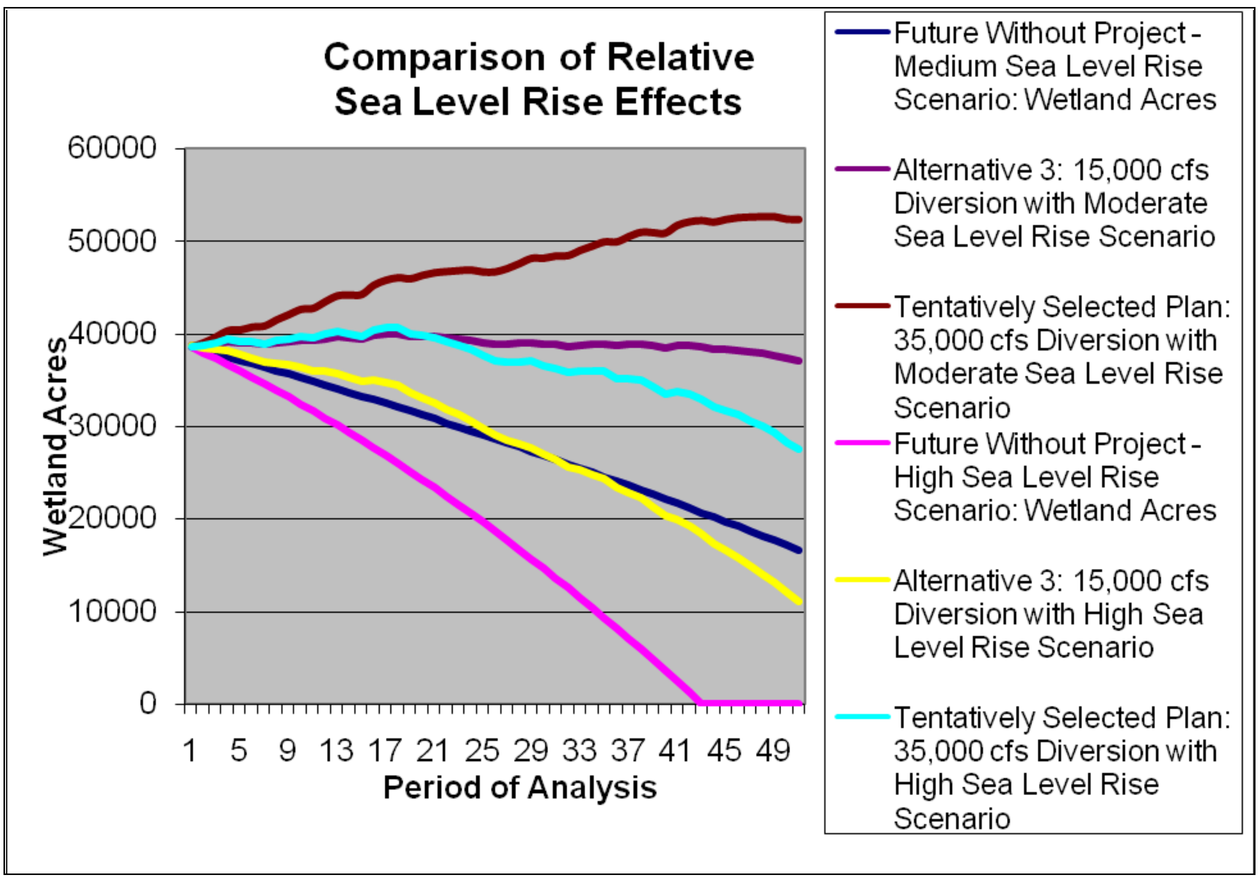

Figure 3.17: The Recommended Plan as Compared to Evaluated Alternatives and Different Rates of Projected Sea-Level Rise

Table 3.15: ERDC-SAND2 Model Calculations of Acreages for the MDWD Project Area Under Historical Sea Level Rise Rates

	Gross Acres of Marsh					
Project Life Years:	0	10	20	30	40	50
No Action Alternative (FWOP)	38,700	36,000	33,300	30,500	27,800	25,000
5,000 cfs Diversion Alternative	38,700	38,300	37,800	37,000	36,600	35,600
10,000 cfs Diversion Alternative	38,700	39,300	39,900	39,900	40,700	40,400
15,000 cfs Diversion Alternative	38,700	40,300	41,900	42,700	44,600	45,000
35,000 cfs Diversion Alternative	38,700	43,800	48,800	52,200	57,300	59,900

Note: the total project area for the Medium Diversion at White Ditch is 98,000 acres.

Table 3.16: ERDC-SAND2 Model Calculations of Acreages for the MDWD Project Area Under the Intermediate and High Sea Level Rise Rates

	Gross Acres of Marsh					
Project Life Years:	0	10	20	30	40	50
No Action Alternative (FWOP)	38,700	34,900	30,900	26,500	21,800	16,900
35,000 cfs Diversion Alternative	38,700	42,800	46,600	48,500	51,800	52,400
No Action Alternative (FWOP)	38,700	31,500	23,700	14,000	2,900	0
35,000 cfs Diversion Alternative	38,700	39,500	39,600	36,300	33,800	27,600

Note: the total project area for the Medium Diversion at White Ditch is 98,000 acres.

3.5.4.4 Breton Sound Benefits

During the initial ERDC-SAND2 evaluation of alternatives in Step 2, it was determined that Alternative 4 has the capability to create marsh in the larger Breton Sound basin (i.e., beyond the MDWD project boundary) through nutrient transfer. The modification of the Caernarvon Diversion is currently being evaluated in an effort to investigate ways to enhance the capture of sediment. It may be possible, with further analysis, to claim benefits to the Caernarvon study area as a result of implementing Alternative 4. This may lead to cost savings for the Caernarvon project.

3.5.4.5 Adaptive Management

Alternative 4 provides the most robust capability for adapting to future risk and uncertainty. As discussed above, Alternative 4 provides the most flexible management of operations to respond to sea level rise. The difference between alternatives 3 and 4 is the outfall canals, ridges and flow notched weirs that are responsible for distributing flows at 15,000 and 35,000 cfs, respectively. Just as sea level rise represents uncertainty at one end of the spectrum, it is also possible that the sea level rise will not be any more pronounced than historic levels. Also, as the science of operating large diversion structures is refined throughout the period of analysis, it is possible to maximize environmental outputs with smaller diversions. Finally, it is expected that as the project is actually operated and benefits are achieved, it will be of value for the Federal, state and local partnership to revisit the goals and objectives associated with the study area. If the project is proving to be very successful at creating marsh it may no longer necessary to maintain a 35,000 cfs diversion capability. To achieve this, O&M could be reduced resulting in outfall canals, ridges and notched weir structures necessary to support a decreased diversion flow.

3.5.4.6 Acceptability, Completeness, Effectiveness, and Efficiency.

Alternative 4 meets the four evaluation criteria of the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. Special consideration is also given to these criteria within the larger context of the LCA Report (2004). The four criteria are acceptability, completeness, effectiveness, and efficiency.

Acceptability. The plan is acceptable to Federal, state, tribal, local entities, and the public. It is compatible with existing laws, regulations, and policies.

Completeness. The plan is complete. Realization of the plan does not depend on implementation of actions outside the plan.

Effectiveness. The plan is effective. It addresses all the project objectives. It improves marsh habitat by restoring deltaic process related to freshwater, nutrient and sediments. It does this by introducing the quantities of freshwater, nutrients and sediments required (objectives) to achieve no net loss of marsh during the period of analysis.

Efficiency. The plan is efficient. It is a cost-effective solution to the stated problems and objectives. No other plan produces the same level of output more cost effectively. The plan is cost effective and provides the greatest increase in benefits for the least increase in costs.

3.5.4.7 Selection of the Recommended Plan

The interagency team selected Alternative Plan 4 as the Tentatively Selected Plan. After approval by the Civil Works Review Board, the Tentatively Selected Plan became known as Recommended Plan. It would result in restoration of deltaic processes within the study area. In cooperation with the USFWS, NOAA, and the State of Louisiana, the Corps has planned and would design a project that serves the needs of the nation. The Recommended Plan best meets the study objectives, is the most flexible, and has the most robust sustainable capability against relative sea level rise over the length of the 50-year planning horizon. Once the Recommended Plan was determined, a year-long hydraulic model scenario was run to analyze the effects of the plan over an annual cycle and these results are available in Appendix L.

3.6 NER PLAN

The NER plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost effectiveness and incremental cost of implementing other restoration options. Alternative 4 Location 3 – 35,000 cfs, based on all considerations is the NER plan as well as the Recommended Plan. This alternative involves construction of a structure capable of diverting up to 35,000 cfs consisting of ten 15-x-15-foot box culverts. Additionally, there would be 31 acres of ridge and terrace creation, and 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal construction. The Recommended Plan has a primary operating regime of up to a maximum 35,000 cfs pulse during March–April with up to a maximum 1,000 cfs maintenance flow throughout the remainder of the 12-month cycle (May–February).

The pulsed operational scheme is as important to the Recommended Plan as the proposed structure itself. This combination of structure operation and size represents an optimization of desirable impacts and a minimization of undesirable impacts. The pulse regime was chosen because it minimizes adverse effects to natural socioeconomic resources and mimics a natural hydrologic regime. The March–April timeframe is specifically meant to target sediment loads that are typically high in the Mississippi River during that time of year. Although the Recommended Plan would be authorized to run up to 35,000 cfs during the March–April timeframe, it does not necessarily mean it always would. If conditions were unfavorable, flow through the structure could be reduced. For example, if the river was falling and sediment concentrations were low, the structure could be closed. Conversely, it could be reopened when water started rising and sediment levels in the river become elevated. Additionally, the 1,000 cfs maintenance flow that is authorized from May–February does not mean that it would continuously operate at 1,000 cfs. It is possible that the structure would be completely shut down during much of the year in order to encourage stabilization of estuarine salinity gradients. This flexibility to actively and adaptively manage the operation within the recommended framework is a critical aspect of the Recommended Plan.

All of the diversion alternatives that were considered during the planning process resulted in freshening of the Breton Sound basin to a comparable degree. The performance obtained by coupling a 35,000 cfs structure with the March–April pulse regime is what makes the Recommended Plan unique among the alternatives considered. It can attain project objectives while minimizing adverse impacts to natural and manmade resources. It is the length of operation that makes the effect of a diversion on salinity regimes either large or small, not the cubic-feet-per-second capacity of the diversion. From this perspective, a large diversion achieves objectives while having negligible long-term effect on salinities and the associated ecosystems. Although somewhat counterintuitive, it is important to note that a larger diversion is in fact smaller when measuring the effect on balance of the estuarine system. For comparison's sake, consider that smaller diversions would require a much longer run time in order to get close to achieving similar sediment input results as the Recommended Plan. Longer runs could potentially disturb desirable estuarine salinity gradients and create conditions unfavorable to vital natural socioeconomic resources while also potentially creating favorable conditions for nuisance invasive plant species. There is also a limit on how big a diversion can be dictated by the conditions of the project area. At the Phoenix location, there is a limit on effectiveness of size because diversions larger than 35,000 cfs would exceed the containment capacity of the River aux Chenes ridges. The Recommended Plan is the optimization point between achieving project objectives and preserving estuarine balance.

The Recommended Plan is capable of achieving no-net-loss of marsh acreages during the period of analysis (2015–2065). Estimated total marsh acreage at the end of the period of analysis is estimated to be 59,000 acres with approximately 32,000 net acres of new marsh created from the primary operating regime. Further, the Recommended Plan is robust enough to achieve benefits through the period of analysis taking into account both the intermediate and high rates of relative sea level rise. The Recommended Plan is capable of achieving no-net-loss of marsh acres accounting for the intermediate relative sea level rise rate. In summary, the Recommended Plan has the potential to reverse the decline of marsh habitats occurring now and in the future within the project area and provides sustainability in the face of uncertainty surrounding relative sea level rise.

The Recommended Plan will restore degraded marsh habitat and impaired deltaic processes between the Mississippi River and River aux Chenes. This will be accomplished by reconnecting the study area to the supplies of freshwater, nutrients and sediment that have been isolated within the Mississippi River by the

MR&T levee. These benefits are represented by the 13,355 AAHUs expected from the Recommended Plan at an estimated fully funded cost of $387,620,000 (Appendix L).

3.7 PLAN SELECTION – RECOMMENDED PLAN

3.7.1 Budget and Reauthorization

Section 902 of the WRDA of 1986 legislates a maximum total project cost. Projects to which this limitation applies and for which increases in costs exceed the limitations established by Section 902 require further authorization by Congress raising the maximum cost established for the project. No funds may be obligated or expended nor any credit afforded that would result in the maximum cost being exceeded, unless the House and Senate committees on Appropriations have been notified that Section 106 of the Energy and Water Development Appropriations Act of 1997 will be utilized. The maximum project cost allowed by Section 902 includes the authorized cost (adjusted for inflation), the current cost of any studies, modifications, and actions authorized by the WRDA of 1986 or any later law, and 20 percent of the authorized cost (without adjustment for inflation).

The authorized cost for the MDWD project in WRDA 2007 is $86,100,000. After Section 902 guidance is applied, the adjusted budget (including inflation and adaptive management costs) of the project is $126,686,400, projected to April 2014 dollars. The first cost of construction estimate for the Recommended Plan is $365,201,000 and the fully funded Recommended Plan cost estimate is $387,620,000 (mid-point of construction).

In order to proceed to the next phases of the proposed project, including Preconstruction, Engineering and Design (PED) and construction, a Congressional reauthorization of the project that accounts for the increase in project costs must be implemented. This could either happen with the enactment of a new WRDA, perhaps as early as 2011, or with the enactment of other amending language that adjusts the project as authorized in WRDA 2007 to account for the increase in the construction cost estimate.

3.7.2 Components

This alternative involves construction of a structure capable of diverting up to 35,000 cfs which involves excavating a section of levee and constructing 10 each, sized 15 feet x 15 feet, box culverts with hydraulic operated sluice gates, replacing the roadway, and constructing an outfall channel to carry freshwater and sediment to the desired locations in the marsh. The plan also includes 31 acres of ridge and terrace creation and 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal being excavated and reconfigured to convey freshwater, sediments, and nutrients. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area.

Table 3.17: Medium Diversion at White Ditch Authorized, Adjusted, and Recommended Plan Cost Table

Authorized cost in WRDA 2007 Title VII, Section 7006 (e)(3)(A):	**$86,100,000**
* Cost Index Used: EM 1110-2-1304 (Revised 31 Mar 2010)	CWBS Feature Code 15 Floodway Control & Diversion Structure
Cost Index Ratio: 1Q FY07 to 3Q FY14	**1.15**
** Current Project Cost Estimate: (Inflation applied from 10/2006 to 4/2014)	**$99,015,000**
20% of Authorized Cost:	**$17,220,000**
*** Monitoring & Adaptive Management: (per WRDA 2007 Section 2039)	$11,143,400 – $692,000 = **$10,451,400**
Maximum Cost Limited by Section 902 B:	$99,015,000 + $17,220,000 + $10,451,400 = **$126,686,400**
Recommended Plan cost	**$387,620,000**

Notes:

* The cost index applied to the current estimate through PED is derived from: EM 1110-2-1304, March 31, 2000, Civil Works Construction Cost Index System (CWCCIS).

** For the purposes of applying the Cost Index to the WRDA Authorized Cost, each project was adjusted for inflation from October 2006 price identified in WRDA 2007 to the mid-point of construction.

*** This is the cost of any modifications required by law. This is derived from section 8.0 of each projects Monitoring and Adaptive Management Plan minus the project monitoring cost found on the LCA Cost Summary Worksheet – October 2004 Price Levels modified study cost December 20, 2004.

3.7.3 Design, Environmental, and Construction Considerations

Major Project Considerations

- Ensure that stability of the Mississippi River Levee will not be compromised during construction.
- Continued access of LA 39, a major evacuation route, will be maintained during construction.
- Construction of the diversion will be done in accordance with industry standards.
- Construction of the channel conveyance systems will be done in accordance with industry standards.
- Ridge restoration features will make use of beneficial spoil from the channel conveyance systems and will be done in accordance with industry standards.
- Any excess spoil from the channel conveyance systems, beyond the ridge restoration features, will go into marsh creation. These marsh creation features will be built to industry standards.

3.7.4 Real Estate Requirements

The White Ditch study area is located in the Breton Sound estuary and covers the area extending north and south from just south of Belair, Louisiana to the coastline of Louisiana and extending east and west from the Mississippi River to River aux Chenes. This area extends about 50 km in the NW-SE directions and about 30 km in the SW-NE direction. Subsidence, erosion, channelization, saltwater intrusion, storm damage and the absence of freshwater, sediments and nutrients from the Mississippi River have all caused significant adverse impacts to the White Ditch study area resulting in extensive wetland loss and ecosystem degradation. There is an existing siphon at the mouth of White Ditch that was built in 1963 and has not been in operation since 1991, except for brief episodes.

This restoration project would reverse the trend of habitat degradation between the Mississippi River and the River Aux Chenes Ridges through Mississippi River re-introduction. This will be accomplished by re-connecting the Mississippi River to the study area through the use of a river diversion. The material obtained through deepening/widening of the outfall channel will be used to stabilize ridges on either side of the channel acting as containment. Dredge material will also be placed in strategic locations to build marsh. Any excess dredged material is to be used for beneficial marsh creation.

Although the White Ditch diversion would increase the frequency of inundation in the interior marshes during the March–April pulse, the project would not interfere with economically viable uses of the property. Therefore, flowage easements are not necessary within the project area. In addition, there is no acquisition of real estate interests proposed specifically to protect the benefits area of the project. Any activity that may have a detrimental effect to the benefits area of the project is regulated. Therefore, the risks over time would be minimal, aside from uncontrollable forces such as nature (hurricanes, etc.).

There is a total of 1,161.2 acres required for this project. The diversion structure will require approximately 7.2 acres. Approximately 317.7 acres are necessary for the dredging of channels and improvement/enhancement of associated channel ridges needed to maximize the conveyance of freshwater and sediment. Approximately 381 acres are required to accommodate marsh restoration efforts. Approximately 3 acres are needed to install notched weirs to redirect and restrict a certain level of flow entering surrounding marshlands from the freshwater diversion. The additional 452.3 acres is required for temporary work area. A more-detailed discussion regarding real estate requirements is in Appendix J, Real Estate Plan.

3.7.5 Operations and Maintenance Considerations

For purposes of analysis, it was assumed that the diversion would operate at maximum capacity during March–April with a 1,000 cfs "maintenance" flow for the remainder of the year. Although the Recommended Plan would be authorized to run up to 35,000 cfs during the March–April timeframe, it does not necessarily mean it always would. Additionally, the 1,000 cfs maintenance flow that is authorized from May–February does not mean that it would continuously operate at 1,000 cfs.

With the proposed diversion there will be needs for channel maintenance dredging and sluice gate maintenance. It is estimated that there will need to be significant channel dredging every 10 years on the proposed channel enhancement features. It is also assumed that there will be annual maintenance and lubrication needs provided to the sluice gates. The project is not anticipated to induce shoaling in the Mississippi River. However, if further analysis determines that the project increases maintenance dredging requirements for the Mississippi River, Baton Rouge to the Gulf of Mexico Project by inducing shoaling, the incremental costs of any additional maintenance dredging would be a 100 percent non-Federal responsibility.

More-detailed information on the operations and maintenance of the proposed diversion can be found in the engineering Appendix L.

Table 3.18: O&MRRR Annualization

	Annualized Operations- Culver Operations & Gate Maintenance	Channel Maintenance Dredging Present Value	Rip Rap Replacement Present Value	Structural Rehabilitation Present Value	Annualized Cost of Present Value Components	Total Annualized O&MRRR
Location 3 – 5,000 CFS Box	**$27,138**	**$7,760,630**	**$6,151,522**	**$1,309,900**	**$754,666**	**$781,804**
Year 9		3,064,984	2,429,483			
Year 19		1,996,436	1,582,490			
Year 24				975,770		
Year 29		1,300,416	1,030,785			
Year 39		847,051	671,421			
Year 49		551,743	437,343	334,130		
Location 3 – 10,000 CFS Box	**$27,138**	**$9,418,113**	**$6,302,499**	**$1,309,900**	**$844,325**	**$871,463**
Year 9		3,719,591	2,489,110			
Year 19		2,422,826	1,621,329			
Year 24				975,770		
Year 29		1,578,154	1,056,083			
Year 39		1,027,961	687,900			
Year 49		669,582	448,077	334,130		
Location 3 – 15,000 CFS Box	**$50,003**	**$11,985,939**	**$6,372,738**	**$3,446,525**	**$1,081,040**	**$1,131,044**
Year 9		4,733,728	2,516,850			
Year 19		3,083,404	1,639,398			
Year 24				2,567,384		
Year 29		2,008,434	1,067,853			
Year 39		1,308,231	695,566			
Year 49		852,141	453,070	879,141		
Location 3 – 35,000 CFS Box	**$50,003**	**$18,403,436**	**$6,748,546**	**$3,446,525**	**$1,417,833**	**$1,467,836**
Year 9		7,268,256	2,665,272			
Year 19		4,734,316	1,736,075			
Year 24				2,567,384		
Year 29		3,083,787	1,130,826			
Year 39		2,008,683	736,585			
Year 49		1,308,394	479,788	879,141		

3.7.6 Monitoring Plan and Adaptive Management

For the Medium Diversion at White Ditch project, there are a number of uncertainties associated with ecosystem function and how the ecosystem components of interest will respond to the restoration project. In addition, there are associated uncertainties about the best design and operation for the project. Using an adaptive management approach during project planning provided a mechanism for building flexibility into project design and for providing new knowledge to better define anticipated ecological responses. This also enabled better selection of appropriate design and operating scenarios to meet the project objectives. Additionally, an adaptive management approach will help define project success and identify outcomes that should realistically be expected for the project.

In order to utilize an adaptive management approach throughout project implementation, an effective monitoring program will be required. Monitoring results will be used through an assessment process to determine whether the project outcomes are consistent with original project goals and objectives. The power of a monitoring program developed to support adaptive management lies in the establishment of feedback between continued project monitoring and corresponding project management, where periodic assessments are performed using monitoring data and reported back to the LCA Adaptive Management Planning Team. This team will review the assessment reports and make recommendations to the LCA Program Management Team for adaptive management actions. A carefully designed monitoring program is central component of the White Ditch diversion adaptive management program.

According to the CECW-PB Memo dated 31 August 2009, "Monitoring 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." The following discussion outlines key components of a monitoring plan that will support the LCA Medium Diversion at White Ditch Adaptive Management Program. The plan identifies performance measures along with desired outcomes and monitoring designs in relation to specific project goals and objectives. Additional monitoring is identified under Supporting Information Need to help further understand and corroborate project effects.

Objective 1: Maintain the current area of marsh habitat, of all types, that provide life requisite habitat conditions for native coastal marsh fish and wildlife.

Performance Measure: Habitat and land:water classification

Desired Outcome: Reduce the rate of land loss (10 year post-construction trend) compared to the pre-project condition (1985–2012).

Desired Outcome: Maintain and/or increase acreage of marsh habitats from pre-construction estimates (41,206 acres)

Monitoring Design: Habitats will be classified using Landsat TM scenes collected in 3 pre- and 10 post-project years and Digital Orthophoto Quadrangles for 1 pre- and 2 post-project years, as well as any available field data in the study area to assess land:water trends and habitat distribution.

Supporting Information Need: Finfish and shellfish status and trends will be assessed by increasing the number of LDWF finfish and shellfish sampling sites in the White Ditch project area.

Objective 2: Restore adequate freshwater and nutrient inputs into the project area such that sustainable areas of fresh, intermediate, brackish and saline marsh are present and existing areas of marsh acres are maintained.

Performance Measure: Plant diversity and cover

Desired Outcome: Enhance floristic quality of marsh vegetation communities

Monitoring Design: Permanent vegetation monitoring stations will be established for assessing project area vegetation communities. These stations will be sampled 3 years prior to project completion to assess pre-project conditions and 10 years post-construction.

Supporting Information Need: Salinity and hydroperiod will be assessed by establishing nine hydrologic sites in project and reference areas

Risk Endpoint: Nutrient loading

Desired Outcome: Nutrient introductions do not contribute to reduced biomass of belowground plant material when compared to pre-construction estimates

Monitoring Design: Belowground biomass will be sampled quarterly at the nine vegetation sites. These stations will be sampled for 3 years prior to project completion to assess pre-project conditions and sampled for 10 years post-construction. Nutrients (TN, Ammonia, Nitrate+Nitrite, TP), Metals, Agro-chemicals, and Dissolved Oxygen will be measured every 2 months in the immediate project outfall channel and at the nine hydrologic sites for 3 years prior to project completion to assess pre-project conditions and sampled for 10 years post-construction.

Desired Outcome: Nutrient introductions do not contribute to expansion of floating aquatic vegetation (water hyacinth) in project area when compared to pre-construction estimates

Monitoring Design: The distribution of water hyacinth throughout the project area will be tracked by visual assessment of water hyacinth cover from overflights during summer.

Objective 3: Restore sediment inputs into the into the project area equivalent to an average of approximately 1,328,580 cubic yards of sediment per year.

Performance Measure: Annual sediment discharge

Desired Outcome: Deliver 1.328 million cubic yards (equivalent to 1.422 million tons) of sediment through the White Ditch diversion each year.

Monitoring Design: Hourly turbidity recorder will be deployed in the outfall channel and at nine hydrologic sites and correlated to TSS to investigate this measure. The sites will be measured for 3 years prior to project completion to assess pre-project conditions and sampled for 10 years post-construction.

Performance Measures: accretion and subsidence

Desired Outcome: Maintain marsh elevation within tidal frame (relative sea level rise = 0 cm yr^{-1}).

Monitoring Design: SET/feldspar stations will be sampled at nine hydrologic sites for assessing project area accretion and marsh elevation changes for 3 years prior to project completion to assess pre-project conditions and sampled for 10 years post-construction.

An Adaptive Management Program for the Medium Diversion at White Ditch project is needed to ensure the project achieves the desired outcomes. The Program will also facilitate coordination of projects within the LCA Program and coordination among PDTs, the LCA S&T, and LCA Program Management. The LCA Adaptive Management Planning Team will lead all LCA project and program adaptive management recommendations and actions. This team is responsible for ensuring that monitoring data and assessments are properly used in the adaptive management decision making process. If this team determines that adaptive management actions are needed, the team will coordinate a path forward with project planners and project managers. Other PDT members may be solicited as needed; for instance, if the adaptive management measure is operational, Operations and Hydraulics representatives might be asked to participate.

The costs associated with implementing these monitoring and adaptive management plans were estimated based on currently available data and information developed during plan formulation as part of the feasibility study. Because uncertainties remain as to the exact project features, monitoring elements, and adaptive management opportunities, the costs estimates will be need to be refined in PED during the development of the detailed monitoring and adaptive management plans. The current total estimate for implementing the monitoring, assessment, and adaptive management program is $9,363,400. Costs to be incurred during PED and Construction include drafting of the detailed monitoring plan, monitoring site establishment and pre-construction and construction data acquisition to establish baseline conditions. Cost calculations for post construction monitoring were calculated for a 10-year (maximum) period post construction. If ecological success is determined earlier (prior to 10 years post construction), the monitoring program will cease and costs will decrease accordingly.

For further details on the Monitoring and Adaptive Management Plan, please refer to Appendix I.

3.7.7 Effectiveness of Recommended Plan in Meeting Goals and Objectives

The Recommended Plan is the most effective alternative at meeting the Goals and Objectives of the alternatives evaluated. It achieves no net loss of marsh acres and provides the requisite freshwater, nutrients and sediments to sustain them. The Recommended Plan restores the functional wetland building processes that have been impaired resulting in a degraded condition of the marsh. For each objective, the Recommended Plan achieves the following:

- *Maintain the current area of marsh habitat, of all types (41,206 acres) that provide life requisite habitat conditions for native coastal marsh fish and wildlife.*

  The Recommended Plan is capable of achieving no net loss of marsh acreages during the period of analysis (2015–2065) resulting in the maintenance of the current area of marsh habitat (41,206 acres). Estimated marsh acreage at the end of the period of analysis is estimated to be 48,000–73,000 acres, depending on the operating regime with approximately 60,000 total acres of marsh resulting from the primary operating regime (Figure 3.16). Further, the Recommended Plan is robust enough to achieve benefits through the period of analysis taking into account both the intermediate and high rates of Relative Sea Level Rise. The Recommended Plan is capable of achieving no net loss of marsh acres accounting for the intermediate Relative Sea Level Rise rate.

- *Restore adequate freshwater and nutrient inputs into the project area such that sustainable areas of fresh, intermediate, brackish and saline marsh are present and existing areas of marsh acres are maintained.*

  Based on the availability of nutrient and freshwater supplies available in the Mississippi River in the vicinity of Recommended Plan's location (USGS Gages data) the Recommended Plan will provide adequate supplies of both to maintain current areas of marsh. The pulsed operation of the Recommended Plan will result in the maintenance of the overall distribution of marsh types within the study area.

- *Restore sediment inputs into the project area equivalent to an average of approximately 1,300,000 cubic yards of sediment per year.*

  The Recommended Plan is designed, relative to the sediment column in the Mississippi River, to capture sufficient sediments to achieve the required to offset the projected loss rate over the 50-year period of analysis.

3.7.8 Effectiveness of Recommended Plan in Meeting Environmental Operating Principles

The formulation of all of the alternatives considered for implementation was done in accordance with the Environmental Operating Principles.

3.7.9 Compensatory Mitigation Measures

The project will provide positive ecosystem benefits to the study area. Temporary negative marsh impacts associated with excavation of outfall canals and management structures will be compensated for by creation of new marsh of better quality as a result of the reintroduction of freshwater, nutrients and sediments into the study area. No mitigation measures are needed.

3.8 RISK AND UNCERTAINTY

3.8.1 Induced Shoaling

A complete qualitative analysis can be found in Appendix N. The diversion of significant quantities of river sediments and water typically leads to unintended consequences, in that the diverted water and sediment concentrations are not in the same proportion as in the river. The typical response is sedimentation and shoaling in the main river downstream of the diversion. In the receiving diversion channel, sedimentation or erosion could take place, depending on a variety of factors.

An additional consideration will be the sedimentation that may take place in interior distribution channels after the flow is diverted. The March–April discharge will be directed into marsh and open water areas and the portion of the diverted sediment load that is sand will settle quickly when the flow velocity decreases. If it is desired for the sand load to be carried well away from the diversion point, the diversion channel(s) must be carefully designed to maintain the velocity necessary to keep the sand load in suspension. Similarly, silts and clays will begin depositing as velocities approach zero, so the diversion channel design should minimize the creation of eddies or areas of low velocity.

The current operating plan for the Recommended Plan is limited to a diversion pulse of 35,000 cfs in March–April of each year during the normal high flow period of the Mississippi River and a diversion of 1,000 cfs the rest of the year. This flow rate may not be experienced over the full 60-day period. The proposed 35,000 cfs diversion will be the largest man-made diverted flow for wetland building on the Lower Mississippi River, but the 1- to 2-month duration will be a modifying factor. The diversion should approximate 5 percent or less of the main channel flow for most years. Although some deposition in the downstream channel could occur, the 1- or 2-month duration should result in minimal shoaling, especially in the navigation channel. Although the peak monthly sediment concentration normally occurs in March, the peak monthly water discharge occurs in April with high flows typically continuing into May and later. When the diversion is reduced to 1,000 cfs, some of this deposition could be resuspended by the Mississippi flow and carried on downstream in the following months. On an annual basis, the net gain in downstream deposition could be minimal. Specific sediment transport studies for the White Ditch Diversion are required to better address the amount of deposition expected. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative. Specific sediment transport studies to better address the amount of deposition expected will be conducted during PED. If further analysis determines that the project increases maintenance dredging requirements for the Mississippi River, Baton Rouge to the Gulf of Mexico Project by inducing shoaling, the incremental costs of any additional maintenance dredging would be a 100 percent non-Federal responsibility.

3.8.2 Relative Sea Level Rise

An analysis of the high sea level rise scenario was conducted utilizing the ERDC-SAND2 model. The model was used to determine whether a net loss or gain of marsh acreage would occur assuming a high sea level rise scenario. Alternative 4 was the most effective at countering the effects of high sea level rise. Alternative 4 could maintain marsh acreage out to approximately year 20 of the analysis which was then quickly followed by a sharp decline and eventual collapse of the marsh and near total conversion to open water. This result was based on the March–April Pulse plus a 1,000 cfs maintenance flow the rest of the year. It should be noted however, that in the event high sea level rise became a reality, Alternative 4 alone has the capability (assuming an open diversion) to divert large enough quantities of freshwater, nutrients and sediments to overcome high sea level rise. While not publicly acceptable at present, if the collapse of the marsh within the study area was imminent, having the ability to respond accordingly with a year-round open diversion would be critical.

3.8.3 ERDC-SAND2 Model Background

The ERDC-SAND2 model was used to calculate acres of marsh created over the life of the project by predicting accretion rates across the project area. Several sites were initially considered for the proposed diversion; however, equivalent data for each site was not available. Ideally, data from each individual potential diversion site could have been used to make this prediction. In an attempt to fairly compare each site, the known water level data for the Mississippi River were taken from the Tarbert’s Landing gage, which has daily records for the past 25 years. Sediment load data were obtained from the Belle Chasse gage site, which is very close to the project area and representative of that section of the river. Together, river level data and sediment load data were used to fairly and evenly compare one potential site to another. There is some uncertainty associated with not using site-specific data for the analysis. However the risk is minimal because the sediment data being used came from nearby stations and the site(s) that were selected, especially those of the Final Array, appear to occur in areas of higher sediment concentration than the location used in the model.

Verification of the ERDC-SAND2 model was conducted by simulating the effects of the freshwater diversions (siphons) at Naomi and West Pointe à la Hache, both of which began operating in 1993, and the larger Caernarvon Freshwater Diversion Project, which began operating in 1991. The model verification work and other work with the model indicates that it is most applicable in interior marsh systems. When applied to open bays or large lakes, it appears to substantially overestimate land-building. This may be related to resuspension and export of deposited sediments, a process the model does not address. The MDWD measures, however, are all generally interior locations which are handled well by the model. Unfortunately, no examples of freshwater introductions without sediment are available to verify the application of the ERDC-SAND2 model for nutrient-only situations.

The ERDC-SAND2 model uses the average water depth of the project area along with the sediment load introduced into the area from the river to project future acres of marsh created. If the assumed average water depth is greater or the introduced sediment load is less than what was assumed, a decrease in the projected benefits could occur. It is uncertain as to the accuracy of the average water depth or actual sediment loads for the project area. The risk of encountering lower sediment loads than what was used in the ERDC-SAND2 calculation is minimal. In fact, it is likely that the site will encounter heavier sediment loads than what was used in the model due to the location selected. This would in turn likely increase project benefits. For more information surrounding the ERDC-SAND2 equations used, see Appendix L.

3.8.4 Real Estate

Although the White Ditch diversion would increase the frequency of inundation in the interior marshes during the March–April pulse, the project would not interfere with economically viable uses of the property. The benefited area consists of low-lying marsh and shallow open water accessible only by boat and vulnerable to tidal surges. The area was once subject to inundation by the Mississippi River during spring high-water events, until levees were constructed along the river by the Mississippi River and Tributaries project. The White Ditch diversion is formulated to mimic these natural, land-building flood events by reintroducing freshwater, sediment and nutrients to the marshes in the project area. Over the 50-year period of analysis, the project is anticipated to prevent the loss of approximately 13,750 acres of emergent marsh in the project area and could potentially lead to a net gain in marsh acres. Economically viable uses of the private property in the project area include recreational and commercial fishing and hunting, as well as alligator farming. These uses are likely to be enhanced through operation of the diversion because it will improve fish and wildlife values in the benefited area. All existing viable uses of the marshlands are not expected to be detrimentally affected by the periodic change in water elevation. Therefore, flowage easements are not necessary within the project area.

The benefited area of the White Ditch diversion is approximately 98,000 acres, nearly all of which is marshlands. Any activity that may have a detrimental effect to the benefits area of the project is regulated. Therefore, the risks over time would be minimal, aside from uncontrollable forces such as nature (hurricanes, etc.). The types of activities that could be considered risks (oil/gas surface exploration, excavation and fill activities, etc.) are currently regulated by the Louisiana Department of Natural Resources, Office of Coastal Management, under Title 43, Chapter 7 of the Louisiana Administrative Code. Specifically, Subchapter C, Section 723.A.2 requires permits for dredging or filling, urban developments, energy development activity(exploration and transmission of oil/gas), mining activities(surface & subsurface), surface water control, shoreline modification, recreational developments, industrial development, drainage projects and "any other activities or projects that would require a permit or other form of consent or authorization from the U.S. Army Corps of Engineers, the Environmental Protection Agency, or the Louisiana Department or Natural Resources." Additionally, activities in the marshes (wetlands) are regulated by Section 404 of the Clean Water Act under the purview of the USACE. Certain other activities are regulated by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. EPA, and the Louisiana Department of Environmental Quality.

More-detailed information regarding real estate is in Appendix J, Real Estate Plan.

3.8.5 Sediment Modeling

Sediment modeling of the Mississippi River was not conducted as part of this study due to time constraints. Modeling is anticipated as part of PED to refine the diversion orientation and determine whether intake structures would benefit the project. The uncertainty associated with the project outputs in the absence of this information is small. The information used in the ERDC-Sand2 Model came from data obtained from the Belle Chasse station, which represented the longest continuous dataset from a nearby location. When comparing the ERDC-Sand2 Model inputs to data that have been collected within the project area, it is seen that the program's estimates are conservative. Data collected by the USGS in the outfall canal of the existing White Ditch Siphon suggests that more sediment is available to enter into the project area than represented by the Belle Chasse Data. Using the Belle Chasse Data, it is expected that the Recommended Plan will deliver approximately 16,600 ton of sediment per day into the project area during the March–April Pulse. Using the USGS sediment loads and the same pulse operation, approximately 17,900 tons of sediment per day could enter the project area. This results in a potential 8% increase in sediment loads from what are currently being projected.

Current research being done by the University of Texas in conjunction with the State of Louisiana also suggests that there will be further increased sediment concentrations specifically at the Phoenix site. The Phoenix location of the Recommended Plan was selected because there is a "back-current" in flows on the Mississippi River. This will enhance the amount of sediment available in the area of the diversion as the back-current will continually pull sediments into the diversion.

All available information points to the proposed location as a suitable location to capture Mississippi River Sediments. However this will be evaluated further during the PED phase.

3.8.6 Reauthorization

The Recommended Plan for this project exceeds the cost authorization presented in the 2004 LCA Report. The Recommended Plan exceeds the maximum project cost authorized in section 7006(e)(3) of the WRDA 2007. The District Commander recommends seeking additional authorization in order to construct the Recommended Plan/NER plan; however, the need to request additional authorization has the potential to impact the project construction schedule.

3.8.7 Other Diversions

Some uncertainty exists as to the potential for future diversion on the Mississippi River to come online during the period of analysis for the White Ditch Project. To the extent possible based on the available information, the alternatives were formulated so as to produce benefits independent of other diversions. However, as other regional diversions are planned or come online, operational coordination will need to occur not only with White Ditch but in a systemic fashion. Joint operation of the proposed White Ditch Diversion with the existing Caernarvon Diversion would be key to maintaining the condition of the overall Breton Sound ecosystem. These two projects should not be operated independently of one another. Modeling results and monitoring data suggests that Caernarvon has the ability to substantially freshen the Breton Sound even without freshwater inputs from another source. In order for Breton Sound salinities to rebound after the March–April pulse from the White Ditch Diversion, flow from Caernarvon would have to be closely controlled. This will mean a change to the current operational plan. It will be crucial that future modeling during PED for White Ditch and during Feasibility for the LCA Modification to Caernarvon investigate joint operation. The LCA 4 Modification to Caernarvon will consider and account for the proposed Medium Diversion at White Ditch project during its analysis. Additionally the existing and proposed operational plans for both White Ditch and Caernarvon are subject to refinement based on any newly acquired data. If significant changes are required, these would be properly disclosed to the public and additional NEPA documents prepared as appropriate.

3.8.8 Water Quality

In preparation of the Water Quality sections, the best available data was used to characterize existing conditions, and best professional judgment was used to predict the project's impacts. During PED, more data will be collected in receiving basin. Water quality parameters will be modeled as part of the hydrologic modeling effort conducted during the PED phase. If the results of these modeling efforts suggest that the project's water quality impacts will differ from those currently anticipated, then a supplemental NEPA document may be prepared as appropriate. If further analysis during PED indicates that the project is likely to have significant adverse impacts to water quality, then the project's features and/or operation will be refined to mitigate the adverse impacts to the fullest extent possible, consistent with the project's overall goals of creating marsh and restoring natural deltaic processes. The project will also be adaptively managed post-construction to maximize the project's ability to meet its goals and objectives and minimize adverse impacts. Appendix I details the Water Quality monitoring that would occur pre- and post-project implementation.

3.8.9 Fisheries

In preparation of the Fisheries sections, the best available data was used to characterize existing conditions and best professional judgment was used to predict the project's impacts. During PED, an aquatic model will be used to further analyze the project's potential impacts on fisheries resources. If the results of the modeling effort suggest that the project's impacts will differ from those currently anticipated, then a supplemental NEPA document may be prepared as appropriate. Although maximizing productivity of fisheries is not an objective of the project, fish populations may be monitored before and after project completion if additional aquatic modeling suggests this is warranted. If further analysis during PED indicates that the project is likely to have significant adverse impacts to fisheries resources, then the project's features and/or operation will be refined to mitigate the adverse impacts to the fullest extent possible, consistent with the project's overall goals of creating marsh and restoring natural deltaic processes. The project will also be adaptively managed post-construction to maximize the project's ability to meet its goals and objectives and minimize adverse impacts.

3.9 IMPLEMENTATION REQUIREMENTS

3.9.1 Milestone Schedule

Milestones	Schedule
Final Report	August 2010
Division Engineer Notice	August 2010
Washington Level Review	August 2010
State and Agency Review	October 2010
Execute Cost-Sharing Agreement for PED	November 2010
Chief of Engineers Report	November 2010
Begin Preconstruction Engineering and Design	2010
ASA and OMB Review	2011
ASA Report to Congress	2011
Execute PPA	November 2011

Milestones	Schedule
Receive Reauthorization from WRDA 2011**	November 2011
Request Construction Funding per Reauthorization**	November 2011
Complete Design Documentation Report	June 2012
Complete Plans and Specifications	July 2012
Complete Real Estate Acquisition	July 2012
Advertise Construction	August–September 2013
Start Construction	November 2013
Complete Construction	November 2016
Turnover Project to Local Sponsor	2016
Initiate Monitoring and Adaptive Management	During PED
Complete Monitoring and Adaptive Management	2026

3.9.2 Implementation Responsibilities

The non-Federal sponsor shall, prior to implementation, agree to perform all of the local cooperation requirements and non-Federal obligations. Local cooperation requirements and non-Federal sponsor obligations include, but are not necessarily limited 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 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 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 portions 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.

3.9.3 Cost Sharing

The State of Louisiana, acting through the CPRA, will be the non-Federal sponsor for the LCA MDWD project. In November 2008, the USACE and CPRA executed a single Feasibility Cost-Share Agreement covering six Louisiana Coastal Area near-term plan elements listed in Section 7006(e) of the Water Resources Development Act of 2007. The six features each underwent a separate feasibility analysis and environmental compliance analysis culminating in a single master feasibility document. The cost-share during the feasibility phase was 50% Federal and 50% non-Federal, however, the individual elements have been divided so that each entity has lead responsibility for preparing three of the six report components. At the end of the feasibility phase the total cost for all elements will have been shared on a 50/50 basis, yet for work on each individual element during the feasibility phase the ratio of funds expended by either the Federal or non-Federal sponsor will be higher depending upon their level of responsibility. The Corps has the technical planning lead for this particular LCA project element. 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. Additionally, project monitoring and any Adaptive Management deemed necessary will be cost shared at 65/35 for the first 10 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.

Table 3.19 provides the distribution of costs for the fully funded project cost estimate. The fully funded cost of implementing the Recommended Plan is estimated to be $387,620,000 (Engineering Appendix L). The Federal Government would provide 65% of the first cost of implementing the Recommended Plan including PED, construction, and construction management, which is estimated to total $251,953,000. The State of Louisiana would be responsible for providing 35% of the First Cost of implementing the Recommended Plan. The 35% share of the project cost includes the State of Louisiana's responsibility for providing all LERRDs. The estimated costs are $135,667,000 in cash with $508,000 in LERRD credit.

The State of Louisiana also would be responsible for OMRR&R of project features. The operation and maintenance costs are anticipated to be minimal over the 50-year period of analysis at an average annual cost of $1,467,836.

3.9.4 Environmental Commitments

Mitigation measures are proposed to avoid or minimize impacts that would otherwise occur as a result of the implementation of the preferred alternative. These environmental and related commitments would be implemented by construction contractors or management authorities. Some commitments, such as monitoring or adaptive management would continue beyond completion of construction of facilities.

Table 3.19: Cost Sharing

Project Feature	Total Cost	Non-Federal		Federal	
		%	Cost	%	Cost
Total first cost of construction[1]	$365,201,000	35	$127,820,000	65	$237,381,000
LERRD credit	$494,000	100	$494,000	0	$0
Monitoring & adaptive management	$11,143,000	35	$3,900,000	65	$7,243,000
OMRR&R[2]	$1,468,000	100	$1,468,000	0	$0

[1] Total first cost of construction is based on the sum of the PED; construction management (i.e., supervision and administration); LERRDs; and monitoring and adaptive management and is based on October 2010 price levels.

[2] Average annual cost based on October 2010 price levels.

Throughout the planning process, efforts have been made to avoid impacts to the extent practicable. If avoidance could not be achieved, mitigation measures were developed to reduce the magnitude and extent of the impact. The Recommended Plan would impact approximately 277 acres of intermediate marsh and 363 acres of shallow open water for construction of the diversion. Approximately 223 acres of intermediate marsh and shallow open water would be excavated for the outfall channel. However, creation of approximately 385 acres of intermediate marsh habitat, nourishment of 35,000 cumulative acres of emergent marsh habitat, and creation of 31 acres of ridge habitat would mitigate for wetland impacts resulting from construction activities.

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

Fishery modeling and habitat change modeling will be performed during the PED phase. The cost and schedule for this will be incorporated into the PMP being developed by the USACE for the PED Phase. At this time a SOW is being developed as part of the Donaldsonville to the Gulf project to look a various models and develop a white paper on the best use of them. The intent of these models is to support adaptive management of this project.

A summary of the environmental and related commitments made during the planning process and incorporated into the proposed project plan include the following:

- Ensure construction contractors limit ground disturbance to the smallest extent feasible.
- Use accepted erosion control measures during construction.

- Conduct a search for bald eagle, other raptors and colonial nesting wading bird active nests within three-quarters of a mile from proposed disturbance activities prior to construction. Appropriate protective measures and no-work distance restrictions would be implemented to avoid or minimize nest disturbance if active nests are identified
- Contact pipeline and gas well companies prior to construction activities to identify and avoid existing hazards.
- Implement best management practices and measures contained in erosion control guidelines to control soil erosion from construction areas.
- Implement measures to control fugitive dust during construction.
- Implement a program to compensate for losses of archaeological sites (if any) that would occur as a result of construction and operation of the proposed project.
- Fishery modeling and habitat change modeling will be performed during the PED phase. The cost and schedule for this will be incorporated into the PMP being developed by the USACE for the PED Phase. At this time a SOW is being developed as part of the Donaldsonville to the Gulf project to look at various models and develop a white paper on the best use of them. The intent of these models is to support adaptive management of this project.
- An operating plan will be developed based on a maximum of a 2-month pulse. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.
- The USACE will follow the “Reasonable and Prudent Measures” and “Terms and Conditions” as described in the USFWS Biological Opinion for Pallid sturgeon which can be found in Appendix A and summarized in Section 5.11.5. The USACE is aware that the 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 habitat acreage amount described herein) 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 this 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 instances where the amount or extent of incidental take is exceeded, any operations causing such take shall cease pending reinitiation.

3.9.5 Financial Requirements

3.9.5.1 Sponsorship Agreement

Prior to the start of construction, the State of Louisiana will be required to enter into a Project Partnership Agreement (PPA) with the Federal Government and satisfy State laws and all applicable regulations. In general, the items included in the PPA have been outlined in the previous paragraphs.

3.9.5.2 Financial Requirements

It is expected that the CPRA will have the capacity to provide the required local cooperation for the Recommended Plan. 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. The 35% share of the project cost includes the State of Louisiana's responsibility for providing all LERRDs.

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 Mineral Management Services 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 the Medium Diversion at White Ditch project, 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, Rights of-way and Disposals (LERRDs) required for the project.

By letters dated July 2, 2009, and December 18, 2009, the Minerals Management Service and the USACE established a process for the Minerals Management Service 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 Minerals Management Services' written determination for a specific study, project, or program will take the form of the grant award document for that activity.

3.9.5.3 Local Cooperation

The CPRA provided a letter of intent to serve as the non-Federal sponsor for the project on August 9, 2010. A copy of the letter can be found in Attachment 2.

3.9.5.4 Project Management Plan

A Project Management Plan (PMP) for implementation of the Recommended Plan will be prepared. The PMP will describe activities, responsibilities, schedules, and costs required for the Plans and Specifications phase and construction of the project. The Plans and Specifications phase will last for an estimated 24 months at a total cost of $36,980,000.

3.9.5.5 Procedures for Project Implementation

Under the 2007 WRDA Section 7006, the LCA program has authority for feasibility-level reports of six near-term critical restoration features. Project construction is contingent upon a favorable Chief's report by December 31, 2010. The excerpt below from WRDA outlines the project authority for this report for the Medium Diversion at White Ditch project.

SEC. 7006. CONSTRUCTION.

(3) PROJECTS SUBJECT TO REPORTS.-

. . .

(B) CONSTRUCTION.-The Secretary may carry out the projects under subparagraph (A) substantially in accordance with the plans and subject to the conditions, recommended in a final report of the Chief of Engineers if a favorable report of the Chief is completed by not later than December 31, 2010.

. . .

The Recommended Plan for the Medium Diversion at White Ditch project exceeds its total authorized cost authorized under Section 7006(e)(3)(A)(v) of WRDA 2007 and Section 902 of WRDA 1986 as amended. As such, additional authority must be enacted to enable the Recommended Plan to be carried out with these increased costs. Future actions necessary for project approval and implementation are summarized as follows:

1. The U.S. Army Corps of Engineers Mississippi Valley Division Commander will review the final report and then issue a public notice announcing completion of the final report. This is referred to as the Division Engineer's Notice, or DE's Notice.

2. The report will then be submitted to Headquarters, U.S. Army Corps of Engineers (HQUSACE), and the Office of the Assistant Secretary of the Army for Civil Works (ASA (CW)) for concurrent Washington level review.

3. The 30-day State and agency review and coordination of the EIS will be ongoing concurrently during the HQUSACE review.

4. Concurrent Washington level review by HQUSACE and ASA(CW) will conclude with a HQUSACE staff assessment, the 30-day State and agency review, review input by the ASA(CW), HQUSACE final assessment, a field visit and meeting, if necessary, and the documentation of report review prepared by HQUSACE.

5. The Washington level decision-making process will follow the decision-making sequence of HQUSACE and ASA(CW), once the documentation of report review has been completed. There will be a briefing, if necessary, for the Designated Senior Representatives of Decision-Makers to resolve any outstanding issues. The Chief of Engineers will provide his recommendations on the report to the ASA(CW), who will provide the report and proposed recommendations to the Office of Management and Budget (OMB) to obtain their views and comments on whether the proposed recommendations are consistent with Administrative policies. Prior to the transmittal of the report to the Congress, the Non-Federal Sponsor, the State of Louisiana, interested Federal agencies, and other parties will be advised of any significant modifications made to the recommendations and will be afforded an opportunity to comment further.

6. The report will then be transmitted to Congress for project authorization with the Chief of Engineer's report, ASA(CW) report, State and agency comments, and Office of Management and Budget comments.

7. Congress will have to enact law to increase the authorized cost of the project.

8. Funds could be provided, when appropriated in the budget, for Preconstruction Engineering and Design (PED) upon issuance of the Division Engineer's public notice, announcing the completion of the final report and pending project funding authorization. A Design Cooperation Agreement will need to be developed and executed between the Federal Government and the State of Louisiana, whereby the sponsor will provide 25% of the cost of PED studies.

9. The U.S. Army Corps of Engineers will complete final design and plans and specifications for project construction.

10. Subsequent to appropriation of construction funds by Congress, formal assurances of local cooperation in the form of a Project Partnership Agreement (PPA) will be required from the State of Louisiana.

11. The State of Louisiana will be required to provide all real estate requirements for project implementation.

12. Bids for construction will be advertised and contracts awarded.

13. Upon completion of construction, the Corps' acceptance from the contractor and notice of construction completion for the project (or a functional portion of the project) to the non-Federal sponsor will proceed or be concurrent with the delivery of an O&M manual and as-built drawings. The State of Louisiana will be responsible for OMRR&R of the project in accordance with guidelines provided by the U.S. Army Corps of Engineers.

3.9.6 Views of Non-Federal Sponsor

CPRA, the non-Federal sponsor, has expressed the desire for implementing the LCA MDWD project and sponsoring the project construction in accordance with the items of local cooperation that are set forth in the recommendations chapter of this report. In addition, CPRA supports the NER/Recommended Plan since this plan has the greatest potential to restore the study area to historic conditions for marsh acreage in addition to being able to offset effects from the range of potential sea-level rise. The plan is also cost-effective and provides the most benefits of all the best-buy plans in the final array. However, due to authorized cost limitations in WRDA 2007, the project may require additional Congressional authorization to increase funding and allow the implementation of the NER/Recommended Plan to fully address the ecosystem needs identified in this report.

The State of Louisiana fully supports the project. The state recognizes that the USACE's position is 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's 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). Nevertheless, while the State is of the opinion that its view is consistent with the authority and Congressional intent under WRDA 2007, the State 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 law is changed.

4.0 AFFECTED ENVIRONMENT

This chapter describes the climate, geomorphic and physiographic setting, and the historic and existing conditions for the following important resources: soils; coastal vegetation; wildlife; fisheries; plankton; benthos; essential fish habitat (EFH); threatened and endangered species; hydrology (including flow and water levels, and sediment); water quality; recreation; public lands; cultural and historic resources; aesthetics; air quality; socioeconomic and human resources (including population; infrastructure; employment and income; navigation; oil, gas, and utilities; pipelines; commercial fisheries; oyster leases; and flood control and hurricane protection). In addition, the characterization of noise and hazardous, toxic, and radioactive waste (HTRW) in the project area are presented.

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 following sections discuss historic and existing conditions of each important resource occurring within the project area.

4.1 ENVIRONMENTAL SETTING OF STUDY AREA

The MDWD project study area is located in LCA Subprovince 1, and comprises part of the Breton Sound hydrologic basin in Plaquemines Parish, Louisiana. Plaquemines Parish is located within the Central Gulf Coastal Plain in southeastern coastal Louisiana. The parish encompasses the current delta of the Mississippi River, which was built up from alluvial silt deposited over centuries when the river was levee-free and overflowed its banks. Elevations range from sea level along the Gulf Coast, to approximately +15 feet above sea level along levee ridges. The project area is located within the Mississippi River Deltaic Plain, with the Mississippi River acting as the primary influence on geomorphic processes in the delta region.

4.1.1 Location

The boundary of the project study area encompasses over 98,000 acres of intermediate to brackish intertidal wetland habitats. The boundary follows distinct landscape features beginning in the north with the confluence of the non-Federal back levee and the Forty-Arpent canal, extending along the non-Federal back levee, the Mississippi River levee, the Federal back levee and along the left descending natural bank of the Mississippi River to the west; past American Bay, California Bay, and through Breton Sound, near Bay Gardene to the south; into and along River aux Chenes to the east, and back to the point of beginning. The area has been significantly impacted by recent tropical storms and hurricanes and is currently isolated from the beneficial effects of the Caernarvon freshwater diversion, located at the northern end of the Breton Sound Basin.

4.1.2 Climate

The climate of the project area is subtropical marine with long humid summers and short moderate winters. The climate is strongly influenced by the water surface of many sounds, bays, lakes and the Gulf of Mexico and seasonal changes in atmospheric circulation. During the fall and winter, the study area experiences cold continental air masses which produce frontal passages with temperature drops. During the spring and summer, the study area experiences tropical air masses which produce a warm, moist airflow conducive to thunderstorm development (LACPR 2008).

The study area is also subject to periods of drought, flood, tropical waves, tropical depressions, tropical storms and hurricanes. These weather systems can cause considerable property and environmental damage and loss of human life. Historical data from 1899 to 2007 indicate that 30 hurricanes and 41 tropical storms have made landfall along the Louisiana coastline (NOAA 2009). The largest recent hurricanes were Katrina and Rita in 2005, which caused considerable damage in the study area. Hurricane Gustav, while much smaller and less intense, caused additional damage in the study area. Hurricane Ike, which made landfall in Galveston, Texas in 2008, caused flooding and wind damage in coastal areas as it passed the Louisiana Coast.

Average annual temperature in the area is 67° (F), with monthly temperatures varying from the mid-90°s (F) in July and August, to the mid-30°s (F) in January and February. Average annual precipitation is 57.0 inches, varying from a monthly average of 7.5 inches in July, to an average of 3.5 inches in October.

Recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level.

4.1.3 Geomorphic and Physiographic Setting

The project study area is located within the Plaquemines-Balize delta complex, one of six such complexes that make up the Mississippi River Deltaic Plain. The primary geomorphic influence in this region is the natural hydrologic process referred to as the delta cycle. The delta cycle is a dynamic and episodic process alternating between periods of seaward progradation of deltas (regressive deposition) and the subsequent landward retreat of deltaic headlands as deltas are abandoned, reworked, and submerged by marine waters (transgressive deposition). The Plaquemines-Balize complex is in the latter phase of the cycle. More detailed information on the delta cycle was provided in the LCA Final Programmatic Environmental Impact Statement (FPEIS).

4.2 SIGNIFICANT RESOURCES

4.2.1 Soils and Waterbottoms

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 (P.L. 97-98; 7 U.S.C. 4201 *et seq.*). Coastal land loss is directly and inextricably linked to the five factors of soil formation (parent material; climate; plants and other organisms; relief; and time). These factors are discussed in detail in the FPEIS for the 2004 LCA report.

4.2.1.1 Soils and Waterbottoms

4.2.1.1.1 Historic Conditions

The soils in the Louisiana coastal zone formed in either alluvial sediments or loess, and many have accumulations of organic material in the upper part. Some soils are organic throughout, and some, nearest to the coast, formed in marine sediments. Deltaic processes have played a significant role in the types of soil present in the project area. The dynamic and episodic deltaic building processes alternates between periods of seaward progradation of deltas (regressive deposition) and the subsequent landward retreat of deltaic headlands as deltas are abandoned, reworked, and submerged by marine waters (transgressive deposition). The types of soils present today in much of the project area are characterized by the depositional environments associated with both of these phases of the deltaic cycle.

4.2.1.1.2 Existing Conditions

The feasibility report for the White's Ditch Diversion Siphon Outfall Management Plan (United States Department of Agriculture, Soil Conservation Services (USDA-SCS, 1992)) noted that there are several different soils mapped in the project area. These are Commerce, Sharkey, Clovelly, Lafitte, and Gentilly. Commerce and Sharkey soils are poorly drained, firm mineral soils formed in loamy or clayey alluvium. Gentilly soils are very poorly drained, very slowly permeable, semi-fluid, mineral soils formed in clay alluvium. Clovelly and Lafitte soils are both level, very poorly drained, semi-fluid, organic soils formed in accumulation of herbaceous plant material in brackish marshes. The Commerce and Sharkey soil series are classified as prime farmland soils where rarely flooded and adequately drained, while the Gentilly, Clovelly, and Lafitte soil series are classified as hydric soils.

4.2.2 Hydrology

This resource is institutionally important because of the Clean Water Act of 1977 (CWA), as amended. The Mississippi River is technically important because it provides habitat for various species of wildlife, finfish and shellfish. The Mississippi River is publicly important because of its use as a major navigational channel and it recreational use for fishing, boating and bird watching.

4.2.2.1 Flow and Water Levels

4.2.2.1.1 Historic Conditions

Over geologic history, the course of the Mississippi River has changed several times through the delta-switching process. Formation of a new delta lobe occurred roughly once every 1,000 years in response to changes in the flow path of the Mississippi River into the Gulf over the past 5,000-6,000 years; the modern delta consequently consists of smaller delta complexes formed over the past 8,000 years (Fisk 1944; Frazier 1967; Penland and Boyd, 1985; Autin et al., 1991, Saucier 1994). Major distributaries over this period have included Bayous Lafourche, Terrebonne, Des Families, Barataria, and to a lesser extent, the Atchafalaya River (USACE 2000).

Historically, the Lower Mississippi River was prone to frequent spring floods that caused catastrophic damage and loss of life post-settlement (Davis 1993, USACE 2009). Federal flood control and navigation measures that began in earnest with the authorization of the MR&T Project by the Flood Control Act of 1928 have since regulated the river's stage and flow and mitigated damage (USACE 2009). These actions have channelized the Lower Mississippi River and prevented the abandonment of the current flow path. Operation of the Old River Control Structure (ORCS) has strictly regulated Mississippi River flows since 1977 to prevent capture by the Atchafalaya River: 30 percent of flows are allocated to the Atchafalaya and 70 percent to the Mississippi River (USACE 2009).

4.2.2.1.2 Existing Conditions

The MDWD project area is part of the Breton Sound estuary system. The Breton Sound estuary is located in southeastern Louisiana, and is bounded on the west by the Mississippi River, on the north by Bayou la Loutre, on the east by the south bank of the Mississippi River-Gulf Outlet (MRGO), and on the south by Baptiste Collette Bayou and Breton Island. The estuary consists of about 430 square miles of fresh and brackish coastal wetlands that comprises shallow-water ponds, lakes, bays, and a man-made canal system. Major natural streamcourses within the estuary are the Oak River (also known as River aux Chenes) and Bayou Terra aux Boeufs. These functioned as distributary channels of the Mississippi River into the estuary prior to construction of the MR&T mainstem levee. Other large water bodies are Big Mar, Lake Leary, Spanish Lake, Grand Lake, and Little Lake.

Flood control measures and flow management have resulted in relatively consistent flows and water levels in the Lower Mississippi River from 1978 to present in the study area. The flow and water level of the Lower Mississippi River are directly related and exhibit a seasonal pattern that is presumably linked to snowmelt runoff and spring rains. High flows and water levels are characteristic of spring months (March 1–May 31), while low flows and low water levels are typical from mid-summer to mid-fall (August 16–November 15). Based on USGS data from their Tarberts Landing gage from 1978 to 2008, the average annual, spring, and summer–fall discharge rates are 566,123 + 306,846; 813,333 + 283,377; and 283,925 + 113,984 cfs (Mean + SD), respectively. Stage and flow are more variable in the spring than summer–fall months.

Other factors influencing the stage and flow of the Lower Mississippi River in the study area are astronomical and meteorological tides, which have the greatest effect during periods of low stage and flow (USACE 2000). Astronomical tides have been observed as far upstream as the head of ship navigation in Baton Rouge, Louisiana. Strong south and southeasterly winds can cause rapid rise and northwesterly winds rapid decline in the river's stage (USACE, 2000). Seasonally, tides tend to be highest in late summer through mid fall (August–November) and lowest in the winter and early spring (December–March). Storm surges can also raise tidal levels in the summer and fall months. These levels can vary greatly depending on the strength and location of the storm.

4.2.2.2 Sedimentation and Erosion

4.2.2.2.1 Historic Conditions

Prior to development of the current mainstem Mississippi River levee system in the mid-twentieth century, seasonal high river stage events periodically replenished the Breton Sound Basin with sediments and nutrients that acted to maintain the area as a functioning estuary.

Extensive research and data exist on the historic and existing sediment dynamics of the Lower Mississippi River. Historically, the Lower Mississippi River transported extremely high sediment loads to the Gulf in association with deltaic processes. When it was a classical meandering alluvial river that was aggrading its channel throughout much of its length, the suspended sediment and bed loads of the Mississippi River have been estimated to have been as high as 270 x 106 m^3/hr (353 x 106 yd^3/hr) and 130 x 106 m^3/yr (170 x 106 yd^3/yr), respectively (Kesel et al. 1992). The Lower Mississippi River has experienced significant changes in sediment transport dynamics over its more recent history, with a general trend of decreased sediment transport from historic to present times. Kesel (1988) estimated a 43 percent reduction in sediment loading from historic (prior to 1900) to predam periods (1930–1952) and a 51 percent decline from predam to postdam periods (1963–1982). Increased land development along the Mississippi River during the 1800s would have contributed to higher sediment loading, and thus this period may provide an inappropriate reference time frame for long-term trend analysis (USACE 2000). Consequently, there is uncertainty as to how current sediment loads of the Lower Mississippi River compare to historic levels.

4.2.2.2.2 Existing Conditions

The absence of a supply of freshwater, sediment, and nutrients combined with the ongoing pressures of wind and wave action, storm surges, and human activities have eroded marsh soils and reduced the ability of the project area to maintain a balance of emergent wetland and shallow water.

The USGS station at Tarbert Landing, Mississippi, maintains an extended record of sediment data for the Lower Mississippi River Period of record for daily measurements extends from 1975 to present. Sediment loading patterns suggest that daily-suspended sediment loads are above average from January through May and below average from August through November (USGS 1999, 2009). Based on water year 2002 through 2008, the average daily measured suspended sediment load at this location was 334,000 tons/day; the daily measured suspended sediment load varies from 39,000 to 119,000 tons/day (USGS 2009). The sand to silt ratio of suspended sediment is typically 20% sand to 80% silt (USGS 1999). Mashriqui and Kemp (1996) reported the mean sediment load of the Mississippi River at Tarbert Landing to be 226 mg/L, of which about 26% was sand, with silts and clays each contributing between 30% and 40%.

In 1995 the USACE derived the long-term relative subsidence rates from radiocarbon dating of buried peat deposits for all of southeast Louisiana. It was determined that the MDWD project area is subsiding at a rate of approximately 0.50 foot per century. Just beyond the project boundary toward Head of Passes, the rate increases to 1.0–4.0 feet per century.

4.2.2.3 Water Use and Supply

4.2.2.3.1 Historic Conditions

Fresh ground and surface water is abundant in southern Louisiana. Prior to the 1900s, water used for most purposes was from surface sources. Many households collected rainwater for domestic uses and farmers generally relied on rainfall and irrigation ditches to provide water to their crops. During the late 1800s, water wells began to come into common usage and quickly proliferated in areas where fresh groundwater was available. The use of groundwater allowed farmers to plant crops in areas where sources of fresh surface water were unreliable or unavailable. In coastal areas of southeastern Louisiana, groundwater supplies are generally limited and surface water is primarily used. Large amounts of fresh groundwater are generally available and groundwater is used for most purposes.

4.2.2.3.2 Existing Conditions

During 2000, about 3,000 million gallons per day (Mgal/d) (11,370 million liters per day [Ml/d]) of freshwater were withdrawn for various uses in the LCA Study area. Of this water, about 97 percent was from surface sources and about 3 percent was from groundwater sources. Most of this use was in southeastern Louisiana in parishes that border or straddle the Mississippi River.

The Mississippi River and some of its distributaries were the largest sources of surface water, contributing 96 percent (2,800 Mgal/d [10,612 Ml/d]) of the total surface withdrawals. Withdrawals for power generation and industry were primarily from the Mississippi River and used for once-through cooling and much of the water was returned to the source. Industrial withdrawals were primarily for petroleum refining and chemical manufacturing.

4.2.2.4 Groundwater

4.2.2.4.1 Historic Conditions

Southern Louisiana generally has very abundant fresh groundwater supplies. However, aquifers along the coast typically contain saltwater that extends inland as a wedge along the base of the aquifer. Coastward, the saltwater wedge typically thickens and the overlying freshwater thins until the entire thickness of the aquifer contains saltwater. Salty groundwater is often defined as water containing a chloride concentration greater than 250 mg/L or a dissolved solids concentration greater than 1,000 mg/L. Saltwater can move into freshwater parts of the aquifer by lowering freshwater levels through pumping. Such movement of saltwater or the saltwater wedge is known as saltwater encroachment. Saltwater can move laterally or vertically in an aquifer.

4.2.2.4.2 Existing Conditions

The water table is at or near the surface throughout most of the coastal zone. The silt- and sand-rich depositional environments such as point bar, intradelta, natural levee, beach, and near shore gulf are generally connected hydraulically to the adjacent water body (i.e., river, lake, distributary channel) and the elevation of the water table in these deposits reflects the level/stage of the adjacent water body. This is especially true in deposits adjacent to the Mississippi and Atchafalaya Rivers.

4.2.3 Water Quality and Salinity

4.2.3.1 Historic Conditions

Historic water quality issues for the project area are similar to existing issues addressed below. Mean salinities in the Breton Sound Basin range from fresh (0–2 parts per thousand [ppt]) in the upper basin to saline (>10 ppt in the middle and lower portions of the basin.

4.2.3.2 Existing Conditions

Historic and current water quality issues for the waters within the White Ditch project include the transport of nutrients, pesticides, synthetic organic compounds, trace elements, suspended sediment, and bacteria. The database for sampling stations on the Mississippi River near the diversion site is extensive, with comprehensive water quality datasets beginning in the mid-1970s. Historically, sites have been operated in cooperation with the USACE and the Louisiana Department of Environmental Quality (LDEQ). The database for the Mississippi River is extensive enough that several general conclusions can be made concerning its suitability for coastal restoration efforts: Trace elements, including heavy metals, are generally not considered a water quality issue in the Mississippi River.

1. Nitrate concentrations average around 1.4–1.6 mg/L in the lower Mississippi River. This is the result of natural and human inputs, particularly agricultural fertilizers in the mid-continent. Nitrate at these concentrations can cause excessive algal growth and eutrophication in coastal water bodies and contribute to the hypoxia problem in the Gulf of Mexico.
2. Fecal coliform bacteria in the lower Mississippi River have declined dramatically with more effective sewage treatment at Baton Rouge and New Orleans since the mid to late 1980s.
3. The primary pesticides detected in the Mississippi River are the herbicides atrazine, metolachlor, and acetochlor.
4. Per LDEQ's database[2], organic compounds are typically not detected in the Mississippi River.
5. For conventional parameters in LDEQ's database[2], there is essentially no difference in water quality spatially along the length of the Mississippi River between Pointe à la Hache and the Louisiana state line.

The most common individual designated uses within proximity to the White Ditch Project Area include primary contact recreation, secondary contact recreation, fish and wildlife propagation, shellfish propagation, and drinking water supply. Primary contact recreation is defined by LDEQ as any recreational activity that involves or requires prolonged body contact with the water, such as swimming, water skiing, tubing, snorkeling, and skin-diving. Secondary contact recreation is defined as any recreational activity that may involve incidental or accidental body contact with the water and during which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, and recreational boating. Fish and wildlife propagation is defined as the use of water for preservation and reproduction of aquatic biota such as indigenous species of fish and invertebrates, as well as reptiles, amphibians, and other wildlife associated with the aquatic environment. This also includes the maintenance of water quality at a level that prevents contamination of aquatic biota consumed by humans. Shellfish propagation is the use of water to sufficiently maintain biological systems that support economically important species of oysters, clams, mussels, or other mollusks so that their productivity is preserved and the health of human consumers of these species is protected.

The Louisiana Department of Health and Hospitals (LDHH) coordinates with LDEQ, the LDWF, and the Louisiana Department of Agriculture and Forestry (LDAF) to issue water body advisories aimed at protecting the public's health. These include fish and shellfish consumption advisories and swimming advisories. Fish and shellfish consumption advisories employ a risk-based method to advise the public to limit or avoid the intake of certain species of fish and shellfish that have unsafe contaminant levels in their tissues. Swimming advisories may be issued for a water body due to fecal coliform or other types of contamination. This information comes from the LDEQ's 2008 305(b)/303(d) Integrated Report. The water bodies within the White Ditch project area are currently meeting their designated uses. The Mississippi River in proximity of the project was fully supporting the designated uses of secondary

[2] LDEQ performs collection and analysis for 29 conventional parameters and fecal coliform through the Surface Water Monitoring Program with a priority pollutant scan quarterly at the Mississippi River site near the White Ditch Project Area.

contact recreation and drinking water supply; however, was assessed as not supporting primary contact recreation or fish and wildlife propagation. The suspected causes of impairment include nitrogen, phosphorus, and total fecal coliform from suspected sources of municipal point source discharges and upstream sources. The Mississippi River Basin Coastal Bays and gulf waters were assessed as not supporting fish and wildlife propagation due to mercury from atmospheric deposition. The Mississippi River within the project area was not assessed for the other designated uses due to insufficient data.

For the White Ditch WVA assessment, baseline salinity values for the project area were determined using 2008–2009 data from Coastal Reference Monitoring stations located within or near the project area. Baseline values determined for intermediate marsh were representative of the mean values during the growing season (March–November), which ranged from 3.7 to 5.7; the mean baseline was calculated as 4.0. Baseline salinity for brackish and saline marsh was representative of the mean annual salinity recorded in 2008–2009. Baseline values of 6.6 for the brackish marsh zone was determined using station data that ranged from 5.0 to 9.9 ppt. A baseline value of 13.0 was estimated for the saline zone by extrapolating data from a single monitoring station in an isolated area of marsh to the larger open-water areas at the lower end of the estuary, where salinities were believed to be higher. Figure 4.1 shows the existing salinity gradients that could be found in a typical July.

4.2.4 Air Quality

This resource is institutionally significant because of the Clean Air Act of 1963 (CAA), as amended, and the Louisiana Environmental Quality Act of 1983 (LEQA), 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). It is publicly significant because of the desire for clean air expressed by virtually all citizens.

4.2.4.1 Historic Conditions

Historic air quality conditions in the project area are similar to those described in Section 4.2.5.2 below.

4.2.4.2 Existing Conditions

The EPA *Green Book Nonattainment Areas for Criteria Pollutants* (Green Book) maintains a list of all areas within the United States that are currently designated nonattainment areas with respect to one or more criteria air pollutants. Nonattainment areas are discussed by county or metropolitan statistical area (MSA). MSAs are geographic locations, characterized by a large population nucleus, that are comprised of adjacent communities with a high degree of social and economic integration. MSAs are generally composed of multiple counties. Review of the Green Book indicates that Plaquemines Parish is in attainment for all Federal NAAQS pollutants (http://www.epa.gov/oar/oaqps/greenbk/multipol.html) (http://www.deq.louisiana.gov/portal/Default.aspx?tabid=112)

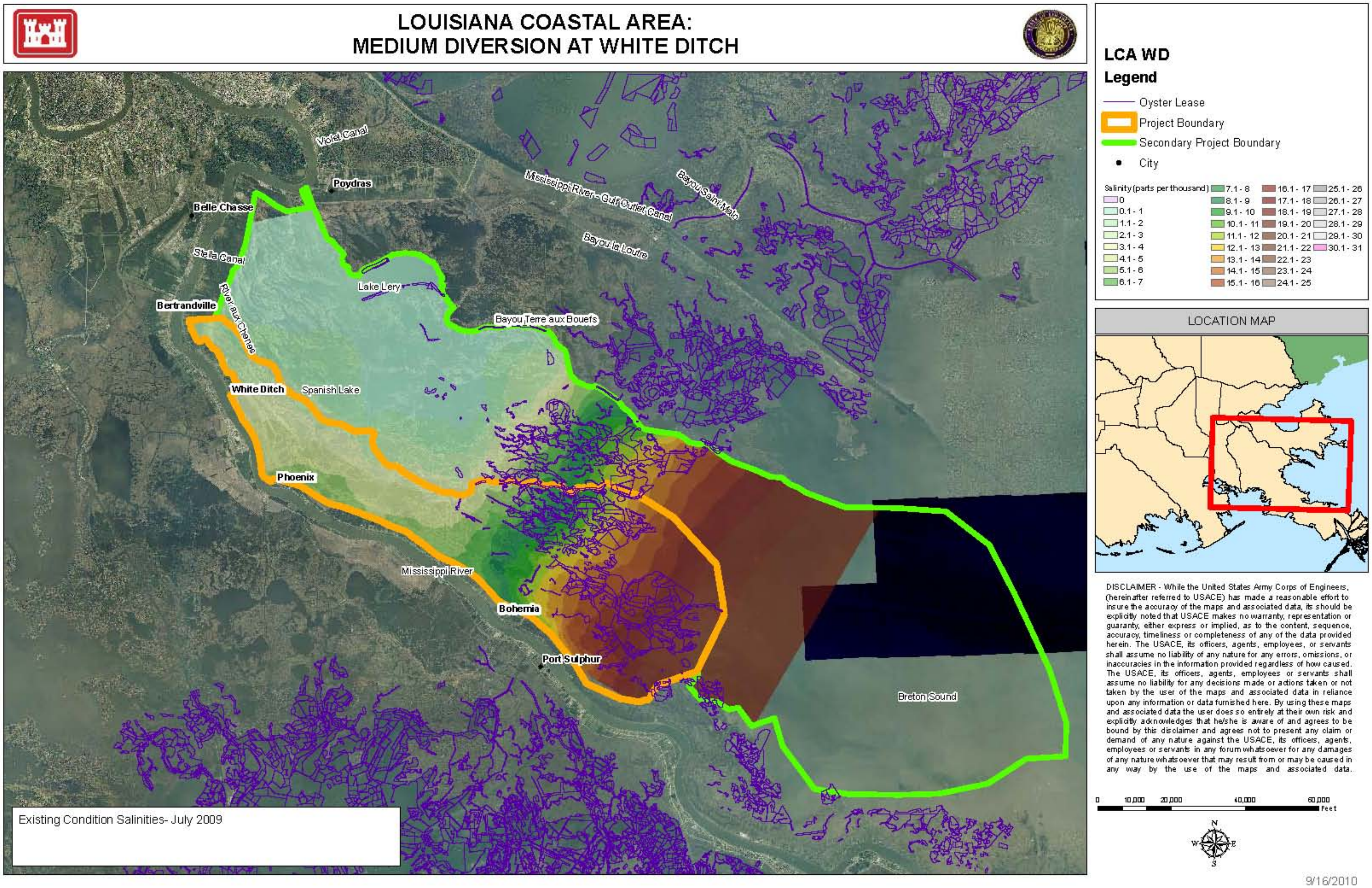

Figure 4.1: LCA White Ditch Existing Condition Salinities – July 2009

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4.2.5 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 (29 CFR, 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, and other types of disturbance to humans and animals, including disruption of colonial nesting birds. Noise is publicly significant because of the public's concern for the potential annoyance and adverse effects of noise on wildlife and humans.

4.2.5.1 Historic Conditions

Noise is typically associated with human activities and habitations, such as operation of commercial and recreational boats, water vessels, air boats, and other recreational vehicles; operation of machinery and motors; and human residential-related noise (air conditioner, lawn mower, etc.). However, the project area is a remote marsh only sparsely populated on its perimeter. The noise from distant urban areas surrounding the project area has little if any impacts on the area.

4.2.5.2 Existing Conditions

The MDWD study area contains a wide array of land use activities that vary throughout the entire project corridor. The dominant land use category located within the project area, as described under the Federal Highway Administration's (FHWA) Noise Abatement Criteria (NAC), is Activity Category C, which includes developed and undeveloped lands. The project area also contains a moderate amount of elements described in Activity Category B, which consists of playgrounds; active sports areas; parks, residences; motels; schools; churches; libraries; and hospitals. The dBA ranges for Activity Categories B and C were calculated by the FHWA using two different noise descriptors (L_{eq} and L_{10}). According to FHWA NAC, the estimated dBA ranges that are typically present for Activity Categories B and C are 67 dBA to 70 dBA and 72 dBA to 75 dBA, respectively (FHWA-2).

4.2.6 Vegetation Resources

Coastal vegetation resources attain institutional significance through the following Federal statutes: the Coastal Barrier Resources Act of 1982; the Coastal Zone Management Act of 1972; the Emergency Wetlands Resources Act of 1986; the Estuary Protection Act of 1968; the Fish and Wildlife Conservation Act of 1980; the Fish and Wildlife Coordination Act of 1958, as amended; the Migratory Bird Conservation Act; the Migratory Bird Treaty Act; the Endangered Species Act of 1973 (ESA); the Magnuson Fishery Conservation and Management Act 1990; the NEPA of 1969; the North American Wetlands Conservation Act; the Water Resources Development Acts of 1976, 1986, 1990, and 1992; and Executive Order 13186—Responsibility of Federal Agencies to Protect Migratory Birds. Coastal vegetation resources are technically significant because they are a critical element of the coastal habitats. In addition, coastal 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. Coastal vegetation resources are publicly significant because of the high priority that the public places on their aesthetic, recreational, and commercial value.

Vegetation in coastal Louisiana is inextricably linked to coastal hydrology. Two of the major mechanisms of vegetation change in the region, which includes the project area, are flooding and salinity. Hydrologic alterations such as levee building, channel construction, and drainage activities have substantially contributed to the vegetation changes in the project area over the past 50 years. A more-detailed discussion of the relationship between regional hydrology and vegetation regimes in the region was provided in the Final Programmatic EIS for the LCA Ecosystem Restoration Study (LCA 2004).

4.2.6.1 Riparian Vegetation

4.2.6.1.1 Historic Conditions

Historically, the Mississippi River had a riparian zone that transitioned from bottomland hardwood (BLH) forested ridges, transitioning through a mixed woodland community, to a swamp habitat between the ridges and eventually into marshland. The study area formed by a crevasse of the Mississippi River, forming River aux Chenes (Oak River) which transported water to the marshes during seasonal high water events, mainly during the late winter and early spring. The Mississippi River protection levee was constructed and reduced the spatial extent of the riparian zone while eliminating the natural flow of river water into the basin. This has eliminated the introduction of freshwater from the river and disrupted natural sediment deposition patterns. In addition, numerous channels have been dredged through natural ridges which increased drainage and tidal exchange. Composite coastal habitat mapping conducted by the USGS's National Wetlands Research Center in 2000 indicated that 839 acres of wetland forest, 460 acres of wetland shrub-scrub, and 0 acre of swamp were present in the project area at that time. Comparable survey data for the post-Katrina period was not available; however, local reports and visual observation suggest that storm damage has further reduced riparian forested acreage.

4.2.6.1.2 Existing Conditions

This resource is institutionally important because of Section 906 of the Water Resources Development Act of 1986 and the Fish and Wildlife Coordination Act of 1958, as amended. BLH forest is technically important because: it provides necessary habitat for a variety of species of plants, fish, and wildlife; it often provides a variety of wetland functions and values; it is an important source of lumber and other commercial forest products; and it provides various consumptive and non-consumptive recreational opportunities. BLH forest is publicly important because of the high priority that the public places on its aesthetic, recreational, and commercial value. BLH provides necessary habitat for a variety of species of plants, fish, and wildlife, and provides a variety of wetland functions and values. Seasonal flooding occurs over portions of the forests.

BLH provides necessary habitat for a variety of species of plants, fish, and wildlife, and provides a variety of wetland functions and values. Existing BLH in the study area is limited to small remnants of forested ridges adjacent to the Mississippi River, Oak River, and numerous oil and gas exploration canals. The BLH species along the Mississippi River batture include Drummond red maple (*Acer drummundii*), sugarberry (*Celtis laevigata*), Chinese tallow (*Sapium sebiferum*) sweet gum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), and black willow (*Salix nigra*). Shrubs and vines include buttonbush (*Cephalanthus occidentalis*), dew berry (*Rubus* sp.), and green briar (*Smilax* sp.)

The species found along Oak River include live oak trees (*Quercus virginiana*), black willow, sugarberry, and scattered baldcypress (*Taxodium distichum*) on the northern end. A lot of the oak trees have died leaving remnant snag trees on the subsiding ridge. Scrub/shrub species include palmetto (*Sabal minor*), elderberry (*Sambucus canadensis*), eastern baccharis (*Baccharis haemifolia*) locally called mung bushes, and wax myrtle (*Myrica cerifera*), and marshhay cordgrass (*Spartina patens*). The Bayou Garelle ridges have subsided to mostly a scrub/shrub habitat with the same species as above.

Canal dredging for oil and gas exploration has created numerous man-made ridges. The species on the banklines include sugarberry, Chinese tallow, and black willow. Shrubs and vines include palmetto, elderberry, mung bushes, and dewberry. Strong southeasterly winds associated with storms causes seasonal flooding over portions of the banklines and ridges.

4.2.6.2 Wetland Vegetation

4.2.6.2.1 Historic Conditions

Historically, there was a basin with wide and gradual salinity transition zones that supported a healthy, natural, and sustainable estuary and fisheries. The 1956 habitat map was used for target land and vegetation distribution. The 1956 USGS analysis divided marsh between fresh (fresh and intermediate) and non-fresh (brackish and saline). According to the 1956 USGS Habitat Analysis, there was 10,716 acres of fresh marsh and 40,130 acres of non-fresh marsh (Figure 4.2).

4.2.6.2.2 Existing Conditions

The following Federal laws recognize the national significance of marshes as a natural resource: the Clean Water Act of 1977, as amended; Executive Order 11990 of 1977, Protection of Wetlands; Coastal Zone Management Act of 1972, as amended; and the Estuary Protection Act of 1968. Marshes are ecologically important because they: 1) provide necessary habitat for various species of plants, fish, and wildlife; they serve as ground water recharge areas; 2) provide storage areas for storm and flood waters; 3) serve as natural water filtration areas; 4) provide protection from wave action, erosion, and storm damage; and 5) provide various consumptive and non-consumptive recreational opportunities. Marshes are significant to the public because of the high value the public places on the ecological functions and human benefits that marshes provide. The basic marsh habitats within the MDWD study area are intermediate, brackish, and saline marsh with an addition of fresh marsh in the extended influence area (Figure 4.3).

There are approximately 2,000 acres of fresh marsh (0–3 ppt salinity) in the extended influence area. There are two basic types of fresh marsh in the area, flotant emergent and attached emergent. The flotant marsh is actually not attached to the underlying soil although the marsh plants form a dense mat that appears to be solid. The flotant marshes contain primarily maiden cane, coastal arrowhead, and Baldwin's spikerush. The attached emergent fresh marsh is attached to the underlying soil and also contains predominantly maiden cane and coastal arrowhead, along with spikerush, alligatorweed, common reed, coastal water-hyssop, penny-wort, and saltmeadow cordgrass.

Intermediate marsh (2–8 ppt salinity) habitat lies between fresh marsh and brackish marsh and the species of vegetation are not much different from fresh marsh, however, the dominance of the species is different. Marshhay cordgrass (*Spartina patens*) is the dominant species, with coastal arrowhead (*Sagittaria falcata*), roseau cane (*Phragmites australis*), coastal water-hyssop (*Bacopa monnieri*), seashore paspalum

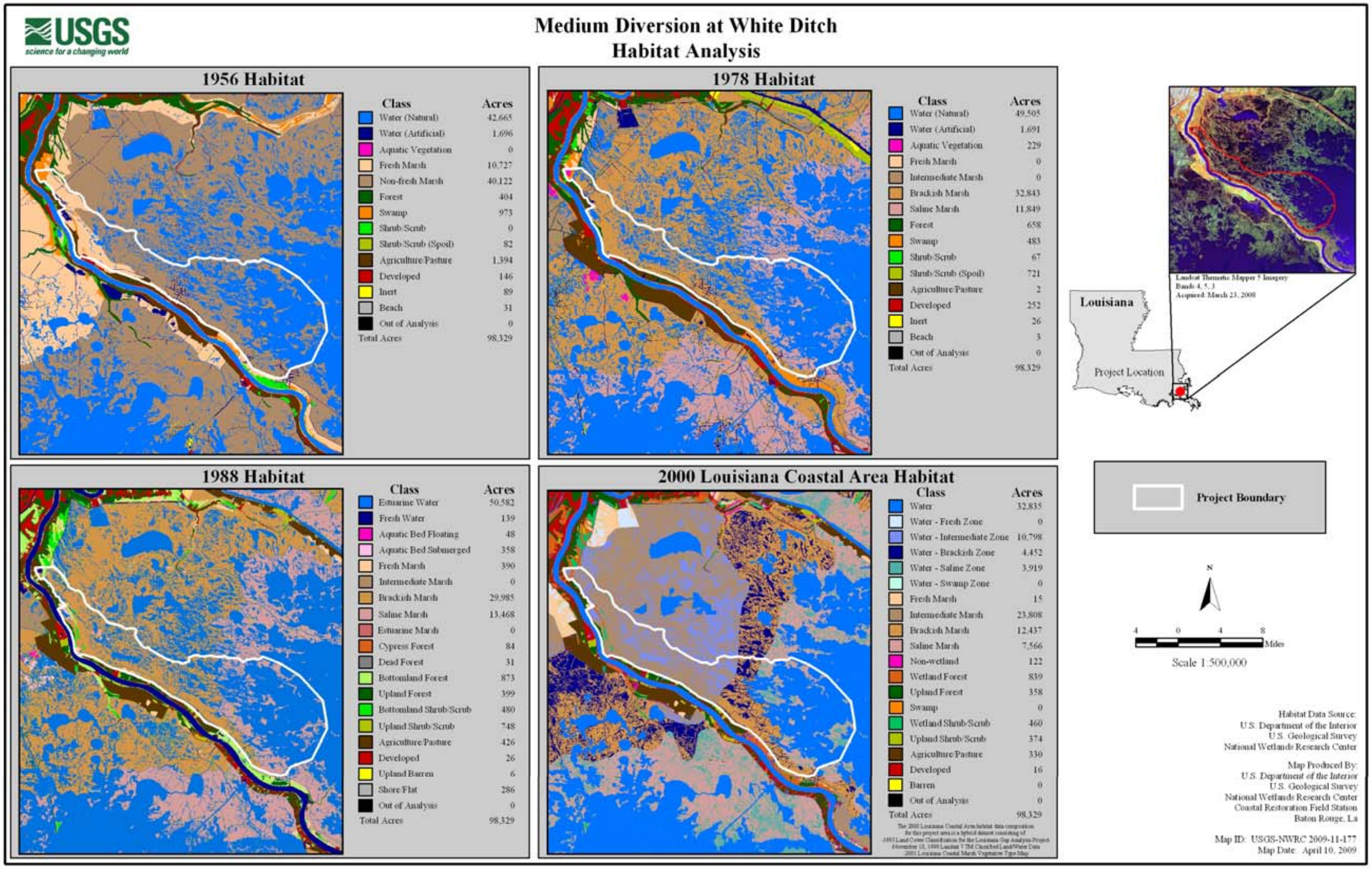

Figure 4.2: Historic Habitat Analysis of the White Ditch Project Area

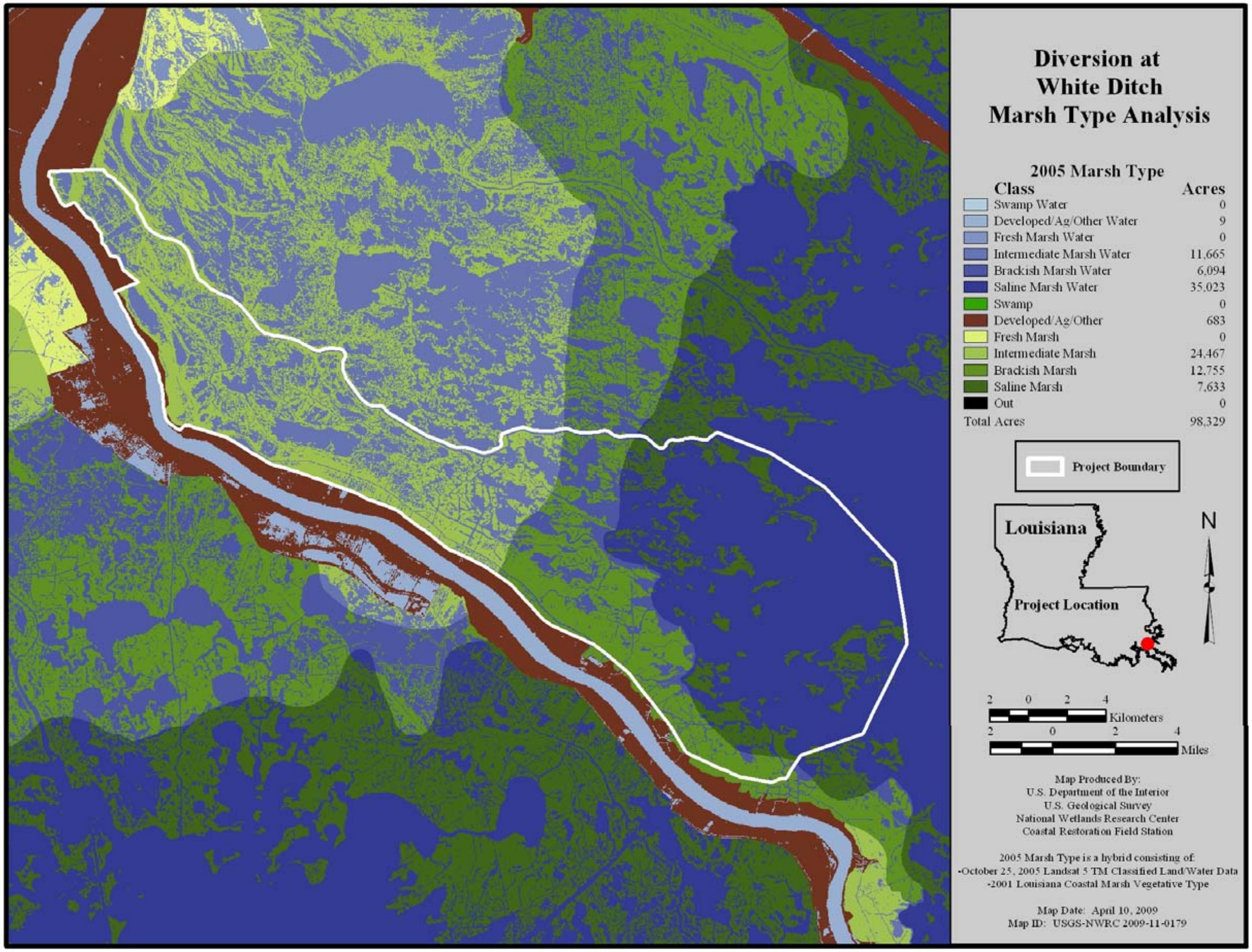

Figure 4.3: Marsh Types in the White Ditch Project Area

(*Paspalum vaginatum*), spikerush (*Eleocharis parvula*), eastern baccharis (*Baccharis halimifolia*) smartweed (*Polygonum* sp.), deerpea (*Vigna repens*), marsh morning glory (*Ipomoea sagittata*), and leafy three-square (*Scirpus robustus*) also common. There are approximately 32,000 and 90,000 acres of intermediate marsh in the MDWD study area and the extended influence areas, respectively.

Brackish marsh (4–18 ppt salinity) habitat lies between intermediate marsh and saline marsh. The dominant brackish marsh plant is marshhay cordgrass, comprising about one-half of the plants (Gosselink 1984: Conner and Day 1987). Other important species include seashore saltgrass (*Distichlis spicata*), camphorweed (*Pluchea camphorata*), and coastal water-hyssop (Conner and Day 1987). There are approximately 17,500 and 11,500 acres of brackish marsh in the MDWD study area and the extended influence areas, respectively.

The saline marsh (8–29 ppt salinity) community typically has the lowest plant species diversity of any marsh type. The dominant species in the salt marshes of the project area is oystergrass (*Spartina alterniflora*). There are approximately 7,500 and 5,000 acres of saline marsh in the MDWD study area and the extended influence areas, respectively.

4.2.6.3 Upland Vegetation

4.2.6.3.1 Historic Conditions

Historically, upland vegetation in the project study area, if present, would have been limited to the highest natural levee areas.

4.2.6.3.2 Existing Conditions

Upland vegetation in the project study area is limited to the highest elevation developed areas such as the Federal levee and landscaping around home sites.

4.2.6.4 Submerged Aquatic Vegetation (SAV)

4.2.6.4.1 Historic Conditions

Fresh and intermediate marshes often support diverse communities of submerged aquatic plants that provide important food and cover to a wide variety of fish and wildlife species. Brackish marshes also have the potential to support aquatic plants that serve as important sources of food and cover for several species of fish and wildlife. Although brackish marshes generally do not support the amounts and kinds of subaquatic plants that occur in fresh/intermediate marshes, certain species, such as widgeon-grass (*Ruppia maritima*), and coontail (*Ceratophyllum demersum*) and Eurasian watermilfoil (*Myriophyllum spicatum*) in lower salinity brackish marshes, can occur abundantly under certain conditions. Those species, particularly widgeon-grass, provide important food and cover for many species of fish and wildlife. The saline marshes typically do not contain an abundance of aquatic vegetation as often found in fresh/intermediate and brackish marshes.

4.2.6.4.2 Existing Conditions

Little to no up-to-date field information is available on the current composition and extent of submerged aquatic vegetation (SAV) in the White Ditch project area. For purposes of the WVA analysis, existing

SAV in the intermediate marsh zone was assumed to be 25% of the total area. That value is the mean of the SAV cover values from the Monsecour Siphon Project (2009), Bertrandville Siphon Project (2008), and White Ditch Siphon Project (2004) WVAs prepared by CWPPRA. Those WVAs encompass the majority of the intermediate marsh zone in the project area. No SAV cover data has been collected in the brackish marsh zone and there are no previous project WVAs that have been conducted in this portion of the project area. It is assumed that SAV cover would be somewhat less in this area (15% assumed) as compared to the intermediate area. Similar to the brackish marsh zone, no SAV cover data has been collected in the saline marsh zone and there are no previous project WVAs that have been conducted in this portion of the project area. SAV cover is typically very low or non-existent within saline marshes and this area contains very large open water areas, which typically contain no SAV. However, it is assumed that SAV cover may exist in some of the more isolated bodies of water (2% coverage assumed).

4.2.6.5 Invasive Species – Vegetation

4.2.6.5.1 Historic Conditions

Invasive plant species often increase and spread rapidly because the new habitat into which they are introduced is often free of insects and diseases that are natural controls in their native habitats. In coastal Louisiana, Chinese tallow, water hyacinth, alligator weed and hydrilla are well-known invasive plants. More recently, common salvinia, giant salvinia, and variable-leaf milfoil also have become invasive, displacing native aquatic species and degrading water quality and habitat quality (LACPR 2008).

4.2.6.5.2 Existing Conditions

Of the invasive plant species occurring or potentially occurring within the White Ditch project area, water hyacinth is currently the species most identified as problematic by local property owners. No information on the existing occurrence or coverage within the project area is available; however, the reported proliferation of this species in canals and water bodies within the Caernarvon subbasin is commonly attributed to the fresher water conditions resulting from operation of that existing diversion.

4.2.7 Wildlife and Habitat

This resource is institutionally significant because of the Fish and Wildlife Conservation Act of 1980, the Fish and Wildlife Coordination Act of 1958, as amended, the Migratory Bird Conservation Act, the Migratory Bird Treaty Act, the ESA, and Executive Order 13186, Migratory Bird Habitat Protection. Wildlife resources are technically significant because they are a critical element of the various coastal habitats, they are an indicator of the health of coastal habitats, and many wildlife species are important commercial resources. Wildlife resources are publicly significant because of the high priority the public places on their aesthetic, recreational, and commercial value.

4.2.7.1 Historic Conditions

The wetlands and associated habitats of coastal Louisiana are of national importance and provide essential habitat to diverse and abundant wildlife resources, including a wide range of resident and migratory birds as well as critical habitat for the wintering populations of the piping plover. Coastal Louisiana has the Nation's largest concentrations of colonial nesting wading birds and seabirds. Coastal marshes in the state provide habitat to 14 species of ducks and geese (those species for which data is available). Marshes, swamps, and associated habitats support millions of neotropical and other migratory avian species such as rails, gallinules, shorebirds, wading birds, and numerous songbirds, providing essential stopover habitat on their annual migration route. Coastal Louisiana has been a leading fur-producing area in North America, and coastal marshes and swamps also support game and small mammals. Louisiana marshes provide abundant habitat for many reptiles, most notably the American alligator, and the swamps and fresh/intermediate marshes also support many amphibians, especially various frog species.

4.2.7.2 Existing Conditions

Existing wetlands in the study area provide important and essential wildlife habitats, used for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The coastal marshes of Louisiana provide winter habitat for more than 50 percent of the duck population of the Mississippi Flyway. Large populations of migratory waterfowl, including gadwalls, blue-winged teal, green-winged teal, wigeons, lesser scaup, shovelers, pintails, and mallards, are present during winter in the MDWD study area. Mottled ducks are present year-round. These waterfowl are highly sought by sportsmen. In addition, coots, gallinules, rails, mourning doves, and snipe are important game species. Dabbling duck and diving duck numbers are increasing in the vicinity of existing freshwater diversions, such as in the Caernarvon area upriver of the study area.

Non-game avian species present in the study area include wading birds, shore birds, and sea birds include egrets, ibis, herons, sandpipers, willets, black-necked stilts, gulls, terns, skimmers, grebes, loons, cormorants, and white and brown pelicans. Various raptors such as barred owls, red-shouldered hawks, northern harriers (marsh hawks), American kestrel, and red-tailed hawks are present. Passerine birds present include sparrows, vireos, warblers, mockingbirds, grackles, red-winged blackbirds, wrens, blue jays, cardinals, and crows. Many of these birds are present primarily during periods of spring and fall migrations.

The study area also contains a great variety of mammals, reptiles, and amphibians. Abundant furbearers, including nutria, muskrat, mink, otter, and raccoon, formerly supported a trapping industry in the nearby Terrebonne Basin. Other species inhabiting the area where suitable habitat is present include white-tailed deer, skunks, rabbits, squirrels, armadillos, and a variety of smaller mammals. The area provides habitat for salamanders, toads, frogs, turtles, and several species of poisonous and nonpoisonous snakes. The American alligator is abundant in fresh to intermediate marsh and is caught commercially for its hides and meat throughout the area.

Numerous terrestrial invertebrates are found throughout the study area. The most notable are insects, which often serve as vectors, transmitting disease organisms to higher animals, including man. Mosquitoes are the most important of the vectors in the area, although other groups, such as deer flies, horseflies, and biting midges are also considered vectors. The area provides suitable breeding habitat for such species as *Aedes sollicitans* (salt-marsh mosquito), *Culex salinarius*, and other species of mosquitoes. Mosquitoes carry the West Nile virus, which has recently caused some illness and even death of both animals and humans in Louisiana.

Native muskrats, once trapped for their valuable fur throughout coastal Louisiana, have been crowded out by invasive South American nutria. Damage by nutria herbivory on marsh vegetation is an ongoing concern in the study area. The first CWPPRA-funded coast-wide survey, conducted in 1998, showed herbivory damage areas totaling approximately 90,000 acres. By 1999 this coast-wide damage had increased to nearly 105,000 acres. This rapid and dramatic increase in damaged acres prompted LDWF to pursue funding for the Coastwide Nutria Control Program (CNCP) in January 2002.

The project is funded by the CWPPRA through the NRCS and the CPRA with the LDWF as the lead implementing agency. The project goal is to significantly reduce damage to coastal wetlands attributable to nutria herbivory by removing 400,000 nutria annually. This project goal is consistent with the Coast 2050 common strategy of controlling herbivory damage to wetlands. The method chosen for the program is an incentive payment to registered trappers/hunters for each nutria tail delivered to established collection centers. Initially, registered participants were given $4.00 per nutria tail. To encourage participation, the payment was increased to $5.00 per tail in the 2006–2007 season. During the 2007–2008 season, a total of 73,797 tails were harvested in Plaquemines Parish (LDWF annual report, 2008).

4.2.8 Aquatic Resources

4.2.8.1 Historic Conditions

A general description of aquatic resources in the overall LCA study area (plankton and benthos) was provided in Sections 3.9 and 3.10 of the LCA FPEIS and is incorporated here by reference. No information is available on historic conditions of aquatic resources in the specific White Ditch project area.

4.2.8.2 Existing Conditions

Aquatic habitat in the project vicinity is provided by the Mississippi River, oxbow lakes, borrow areas and estuarine wetlands. The main stem of the Mississippi River with an average depth of greater than 5 feet is inherently low in primary productivity on a relative basis because of high turbidity. Poor benthic productivity is characteristic of the shifting substrates and high current velocities in the area. The deep main river channel is the habitat of large predaceous fishes, some plankton feeders and a number of omnivorous species.

Plankton communities serve an important role in the coastal waters of Louisiana. Phytoplankton are the primary producers of the water column, and form the base of the estuarine food web. Zooplankton provide the trophic link between the phytoplankton and the intermediate level consumers such as aquatic invertebrates, larval fish, and smaller forage fish species (Day et al., 1989). Microzooplankton appear to be important consumers of bacterioplankton, which are typically enumerated primarily by culture and microscopic techniques. Culture techniques are selective and invariably underestimate bacterial densities (Day et al., 1989). "The Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana," prepared by the Louisiana Wildlife and Fisheries Commission in 1971 provides a summary of plankton across the coastal estuaries of Louisiana in the late 1960s (Perret et al., 1971). The dominant member of the zooplankton community throughout that study was the copepod *Acartia tonsa*. The greatest concentrations of zooplankton were encountered in Breton Sound. The lowest concentrations were encountered in Chandeleur Sound and Lake Borgne east of the Mississippi River, Lakes Barre and Raccourci, and Terrebonne and Timbalier Bays. Species diversity was greatest in the Breton Sound and Mississippi River, East Bay, Garden Island Bay, and West Bay areas.

Historically, salinity appears to be the chief controlling factor in the number of species present, while temperature, competition, and predation control the number of individuals present (Day et al., 1989). In addition, the abundance of certain zooplankton may be indicative of good fishing areas. While some zooplankton are euryhaline, others have distinct salinity preferences (Day et al., 1989). Therefore, introduction of river water into estuarine systems may have dramatic short-term impacts on plankton populations in adjacent coastal waters (Hawes and Perry, 1978).

4.2.9 Fisheries

Fishery resources are institutionally significant because of the Fish and Wildlife Coordination Act of 1958, as amended; the ESA; the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act), as amended; the Magnuson-Stevens Act Reauthorization of 2006; 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 indicators of the health of various freshwater and marine habitats; and many species are commercially important. Fishery resources are publicly significant because of the high priority placed on their aesthetic, recreational, and commercial value.

4.2.9.1 Historic Conditions

Prior to the twentieth century, the tremendous estuarine productivity of coastal Louisiana was sustained by the river's distributaries and periodic floodwaters, which deposited millions of tons of sediments and nutrients on adjacent coastal marshes. The beneficial impact of this alluvial renourishment to fisheries was recognized by early native inhabitants and is documented in formal reports dating back to 1906. Levee construction and subsequent fortification through the twentieth century has resulted in major disruption to the river's natural deltaic cycle. Processes such as subsidence, saltwater intrusion, and wave erosion were no longer offset by accretion, resulting in extensive loss of coastal wetlands (Caffey and Schexnayder 2002). Despite this, Louisiana commercial fishery landings have increased significantly since the early 1900s and recreational harvests have been relatively stable for the past 10 years. At the same time, coastal habitats that support Louisiana fisheries have been increasingly impacted over the last 50 years by subsidence, sea level change, channelization of bayous, dredging of canals, and intensive management of marshes for wildlife and waterfowl.

4.2.9.2 Existing Conditions

The MDWD project study area is located in LCA Subprovince 1 in the Breton Sound hydrologic basin in Plaquemines Parish, Louisiana. The boundary of the project encompasses over 98,000 acres of intermediate to brackish intertidal wetland habitats. The study area boundary follows distinct landscape features beginning in the north with the confluence of the non-Federal back levee and the Forty-Arpent canal, extending along the non-Federal back levee, the Mississippi River levee, the Federal back levee and along the left descending natural bank of the Mississippi River to the west; past American Bay, California Bay, and through Breton Sound, near Bay Gardene to the south; into and along River aux Chenes to the east, and back to the point of beginning.

The majority of the MDWD study area is estuarine habitat. Estuarine fishery species may be resident (inhabiting the estuary throughout their life cycle), such as killifishes, or transient (utilizing the estuary for some portion of their life cycle) such as gulf menhaden, blue crab, or shrimp. Marine species are found in offshore waters throughout the gulf coast and generally do not depend on estuaries to complete any part of their life cycle. These species are in some ways dependent on the health and productivity of coastal estuaries, in that their prey often is made up of estuarine dependent species. In addition, some marine species frequently inhabit the lower reaches of estuaries, where productivity is high. Noted finfish species found in the Breton Sound Basin include speckled trout, red drum, black drum, sheepshead, sand seatrout, Atlantic croaker, spot, gulf menhaden, and spotted seatrout.

Three species of crustaceans — brown shrimp, white shrimp, and blue crab — are of major commercial and recreational importance in the coastal waters of Louisiana. Each of these species follows a circular migration, which encompasses a broad range of estuarine salinities. Because commercial harvesting targets the late juvenile and adult stages, productivity is often incorrectly equated with higher salinities. Though higher salinities tend to favor harvestability, they are not directly linked to absolute productivity (Caffey and Schexnayder 2002).

The American oyster is indigenous to coastal Louisiana and provides a substantial ecological and commercial resource. This organism is notable in that it is sessile and cannot migrate like many other estuarine species. Salinity plays a key role in oyster sustainability (Eastern Oyster Biological Review Team [EOBRT], 2007). Adult oyster can tolerate salinities from 0 to 42 ppt, but the optimal range is 14 to 28 ppt (EOBRT, 2007). Oyster spat can settle out at salinities as low as 3 ppt, but will have difficulty surviving. Fresher waters fail to support biological function, and more saline waters promote disease and predation. The upper two-thirds of the study area and extended influence area are either not conducive for spat settlement or suboptimal for natural oyster reef formation (Figure 4.1). Adult oysters are more prone to impacts from changes in water quality than commercially harvested fishes and crustaceans because they are sessile, and cannot relocate in response to changes in water quality parameters. Production of oysters in Louisiana has been relatively stable for the last 50 years, with harvest from public beds replacing the decreasing harvest from private leases. See Section 4.2.15.15.2 for a discussion of oyster leases. The Louisiana oyster industry has been experiencing many stressors over the past several decades that threaten the long-term sustainability of both the industry and the resource (Coleman, 2003). Increasing coastal land loss is reducing the amount of marsh that provides shelter to reefs, and saltwater intrusion is exacerbating disease and predation. In addition, the industry is faced with changing environmental conditions, fluctuating market demands, public perception issues, and increased competition.

4.2.10 Essential Fish Habitat (EFH)

This resource has statutory significance because of the Magnuson-Stevens Act (P.L. 104-297), which intended to promote the protection, conservation, and enhancement of EFH. The EFH designation is an important component of building and maintaining sustainable marine fisheries through habitat protection. The Magnuson-Stevens Act defines EFH for federally managed fish species as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”

4.2.10.1 Historic Conditions

Emergent wetlands and shallow open water areas in the MDWD project area and adjacent areas of the Breton Sound Basin provide transitional habitat between estuarine and marine environments used by migratory and resident fish and other aquatic organisms for nursery, foraging, breeding and spawning, and other life requirements. The marshes and shallow bays function as nursery grounds for stocks of shrimp, oysters, crabs, and a variety of finfish (Louisiana Coastal Wetlands Conservation and Restoration Task Force, 1993).

4.2.10.2 Existing Conditions

By letter dated February 10, 2009, the NMFS provided information on EFH in the study area in support of the public scoping effort for the project feasibility study and EIS. Aquatic and tidally influenced wetland habitats in portions of the MDWD study area are designated as EFH for various federally managed species, including white shrimp, brown shrimp, red drum, lane snapper, dog snapper, and Gulf stone crab. These species are managed by the Gulf of Mexico Fishery Management Council (GMFMC). Table 4.1 lists life stages and subcategories of EFH for these species that would potentially be benefited or impacted by this project. Primary categories of EFH in the study area include estuarine emergent wetlands; SAV; mud, sand, and shell substrates; and estuarine water column. Detailed information on federally managed fisheries and their EFH is provided in the 2005 generic amendment of the Fisheries Management Plans (FMPs) for the Gulf of Mexico prepared by the GMFMC. The generic amendment was prepared as required by the Magnuson-Stevens Act (P.L. 104-297).

In addition to being designated as EFH for the species listed in Table 4.1, water bodies and wetlands in the study area provide nursery and foraging habitats supportive of a variety of economically important marine fishery species, such as striped mullet, Atlantic croaker, gulf menhaden, spotted seatrout, sand seatrout, southern flounder, black drum, and blue crab. Some of these species also serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). (NOAA 2009)

Table 4.1: Essential Fish Habitat (EFH) for Various Life Stages for Shrimp, Red Drum, Reef Fish, and Stone Crab (NMFS Scoping Correspondence, 2009)

Species	Life Stage	System	EFH
Brown Shrimp	Larvae	Marine	<82 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
	Juvenile	Estuarine	<18 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
White Shrimp	Juvenile	Estuarine	<30 m; SAV, soft bottom, emergent marsh
Gulf Stone Crab	Eggs	Estuarine/Marine	<18 m; sand/shell/soft bottom
	Larvae/postlarvae	Estuarine/Marine	<18 m; planktonic/oyster reefs, soft bottom
	Juvenile	Estuarine	<18 m; sand/shell/soft bottom, oyster reef
Red Drum	Larvae/postlarvae	Estuarine	All estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	Juvenile	Estuarine/Marine	GOM <5 m W from Mobile Bay; all estuaries SAV, sand/shell/soft/hard bottom, emergent marsh
	Adults	Marine/Estuarine	GOM 1–46 m W from Mobile Bay; all estuaries SAV, pelagic, sand/shell/soft/hard bottom, emergent marsh
Lane Snapper	Larvae	Estuarine/Marine	4–132 m; reefs, SAV
	Juvenile	Estuarine/Marine	<20 m; SAV, mangrove, reefs, sand/shell/soft bottom
Dog Snapper	Juvenile	Estuarine/Marine	SAV, mangrove, emergent marsh

4.2.11 Threatened and Endangered Species

4.2.11.1 Historic Conditions

In Louisiana, Plaquemines parish has experienced some of the most dramatic environmental changes within the state over the past century. These changes have stressed listed species in Louisiana as their habitats are lost or modified. Some species that historically may have inhabited the area are the red wolf (*Canis rufus*) and the Louisiana black bear (*Ursus americanus luteolus*). Other species that were listed on the Endangered Species List, but have since then been de-listed because population's levels have improved are the bald eagle (*Haliaeetus Leucocephalus*) and the brown pelican (*Pelecanus occidentalis*).

Red wolf (*Canis rufus*). The red wolf is one of the world's most endangered wild canids. Once common throughout the southeastern United States, red wolf populations were decimated by the 1960s due to intensive predator control programs and loss of habitat. A remnant population of red wolves was found along the Gulf Coast of Texas and Louisiana. The USFWS declared red wolves extinct in the wild in 1980 (USFWS 2007). At one time red wolves may have occurred in the project area, but no documented sightings have occurred since they were declared extinct in the wild.

Louisiana Black Bear (*Ursus americanus luteolus*). The Louisiana black bear was listed as a threatened species in 1992. The Louisiana black bear is a subspecies of the American black bear, found in Louisiana, south Mississippi and east Texas. This bear is usually black in color and typically weighs 150 to 300 pounds as an adult (USFWS 2008). The Louisiana black bear was numerous during colonial times and may have inhabited the project area, but no documented cases exist in this area for the twentieth century.

Bald Eagle (*Haliaeetus leucocephalus*). Bald eagles live near rivers, lakes, and marshes where they can find fish, their staple food (USFWS 2009a). The successful recovery of bald eagle populations within the continental United States resulted in the delisting of the species from the Endangered Species List by the USFWS on August 9, 2007. Bald eagles may occur in the project area but no nest trees are documented within the MDWD project area.

Brown Pelican (*Pelecanus occidentalis*). Brown pelicans live in coastal regions along the Gulf and feed primarily of on fish. The successful recovery of the brown pelican population within the continental United States resulted in the delisting of the species from the Endangered Species List by the USFWS on November 17, 2009. Brown pelicans inhabit the area, but do not nest within areas directly affected by the proposed action.

4.2.11.2 Existing Conditions

Within the study area there are several animal and plant species under the Federal jurisdiction of the USFWS and/or the NMFS, presently classified as endangered or threatened. Within Plaquemines Parish, location of the MDWD study area, federally listed species include the pallid sturgeon (*Scaphirynchus albus*), Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), West Indian manatee (*Trichechus manatus*), piping plover (*Charadrius melodus*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and loggerhead sea turtle (*Caretta caretta*)

Gulf Sturgeon (*Acipenser oxyrhynchus desotoi*). The Gulf sturgeon was listed as threatened throughout its range on September 30, 1991. Gulf sturgeon live in the estuaries and coastal shelf regions of the Gulf of Mexico during the cooler months of the year, from October to March. Distribution of Gulf sturgeon in Louisiana extends from the Mississippi River east to the Pearl River. The majority of sturgeon have their origins in the Pearl River system, where the largest population occurs (Carr, Tatman, & Chapman, 1996).

Green Sea Turtle (*Chelonia mydas*). The green sea turtle was listed as threatened in U.S. waters, except for the Florida breeding population which was listed as endangered, on July 28, 1978. Due to the inability to distinguish between these populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters. The green sea turtle is one of the largest marine turtles with adult weights averaging between 250 to 450 pounds (Dundee 1989). In the Atlantic and Gulf of Mexico waters, the green sea turtle typically inhabits areas adjacent to the coastline and has been known to have a range spanning from Texas to as far north as Massachusetts (NOAA-1).

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). The Kemp's ridley sea turtle was listed as endangered throughout its range, on December 2, 1970. The Kemp's ridley sea turtle is the smallest of the sea turtles with adults reaching an approximate length of 2 to 2½ feet and weighing around 110 pounds (Dundee 1989). During the months of May to October, this species can be found in and around the shore line of Louisiana with adults occupying areas around the mouth of Mississippi during the spring and summertime (LDWF 2005).

Loggerhead Sea Turtle (*Caretta caretta*). The loggerhead sea turtle was listed as threatened throughout its range on July 28, 1978. The loggerhead sea turtle is also one the larger marine turtles with average adult lengths ranging from 3 to 7 feet and weighing approximately 300 to 1,100 pounds (Dundee 1989). In Louisiana, this species has been found nesting on the Chandeleur Islands and Grand Isle in Terrebonne Parish (Dundee 1989).

Pallid Sturgeon (*Scaphirynchus albus*). The pallid sturgeon was listed as endangered throughout its range on October 9, 1990. The pallid sturgeon is a bottom oriented, large river obligate inhabiting the Missouri and Mississippi Rivers from Montana to Louisiana and the Atchafalaya River. The pallid sturgeon is adapted to the predevelopment habitat conditions that historically existed in these large rivers (USFWS 2009b).

West Indian Manatee (*Trichechus manatus*). The West Indian manatee was listed as endangered on June 2, 1970. The West Indian manatee is a large gray or brown aquatic mammal. Adults average approximately 10 feet in length and weigh up to 2,200 pounds. Manatees inhabit both salt and freshwater of sufficient depth (5 feet to usually less than 20 feet) throughout their range. A few individuals have been known to stray as far north as the northern Georgia coast and as far west as the coastal waters of Louisiana (USFWS 2001).

Piping Plover (*Charadrius melodus*). The piping plover was listed as threatened and endangered on December 11, 1985. The piping plover is a shorebird that inhabits open beaches, alkali flats, and sandflats of North America. It breeds primarily along the Atlantic coast from North Carolina to southern Canada, along rivers and wetlands of the northern Great Plains from Nebraska to the southern prairie provinces, and along portions of the western Great Lakes. In winter, most individuals are found on coastal beaches and sand flats from the Carolinas to Yucatan; some scatter through the Bahamas and West Indies (Haig, 1992).

4.2.12 Cultural and Historic Resources

This resource is institutionally significant because of the National Historic Preservation Act of 1966 (NHPA), as amended, and the NEPA of 1969. Cultural resources are technically significant 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 significant information about prehistory and history. Cultural resources are publicly significant because preservation groups and private individuals support their protection, restoration, enhancement, or recovery.

4.2.12.1 Historic Conditions

According to the records at the Louisiana State Division of Archaeology there has only been one previous cultural resource survey in the project area. This survey was a linear inventory for a proposed 24 inch pipeline for Gulf Refining Company (Chance and Associates 1981). No sites were identified by this survey. However this survey was not conducted to today's standards and any buried sites were most likely missed. Besides the possibility of encountering historic and prehistoric period terrestrial sites there is also the possibility of impacting historic period sunken ships in the main channel of the Mississippi River.

4.2.12.2 Existing Conditions

Four archaeological sites are known to exist in or near the project area. These are 16PL16, 16PL15, 16PL193, and 16PL25. One historic period site was thought to be within the project area, 16PL27, Fort De Boulye. The three prehistoric sites were visited and two, 16PL15 and 16PL25 were found to be not eligible to the National Register of Historic Places. 16PL16 has not been evaluated because it is located just outside the Area of Potential Effect. 16PL27 is a National Historic Landmark but is not located where it is shown on Louisiana Division of Archaeology records. By law any effect to a National Historic Landmark has be the subject of consultation with the National Park Service. Consultation with the National Park Service on this issue begin with the DEIS and coordination has occurred since. It is believed that 16PL27, if it does still exist, is located outside the Area of Potential Effect. 16PL193 is a standing structure and also was not found eligible for the National Register of Historic Places. At this time the area along Oak River and the Mississippi River batture has been surveyed for cultural resources. Bayou Garelle remains to be surveyed. A task order for this is in the process of being issued.

4.2.13 Aesthetics

This resource is institutionally important because of the laws and policies that affect visual resources, most notably the 1969 NEPA. Visual resources are publicly and technically important because of the high value placed on the preservation of unique natural and culture landscapes.

4.2.13.1 Historic Conditions

Based on available aerial photography (namely, comparisons between 2008 photography and 1992 photography), the visual conditions of the White Ditch Study Area have seen little change over the past 20 years as it pertains to aesthetic (visual) resources. The same public thoroughfares that are in place today were in place then, along with similar view sheds. Primary view sheds, as they are today, were best taken from atop the local levee system, and, in some instances, LA 39. With limited access to the site, the only other alternative for viewing and enjoying the aesthetic qualities of the land becomes available via watercraft. Comparisons between the two sets of photography show that areas associated with view sheds from the public thoroughfares have changed little, while areas to be accessed by watercraft have seen dramatic change through land loss and conversion to larger open water areas. Without older aerial photography, ground photographs of the site, or other historical visual data, further analysis of aesthetic (visual) conditions will not be possible.

4.2.13.2 Existing Conditions

The landscape of the region is dominated by fields and marshland with a mixture of water tolerant vegetation and some forestation. The flood side of the levees is moderate to densely vegetated offering some minimal view sheds into the swamps and marshlands. For a significant portion of the study area, view sheds are only offered from atop the levee system. For those who participate in outdoor activities, such as recreational walking, hiking and biking, nature/ ecological study, fishing, and/ or birding the visual characteristics are much more apparent and important when on the levees or the land on the flood side.

The most likely scenario is that the local residents are the primary utilizers of the banks of the levees for recreational purposes and would greatly benefit from an aesthetically pleasing recreational environment.

4.2.14 Recreational Resources

4.2.14.1 Historic Conditions

Due to the somewhat isolated nature of the project area and limited access, consumptive recreational use pressures have been moderate. Historically, primary recreational activities in the study area have been consumptive in nature, including fishing and hunting. Saltwater recreational activities have revolved primarily around saltwater fishing and to a lesser degree recreational shrimping and crabbing. Freshwater based recreational opportunities have primarily been waterfowl hunting and some limited freshwater fishing. Historically, natural ridges in the study area have supported deer and small game hunting.

As throughout much of coastal Louisiana, the study area has experienced substantial coastal erosion, loss of wetlands and increasing salinity levels. Some of the effects were exacerbated by past and recent hurricanes.

Due to increased salinity levels, deterioration of freshwater and intermediate marsh habitats have resulted in decreased opportunities for waterfowl hunting. According to duck hunters, waterfowl hunting flourished in the 1980s when the existing White Ditch siphon operated at full capacity. In recent decades, as marshes and SAV in the area have disappeared, waterfowl have shown less preference for the study area and duck hunting success has decreased.

Similarly, the study area has experienced erosion and subsidence, which has threatened the natural ridges in the area that have traditionally provided opportunities for hunting deer and small game.

The lower reaches of the study area have historically offered quality saltwater fishing opportunities as is the situation today. After the 2005 hurricanes when salinity levels were very high, anglers reported that the area experienced one of the best periods of recreational saltwater fishing.

4.2.14.2 Existing Conditions

The most prominent recreational activities within the study area are consumptive uses, saltwater fishing and waterfowl hunting. Other consumptive recreation uses include recreational crabbing and shrimping with limited deer and small game hunting on natural ridges. Non-consumptive recreational activities appear to be minimal and include wildlife observation.

Recreation resources are publicly significant because of the high value that the public places on fishing, boating, and hunting 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. This is particularly important as most of the recreational activities in the study area are only accessible by boat.

There are a variety of water features in the area including canals, tributaries, bayous, wetlands and marshes. Within the study area, recreational walking, nature/ecological study and birding are activities in which residents and visitors may participate. Recreational sport fishing and boating in the waters is available and encouraged where public access is available.

Tables 4-2, 4-3, and 4-4 below show the number of recreational fishing and hunting licenses and boat registrations, respectively, within the study area. The fishing and hunting license and boat registration data are provided by the LDWF (http://www.wlf.louisiana.gov/education/economics/).

Table 4.2: Fishing Licenses Year 2009

	All Resident Fishing Privileges	All Resident Saltwater Privileges	All NR* Fishing Privileges	All NR* Saltwater Privileges
St. Bernard	3,739	3,748	581	570
Plaquemines	3,647	3,678	1,266	1,261
Orleans	6,264	6,238	1,069	1,039
Jefferson	47,645	47,500	9,649	9,296

* Non-Resident

Table 4.3: Hunting Licenses Year 2009

Parish	Hunting Licenses	
	Resident	Non-Resident
St. Bernard	1,335	12
Plaquemines	1,023	24
Orleans	1,858	45
Jefferson	13,681	253

Table 4.4: Boat Registrations
Year 2008

Parish	Boat Registrations
St. Bernard	2,294
Plaquemines	3,340
Orleans	4,157
Jefferson	19,258

There are two boat launches located within the White Ditch project area (Figure 4.4):

- The Belair Pump Station launch provides a gravel ramp approximately 18 feet wide by 15 feet in length. There is parking for 15 vehicles; however, no lighting, power, water or services are available.

- The Pointe à la Hache Marina Boat Launch provides two concrete boat ramps each 15 feet wide by 20 feet in length and an electric boat lift. The launch provides lighting, power, and water along with a fuel station, a small retail store, and bait shop. The marina has a launch as well as in-water slips.

4.2.15 Socioeconomics and Human Resources

This resource is institutionally significant because of the NEPA of 1969; the Estuary Protection Act; the CWA; 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 proposed action 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 of the public's concern for health, welfare, and economic and social well-being from water resources projects.

Nearly two million people, representing approximately 43 percent of the State's population, reside within the LCA Study area. The rich soil conditions, mild climate, natural waterways, and abundance of water and other natural resources have long attracted and supported economic development in coastal Louisiana. The diversified economy that exists in the region today includes oil and gas production and transportation, navigation, commercial fishing, agriculture, recreation, and tourism. Employment has varied widely with periods of rapid growth and contraction; in 2000 there were more than 800,000 jobs in coastal Louisiana. The most influential industries for the study area's economy include oil and gas; navigation; commercial and recreational fishing and hunting; and agriculture, all of which are essential for supporting Louisiana's economy.

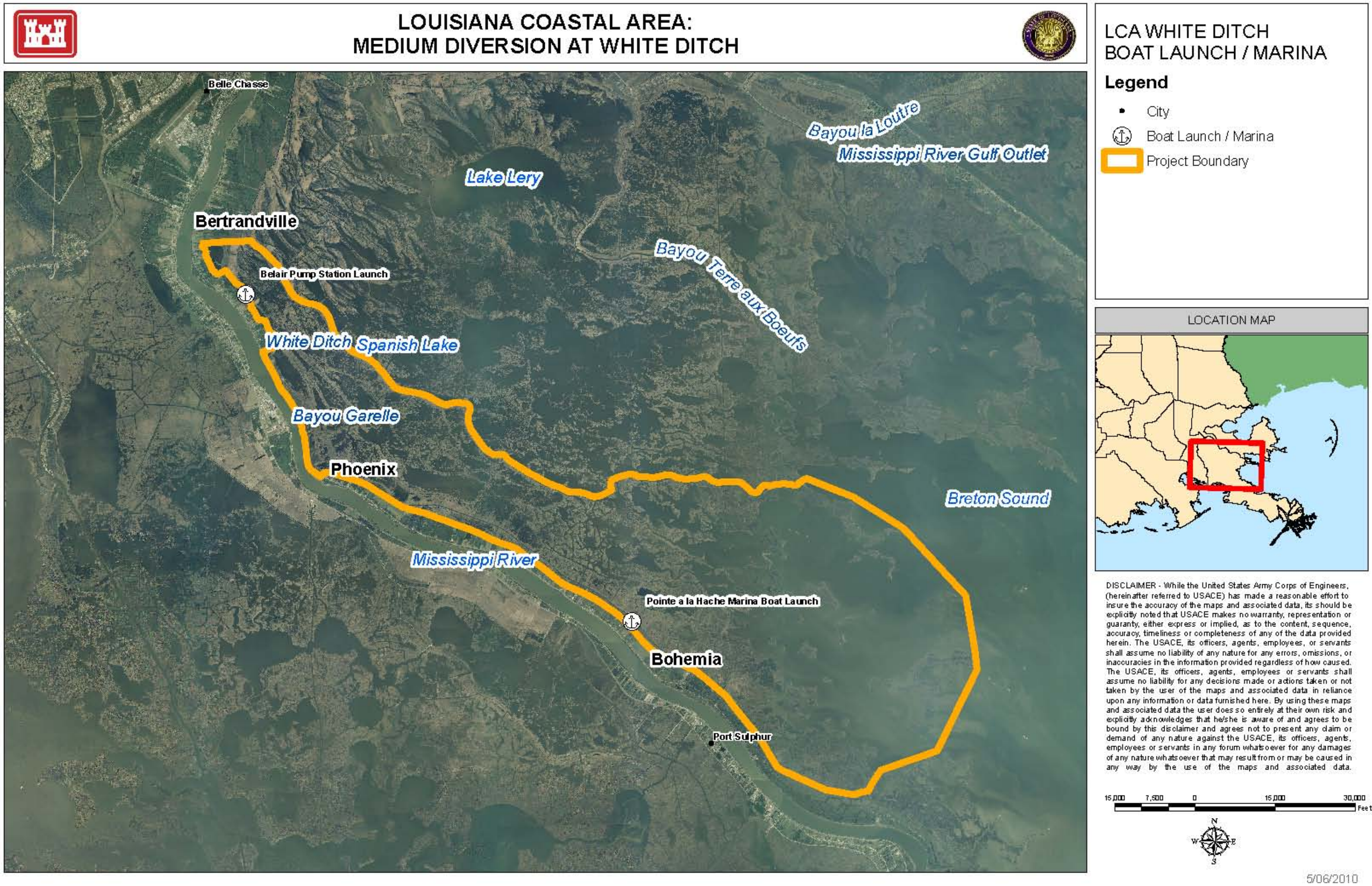

Figure 4.4: LCA White Ditch Boat Launch/Marina

4.2.15.1 Population and Housing

4.2.15.1.1 Historic Conditions

Native American settlement in the area goes back to unknown dates. The earliest European settlement in the area was by the French about 1700.

Phoenix is a rural town of 600 families in Plaquemines Parish on the East Bank of the Mississippi River. It is on the opposite side of the river from Myrtle Grove. It is the closest town to the Fort De La Boulave Site, a National Historic Landmark. In the foot-shaped delta region, locals call Plaquemines Parish "the big toe dat slipped out da boot."

Pointe à la Hache is a rural community. The name "Pointe à la Hache" is French for "cape of the axe." In 1915 a major hurricane devastated the area, busting levees and flooding the region, and 31 died in the area. The Parish Courthouse was destroyed, but some of its material was salvaged for reuse in the new Courthouse completed the same year. In 1965 Hurricane Betsy damaged the area with severe flooding. The 1930 census showed the Point à la Hache area having a population of 404. The area was again severely damaged by Hurricane Katrina at the end of August 2005. As of mid 2009, only a small number of people have returned to live full time here

The communities of Phoenix and Pointe à la Hache are relatively old communities consisting predominantly of mobile homes and some permanent housing, some dating back to the 1960s. There is a sparse population within the area, with most of the residents residing between LA Hwy 15 and LA Hwy 39.

There is no new residential development, and some of the existing facilities are abandoned and in disrepair. There is a high school in the Phoenix community which services the residents of lower East Plaquemines Parish.

4.2.15.1.2 Existing Conditions

Population for Plaquemines Parish, location of the MDWD study area, was estimated at approximately 21,540 in 2007 (U.S. Census Bureau, 2009). This represents a decline of about 19.5 percent from the 2000 Census. The largest age category was persons between 18 and 64 years old, at approximately 62.7 percent. The White population represented an estimated 70.8 percent of the total population, African Americans 22.2 percent, persons of Hispanic or Latino origin 3.3 percent, Asians 3.1 percent, American Indian and Alaska native persons 2.4 percent, and persons reporting two or more races 1.3 percent. Housing units in the parish were estimated at 8,680 in 2007, and the 2007 median household income was estimated at $44,896.

4.2.15.2 Employment, Business, and Industrial Activity

4.2.15.2.1 Historic Conditions

Employment and businesses operating in the diversion area have been limited due to its remote location and limited population. The area along the East Bank of the Mississippi River in the Phoenix and Pointe à la Hache vicinity has been used as a remote site for commercial storage of chemical and fuel related products. Barges and Ships use the area for mooring and storage.

Prior to the Hurricanes Betsy and Katrina, the area did maintain better employment and business opportunities for the populace, but many of the residents have not returned since these storms devastated the area, and there is very limited opportunity existing for the few residents remaining in the local area.

There are now only two businesses in the project area consisting of a crude material storage facility in the Phoenix area, and a fuel storage facility in the Pointe à la Hache area. There are several barges and some ships that moor along the Mississippi River, but they do not provide sustainable employment opportunities for the residents. There is a small boat harbor located near Pointe à la Hache on the Eastern side of LA Hwy 39. There are very limited small businesses in the area, consisting of older convenience stores servicing the local community. There is one gas station in the area.

4.2.15.2.2 Existing Conditions

The most influential industries for the study area economy, and the ones most likely to be impacted by coastal wetland losses or by restoration efforts, include oil and gas, navigation (transportation); and commercial and recreational fishing and hunting.

Of interest to the coastal degradation issue are those pipelines that exist within the coastal areas that are vitally important as a conveyance means to move oil, gas, or chemical products from point of production to refineries, gas plants, and intrastate and interstate pipelines. Many thousands of miles of pipelines can be found in coastal Louisiana ranging from small gathering lines connecting production wells with storage tanks to larger pipelines carrying very large quantities of gas or oil.

Areas east of the Mississippi River and the Barataria Basin dominate oyster production in Louisiana. St. Bernard and Plaquemines Parishes encompass virtually all of the oyster producing areas east of the river, and Plaquemines Parish also includes part of the Barataria Basin. From 1988 through 1997, these two parishes accounted for approximately 50 percent of the oysters landed in Louisiana, and approximately 47 percent of landings from private leases in Louisiana. Monitoring data from the existing Caernarvon diversion structure has shown that production of both oysters and menhaden has increased.

4.2.15.3 Community Cohesion

Community cohesion refers to the common vision and sense of belonging within a community that is created and sustained by the extensive development of individual relationships that are social, economic, cultural, and historical in nature. The degree to which these relationships are facilitated and made effective is contingent upon the physical and spatial configuration of the community itself: the functionality of the community owes much to the physical landscape within which it is set. The viability of community cohesion is compromised to the extent to which these physical features are exposed to interference from outside sources.

4.2.15.3.1 Historic Conditions

The downstream unincorporated communities of Phoenix and Pointe à la Hache are relatively old. Pointe à la Hache, one of the largest settlements between English Turn and the Gulf during the first half of the nineteenth century, was selected as the parish seat in 1846. The first church in the town was built in 1820, the jail in 1835, and the courthouse in 1890. The first newspaper in the parish, *The Rice Planter*, was published at Pointe à la Hache during the decade preceding the Civil War.

4.2.15.3.2 Existing Conditions

With the exception of a decline in population, existing conditions in the downstream communities of Phoenix and Pointe à la Hache are largely unchanged from the historic condition, consisting predominantly of mobile homes and some permanent housing, some dating back into the 1960s. There has been little employment mobility for the population. There had been, and still remains, a sparse population within the area, with most of the residents residing between LA 15 and LA 39.

4.2.15.4 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 (50 percent) and/or percent low-income (20 percent) population in an EJ study area are greater than those in the reference community. For purposes of this analysis, all Census Block Groups within the project footprint are defined as the EJ study area. Plaquemines Parish, of which the LCA Medium Diversion at White Ditch (MDWD) project is located, is considered the reference community of comparison, whose population is therefore considered the EJ reference population for comparison purposes. Parish figures were used for unincorporated areas located within 1 mile of the proposed project footprint. Where applicable, parish figures were used for unincorporated areas (Census Block Groups) located within 1 mile of the proposed project footprint if the block group numbers are so small as to not meet the requirements for further consideration.

The methodology, consistent with E.O. 12898, to accomplish this EJ analysis includes, identifying low-income and minority populations within the LCA-MDWD project area using up-to-date economic statistics, aerial photographs, 2000 U.S. Census records, Environmental Systems Research Institute, Inc. (ESRI) estimates, as well as conducting community outreach activities such as public meetings. Despite the 2000 U.S. Census being 9 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 Census reports data at a much smaller geographic level than other survey sources, providing a more defined and versatile option for data reporting.
- 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 data, including 2007 and 2008 estimates provided by ESRI. The 2007 and 2008 estimates are utilized for reference purposes only to show changing trends in population since 2000.

4.2.15.4.1 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.

Residential areas and businesses for minority and low-income populations have historically been limited within the White Ditch Diversion study area due to the area being predominantly surrounded by brackish marsh and unsuitable for building. Some areas were drained and later inhabited, but the areas adjacent to the diversion area remain uninhabited.

4.2.15.4.2 Existing Conditions

The total population of this parish, according to the 2000 U.S. Census Bureau is 26,757. Because the area has such a low population density, the Plaquemines Parish and Louisiana state census figures were used to determine whether the White Ditch Diversion area meets the requirements set under Executive Order 12898 for further consideration. For 2008 the U.S. Census Bureau's population estimates were 21,276. This represents a slight population decline possibly due to the effects of Hurricanes Katrina and Rita in 2005.

According to the 2000 U.S. Census, the LCA MDWD project boundary in Plaquemines Parish is located within Census Tract 501, Block Group 1. The 2000 Census demographic profile records indicate that the minority population in Louisiana was 38.7 percent of the total population and the low-income population was 19.6 percent of the total population. The minority population in Plaquemines Parish was 31.8 percent and the low-income population was 18.0 percent in 2000. The 2008 estimates were approximately 32.1 percent minority and 11.2 percent low-income (http://censtats.census.gov, accessed November 11, 2009).

Analyses of the above information show that the percentage of the population that is minority is comparable to that of state figures and low-income populations are lower than state figures. Because there are few residential neighborhoods in the proposed project area, and based on the aforementioned 2000 U.S. Census figures, as well as field visits conducted in November 2009 to the proposed project area, it has been determined that the proposed LCA MDWD project area is not a minority and/or low income population per Executive Order 12898.

4.2.15.5 Infrastructure

4.2.15.5.1 Historic Conditions

Infrastructure in the project area has historically been limited due to the remote and low-elevation location as well as low population in this part of southeastern Louisiana.

4.2.15.5.2 Existing Conditions

Infrastructure in the project area includes the Federal Mississippi River levee, LA 39, and non-Federal back levees to the north and south of the proposed diversion location. An overhead power-line operated by Entergy has three poles that are located in the vicinity of the proposed construction area. A buried telephone cable is also located in the vicinity.

4.2.15.6 Business and Industry

4.2.15.6.1 Historic Conditions

Business and industry had historically been limited within White Ditch Diversion area. The early predominant industries have been trapping and hunting. However, oil production, commercial fishing activities and oyster harvesting have had some impact within the area.

4.2.15.6.2 Existing Conditions

There are no industries located in the inhabited areas adjacent to the White Ditch Diversion area. The two significant business operations consist of a chemical storage facility near Phoenix and a fuel storage operation near Pointe à la Hache. There is also a small boat harbor near Pointe à la Hache. Most other businesses are small operations supporting the local populations. The area adjacent to the White Ditch Diversion area is protected by a levee system. Pipelines and oyster leases exist within the project area.

4.2.15.7 Traffic and Transportation

4.2.15.7.1 Historic Conditions

The communities east of LA Hwy 39 are remote and receive little vehicle traffic. LA Hwy 39 services local residents but is used mostly for commercial vehicles traveling to the two commercial chemical and fuel storage facilities located in the area.

4.2.15.7.2 Existing Conditions

LA Hwy 39 is a two-lane sparsely traveled highway which terminates at Pointe à la Hache. Traffic consists predominately of commercial vehicles traveling to the two commercial chemical and fuel storage facilities located in the area. It also provides egress for the residents of Phoenix and Pointe à la Hache. There is additional recreational traffic from vehicles transiting to the Pointe à la Hache Boat Harbor. The area adjacent to the White Ditch Diversion area is protected by a levee system.

4.2.15.8 Public Facilities and Services

4.2.15.8.1 Historic Conditions

The inhabited area adjacent to the White Ditch project area is sparsely populated with the heaviest concentration of residents residing in the Phoenix and Pointe à la Hache areas. There are few public facilities or services provided within the populated areas. There is a public high school servicing the students in the lower portion of East Plaquemines Parish. There is also a volunteer fire department located in Phoenix.

The community of Pointe à la Hache once contained the Plaquemines Parish Public Courthouse, built in 1915. It was damaged by recurring hurricanes, and was finally burned by arson in 2002.

4.2.15.8.2 Existing Conditions

There are a limited number of public facilities in the vicinity of the proposed Phoenix diversion area. These facilities include a volunteer fire department and the Phoenix High School.

4.2.15.9 Tax Revenues and Property Values

4.2.15.9.1 Historic Conditions

The White Ditch diversion area is an under-developed marsh. The area East of LA Hwy 39 consisted of marsh and bayous, with some man-made canals. The majority of tax revenues have been derived from taxes on oil production and seafood products harvested in the area.

4.2.15.9.2 Existing Conditions

The proposed White Ditch project area is located near Phoenix, Louisiana. No economic data is available for the specific project area, but the nearest available data is at the parish level. Median household income in Plaquemines Parish in 2007 was estimated at $44,896 (statewide average was estimated at $40,866 for the same year). The median value of owner-occupied homes in Plaquemines Parish in 2000 was $110,100 (compared with the state average of $85,000) (Source: U.S. Census Bureau: State and County QuickFacts. Data derived from Population Estimates, Census of Population and Housing, Small Area Income and Poverty Estimates, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census, Survey of Business Owners, Building Permits, Consolidated Federal Funds Report, Last Revised November 17, 2009).

4.2.15.10 Community and Regional Growth

4.2.15.10.1 Historic Conditions

The communities adjacent to the White Ditch Diversion area were originally populated by trappers and hunters. Over time, Phoenix and Pointe à la Hache experienced limited economic growth primarily consisting of local small businesses supporting the area's population.

There is little population within the project area. The area is used primarily for recreational activity and there are oil and gas wells and commercial oyster leases existing in portions of the affected area.

4.2.15.10.2 Existing Conditions

Community and regional growth are generally influenced by national trends, but otherwise depend significantly upon relatively local attributes that allow it to be evaluated apart from the national economy. For the purposes of socioeconomic impact analysis, the project area is first described in summary terms with respect to prevailing trends in the growth of population, housing, income, and employment. Against this baseline, the relative effects of the proposed and alternative actions are evaluated.

Data for Plaquemines Parish, East Bank is not easily discernable through census data. The nearest impacted areas with available census data is St. Bernard Parish. According to U.S. Census data from 1990 and 2000 the following trends were observed in St. Bernard Parish: population grew from 66,631 to 67,229; employment grew from 30,738 to 31,267; and median household income grew from $25,482 to $35,939.

Preliminary 2010 Census data will be available in 2011 at the earliest. However, intermediate census estimates reported by the Greater New Orleans Data Center indicated a population in St. Bernard Parish of 19,826 in 2007.

4.2.15.11 Land Use Socioeconomics

4.2.15.11.1 Agriculture

4.2.15.11.1.1 Historic Conditions

Agriculture in Plaquemines Parish (excluding commercial fishing as discussed in Section 4.2.15.15) consists mainly of citrus and nursery crops, as well as livestock (primarily cattle) production. Agriculture on the east bank of the parish is limited by the availability of land suitable for cultivation of crops or livestock. Loss of marsh and marsh land in the project area during the past several decades has limited the potential for agricultural production in the project area. Reports from long-time residents of the east bank of Plaquemines Parish indicate that some portions of the project area may have been used for livestock grazing. No current agricultural production is known to be located within the immediate White Ditch project area, with the exception of alligator farming (egg harvesting), which occurs seasonally in portions of the project area and adjacent parts of the northern Breton Sound Basin under permits issued by the Louisiana Department of Fish and Wildlife.

4.2.15.11.1.2 Existing Conditions

Louisiana's alligator farming program began in the early 1970s, but production did not significantly increase until the early 1990s. In the last few years, production has exceeded 200,000 skins. Nearly all of this production is the result of collecting eggs from nests in the wild. To compensate for the removal of eggs, a proportion of the alligators raised on the farm are returned to the marshland where the eggs were originally collected.

Statewide data collected by the LDWF showed that in 2008 a total of 530,579 eggs were collected, 459,887 were hatched, and 45,578 of these hatchlings were returned to the wild. While statewide estimates indicated an increase in nest production of 3.1 percent over 2007 figures, estimates for southeastern Louisiana (which includes the White Ditch project area) indicated a 0.3 percent decrease from 2007–2008, compared with an estimated 8.7 percent increase for southwestern Louisiana for the same period.

4.2.15.11.2 Forestry

4.2.15.11.2.1 Historic Conditions

None.

4.2.15.11.2.2 Existing Conditions

The MDWD project has no commercial forestry production located within the proposed project area.

4.2.15.11.3 Public Lands

4.2.15.11.3.1 Historic Conditions

None.

4.2.15.11.3.2 Existing Conditions

The MDWD project has no public lands located within the proposed project area.

4.2.15.12 Water Use and Supply

4.2.15.12.1 Historic Conditions

The Mississippi River has historically been the primary source of freshwater in the project area.

4.2.15.12.2 Existing Conditions

The Mississippi River is the primary source of public water supply in Plaquemines Parish. Water use and supply facilities located within the vicinity of the White Ditch project area include a water tower servicing the residents of the Pointe à la Hache and Phoenix communities.

4.2.15.13 Navigation

4.2.15.13.1 Historic Conditions

Annual U.S. port tonnage statistics consistently rank the Ports of New Orleans, South Louisiana, and Baton Rouge fourth, first, and ninth, respectively. Primary inbound cargos at the Port of Baton Rouge are petroleum and chemicals. Outbound cargos are grain, chemicals, and petroleum products. Primary inbound cargos at the Port of South Louisiana are crude oil and petroleum products, while corn, wheat, and animal feed dominate the port's exports. At the Port of New Orleans, principal inbound cargos consist of steel, crude, and refined petroleum products and outbound cargos include grain, forest products, and steel. The river reach adjacent to the MDWD project area is within the Port of Plaquemines. In 2008, U.S. port tonnage statistics ranked the Port of Plaquemines tenth in the nation, with estimated cargos totally over 63,744 million short tons.

4.2.15.13.2 Existing Conditions

The Mississippi River is the major navigable waterway in the vicinity of the proposed project. Commercial navigation is a critical activity in the river bordering the west side of the White Ditch project area. On the east bank of the Mississippi River, the water bodies within the project area have not been used extensively for shallow water navigation, and there is no deep water navigation possible in the area. There are man-made canals once used by oil companies, but commercial use of these canals is limited and they are now used mostly for recreational purposes.

4.2.15.14 Man-Made Resources

4.2.15.14.1 Oil, Gas, Utilities, Pipelines

4.2.15.14.1.1 Historic Conditions

Louisiana is laced with thousands of pipelines conveying oil, gas, and other liquid and gaseous materials for short and long distances. Included are 25,000 miles (40,250 km) of pipe moving natural gas through interstate pipelines, 7,600 miles (12,236 km) of pipe carrying natural gas through intrastate pipelines to users within the state's boundaries, 3,450 miles (5,554 km) of pipe transporting crude oil and crude oil products, and thousands of miles of flowlines carrying oil and gas from the wellhead to separating facilities.

The petroleum industry in the state accounts for almost 25 percent of the total state revenues and employs more than 116,000 people (about 6 percent of the state's total workforce). These workers earn almost 12 percent of the total wages paid in Louisiana. The oil and gas production industry, and the numerous associated support industries, are an important part of the socioeconomic landscape of the project area (see Employment and Income section). Indirect employment levels in support industries make this economic sector more important than is indicated by the direct employment figures.

Of interest to the coastal degradation issue are those pipelines existing within the coastal areas that are vitally important as a conveyance means to move oil, gas, or chemical products from point of production to refineries, gas plants, and intrastate and interstate pipelines. Pipelines found in coastal Louisiana range from small gathering lines connecting production wells with storage tanks to larger pipelines carrying very large quantities of gas or oil.

4.2.15.14.1.2 Existing Conditions

The MDWD project area contains some pipelines that cross LA Hwy 39. There are utility service lines that traverse the length of LA Hwy 39 servicing the communities located south of the proposed diversion structure. There are no oil refineries or rigs located within the diversion area. State database records show several oil wells in the vicinity of proposed construction features (Figure 4.5). As noted in Appendix J (Real Estate Plan), there are two oil wells located within the proposed channel, and one oil well located within the proposed marsh creation/wetland restoration. All wells located within the right-of-way limits of the project are closed/abandoned and, therefore, not productive or in use. Closed/abandoned wells within the project area are not anticipated to cause real estate issues or delays for the project.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time (August 5, 2010). This spill 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 or baseline conditions, as well as changes to future-without and future with project conditions. 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 USACE water resources development projects/studies. This could include revisions to proposed actions as well as the generation of supplemental environmental analysis and documentation for specific projects/studies as warranted by changing conditions.

4.2.15.14.2 Flood Control and Hurricane Protection

4.2.15.14.2.1 Historic Conditions

None.

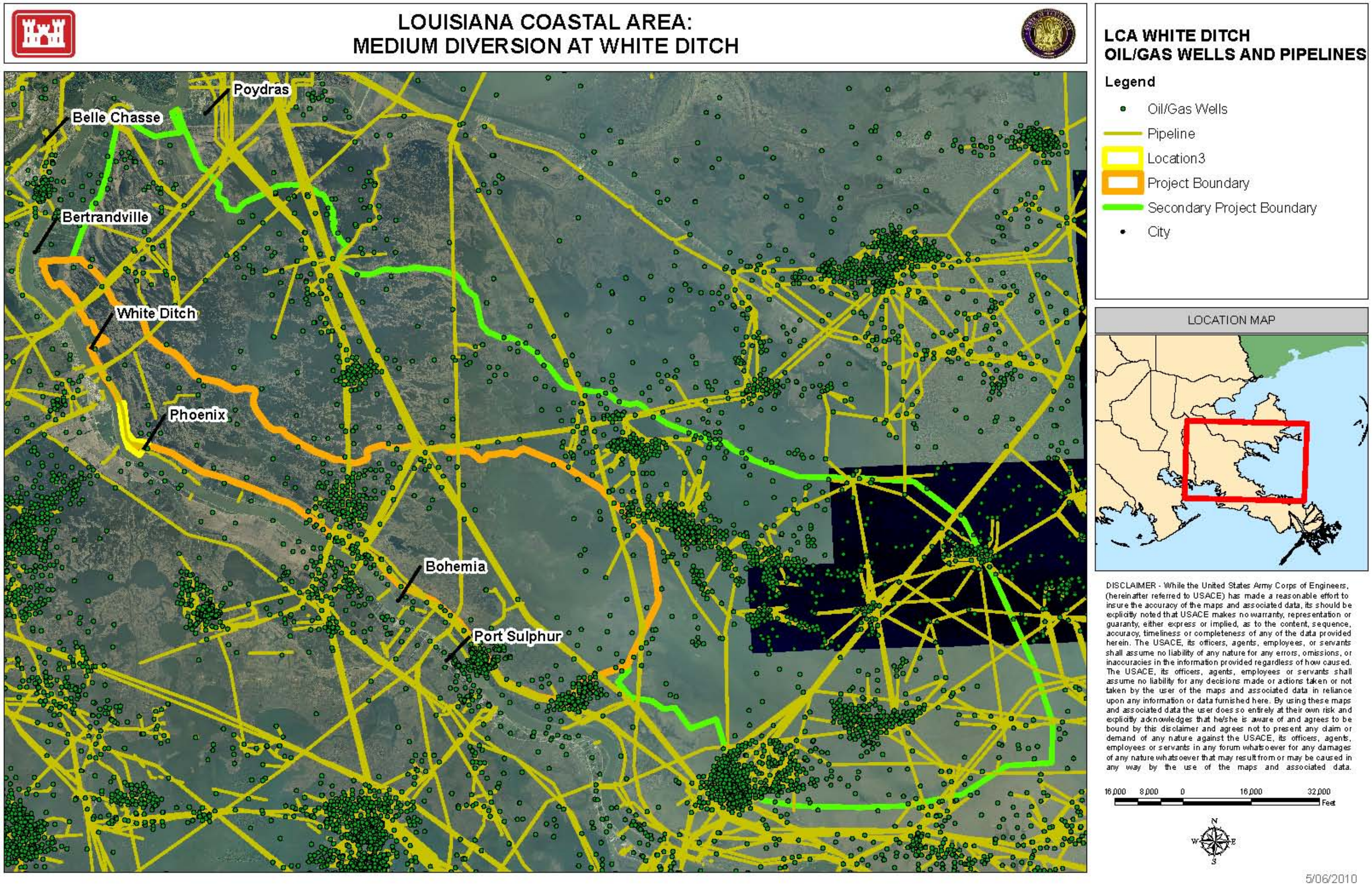

Figure 4.5: LCA White Ditch Oil/Gas Wells and Pipelines

4.2.15.14.2.2 Existing Conditions

Protection from high Mississippi River levels in the vicinity of the proposed project is provided by the Federal levee that runs the length of the western border of the White Ditch project area. Residences and businesses upstream and downstream of the proposed diversion construction site are protected from Gulf storm surges by non-Federal back levees.

4.2.15.15 Natural Resources

4.2.15.15.1 Commercial Fisheries

4.2.15.15.1.1 Historic Conditions

Louisiana's coastal wetlands are the richest estuaries in the country for fisheries production. Commercially and recreationally important species such as brown and white shrimp, blue crabs, eastern oysters, and menhaden are abundant, but these species populations are threatened if land loss continues. Louisiana has historically been an important contributor to the nation's domestic fish and shellfish production, and is one of the primary contributors to the nation's food supply for protein. While Louisiana has long been the nation's largest shrimp and menhaden producer, it has also recently become the leading producer of blue crabs and oysters. Total landings in Louisiana were 1.2 billion pounds (0.54 billion kg) in 2001. The percentage contribution of total landings for the Gulf region was 74 percent and for the nation was 12.5 percent. Dockside revenues for commercial fisheries in coastal Louisiana were $343 million in 2001 (NMFS 2003b). These revenues were the largest for any state in the contiguous United States, second only to Alaska.

4.2.15.15.1.2 Existing Conditions

The MDWD project area along with the larger Breton Sound Basin contains important commercial fishery resources including saltwater fish, shellfish and oysters.

4.2.15.15.2 Oyster Leases

4.2.15.15.2.1 Historic Conditions

Louisiana is the top producer of the eastern oyster in the United States, averaging approximately 13.1 million pounds per year since 2000, with an average value of $34.0 million (NMFS Fisheries Statistics Division, personal communication, 2009). The fishery has two main sources: privately leased grounds and public seed grounds. The State of Louisiana owns the water bottoms and leases out acreage to oyster fishermen. The public grounds are open to harvesting by all licensed fishermen, but are only open during the public season, which runs from September through March. Oysters can be harvested from the private grounds throughout the year.

4.2.15.15.2.2 Existing Conditions

Areas east of the Mississippi River and the Barataria Basin dominate oyster production in Louisiana. St. Bernard and Plaquemines parishes encompass virtually all of the oyster producing areas east of the river. From 1988 through 1997, these two parishes accounted for approximately 50 percent of the oysters landed in Louisiana, and approximately 47 percent of landings from private leases in Louisiana. Oyster leases in Plaquemines Parish have 15-year terms and are leased from the state for $2 per acre per year. The White Ditch project area contains 311 oyster leases at the Gulf end of the proposed freshwater diversion area. Figure 4.6 below, and also found in Appendix J (Real Estate Plan, Exhibit B) of this report, shows the locations of these oyster leases. When existing conditions salinities are overlaid on the leases, approximately seven of the leases could experience suboptimal salinities for high oyster production.

4.2.16 Hazardous, Toxic, and Radioactive Wastes

4.2.16.1 Historic Conditions

The USACE is obligated under Engineer Regulation (ER) 1165-2-132 to assume responsibility for the reasonable identification and evaluation of all HTRW contamination within the vicinity of the proposed action. ER 1165-2-132 identifies the USACE policy to avoid the use of project funds for HTRW removal and remediation activities. Costs for necessary special handling or remediation of wastes (e.g., those regulated by the Resource Conservation and Recovery Act of 1976 [RCRA]), pollutants and other contaminants, which are not regulated under the CERCLA, will be treated as project costs if the requirement is the result of a validly promulgated Federal, state or local regulation.

HTRW investigations facilitate early identification and consideration of HTRW problems. The Civil Works Project Plan routinely includes a phased and documented review to provide for early identification of HTRW potential at project sites. ER 1165-2-132 requires that viable options to avoid HTRW problems be determined and a procedure for resolution of HTRW concerns be established.

The discharge of dredged material into waters of the U.S. is regulated under the CWA, and the Marine Protection and Sanctuaries Act governs the transportation of dredged material to ocean waters for the purpose of disposal. The RCRA hazardous waste management regulations, promulgated pursuant to RCRA (42 U.S.C. 6905) specifically exempt dredge material from the hazardous waste definition if that material is covered by:

1) a permit issued under Section 404 of the CWA, 33 U.S.C. 1344;

2) a permit issued under Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 33 U.S.C. 1413; or

3) the administrative equivalent of such permits where the work involves an Army Corps of Engineers civil works project, 40 C.F.R. 261.4(g), 63 F.R. 65874, 65921; November 30, 1998. ER1165-2-132 states, 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 NPL site under CERCLA.

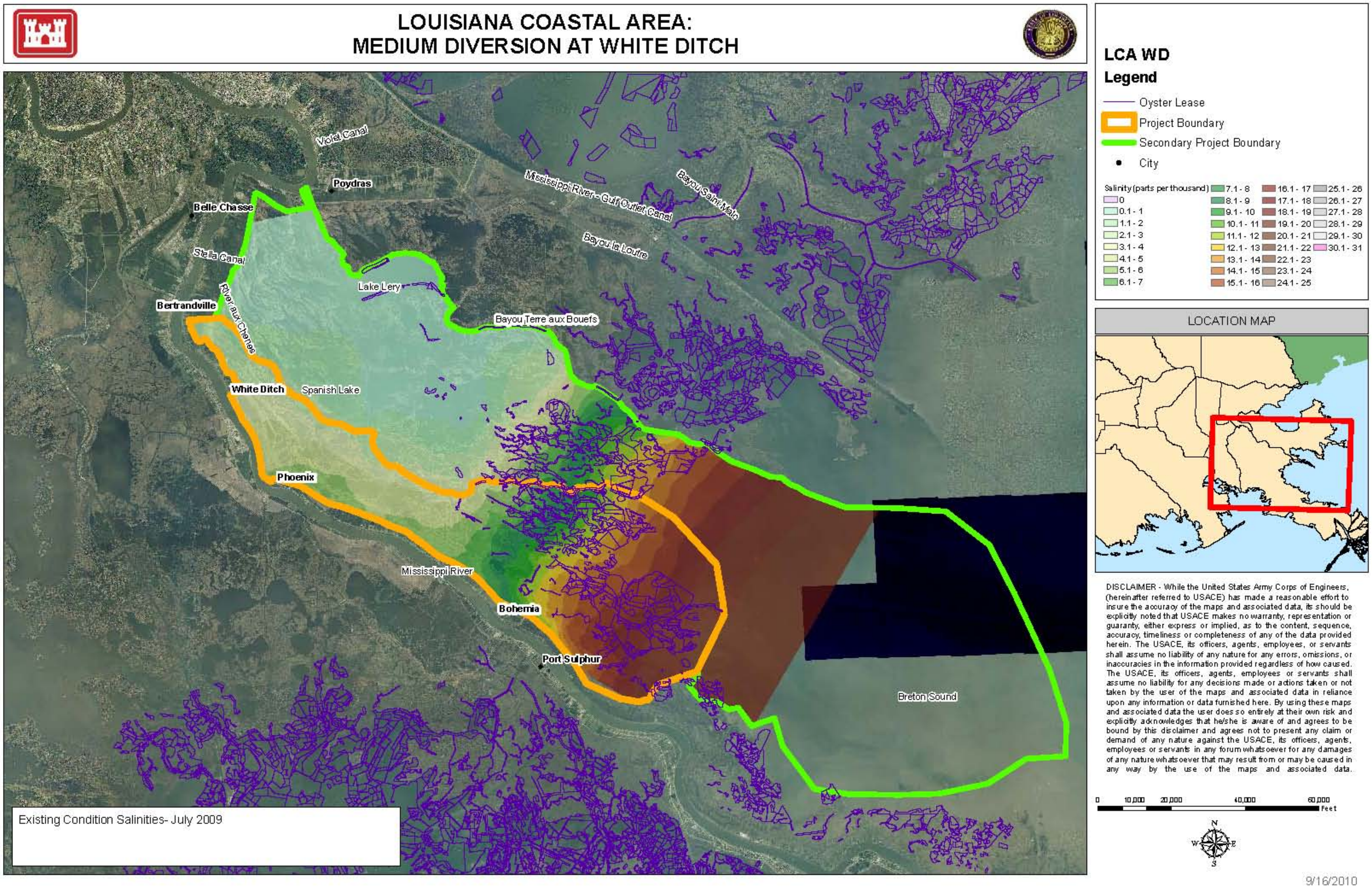

Figure 4.6: LCA White Ditch Existing Condition Salinities – July 2009

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4.2.16.2 Existing Conditions

As reported in the Phase I ESA, during records research and site reconnaissance it was determined that areas adjacent to some of the project features contained RECs that presented a low to moderate risk of affecting potential project features, albeit that no Recognized Environmental Conditions (RECs) were noted within direct proximity of land associated with any of the potential project features.

Should at anytime during the project HTRW concerns arise, the CEMVN would take immediate actions to investigate the concerns. Should an HTRW issue be determined and the development of a response action required, CEMVN would coordinate with the appropriate Federal and state authorities to implement an approved response action.

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5.0 ENVIRONMENTAL CONSEQUENCES

This chapter describes the potential environmental consequences of implementing alternative plans considered for freshwater diversion and marsh restoration in the project study area. The following analysis compares the No Action Alternative to four alternatives carried over for detailed analysis: Alternative Plans 1, 2, 3, and 4. Alternative 4 is the Recommended Plan. Alternatives developed and evaluated in this study are described in Chapter 3, Alternatives. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

A comparison of the direct, indirect, and cumulative impacts for wetland creation and enhancement is presented herein. Direct impacts would be those effects that would be caused by the proposed action and occur at the same time and place (Section 1508.8(a) of 40 CFR Parts 1500–1508). For example, the use of excavated material from construction of outfall management features would be used directly to create acres of emergent wetland habitat. Indirect impacts would be those effects that would be caused by the action and would be later in time or further removed in distance, but would be still reasonably foreseeable (Section 1508.8(b) of 40 CFR Parts 1500–1508). For example, shoreline protection features reduce the long-term rate of erosion to interior wetlands. Cumulative impacts would be the aggregate of impacts to the environment resulting from the proposed action in combination with other ongoing actions, and actions being considered within the reasonably foreseeable future. Cumulative impacts would be the effects on the environment that would 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 would be minor, but collectively result in significant actions taking place over time (Section 1508.7 40 CFR Parts 1500–1508). For example, the incremental impacts of emergent wetland creation at several localized areas could significantly modify an entire basin's habitat diversity. The cumulative impact analysis followed the 11-step process described in the 1997 report by the Council of Environmental Quality entitled "Considering Cumulative Effect Under the National Environmental Policy Act." Section 5.21 summarizes cumulative impacts for all important resources.

This environmental analysis evaluates and compares, from a qualitative and quantitative perspective, the four alternatives carried over for detailed analysis. Impact analysis described in this chapter is based on a combination of scientific and engineering analyses, professional judgment, and previously compiled information.

The operational scenario used in the evaluation of all alternatives, including the Recommended Plan, involves operating the diversion structure at full flow capacity for 2 months each year, and at a reduced "maintenance flow" for the remainder of the year. High river flows (with corresponding high suspended sediment levels) historically occurred in the early spring on the lower Mississippi River, and prior to construction of the Federal levee system would have naturally replenished coastal wetlands in the project study area with freshwater, sediment and nutrients. In addition, both historical information and more recent scientific investigations of freshwater diversions such as the Caernarvon freshwater diversion suggest that potential negative consequences of reintroduction of river inflows in the MDWD project would be more likely to be reduced or minimized if flows would be limited in duration and would be timed to avoid sensitive periods in the annual life cycles of marsh vegetation and associated aquatic organisms.

The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time (August 5, 2010). This spill 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 or baseline conditions, as well as changes to future-without and future with project conditions. 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 USACE water resources development projects/studies. This could include revisions to proposed actions as well as the generation of supplemental environmental analysis and documentation for specific projects/studies as warranted by changing conditions.

5.1 SOILS AND WATERBOTTOMS

5.1.1 Soils and Waterbottoms

5.1.1.1 No Action Alternative (Future Without Project Conditions)

5.1.1.1.1 Direct

No direct alteration of soils or substrate would occur under the No Action Alternative and associated water management features. No conversion of prime or unique farmland would occur, and the No Action Alternative would have no direct impact on these resources.

5.1.1.1.2 Indirect

Under the No Action Alternative, existing patterns of soil erosion and land loss would continue into the future. Organic soils in the project area would not be able to maintain their elevations due to subsidence, decreased plant productivity, wave erosion, and relative sea level rise. 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 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. In the future, if no actions would be taken to restore and protect marsh habitat within the project area, any prime and unique farmland that remains outside of the protection of existing Federal and non-Federal back levees would continue to be subject to further degradation and possible loss.

5.1.1.1.3 Cumulative

Under the No Action Alternative, as erosion continued, there would be a continued loss of marsh soils. Waterbodies would grow larger and wave erosion would accelerate causing further land loss, thus making remaining marsh lands in the project area and the larger Breton Sound Basin more vulnerable to tropical storms. In addition to land loss in coastal Louisiana, a large percentage of the nation’s wetlands would continue to disappear with accompanying impacts to wildlife, fisheries, coastal communities, and socioeconomic resources.

5.1.1.2 Alternative 1 – 5,000 cfs max Diversion

5.1.1.2.1 Direct

Construction of the 5,000 cfs maximum diversion would directly impact approximately 324 acres in the intermediate zone (136 acres of marsh and 188 acres of shallow open water). Approximately 153 acres of marsh and shallow water area would be excavated to enlarge the outfall channel for the structure. This excavated material would be placed on organic marsh soils and aquatic substrates to create approximately 32 acres of ridges lining the outfall channels, and 139 acres of created marsh in locations adjacent to the outfall channels.

5.1.1.2.2 Indirect

Loss of marsh soils would continue in the project area; however, indirect impacts of implementing the 5,000 cfs max diversion would include reducing the rate of marsh soil loss in the project area compared to the projected rate of loss under the FWOP condition over the 50-year period following construction.

5.1.1.2.3 Cumulative

This alternative would have positive synergistic effects on soil resources when combined with other Federal, state, local, and private restoration efforts, including the nearby Caernarvon diversion. Implementing the 5,000 cfs diversion alternative would contribute to reducing regional rates of marsh soil loss over the 50-year project life.

5.1.1.3 Alternative 2 – 10,000 cfs max Diversion

5.1.1.3.1 Direct

Construction of the 10,000 cfs maximum diversion would directly impact approximately 375 acres in the intermediate zone (155 acres of marsh and 220 acres of shallow open water). Approximately 167 acres of marsh and shallow water area would be excavated to enlarge the outfall channel for the structure. This excavated material would be placed on organic marsh soils and aquatic substrates to create approximately 32 acres of ridges lining the outfall channels, and 176 acres of created marsh in locations adjacent to the outfall channels.

5.1.1.3.2 Indirect

Indirect impacts of implementing the 10,000 cfs max diversion would include substantially reducing the rate of marsh soil loss in the project area compared to the projected loss rate under FWOP conditions over the 50-year period following construction.

5.1.1.3.3 Cumulative

This alternative would have positive synergistic effects on soil resources when combined with other Federal, state, local, and private restoration efforts, including the nearby Caernarvon diversion. Implementing the 10,000 cfs diversion alternative would contribute to reducing regional rates of marsh soil loss over the 50-year project life.

5.1.1.4 Alternative 3 – 15,000 cfs max Diversion

5.1.1.4.1 Direct

Construction of the 15,000 cfs maximum diversion would directly impact approximately 449 acres in the intermediate zone (199 acres of marsh and 250 acres of shallow open water). Approximately 182 acres of marsh and shallow water area would be excavated to enlarge the outfall channel for the structure. This excavated material would be placed on organic marsh soils and aquatic substrates to create approximately 32 acres of ridges lining the outfall channels, and 235 acres of created marsh in locations adjacent to the outfall channels.

5.1.1.4.2 Indirect

Indirect impacts of implementing the 15,000 cfs max diversion would include the expected restoration of emergent marsh soils at a rate that would exceed the projected loss rate under the FWOP condition over the 50-year period following project construction.

5.1.1.4.3 Cumulative

This alternative would have positive synergistic effects on soil resources when combined with other Federal, state, local, and private restoration efforts, including the nearby Caernarvon diversion. Implementing the 15,000 cfs diversion alternative would contribute to reducing regional rates of marsh soil loss over the 50-year project life.

5.1.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.1.1.5.1 Direct

Construction of the 35,000 cfs maximum diversion would directly impact approximately 640 acres in the intermediate zone (277 acres of marsh and 363 acres of shallow open water). Approximately 223 acres of marsh and shallow water area would be excavated to enlarge the outfall channel for the structure. This excavated material would be placed on organic marsh soils and aquatic substrates to create approximately 32 acres of ridges lining the outfall channels, and 385 acres of created marsh in locations adjacent to the outfall channels.

5.1.1.5.2 Indirect

Indirect impacts of implementing the 35,000 cfs max diversion would include the expected restoration of emergent marsh soils at a rate that would substantially exceed the projected loss rate under the FWOP condition over the 50-year period following project construction.

5.1.1.5.3 Cumulative

This alternative would have positive synergistic effects on soil resources when combined with other Federal, state, local, and private restoration efforts, including the nearby Caernarvon diversion. Implementing the 35,000 cfs diversion alternative would provide the highest potential contribution of the four alternatives evaluated in detail in this study to reducing regional rates of marsh soil loss.

5.2 HYDROLOGY

5.2.1 Flow and Water Levels

5.2.1.1 No Action Alternative (Future Without Project Conditions)

5.2.1.1.1 Direct

The No Action Alternative would have no direct impacts on flow or water levels within the surrounding marsh or historic distributaries such as River aux Chenes.

5.2.1.1.2 Indirect

Indirect impacts of the No Action Alternative, not implementing the diversion, would result in the persistence of existing conditions. Consequences would include further degradation of the existing marsh from saltwater intrusion due to short circuited hydrologic processes present in the basin, as well as the continued lack of sediments, nutrients, and freshwater. With the absences of these inputs, the marsh would not be able to sustain itself against subsidence and prolonged inundation from increasing sea level rise rates, Figure 5-1.

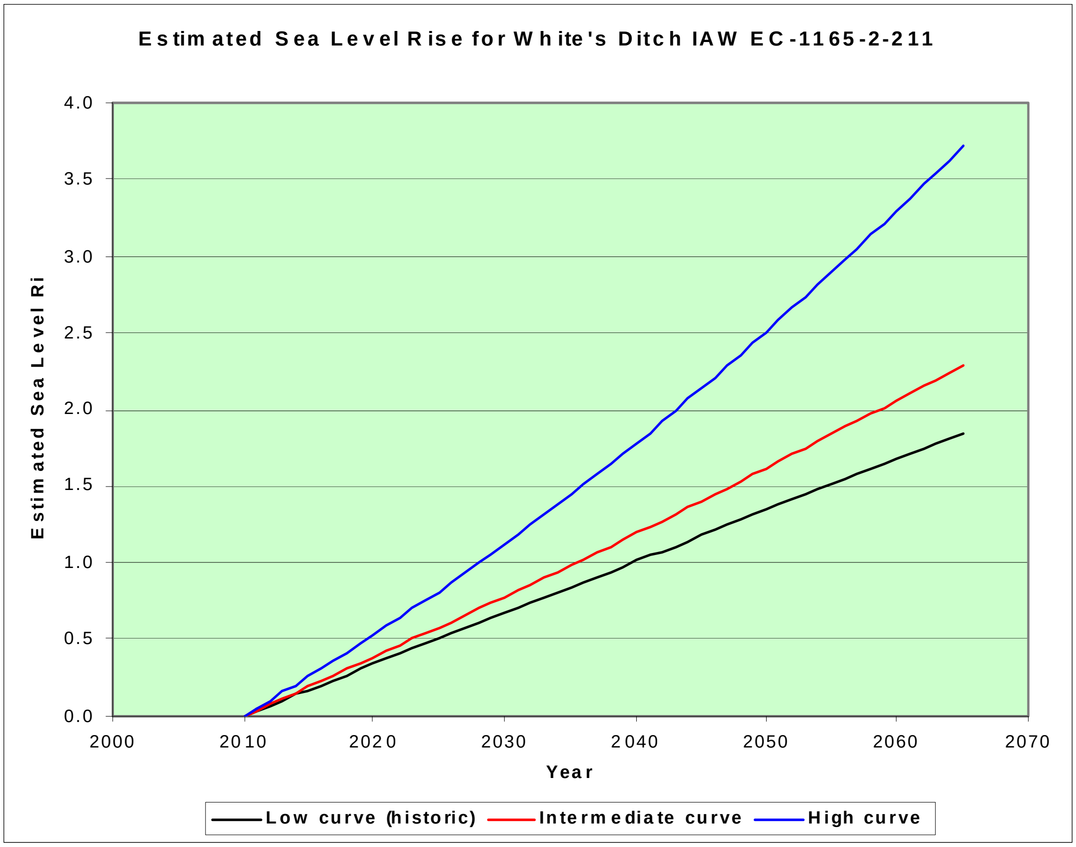

Figure 5.1: Sea Level Rise Rates for the White Ditch Study Area

The No Action Alternative would result in the existing marsh persisting with minimal circulation of water, nutrients, and sediment. The sediment deficit has and would continue to result in both subsidence and a disruption of natural processes that promote productivity and diversity in the marsh ecosystem. Increases in relative sea level due to continued subsidence and sea level rise would continue to inundate plant communities with saltwater, which would induce stress and lead to further degradation.

Current guidance for incorporating the direct and indirect physical effects of projected future sea-level change in all aspects of USACE projects (i.e., managing, planning, engineering, designing, constructing, operating, and maintaining) is established by Circular No. 1165-2-211, dated July 1, 2009. Under this direction, the no action and action alternatives must be evaluated under “low,” “intermediate,” and “high” projected rates of future sea-level change. Scenarios differ in whether and how eustatic sea-level rise accelerates over time. Accordingly, the low estimate is based on an extrapolation of the historic rate of RSLR for the study area. Against the high sea level rise scenario, all marsh would be gone in approximately 45 years under the No Action Alternative.

5.2.1.1.3 Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on flow and water levels with the added combination of similar wetland degradation and wetland loss impacts to flow and water levels throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. The Caernarvon Diversion does freshen the White Ditch project area, albeit to an unknown extent. It could potentially impact the flow patterns in and near the study area, but would not likely affect water levels. The proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch could have impacts on the project area, but conclusive detail as to those extents would not be available at this time. Other diversion along the Mississippi River would collectively have impacts on Mississippi River stages and possibly sediment and nutrient loads available to the Breton Sound Basin.

5.2.1.2 Alternative 1 – 5,000 cfs max Diversion

5.2.1.2.1 Direct

The direct impact of a diversion with the potential of operating up to 5,000 cfs in the area between River aux Chenes and the Mississippi River would be increased water levels and flows within the project area while the structure is being operated. During operations, Mississippi River water would flow through River aux Chenes, Bayou Garelle, and numerous other natural and man-made channels. Stages would be elevated near the outfalls of where water is leaving the Bayou Garelle and flowing into larger, more open, bodies of water.

The direct impact of the diversion of water from the Mississippi River at the proposed diversion site would be a very small decrease in the flow in the Mississippi River. Based on data from 1978 to 2008, the average spring (March 1 – May 31) flow at Tarbert Landing is 813,333 cfs ± 283,377 cfs (Mean + SD), vs. a diversion rate of 5,000 cfs. The small decrease in flow at this intake location would have no impact on water levels in the Mississippi.

5.2.1.2.2 Indirect

Indirect impacts of a 5,000 cfs diversion would be the slight inundation of lands while the structure is being operated. During operations lands that would not always be inundate during the period would become submerged. With this submergence, there would be an opportunity for the lands to collect sediments that would be carried by the diverted Mississippi River water, thus renewing historic deltaic processes.

The indirect impact of the diversion of water into the project area would be a very small decrease in the flow in the Mississippi River. The small decrease in flow at this intake location should have no impact on water levels in the Mississippi River, particularly during typical spring discharge.

5.2.1.2.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 5,000 cfs diversion with all past, present, and reasonably foreseeable activities causing changes to or maintaining hydrology in and around the project area.

Operations of the White Ditch structure would need to be done in concert with the existing Caernarvon diversion, as well as the proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch. Coordinated operations of all structures would be necessary to optimize potential benefits within the Breton Sound Basin.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 5,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in flow patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sediment levels and flows. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.1.3 Alternative 2 – 10,000 cfs max Diversion

5.2.1.3.1 Direct

The direct impact of a diversion with the potential of operating up to 10,000 cfs in the area between River aux Chenes and the Mississippi River would be increased water levels and flows within the project area while the structure is being operated. During operations, Mississippi River water would flow through River aux Chenes, Bayou Garelle, and numerous other natural and man-made channels. Flows through these channels would have velocities similar to those in the 5,000 cfs diversion due to the proposed channel improvements (i.e. deepening or widening) as described in the Engineering Appendix (Appendix L). Stages would be elevated near the outfalls of where diverted water is leaving the Bayou Garelle and flowing into larger, more open, bodies of water. Results from hydrodynamic modeling yield that these stages would be higher than those from the 5,000 cfs diversion.

5.2.1.3.2 Indirect

Indirect impacts of a 10,000 cfs diversion would be the slight inundation of lands while the structure is being operated. During operations these lands would be submerged deeper than the 5,000 cfs diversion. Lands that would not always be inundated during the period would become submerged. With this submergence, there would be an opportunity for the lands to collect sediments, more than the 5,000 cfs diversion, that would be carried by the diverted Mississippi River water, thus renewing historic deltaic processes.

5.2.1.3.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 10,000 cfs diversion with all past, present, and reasonably foreseeable activities causing changes to or maintaining hydrology in and around the project area.

Operations of the White Ditch structure would need to be done in concert with the existing Caernarvon diversion, as well as the proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch. Coordinated operations of all structures would be necessary to optimize potential benefits within the Breton Sound Basin.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 10,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in flow patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sediment levels and flows. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.1.4 Alternative 3 – 15,000 cfs max Diversion

5.2.1.4.1 Direct

The direct impact of a diversion with the potential of operating up to 15,000 cfs in the area between River aux Chenes and the Mississippi River would be increased water levels and flows within the project area while the structure is being operated. During operations, Mississippi River water would flow through River aux Chenes, Bayou Garelle, and numerous other natural and man-made channels. Flows through these channels would have velocities similar to those in the 10,000 cfs diversion due to the proposed channel improvements (i.e. deepening or widening) as described in the Engineering Appendix. Stages would be elevated near the outfalls of where diverted water is leaving the Bayou Garelle and flowing into larger, more open, bodies of water. Results from hydrodynamic modeling yield that these stages would be higher than those from the 10,000 cfs diversion.

5.2.1.4.2 Indirect

Indirect impacts of a 15,000 cfs diversion would be the slight excess inundation of lands while the structure is being operated. During operations these lands would be submerged deeper than those from the 10,000 cfs diversion. Lands that would not always be inundated during the period would become submerged. With this submergence, there would be an opportunity for the lands to collect sediments, more than from the 10,000 cfs alternative, that would be being carried by the diverted Mississippi River water thus renewing historic deltaic processes.

5.2.1.4.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 15,000 cfs diversion with all past, present, and reasonably foreseeable activities causing changes to or maintaining hydrology in and around the project area.

Operations of the White Ditch structure would need to be done in concert with the existing Caernarvon diversion, as well as the proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch. Coordinated operations of all structures would be necessary to optimize potential benefits within the Breton Sound Basin.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 15,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in flow patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sediment levels and flows. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.2.1.5.1 Direct

The direct impact of a diversion with the potential of operating up to 35,000 cfs in the area between River aux Chenes and the Mississippi River would be increased water levels and flows within the project area while the structure is being operated. During operations, Mississippi River water would flow through River aux Chenes, Bayou Garelle, and numerous other natural and man-made channels. Flows through these channels would have velocities similar to those in the 15,000 cfs diversion due to the proposed channel improvements (i.e., deepening or widening) as described in the Engineering Appendix. Stages would be elevated across large portions of the project area surrounding the outfalls of where diverted water is leaving the Bayou Garelle. Results from hydrodynamic modeling yield that these stages would be higher than those from the 15,000 cfs diversion. Large areas of the marsh (from approximately 1 mile south and west of Bayou Garelle and the main outfall channel, extending to the northern extent of the project boundary, and being contained by the River aux Chenes and Mississippi River ridges) would be inundated on the order of 0.3 to 0.6 foot during maximum diversion operations. The model indicates that these areas would quickly drain to the normally inundated extent on the order of 5 to 7 days when operations would be shifted from maximum flow to the proposed 1,000 cfs maintenance flow at the end of the March–April pulse.

5.2.1.5.2 Indirect

Indirect impacts of a 35,000 cfs diversion would be the slight inundation of lands while the structure is being operated. During operations these lands would be submerged deeper than those from the 15,000 cfs diversion. Lands that would not always be inundated during the period would become submerged. With this submergence, there would be an opportunity for the lands to collect beneficial sediments, more than from the 15,000 cfs diversion, that would be being carried by the diverted Mississippi River water thus renewing historic deltaic processes.

5.2.1.5.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 35,000 cfs diversion with all past, present, and reasonably foreseeable activities causing changes to or maintaining hydrology in and around the project area.

Operations of the White Ditch structure would need to be done in concert with the existing Caernarvon diversion, as well as the proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch. Coordinated operations of all structures would be necessary to optimize potential benefits within the Breton Sound Basin.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 35,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in flow patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sediment levels and flows. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals. See Appendix L for additional information.

5.2.2 Sedimentation and Erosion

5.2.2.1 No Action Alternative (Future Without Project Conditions)

5.2.2.1.1 Direct

The No Action Alternative, i.e., not implementing a diversion in the White Ditch Study Area, would have a direct impact on sedimentation and erosion within the area between the Mississippi River and River aux Chenes through the continuation of existing degradation of marsh. The absence of a supply of freshwater, sediment, and nutrients combined with the ongoing pressures of wind and wave action, storm surges, and human activities would continue to erode marsh soils and reduce the ability of the project area to maintain a balance of emergent wetland and shallow water.

5.2.2.1.2 Indirect

Indirect impacts of the No Action Alternative would result in the persistence of existing conditions. Consequences would include further degradation of the existing marsh from saltwater intrusion due to impaired hydrologic processes present in the basin; as well as the continued lack of sediments, nutrients, and freshwater. With the absences of these processes, the marsh would not be able to sustain itself against subsidence and prolonged inundation from sea level rise.

The No Action Alternative would cause the marsh to continue with minimal inputs of freshwater, nutrients, and sediment. The sediment deficit would continue to result in subsidence and a disruption of natural processes that promote productivity and diversity in the marsh ecosystem. Increases in relative sea level (i.e., subsidence plus sea level rise) would continue to permanently inundate marsh communities, which would ultimately lead to substantial losses of acreage.

5.2.2.1.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the No Action Alternative with all past, present, and reasonably foreseeable activities causing changes to or maintaining sedimentation and erosion in and around the project area.

5.2.2.2 Alternative 1 – 5,000 cfs max Diversion

5.2.2.2.1 Direct

The direct impact of a diversion with the potential of operating up to 5,000 cfs in the area between River aux Chenes and the Mississippi River would be increased availability of freshwater, sediments, and nutrients. The sediments in the waters would be available to help “fill in” areas of open water that were historically marsh. The areas that would receive the most potential benefits from the sediments would be the open water areas that would be adjacent to the Bayou Garelle. As sediments reach these areas their velocities begin to decrease and particles would begin to fall out.

Assuming the diversion operated at maximum capacity (5,000 cfs) for 2 months in the spring and 1,000 cfs for the remainder of the year, 74,000 tons of sediment would be expected annually. This amount of sediment would be beneficial to the project area, but it would not be a sufficient amount to offset the rate of marsh loss the project area has historically experienced.

Measures would be taken to prevent erosion of existing features. Restoration of historic ridge features as well as armoring of necessary channels would be done to prevent degradation of the project area from erosive hydraulic forces that would result from diverted flows. The sediments that would be deposited from the diversion would be subject to erosive forces due to their lack of cohesion or consolidation. This is not deemed as a negative impact, but rather a natural process.

5.2.2.2.2 Indirect

Increased sediment introduction into the project area would result in the "filling-in" of open water areas adjacent to the Bayou Garelle. With these areas filling in, there would be more opportunity for SAV to establish themselves across the project area. As time progress in the project area, these areas would likely transition from SAVs to emergent vegetation as more sediment is brought into the area.

With the inundation of land from diverted flows, there would be an opportunity for the lands to collect sediments through overland flow. This process would help established marsh keep pace with the relative sea level rise by aiding in accretion.

5.2.2.2.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 5,000 cfs Alternative with all past, present, and reasonably foreseeable activities causing changes to or maintaining sedimentation and erosion in and around the project area.

The Caernarvon Diversion inputs sediments into the Breton Sound Basin. These sediments likely fall out long before they reach River aux Chenes having no impact on the project area. The CWPPRA project for the rehabilitation of the existing siphon at White Ditch would have direct sediment introduction into the project area, specifically in the northern extents.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 5,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in sedimentation and erosion patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sedimentation and erosion. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.2.3 Alternative 2 – 10,000 cfs max Diversion

5.2.2.3.1 Direct

The direct impact of a diversion with the potential of operating up to 10,000 cfs in the project area would be increased availability of freshwater, sediments, and nutrients. The sediments in the waters would be available to help "fill in" areas of open water that were historically marsh. The areas that would receive the most potential benefits from the sediments would be the open water areas that would be adjacent to the Bayou Garelle. As sediments reach these areas velocities would decrease and particles would fall out.

Assuming the diversion operated at maximum capacity (10,000 cfs) for 2 months in the spring and 1,000 cfs for the remainder of the year, 108,000 tons of sediment would be expected annually. This amount of sediment would be beneficial to the project area and would be sufficient maintain existing acreage against the current rate of loss.

Measures would be taken to prevent erosion of existing features. Restoration of historic ridge features as well as armoring of necessary channels would be done to prevent degradation of the project area from erosive hydraulic forces that would result from increased velocities of diverted flows. The sediments that would be deposited from the diversion would be subject to erosive forces due to their lack of cohesion or consolidation. This is not deemed as a negative impact, but rather a natural process.

5.2.2.3.2 Indirect

Increased sediment introduction into the project area would result in the “filling-in” of open water areas adjacent to the Bayou Garelle. This effect would be roughly twice that of the 5,000 cfs diversion (assuming a March–April Pulse). With these areas filling in, there would be more opportunity for SAV to establish themselves across the project area. As time progress in the project area, these areas would begin to transition from SAVs to emergent vegetation as more sediment would be brought into the area.

With the inundation of land from diverted flows, there would be an opportunity for the lands to collect sediments through overland flow. This effect would be roughly twice that of the 5,000 cfs diversion (assuming similar operational schemes). This process would help established marsh keep up with relative sea level rise by aiding in accretion.

5.2.2.3.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 10,000 cfs Alternative with all past, present, and reasonably foreseeable activities causing changes to or maintaining sedimentation and erosion in and around the project area.

The Caernarvon Diversion inputs sediments into the Breton Sound Basin. These sediments likely fall out long before they reach River aux Chenes having no impact on the project area. The CWPPRA project for the rehabilitation of the existing siphon at White Ditch would have direct sediment introduction into the project area, specifically in the northern extents.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 10,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in sedimentation and erosion patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sedimentation and erosion. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.2.4 Alternative 3 – 15,000 cfs max Diversion

5.2.2.4.1 Direct

The direct impact of a diversion with the potential of operating up to 15,000 cfs in the project area would be increased availability of freshwater, sediments, and nutrients. The sediments in the waters would be available to help "fill in" areas of open water that were historically marsh. The areas that would receive the most potential benefits from the sediments would be the open water areas that would be adjacent to the Bayou Garelle. As sediments reach these areas velocities would decrease and particles would fall out.

Assuming the diversion operated at maximum capacity (15,000 cfs) for 2 months in the spring and 1,000 cfs for the remainder of the year, 143,000 tons of sediment would be expected annually. This amount of sediment would be beneficial to the project area and would be sufficient maintain existing acreage against the current rate of loss.

Measures would be taken to prevent erosion of existing features. Restoration of historic ridge features as well as armoring of necessary channels would be done to prevent degradation of the project area from erosive hydraulic forces that would result from increased velocities of diverted flows. The sediments that would be deposited from the diversion would be subject to erosive forces due to their lack of cohesion or consolidation. This is not deemed as a negative impact, but rather a natural process.

5.2.2.4.2 Indirect

Increased sediment introduction into the project area would result in the "filling-in" of open water areas adjacent to the Bayou Garelle. This effect would be roughly three times that of the 5,000 cfs diversion (assuming a March–April Pulse). With these areas filling in, there would be more opportunity for SAV to establish themselves across the project area. As time progress in the project area, these areas would begin to transition from SAVs to emergent vegetation as more sediment is brought into the area.

With the inundation of land from diverted flows, there would be an opportunity for the lands to collect sediments through overland flow. This effect would be roughly three times that of the 5,000 cfs diversion (assuming similar operational schemes). This process would help established marsh keep up with the relative sea level rise by aiding in accretion.

5.2.2.4.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 15,000 cfs Alternative with all past, present, and reasonably foreseeable activities causing changes to or maintaining sedimentation and erosion in and around the project area.

The Caernarvon Diversion inputs sediments into the Breton Sound Basin. These sediments likely fall out long before they reach River aux Chenes having no impact on the project area. The CWPPRA project for the rehabilitation of the existing siphon at White Ditch would have direct sediment introduction into the project area, specifically in the northern extents.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 15,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in sedimentation and erosion patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sedimentation and erosion. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.2.2.5.1 Direct

The direct impact of a diversion with the potential of operating up to 35,000 cfs in the project area would be increased availability of freshwater, sediments, and nutrients. The sediments in the waters would be available to help “fill in” areas of open water that were historically marsh. The areas that would receive the most potential benefits from the sediments would be the open water areas that would be adjacent to the Bayou Garelle. As sediments reach these areas velocities would decrease and particles would fall out.

Assuming the diversion operated at maximum capacity (35,000 cfs) for 2 months in the spring and 1,000 cfs for the remainder of the year, 279,000 tons of sediment would be expected annually. This amount of sediment would be sufficient to exceed the current rate of marsh loss and would have potential to recreate acreage comparable to that present in the 1950s.

Measures would be taken to prevent erosion of existing features. Restoration of historic ridge features as well as armoring of necessary channels would be done to prevent degradation of the project area from erosive hydraulic forces that would result from increased velocities of diverted flows. The sediments that would be deposited from the diversion would be subject to erosive forces due to their lack of cohesion or consolidation. This is not deemed as a negative impact, but rather a natural process.

5.2.2.5.2 Indirect

Increased sediment introduction into the project area would result in the “filling-in” of open water areas adjacent to the Bayou Garelle. This effect would be roughly seven times that of the 5,000 cfs diversion (assuming a March–April Pulse). With these areas filling in, there would be more opportunity for SAV to establish themselves across the project area. As time progress in the project area, these areas would begin to transition from SAVs to emergent vegetation as more sediment is brought into the area.

With the inundation of land from diverted flows, there would be an opportunity for the lands to collect sediments through overland flow. This effect would be roughly seven times that of the 5,000 cfs diversion (assuming similar operational schemes). This process would help established marsh keep up with the relative sea level rise by aiding in accretion.

5.2.2.5.3 Cumulative

Cumulative impacts would be the synergistic and combined effect of the 35,000 cfs Alternative with all past, present, and reasonably foreseeable activities causing changes to or maintaining sedimentation and erosion in and around the project area.

The Caernarvon Diversion inputs sediments into the Breton Sound Basin. These sediments likely fall out long before they reach River aux Chenes having no impact on the project area. The CWPPRA project for the rehabilitation of the existing siphon at White Ditch would have direct sediment introduction into the project area, specifically in the northern extents.

The proposed Myrtle Grove diversion, which if constructed would be directly across the river from the proposed White Ditch structure could have cumulative effects with the 35,000 cfs diversion. The combination of the two structures working in proximity to each other on opposite sides of the Mississippi River could potentially create changes in sedimentation and erosion patterns. The risk of this is low due to the relatively small percentage of water actually that would actually be diverted from the river.

Other existing and proposed diversions along the Mississippi River could collectively have impacts on sedimentation and erosion. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole assemblage could have effects on flows and stages. System-wide coordination would be necessary to ensure avoidance of potentially undesirable impacts. An overall operating plan for diversions would allow beneficial use of the river for multiple uses and goals.

5.2.3 Water Use and Supply

5.2.3.1 No Action Alternative (Future Without Project Conditions)

5.2.3.1.1 Direct

Under the No Action Alternative no direct impacts to water use and supply of the project area would occur.

5.2.3.1.2 Indirect

Indirect impacts of not implementing restoration features would result in the persistence of existing conditions for the Mississippi River and White Ditch project area.

5.2.3.1.3 Cumulative

Cumulative impacts would be the synergistic effect on the No Action Alternative for water use and supply with the added combination of similar wetland degradation and wetland loss impacts to water use and supply throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity.

5.2.3.2 Alternative 1 – 5,000 cfs max Diversion

5.2.3.2.1 Direct

Under the 5,000 cfs diversion, no significant direct impacts to water use and supply of the project area would occur.

5.2.3.2.2 Indirect

Under the 5,000 cfs diversion, no significant indirect impacts to water use and supply of the project area would occur.

5.2.3.2.3 Cumulative

Cumulative impacts would be the synergistic effect on the 5,000 cfs diversion for water use and supply with the added combination of similar wetland degradation and wetland loss impacts to water use and supply throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity.

5.2.3.3 Alternative 2 – 10,000 cfs max Diversion

5.2.3.3.1 Direct

Under the 10,000 cfs diversion, no direct impacts to water use and supply of the project area would occur.

5.2.3.3.2 Indirect

Under the 10,000 cfs diversion, no indirect impacts to water use and supply of the project area would occur.

5.2.3.3.3 Cumulative

Cumulative impacts would be the synergistic effect on the 10,000 cfs diversion for water use and supply with the added combination of similar wetland degradation and wetland loss impacts to water use and supply throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity.

5.2.3.4 Alternative 3 – 15,000 cfs max Diversion

5.2.3.4.1 Direct

Under the 15,000 cfs diversion, no direct impacts to water use and supply of the project area would occur.

5.2.3.4.2 Indirect

Under the 15,000 cfs diversion, no indirect impacts to water use and supply of the project area would occur.

5.2.3.4.3 Cumulative

Cumulative impacts would be the synergistic effect on the 15,000 cfs diversion for water use and supply with the added combination of similar wetland degradation and wetland loss impacts to water use and supply throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity.

5.2.3.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.2.3.5.1 Direct

Under the 35,000 cfs diversion, no direct impacts to water use and supply of the project area would occur.

5.2.3.5.2 Indirect

Under the 35,000 cfs diversion, no indirect impacts to water use and supply of the project area would occur.

5.2.3.5.3 Cumulative

Cumulative impacts would be the synergistic effect on the 35,000 cfs diversion for water use and supply with the added combination of similar wetland degradation and wetland loss impacts to water use and supply throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity.

5.2.4 Groundwater

5.2.4.1 No Action Alternative (Future Without Project Conditions)

5.2.4.1.1 Direct

Under the No Action Alternative no direct impacts to groundwater of the project area would occur.

5.2.4.1.2 Indirect

Under the No Action Alternative no indirect impacts to groundwater of the project area would occur.

5.2.4.1.3 Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on groundwater with the added combination of similar wetland degradation and wetland loss impacts to groundwater, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. No cumulative impacts would be anticipated.

5.2.4.2 Alternative 1 – 5,000 cfs max Diversion

5.2.4.2.1 Direct

Under the 5,000 cfs diversion, no direct impacts to groundwater of the project area would occur.

5.2.4.2.2 Indirect

Under the 5,000 cfs diversion, no indirect impacts to groundwater of the project area would occur.

5.2.4.2.3 Cumulative

Cumulative impacts would be the synergistic effect of the 5,000 cfs diversion on groundwater with the added combination of similar wetland degradation and wetland loss impacts to groundwater, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. No cumulative impacts would be anticipated.

5.2.4.3 Alternative 2 – 10,000 cfs max Diversion

5.2.4.3.1 Direct

Under the 10,000 cfs diversion, no direct impacts to groundwater of the project area would occur.

5.2.4.3.2 Indirect

Under the 10,000 cfs diversion, no indirect impacts to groundwater of the project area would occur.

5.2.4.3.3 Cumulative

Cumulative impacts would be the synergistic effect of the 10,000 cfs diversion on groundwater with the added combination of similar wetland degradation and wetland loss impacts to groundwater, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. No cumulative impacts would be anticipated.

5.2.4.4 Alternative 3 – 15,000 cfs max Diversion

5.2.4.4.1 Direct

Under the 15,000 cfs diversion, no direct impacts to groundwater of the project area would occur.

5.2.4.4.2 Indirect

Under the 15,000 cfs diversion, no indirect impacts to groundwater of the project area would occur.

5.2.4.4.3 Cumulative

Cumulative impacts would be the synergistic effect of the 15,000 cfs diversion on groundwater with the added combination of similar wetland degradation and wetland loss impacts to groundwater, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. No cumulative impacts would be anticipated.

5.2.4.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.2.4.5.1 Direct

Under the 35,000 cfs diversion, no direct impacts to groundwater of the project area would occur.

5.2.4.5.2 Indirect

Under the 35,000 cfs diversion, no indirect impacts to groundwater of the project area would occur.

5.2.4.5.3 Cumulative

Cumulative impacts would be the synergistic effect of the 35,000 cfs diversion on groundwater with the added combination of similar wetland degradation and wetland loss impacts to groundwater, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity. No cumulative impacts would be anticipated.

5.3 WATER QUALITY AND SALINITY

5.3.1 Water Quality

5.3.1.1 No Action Alternative (Future Without Project Conditions)

5.3.1.1.1 Direct

Under the No Action Alternative, no diversion of river water and no input of river sediments and nutrients would occur in the MDWD project area. None of the potential negative effects of river inflows to this portion of the Breton Sound Basin would result; however, the project area would continue to be isolated from natural riverine processes critical to maintaining functioning and sustainable coastal wetlands and estuaries.

5.3.1.1.2 Indirect

The most notable indirect impact from no action is the ongoing erosion/subsidence and land loss of the coastal areas. This would continue to expose the pipelines of the expansive oil and gas infrastructure along the coast of Louisiana. This would be a precarious situation, especially during storm events and within navigable waterways. Exposed pipelines would be vulnerable to navigation vessels striking them, which could lead to discharges into waters of the project area. In the event of discharges, extensive ecological damage would probably occur. The owner(s) of the infrastructure could incur expensive fines and cleanup costs; and vessel operators could be seriously injured. There would be other forms of infrastructure that could potentially be exposed due to coastal erosion including wastewater collection systems and other commercial industry related systems.

5.3.1.1.3 Cumulative

Without the proposed actions of White Ditch Medium Diversion Project the Breton Sound Basin would still be affected by activities, natural and man-influenced, that would have both beneficial and detrimental effects to water quality conditions. Some of these activities include: other Federal, state, local, and private restoration efforts such as CWPPRA, USACE ecosystem restoration projects, various NRCS programs (e.g., Coastal Wetlands Restoration Program), and CPRA projects; state and local water quality management programs; national level programs to address hypoxia in the northern Gulf of Mexico; the continued erosion/subsidence of the coast; oil and gas development; industrial, commercial, and residential development; and Federal, state, and municipal navigation and flood-damage reduction projects. There would be a number of present and future activities that would continue to occur without the proposed actions of the LCA Plan and would affect surface water quality conditions within the White Ditch Project Area. The cumulative impact of these activities without the LCA Plan is discussed below. Passage of the Federal Water Pollution Control Act (FWPCA) in 1948 and its amendments including the CWA and the Water Quality Act of 1987 and the establishment of state and Federal environmental protection agencies resulted in water pollution control regulations, including:

- The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution. In 1997 the USEPA granted NPDES delegation to LDEQ, which is known as the Louisiana Pollutant Discharge Elimination System (LPDES).
- LDEQ's Nonpoint Source Pollution Program is continuing to implement watershed initiatives to address nonpoint source pollution sources such as agriculture, home sewage treatment, hydro modification, urban runoff, construction activities, and resource extraction.
- LDNR's Coastal Nonpoint Pollution Program is responsible for identifying Best Management Practices (BMPs) appropriate for all applicable pollutant source categories and carrying out initiatives of public education, technical assistance, and development of enforcement protocols.
- Total Maximum Daily Loads (TMDLs) – Section 303(d) of the CWA requires states to identify, list, and rank for development of TMDLs waters that do not meet applicable water quality standards after implementation of technology-based controls.

The programs discussed above would continue to develop or remain in place with or without MDWD project features to ensure protection of Louisiana's public health and natural resources. Water quality conditions would likely improve with the programs in place. However, some activities that could potentially have negative effects on water quality would also continue to occur with or without the proposed MDWD Plan. Other efforts that would probably improve water quality conditions would be the present and future Federal, state, local, and private ecosystem restoration projects.

Industrial, commercial, and residential development along the coast could contribute to adverse impacts to water quality within the MDWD project area. With this activity comes increased point and nonpoint source pollution from sources such as wastewater treatment facilities and urban runoff from new development. Also, activities associated with maintaining and improving navigation along the coast would continue to occur.

Flood-damage reduction projects would continue to be planned, designed, and constructed especially in areas highly susceptible to flood damages due to hurricanes and tropical storm events. With these activities, more alterations to the hydrology of the coast would potentially occur leading to areas of degraded water quality. Some projects, such as the Southeast Louisiana Urban Flood Control Project, would be providing flood protection for a 10-year rainfall event. However, this is also increasing the flow of urban runoff that is diverted into Lake Pontchartrain and other surrounding water bodies without providing pollutant reduction measures as seen in many stormwater collection systems across the nation. Unfortunately, metro New Orleans' unique geographic setting does not allow for incorporating many pollutant reduction methods; however, the NPDES Storm Water Program and the continued development of TMDLs could require stormwater professionals to find innovative methods, such as subsurface structural BMP to drain the populated areas effectively while protecting the receiving water bodies as much as practicable. Adverse impacts to water quality by these Federal projects would be mitigated as legally mandated.

5.3.1.2 Alternative 1 – 5,000 cfs max Diversion

5.3.1.2.1 Direct

The direct impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.2.2 Indirect

The indirect impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.2.3 Cumulative

The cumulative impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.3 Alternative 2 – 10,000 cfs max Diversion

5.3.1.3.1 Direct

The Direct impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.3.2 Indirect

The indirect impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.3.3 Cumulative

The cumulative impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.4 Alternative 3 – 15,000 cfs max Diversion

5.3.1.4.1 Direct

The Direct impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.4.2 Indirect

The indirect impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.4.3 Cumulative

The cumulative impacts of this alternative would have the similar effects as the 35,000 cfs diversion, but they would be on a lesser scale due to the amount of water being diverted.

5.3.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.3.1.5.1 Direct

In general, river diversions could cause short- to long-term adverse impacts due to construction of restoration features including: increased total suspended sediments, turbidity, and organic/nutrient enrichment of the water column; disturbance and release of possible contaminants; decrease in water temperatures; and the possible release of oxygen depleting substances (organic or anaerobic sediments) as well as possibly decreasing dissolved oxygen (DO) levels. Note that many of the direct impacts could also be indirect effects (see below). These impacts would be minimized, as much as practicable, through the implementation of stormwater pollution prevention plans (SWPPPs), the ITM protocols, and other applicable best management practices (BMPs).

Generally, four water quality conditions could change with implementation of the proposed restoration alternative. The four water quality conditions that would change include:

1. Freshwater would be moved throughout the entire MDWD project area;
2. Salinities would decrease throughout the entire project area, especially during and after the months of maximum diversion;
3. Sediments in the project area would increase allowing the maximum amount of marsh creation of all the alternatives, along with accompanying minor increases in trace metals associated with suspended and bed sediments; and
4. Agrochemicals/Nutrients in the project area could increase.

Introduction of river water into the Breton Sound Basin would immediately change the water chemistry of receiving areas. Change could be beneficial or detrimental, depending the water uses. The change from a less fresh to a fresher system could be perceived as beneficial to wetland nourishment, but detrimental to recreational use because of water color changes, and possible changes in fish species assemblages. However, the changes in water chemistry would mimic what occurred naturally prior to the construction of levees.

Data has been collected from the Mississippi River at the Luling Water Plant Collection Site, Site WSS 1, coordinates N 29.56.076, W 90.21.602, for the Davis Pond Diversion project. This data has been reviewed with respect to nutrients and atrazine, and an estimated load was calculated based on the TSP of 35,000 CFS for the months of March and April along with the loads associated with a 1,000 CFS diversion for the rest of the months of the year. This data captures the estimated average Mississippi River water quality for the 10 years that data has been collected for Total Nitrogen and Total Phosphate. The estimated Atrazine loads were calculated on data that was collect from the years 2001 through 2008; however, during 2005 there was no Atrazine data collected and for the years prior to 2001 the observed values were below the detection limit of the laboratory. Table 5.1 shows the estimated average total load per month. The anticipated loads to the project area are estimated values due to the fact that daily values were not collected, so a monthly value was used for the calculations. During PED, more data will be collected in the project area and analyzed. See Section 3.8.8 for more details.

Table 5.1: Estimated Average Total Load (Tonnes)/Month

Month	Total Nitrogen	Total Phosphate	Total Atrazine
January	169	20	35.4
February	179	15	53.7
March	6927	712	1954.6
April	8131	517	2490.5
May	195	18	78.2
June	225	19	79.1
July	196	22	58.0
August	192	16	66.0
September	137	18	53.1
October	96	16	49.3
November	136	15	48.6
December	159	13	48.7
Total per year	16742	1401	5015.2
Load (mg) = mg/L x (L/ft^3) x (ft^3/sec) x (secs/day) x days			

There could be potential chemical effects due to either an increase or decrease in the methylation of mercury. The potential for increase in mercury methylation would occur during the initial construction of the structure, the outfall canals and the creation of new wetlands due to sediment disturbance. This would be a short term adverse impact. Reintroduction of river water could increase the risk of conditions favorable to the causes of methylation by changing the levels of dissolved organic carbon and changing the pH of the water. This would be a potential long term adverse impact. At the same time the increased sediment load would trap mercury in the soil as new marsh is created by the diversion as well as the accumulation of the mercury in the plants would be a long term positive impact.

The reintroduction of streambed sediments into the MDWD project area could add some contaminants; these could include primarily trace metals and hydrophobic organic compounds from Mississippi River streambed sediments. Trace metals and hydrophobic organic compounds such as pyrenes, hexachlorobenzene, and chlorinated hydrocarbons such as DDT, or its degradates, would adsorb onto sediment particles or the organic coatings of sediment particles (Demas and Demcheck 2003).

5.3.1.5.2 Indirect

Indirect effects of changes to water quality could include: nutrient enrichment possibly leading to increased algae blooms and freshwater tolerant aquatic organisms; increased turbidity leading to disruption of freshwater and marine organisms; decreased water temperatures; increased DO; freshwater areas would increase thereby providing additional habitats for aquatic organisms; salinities would stabilize or decrease; sediments in the coastal zone would increase, with accompanying minor increases in trace metals associated with bed sediments; and agrichemicals in the water could increase.

A model of nitrate-nitrogen retention by wetlands in the Mississippi River Basin was developed combining 24 wetland-years of nitrate-nitrogen data from Ohio and Louisiana with nitrate reduction data from another 26 wetland-years of data from additional wetlands in Ohio, Illinois and Louisiana (Phipps and Crumpton, 1994; Kovacic et al., 2000; Lane et al., 2002; Fink and Mitsch, 2004; Mitsch and Day, in press). The study shows that wetlands in their study area in Louisiana have an average retention of 46 g-N per square meter per year. All of these studies received either Mississippi River diversion water or agricultural runoff. The wetland would be expected to reduce nutrient concentrations by about 45% (William J. Mitsch, et al.). There are approximately 56,000 acres (226,622,200 square meters) of wetlands in the MDWD study area. Table 5.2 shows the estimated residual nitrogen in the water in wetlands in the study area. Hydraulic modeling results show that some of the diversion water would pass through the ridge into the extended influence boundary. From this we can infer that some of the remaining nitrogen would be taken up by the wetlands in that area. The hydraulic model also shows that some of the water would also flow south in to America Bay and Brenton Sound.

Table 5.2: Estimated Residual N After Wetland Uptake

Month	Estimated Avg. Total Load N input water (g-N)	Grams-N/Square Meter wetlands in Study Area	Potential Uptake of Wetlands (g-N/m^2 month)	Residual N in Water (g-N/m^2 month)
January	169,000,000	0.75	3.83	0
February	179,000,000	0.79	3.83	0
March	6,927,000,000	30.57	3.83	26.73
April	8,131,000,000	35.88	3.83	32.05
May	195,000,000	0.86	3.83	0
June	225,000,000	0.99	3.83	0
July	196,000,000	0.86	3.83	0
August	192,000,000	0.85	3.83	0
September	137,000,000	0.60	3.83	0
October	96,000,000	0.42	3.83	0
November	136,000,000	0.60	3.83	0
December	159,000,000	0.70	3.83	0
Total per year	16,742,000,000	73.88	46.00 g-N/m^2 year	27.88 g-N/m^2 year

The uptake of nutrients by wetland plants and sediments would lower the potential for eutrophication of waters in the study area. In addition, long term experience with the operation of the Caernarvon and Davis Pond freshwater diversion structures indicates that the operation of these projects has not been related to eutrophication and fish kills. In 2010 the State of Louisiana operated both of these structures near their maximum capacity for an extended period, contributing greatly to freshening their respective receiving areas with river water. During this time period there were no eutrophication issues or fish kills related to this operation.

At a pulse flow rate of 35,000 cfs at White Ditch, river water would displace the water in the White Ditch receiving area. During these maximum pulse diversions, conditions would not be conducive for algae bloom formation because water movement would keep suspended material in the water column, inhibiting light penetration. Also, water temperatures would not be at their peak in March and April. After flow is reduced to 1,000 cfs, the potential for algae blooms would increase. However, this would be similar to the conditions that occurred in summer 2010 in the Caernarvon and Davis Pond receiving areas after the flow rates for those structures were reduced to minimum levels.

Monitoring and management of the MDWD project through adaptive management would help to ensure that operation of the project would minimize the potential for algae blooms and eutrophication of the receiving waters. Coordination with LDEQ, USEPA, and other stakeholders would also contribute to minimizing impacts to receiving waters.

This nutrient pulse from the diversion and the associated reduction would have a direct influence on increased plant production within the project area. A concept of nutrient "potential" energy is used to describe the energy or nutrition available to potentially support biomass production per unit area of marsh. The analysis generates an estimate of the maximum biomass production that can be expected in a given marsh type (e.g., fresh, brackish, or salt) from the nutrients available in a volume of water from a given water source (Boustany, Ronald G.). This analysis is part of the ERDC-SAND2 model that was used to identify the potential of the diversion to create marsh. For more information on this model and how it was used, see sections 3.3.4.1, 3.5.4.2, 3.5.4.3, 3.8.2, 3.8.3, and Appendix L.

Estimated atrazine loads were calculated (Table 5.2) based on the Recommended Plan. There are no direct ways to calculate the impacts to water quality associated with the estimated loads into the Breton Sound Basin. However research performed at the University of South Carolina found the following:

The fate and transport of pesticides in aquatic systems are facilitated to a large degree by physical, biological and chemical processes such as oxidation, sorption, volatilization, microbial degradation and photolysis. Atrazine, a preemergent triazine herbicide has the potential to persist in the environment due to its slight water solubility and long half-life. Deethylatrazine (DEA) and deisopropylatrazine (DIA), the two major microbial breakdown products, have been measured extensively in surface and groundwater. The biodegradation of atrazine was monitored in sediments collected from coastal South Carolina by examining the distribution into three chemical fractions over time. Due to sorption to sediment organic matter after 80 days only 50–70% of the total added atrazine was recovered. Of this, between 20 and 30% of the activity measured was associated with the aqueous fraction indicating degradation to more water-soluble metabolites. Another 20–50% of the remaining activity, depending on site, was associated with the basic fraction indicative of sorption of atrazine and/or its metabolites to sediment organic matter. These results suggest that degradation and sorption account for the fate of greater than 80% of the atrazine recovered in these coastal sediments (Kelly L. Smalling and C. Marjorie Aelion).

Similar results are anticipated to occur within the project area based on the estimated atrazine loads calculated to enter the project based on the operations of the Recommended Plan. However the fate would be dependent on the actual load into the project area and the retention time of the diversion within the project area. Furthermore in the article "Atrazine Fate Processes in a Constructed Emergent marsh" 1998 research updates, it is stated that restoration or creation of wetlands adjacent to rivers has been proposed as a means of treating agricultural runoff and protecting downstream surface waters from the effects of non-point pollutants (Detenbeck et al.).

Although the water quality impacts associated with the predicted atrazine loads into Breton Sound cannot be directly calculated, the risk of adverse ecological impacts attributable to the atrazine loading is anticipated to be low. EPA has developed draft ambient water quality criteria for atrazine for the protection of aquatic life through its authority under section 304(a) of the Clean Water Act (CWA). These water quality criteria are guidance for Sates and Tribes and in themselves have no binding legal effect. The criteria may form the basis for State and Tribal water quality standards and in turn become enforceable through National Pollutant Discharge Elimination System (NPDES) permits or other environmental programs. The EPA has identified 10 to 20 ppb as a level of ecological concern as part of the corn and sorghum monitoring program. Maximum atrazine concentrations in the Mississippi River are less than 3 ppb, lower than not only the ecological level of concern but also the Maximum Contaminant Level for atrazine under the Safe Drinking Water Act (33 U.S.C. section 300f et seq.). Therefore it is not predicted at this time that the project's operation will elevate atrazine concentrations to levels that could cause adverse impacts.

Reduction in salinities could improve water quality by reducing chelating potential of metals since total dissolved solids would be decreased. Also, reduction in salinity would decrease temperature variations in the fresher waters. It should be noted that there has been some discussion in the scientific community of the potential for negative effects due to Mississippi River diversions introducing excessive amounts of nutrients. However, monitoring and management through the adaptive management approach would be necessary to ensure that proper assimilation is occurring in the receiving areas. Coordination with LDEQ, USEPA, and other stakeholders would be necessary to ensure the applicable water bodies would be protected.

5.3.1.5.3 Cumulative

The introduction of agrochemicals into the MDWD project area would be a management issue. Agricultural chemicals, primarily herbicides and fertilizers, would be introduced into the area from the Mississippi River system. These agricultural chemicals would then be further distributed into portions of the basin via the Caernarvon diversion. This input of agrochemicals, known as the spring flush, would be further distributed, to varying degrees, into the Breton Sound Basin area. Adaptive management would be important in addressing this issue. A water quality concern would be the herbicide atrazine, which is known to have endocrine disruption effects. The overall effect of this herbicide on the project area would be unknown. Acute effects, such as marsh plant death would not occur, as evidenced by plants in Breton Sound Basin that are presently exposed to atrazine-laced water from the Mississippi River, with no readily obvious detrimental effects. The fertilizers in the spring flush would have both beneficial and detrimental effects, depending on site-specific areas. In review of nutrient data collected by the USGS from the years 1999 to present it is shown that the highest nutrient loads based on data published in U.S. Geological Survey Open-File Report 2007-1080 at the Mississippi River near St. Francisville, Louisiana (Station ID 07373420) are during the months of March through June. There are slight variations through the years that can be attributed to differences in rainfall and the timing of application of agrochemicals in the upper Mississippi River Basin. Also in reviewing the Caernarvon Freshwater Diversion Structure Hydrologic, Water, and Sediment Quality Monitoring Program 1994 post construction Report, Dated September 1995, it is noted that albeit at a lesser diversion rate there was no significant degradation of water quality or impairment of designated uses in the receiving area such as fish kills or eutrophication.

These nutrients would be strongly implicated in the formation of the hypoxic zone off the mouth of the Mississippi River; however a diversion of this magnitude could aid in reducing the size or duration of the gulf hypoxic zone. But, the reintroductions could have the potential to contribute to eutrophication within the Breton Sound Basin. There would be a monitoring plan developed that would monitor not only nutrients but also metals, agrochemicals and dissolved oxygen for three years prior to construction and ten years after construction to adequately gauge the water quality impacts in the basin. Monitoring efforts and adaptive management actions would be key to addressing and controlling the effects of the diversion pulses into the MDWD project area.

Implementing the MDWD, the Breton Sound Basin and Subprovince 1 would be affected by other activities and programs that would cumulatively have both beneficial and detrimental effects on water quality conditions. Some of these past, present, and foreseeable future activities include state and local water quality management programs; oil and gas development; industrial, commercial, and residential development; and Federal, state, and local navigation and flood-damage reduction projects.

Management officials should consider these other activities, and ensure that all activities including the other LCA projects complement each other. This is critical to ensure the protection of Louisiana's coastal waters and the health of the public that utilizes these waters.

The LDEQ TMDL program is an example of a present program that would be affected by the implementation of some LCA Plan project elements. Consequently, the incremental impact of both would affect water quality conditions. Section 303(d) of the CWA requires the state to identify, list, and rank for development of TMDLs waters that do not meet applicable water quality standards after implementation of technology based controls. Other programs that could be affected by the MDWD and, simultaneously, cumulatively impact water quality conditions include LDEQ's LPDES program, LDEQ's Nonpoint Source program, LDNR's Coastal Nonpoint Source program and others.

The direct and indirect impacts discussed previously would cumulatively impact water quality conditions along with other coastal activities. The proposed diversion could independently elevate water quality constituents such as nutrients and sediment in receiving areas. Other activities such as development would potentially increase point and nonpoint source pollution in the same water bodies, therefore, causing a cumulative effect. However, continued state and Federal programs tasked with regulating water quality impacts would benefit the same water bodies. It is not possible to quantify the effects to the Breton Sound Basin and Subprovince 1 from all of the coastal activities; however, during the project implementation phase testing and analysis would be conducted to better assess the effects.

In summation the cumulative impacts to water quality would primarily be related to the incremental impact of all past, present, and future actions effecting water quality within the Basin such as:

- Increase in freshwater areas;
- Stabilization or decrease in salinities;
- Increase in sediment introduction to the coastal zone, with accompanying minor increases in trace metals associated with bed sediments;
- Increase in agrichemicals in the water;
- Increased total suspended sediments;
- Increased turbidity;
- Increased organic/nutrient enrichment of the water column;
- Disturbance and release of possible contaminants;

- Decrease in water temperatures along with fewer water temperature fluctuations; and
- Less potential for chelating metals due to reduced total dissolved solids.

However the cumulative impacts to the water quality of the Breton Sound Basin from this alternative would be a synergistic positive result over and above the additive combination of impacts and benefits of the other alternatives.

5.3.2 Salinity

5.3.2.1 No Action Alternative (Future Without Project Conditions)

5.3.2.1.1 Direct

Under the No Action Alternative no direct impacts to salinity levels of the project area would occur.

5.3.2.1.2 Indirect

Indirect impacts of no action would be the persistence of existing conditions and continued degradation of the White Ditch project area with respect to increasing salinities over time. Over the 50-year planning horizon, baseline salinity values of 4.4 ppt in the intermediate marsh zone would be anticipated to increase to approximately 5.0 ppt, the baseline of 6.6 ppt in the brackish marsh zone would be expected to increase to approximately 8.0 ppt, and the saline zone baseline of 13.0 ppt would increase to approximately 15.0.

5.3.2.1.3 Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on salinity levels when considered in context with all past, present, and reasonably foreseeable acts of nature and/or the actions private entities, state government, and Federal Government. The No Action Alternative would contribute in a negative manner to the cumulative effects on salinity experienced by most marsh areas in Southern Louisiana.

5.3.2.2 Alternative 1 – 5,000 cfs max Diversion

5.3.2.2.1 Direct

Year-long hydrological model simulations were performed to determine salinity changes resulting from diversion operation. Model runs consisted of a March–April open operation (i.e., pulse up to 35,000 cfs) (Figure 5.2) and maintenance flow (i.e., 1,000 cfs) (Figure 5.3) for the May–February period. Flows for the Caernarvon Structure were set to yearly averages. During the March–April open operation period, model results indicated that the fresh-intermediate and brackish zones would become completely fresh and the saline marsh zone would average approximately 1 ppt.

In the fresh marsh areas salinities would remain at 0 ppt during the 2-month pulse and for approximately 2 months afterwards. During the rest of the growing season, salinities would range up to 1.5 ppt. An overall mean salinity during the growing season was calculated to be approximately 0.5 ppt, which is within the optimal range for fresh marsh. Based on the modeling results, a portion of the existing intermediate marsh area would convert to fresh marsh.

The intermediate marsh area is projected to be at 0 ppt during the 2-month pulse and for approximately 1 month afterwards. Salinities begin to increase during the maintenance flow period resulting in a mean salinity during the growing season of 1.6 ppt.

For the brackish area, salinities are projected to be 0 ppt during the 2-month pulse, increase to 2 ppt in the following month, and 4 ppt the next month. Salinities are projected to average approximately 6.6 ppt during the remainder of the year, resulting in a mean annual salinity of 5 ppt.

For the saline area, salinities are projected to average near 1 ppt during the 2-month pulse, then increase to 5 ppt in the following month and 10 ppt in the next month, and average approximately 13 ppt during the remainder of the year. Mean annual salinity would be approximately 10 ppt.

Operation and management measures could work toward establishing target zones for optimum marsh type production throughout the project area. Of the implementation alternatives considered, the 5,000 cfs diversion would have the least amount of flexibility in terms of controlling and manipulating the salinity regime. Consequently, it would present the least amount of options for adaptive management.

5.3.2.2.2 Indirect

Indirect impacts of implementing restoration features into the project area would be the possible permanent transition of marsh types. These changes could have short term consequences, such as displacement of one type of marsh vegetation by another, but have long term benefits by providing a sustainable marsh and delta forming functions. Based on a review of hydrologic modeling output, which provided predicted salinities across the project area, it was determined that a portion of the intermediate marsh area would transition to fresh marsh. The transition line from fresh to intermediate was determined by reviewing the salinity modeling results and reviewing habitat data for the Caernarvon Diversion outfall area to determine the range of fresh marsh in the outfall area. The fresh-intermediate marsh boundary was delineated at the approximate 1.0 ppt isohaline. Based on the modeling results, it was assumed that the intermediate-brackish and brackish-saline marsh boundaries would remain as shown on the 2001 Coastal Marsh Vegetative Type Map.

5.3.2.2.3 Cumulative

Cumulative impacts would be the synergistic effect of the 5,000 cfs Alternative on salinity levels when considered in context with all past, present, and reasonably foreseeable acts of nature and/or the actions private entities, state government, and Federal Government. The operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin.

5.3.2.3 Alternative 2 – 10,000 cfs max Diversion

5.3.2.3.1 Direct

Salinity levels within the White Ditch project area would be affected. Significant freshening of the project area as well as the entire Breton Sound Basin would occur with maximum operations of the structure. Since all build alternatives completely freshen the Breton Sound, anticipated salinity changes are the same as described in Section 5.3.2.2.1. Operation and management measures could work toward

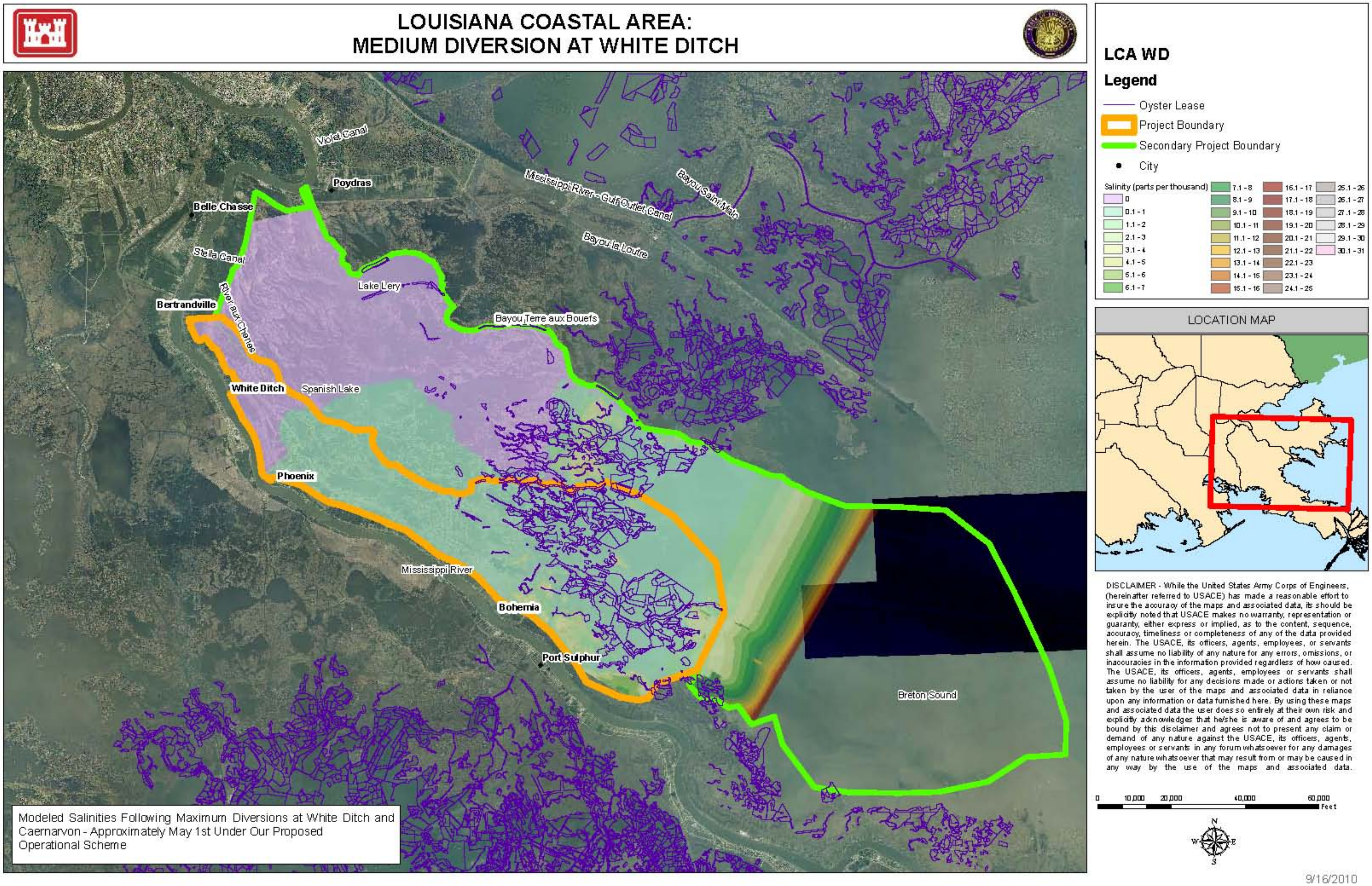

Figure 5.2: Modeled Salinities Following Maximum Diversions at White Ditch and Caernarvon – Approximately May 1st Under Our Proposed Operational Scheme

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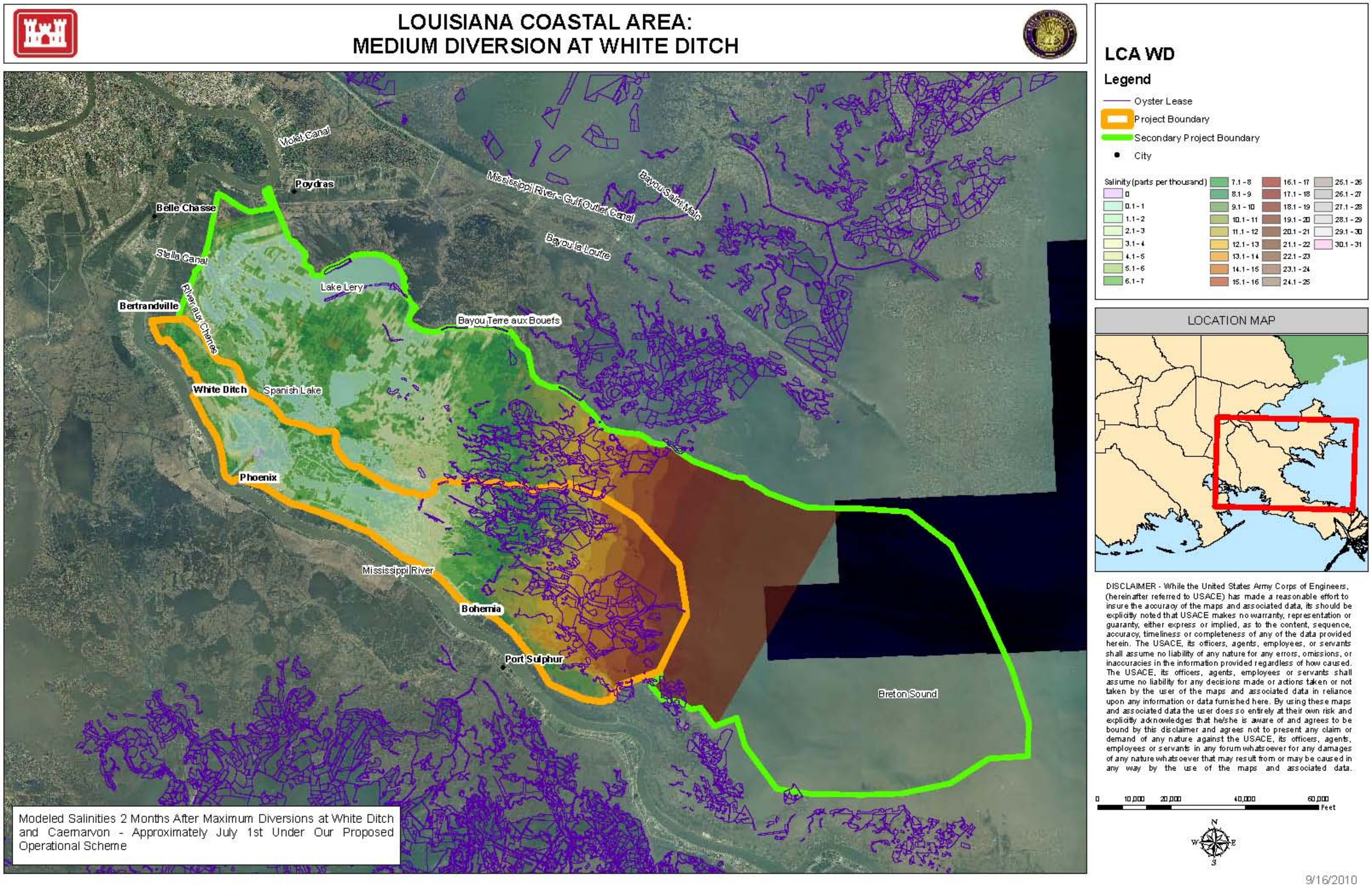

Figure 5.3: Modeled Salinities Two Months After Maximum Diversions at White Ditch and Caernarvon – Approximately July 1st Under Our Proposed Operational Scheme

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establishing target zones for optimum marsh type production throughout the project area. Of the implementation alternatives considered, the 10,000 cfs diversion would have more flexibility in terms of controlling and manipulating the salinity regime than the 5,000 cfs but less than the 15,000 cfs.

5.3.2.3.2 Indirect

Indirect impacts of implementing restoration features into the project area would be the possible permanent transition of marsh types. These changes could have short-term consequences, such as displacement of one type of marsh vegetation by another, but have long-term benefits by providing a sustainable marsh and delta forming functions. Indirect impacts to marsh zones of the 10,000 cfs alternative would be anticipated to be as described in Section 5.3.2.2.2 under the proposed operating plan; however, the operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin. With these structures running concurrently for an extended period of time, there could be undesired consequences in the Breton Sound.

5.3.2.3.3 Cumulative

Cumulative impacts would be the synergistic effect of the 10,000 cfs Alternative on salinity levels when considered in context with all past, present, and reasonably foreseeable acts of nature and/or the actions private entities, state government, and Federal Government. The operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin.

5.3.2.4 Alternative 3 – 15,000 cfs max Diversion

5.3.2.4.1 Direct

Under the 15,000 cfs diversion, direct impacts to salinity levels in the Mississippi River would not occur. The proposed operating plan would result in the diversion only operating at maximum flows during spring flood pulses. There would be no salt wedge intrusion from the gulf during this time.

Salinity levels within the White Ditch project area would be affected. Significant freshening of the project area as well as the entire Breton Sound Basin would occur with maximum operations of the structure. Since all build alternatives completely freshen the Breton Sound, anticipated salinity changes are the same as described in Section 5.3.2.2.1. Operation and management measures could work toward establishing target zones for optimum marsh type production throughout the project area. Of the implementation alternatives considered, the 15,000 cfs diversion would have more flexibility in terms of controlling and manipulating the salinity regime than the 10,000 cfs but less than the 35,000 cfs.

5.3.2.4.2 Indirect

Indirect impacts of implementing restoration features into the project area would be the possible permanent transition of marsh types. These changes could have short-term consequences, such as displacement of one type of marsh vegetation by another, but have long-term benefits by providing a sustainable marsh and delta forming functions. Indirect impacts to marsh zones of the 15,000 cfs alternative would be anticipated to be as described in Section 5.3.2.2.2 under the proposed operating plan; however, the operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White

Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin. With these structures running concurrently for an extended period of time, there could be undesired consequences in the Breton Sound.

5.3.2.4.3 Cumulative

Cumulative impacts would be the synergistic effect of the 15,000 cfs Alternative on salinity levels when considered in context with all past, present, and reasonably foreseeable acts of nature and/or the actions private entities, state government, and Federal Government. The operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin.

5.3.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.3.2.5.1 Direct

Salinity levels within the White Ditch project area would be affected. Significant freshening of the project area as well as the entire Breton Sound Basin would occur with maximum operations of the structure. Since all build alternatives completely freshen the Breton Sound, anticipated salinity changes are the same as described in Section 5.3.2.2.1. Operation and management measures could work toward establishing target zones for optimum marsh type production throughout the project area. Of the implementation alternatives considered, the 35,000 cfs diversion would have the most flexibility in terms of controlling and manipulating the salinity regime. In relation, it would present the most options for adaptive management.

5.3.2.5.2 Indirect

Indirect impacts of implementing restoration features into the project area would be the possible permanent transition of marsh types. These changes could have short-term consequences, such as displacement of one type of marsh vegetation by another, but have long-term benefits by providing a sustainable marsh and delta forming functions. Indirect impacts to marsh zones of the 15,000 cfs alternative would be anticipated to be as described in Section 5.3.2.2.2 under the proposed operating plan; however, the operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin. With these structures running concurrently for an extended period of time, there could be undesired consequences in the Breton Sound.

5.3.2.5.3 Cumulative

Cumulative impacts would be the synergistic effect of the 35,000 cfs Alternative on salinity levels when considered in context with all past, present, and reasonably foreseeable acts of nature and/or the actions private entities, state government, and Federal Government. The operations of the Caernarvon Diversion, the CWPPRA rehabilitation of the existing White Ditch Siphon, and the proposed White Ditch structure would need a coordinated operations effort to manage salinity levels throughout the Breton Sound Basin.

5.4 AIR QUALITY

5.4.1 No Action Alternative (Future Without Project Conditions)

The No Action Alternative would have no direct impacts on air quality. Indirect impacts of not implementing the diversion and outfall management features would result in the persistence of existing conditions. The project area is a remote and largely uninhabited marsh. Air quality would continue to be subject to institutional recognition and further regulations. However, air quality in the project area would likely decline for the following reasons: continued population growth, further commercialization and industrialization, increased numbers of motor vehicles, and increased emissions from various engines. These impacts would be coupled with the continued loss of Louisiana coastal wetland vegetation that would no longer be available to remove gaseous pollutants. Nevertheless, air quality degradation is not anticipated to be a significant problem in the project area under the No Action Alternative during the 50-year period of analysis. Cumulative impacts would be the synergistic effect of the No Action Alternative on air quality with the additive combination of similar air quality 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.

5.4.2 Alternative 1 – 5,000 cfs max Diversion

5.4.2.1 Direct

Direct impacts of the 5,000 cfs diversion alternative on air quality would be similar to, but lesser in magnitude, than those expected to result from the Recommended Plan.

5.4.2.2 Indirect

Over the 50-year period of analysis, the 5,000 cfs diversion is projected to reduce anticipated future losses of emergent wetlands that help to improve local air quality by reducing particulates and gaseous air pollutants. Impacts of the wetland restoration on air quality would be expected to be similar to, but lesser in magnitude than, those expected to result from implementation of the Recommended Plan.

5.4.2.3 Cumulative

Cumulative impacts of the 5,000 cfs diversion alternative on air quality would be similar to, but lesser in magnitude, than those expected to result from the Recommended Plan.

5.4.3 Alternative 2 – 10,000 cfs max Diversion

5.4.3.1 Direct

Direct impacts of the 10,000 cfs diversion alternative on air quality would be similar to, but lesser in magnitude, than those expected to result from the Recommended Plan.

5.4.3.2 Indirect

Over the 50-year period of analysis, the 10,000 cfs diversion is projected to reduce anticipated future losses of emergent wetlands that help to improve local air quality by reducing particulates and gaseous air pollutants. Impacts of the wetland restoration on air quality would be expected to be similar to, but lesser in magnitude than, those expected to result from implementation of the Recommended Plan.

5.4.3.3 Cumulative

Cumulative impacts of the 10,000 cfs diversion alternative would be similar to, but lesser in magnitude, than those expected to result from the Recommended Plan.

5.4.4 Alternative 3 – 15,000 cfs max Diversion

5.4.4.1 Direct

Direct impacts of the 15,000 cfs diversion alternative on air quality would be similar to, but lesser in magnitude, than those expected to result from the Recommended Plan.

5.4.4.2 Indirect

Over the 50-year period of analysis, the 15,000 cfs diversion is projected to reduce anticipated future losses of emergent wetlands that help to improve local air quality by reducing particulates and gaseous air pollutants. Impacts of the wetland restoration on air quality would be expected to be similar to, but lesser in magnitude than, those expected to result from implementation of the Recommended Plan.

5.4.4.3 Cumulative

Cumulative impacts of the 15,000 cfs diversion alternative would be similar to, but lesser in magnitude, than those expected to result from the Recommended Plan.

5.4.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.4.5.1 Direct

Direct impacts to ambient air quality resulting from construction of the 35,000 cfs diversion and outfall management features would be temporary and localized, resulting primarily from the emissions of construction equipment within the project area. Total emissions generally do not exceed the threshold limit applicable to volatile organic compounds (VOC) for parishes where the most stringent requirement (50 tons per year [49.38 metric tons per year] in serious non-attainment parishes) is in effect. Additionally, these effects to air quality would be temporary, and air quality would return to pre-construction conditions shortly after the completion of construction activities.

5.4.5.2 Indirect

Over the 50-year period of analysis, the 35,000 cfs diversion is projected to restore a substantial portion of emergent wetlands that historically existed in the project area, and protect emergent wetlands that help to improve local air quality by reducing particulates and gaseous air pollutants, from future losses that would be expected to occur if the project was not constructed. Studies of the effects of common wetland plants on removing or reducing air pollution in the coastal Louisiana area have yet to be done. However, it is reasonable to extrapolate from the findings of researchers such as David J. Nowak (personal communication, Mr. David J. Nowak, Project Leader, USDA Forest Service, Northeastern Research Station, 5 Moon Library, SUNY-CESF, Syracuse, New York) that 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 minimal because of the size of the project area and distance from population centers.

5.4.5.3 Cumulative

Implementation of the 35,000 cfs diversion would work synergistically with other ecosystem restoration projects in coastal Louisiana to provide greater longevity for wetlands in the region. Although unlikely to greatly impact air quality alone, the project would provide some air quality improvement from the cumulative effects of creating, nourishing and protecting these wetlands in conjunction with other restoration efforts.

5.5 NOISE

5.5.1 No Action Alternative (Future Without Project Conditions)

There would be no direct, indirect, or cumulative impacts of the No Action Alternative on noise. Not implementing the proposed river diversion and outfall management features would result in the persistence of existing conditions. The project area is a remote and largely uninhabited marsh. The noise from nearby urban areas has little, if any, impact on the project area. This is expected to continue in the future.

5.5.2 Alternative 1 – 5,000 cfs max Diversion

5.5.2.1 Direct

Direct impacts to noise levels resulting from construction of the 5,000 cfs diversion and associated features would be expected to be similar to those anticipated to result from construction of the Recommended Plan.

5.5.2.2 Indirect

Noise could temporarily cause some local fish and wildlife species to relocate during construction activities. However, any indirect impacts due to noise would be expected to be localized, temporary, and minor in nature.

5.5.2.3 Cumulative

Cumulative impacts to noise levels resulting from construction of the 5,000 cfs diversion and associated features would be expected to be similar to those anticipated to result from construction of the Recommended Plan.

5.5.3 Alternative 2 – 10,000 cfs max Diversion

5.5.3.1 Direct

Direct impacts to noise levels resulting from construction of the 10,000 cfs diversion and associated features would be expected to be similar to those anticipated to result from construction of the Recommended Plan.

5.5.3.2 Indirect

Noise could temporarily cause some local fish and wildlife species to relocate during construction activities. However, any indirect impacts due to noise would be expected to be localized, temporary, and minor in nature.

5.5.3.3 Cumulative

Cumulative impacts to noise levels resulting from construction of the 10,000 cfs diversion and associated features would be expected to be similar to those anticipated to result from construction of the Recommended Plan.

5.5.4 Alternative 3 – 15,000 cfs max Diversion

5.5.4.1 Direct

Direct impacts to noise levels resulting from construction of the 15,000 cfs diversion and associated features would be expected to be similar to those anticipated to result from construction of the Recommended Plan.

5.5.4.2 Indirect

Noise could temporarily cause some local fish and wildlife species to relocate during construction activities. However, any indirect impacts due to noise would be expected to be localized, temporary, and minor in nature.

5.5.4.3 Cumulative

Cumulative impacts to noise levels resulting from construction of the 15,000 cfs diversion and associated features would be expected to be similar to those anticipated to result from construction of the Recommended Plan.

5.5.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.5.5.1 Direct

Construction activities associated with implementing the 35,000 cfs diversion and outfall management features would temporarily increase the noise level in the project area. However, the project area is remote and sparsely populated so the noise level would not affect any nearby human communities. Once construction activities would be completed, noise levels would be expected return to preconstruction conditions.

Potential noise impacts concerns could 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 8 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 could directly impact fish and wildlife species. These organisms would generally avoid the construction area. At this point, no sensitive species have been determined to be present in the project area. However, if ever it is determined that a key species of concern is present, then the team would follow feasible administrative and or engineering controls, determine and implement appropriate buffer zones, and implement construction activity windows.

5.5.5.2 Indirect

Noise could temporarily cause some local fish and wildlife species to relocate during construction activities. However, any indirect impacts due to noise would be expected to be localized, temporary, and minor in nature.

5.5.5.3 Cumulative

Cumulative impacts to noise levels resulting from implementation of the 35,000 cfs diversion 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. Long-term adverse cumulative impacts due to noise levels would not be expected with implementation of the diversion.

5.6 VEGETATIVE RESOURCES

5.6.1 Riparian Vegetation Resources

5.6.1.1 No Action Alternative (Future Without Project Conditions)

5.6.1.1.1 Direct

Under the No Action Alternative, no construction of diversion structure or associated outfall management features would occur, and no BLH would be cleared or filled by construction activities. No opportunities for beneficial use of dredged material for construction features would occur. Existing BLH in the project footprint would continue to degrade and convert to intermediate marsh.

5.6.1.1.2 Indirect

With no action, no input of sediment, freshwater and nutrients to the project area would occur. This would result in the persistence of existing conditions including continued erosion of marsh soils, and continued fragmentation and conversion of BLH to intermediate and brackish marsh habitats. Both man-made and natural processes would contribute to the continued loss of vegetated habitats, including: continued erosion and subsidence, increased saltwater intrusion, and increased water velocities. Over the next 50 years, the remaining BLH species in the study area would experience continued subsidence, sea level rise, and salinity increases. The BLH would eventually diminish and convert to marsh.

5.6.1.1.3 Cumulative

Cumulative impacts would be the same effect of the No Action Alternative with land loss rates of approximately 274.5 acres per year throughout the 50-year project life. In addition, cumulative impacts would include the additive combination of coast wide BLH loss and degradation, as well as the benefits and impacts of other local, state, Federal, and private projects summarized in Section 1.5. The existing freshwater diversion at Caernarvon would freshen the surrounding waters, albeit to an unknown extent. In addition, the LCA Caernarvon Freshwater Diversion Modification (CFDM) project could potentially result in a selected plan having features that create and restore BLH ridges from the secondary use of channel dredging to redirect water flows. Some Section 10 and 404 permits have been issued by the CEMVN for maintenance dredging canals northeast of the WDWD project. Some dredged material placement areas from this dredging would likely reforest with BLH species.

5.6.1.2 Alternative 1 – 5,000 cfs max Diversion

5.6.1.2.1 Direct

Construction of the 5,000 cfs diversion structure would have direct negative impacts to 2.5 acres of BLH between the Mississippi River Levee and the Mississippi River. The proposed 2.5 acres of BLH loss has a value of –1.25 AAHUs. The placement of dredged material would provide direct positive benefit of 16.91 AAHUs by establishing approximately 32 acres of BLH ridge creation.

5.6.1.2.2 Indirect

Operation of the 5,000 cfs diversion alternative would indirectly provide an inflow of freshwater, sediments and nutrients to the project area and redistribute sediments along existing and created BLH ridges during pulses. A net loss of acreage of all habitat types in the project area is expected to continue under this alternative; however, riparian vegetation on the created BLH ridges could persist through much of the 50-year period following project construction.

5.6.1.2.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide BLH loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Modification of the operation of the Caernarvon structure project could potentially result in a selected plan that would have features that create and restore BLH ridges from the secondary use of channels dredged to redirect water flows. Some Section 10 and 404 permits have been issued by the CEMVN for maintenance dredging canals northeast of the WDWD project. Some dredged material placement areas from this dredging would likely reforest with BLH species.

5.6.1.3 Alternative 2 – 10,000 cfs max Diversion

5.6.1.3.1 Direct

Construction of the 10,000 cfs diversion structure would have direct negative impacts to 2.5 acres of BLH between the Mississippi River Levee and the Mississippi River. The proposed 2.5 acres of BLH loss has a value of –1.25 AAHUs. The placement of dredged material would provide direct positive benefit of 16.91 AAHUs by establishing approximately 32 acres of BLH ridge creation.

5.6.1.3.2 Indirect

Operation of the 10,000 cfs diversion alternative would indirectly provide an inflow of freshwater, sediments and nutrients to the project area and redistribute sediments along existing and created BLH ridges during pulses. No net loss of total acreage of vegetation in the project area is expected to occur with this alternative; however, it is possible that existing remnants of BLH in the project area could continue to deteriorate with this alternative.

5.6.1.3.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide BLH loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Modification of the operation of the Caernarvon structure project could potentially result in a selected plan that would have features that create and restore BLH ridges from the secondary use of channels dredged to redirect water flows. Some Section 10 and 404 permits have been issued by the CEMVN for maintenance dredging canals northeast of the WDWD project. Some dredged material placement areas from this dredging would likely reforest with BLH species.

5.6.1.4 Alternative 3- 15,000 cfs max Diversion

5.6.1.4.1 Direct

Construction of the 15,000 cfs diversion structure would have direct negative impacts to 5 acres of BLH between the Mississippi River Levee and the Mississippi River. The proposed 5 acres of BLH loss has a value of –2.50 AAHUs in the study area. The placement of dredged material would provide direct positive benefit of 16.91 AAHUs by establishing approximately 32 acres of BLH ridge creation.

5.6.1.4.2 Indirect

Operation of the 15,000 cfs diversion alternative would indirectly provide an inflow of freshwater, sediments and nutrients to the project area and redistribute sediments along existing and created BLH ridges during pulses. Increases in overall coverage of vegetation would occur in the project area; however, increases in BLH beyond the created ridges is expected to be negligible in the project area.

5.6.1.4.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide BLH loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Modification of the operation of the Caernarvon structure project could potentially result in a selected plan that would have features that create and restore BLH ridges from the secondary use of channels dredged to redirect water flows. Some Section 10 and 404 permits have been issued by the CEMVN for maintenance dredging canals northeast of the WDWD project. Some dredged material placement areas from this dredging would likely reforest with BLH species.

5.6.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.6.1.5.1 Direct

Construction of the 35,000 cfs diversion structure would have direct negative impacts to 5 acres of BLH between the Mississippi River Levee and the Mississippi River. The proposed 5 acres of BLH loss has a value of –2.50 AAHUs in the study area. The placement of dredged material would provide direct positive benefit of 15.99 AAHUs by establishing approximately 31 acres of BLH ridge creation.

5.6.1.5.2 Indirect

Operation of the 35,000 cfs diversion alternative would indirectly provide an inflow of freshwater, sediments and nutrients to the project area and redistribute sediments along existing and created BLH ridges during pulses. No net loss of acreage of all land types in the project area is expected to occur with this alternative. Additionally, the WVA assessment of proposed diversion alternatives projected that the 35,000 cfs diversion would produce overall gains in vegetation coverage in the project area; however, no substantial gains in BLH coverage beyond the created ridges would be expected.

5.6.1.5.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide BLH loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in

Section 1.5. Modification of the operation of the Caernarvon structure project could potentially result in a selected plan that would have features that create and restore BLH ridges from the secondary use of channels dredged to redirect water flows. Some Section 10 and 404 permits have been issued by the CEMVN for maintenance dredging canals northeast of the WDWD project. Some dredged material placement areas from this dredging would likely reforest with BLH species.

5.6.2 Wetland Vegetation Resources

5.6.2.1 No Action Alternative (Future Without Project Conditions)

5.6.2.1.1 Direct

Under the No Action Alternative, no direct impacts to existing wetland vegetation resulting from construction of the proposed diversion and associated features would occur. No opportunities for beneficial reuse of marsh soil and substrate excavated for construction would be realized.

5.6.2.1.2 Indirect

With no action, no increase in input of sediment, freshwater and nutrients to the project area would occur. This would result in the persistence of existing conditions including continued erosion of marsh soils, and continued fragmentation and conversion of existing intermediate, brackish and saline marsh to shallow open-water habitats. Both man-made and natural processes would contribute to the continued loss of vegetated habitats, including: continued erosion and subsidence, increased saltwater intrusion, increased water velocities, and increased herbivory. Over the next 50 years, substantial acreage of wetland vegetation is projected to be lost.

5.6.2.1.3 Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coast wide wetland loss and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity. The existing freshwater diversion at Caernarvon would freshen the surrounding waters, albeit to an unknown extent. Modification of the operation of the Caernarvon structure could result in a conversion of some intermediate marsh to fresh marsh in areas adjacent to the MDWD 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, but any potential effects on productivity within the MDWD project area would be unknown at this time.

5.6.2.2 Alternative 1 – 5,000 cfs max Diversion

5.6.2.2.1 Direct

Construction of the 5,000 cfs diversion and associated outfall management features would have an initial negative impact on existing wetland vegetation within the construction footprint, primarily through the excavation of outfall channels and placement of excavated material on existing marsh. However, this placement of excavated material would provide a base for the regeneration of approximately 171 acres of wetland vegetation, 32 acres of which (ridge creation) is expected to be suitable for the re-establishment of bottomland hardwoods.

5.6.2.2.2 Indirect

Operation of the 5,000 cfs diversion alternative would provide an inflow of freshwater, sediments and nutrients to the project area and support the re-establishment and nourishment of wetland vegetation in the project area. Loss of acreage of all marsh types in the project area is expected to continue under this alternative. However, the WVA assessment of proposed diversion alternatives projected that the 5,000 cfs diversion would reduce overall wetland vegetation losses in the project area compared to the expected overall loss for the No Action Alternative. It is expected that this alternative would show a gain of approximate 5,197 AAHUs and 35,638 acres. It was anticipated that a small portion (less than 14%; see discussion in Alternative 4) of the project area currently classified as intermediate marsh would be converted to fresh marsh within approximately 5 years following project implementation. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

5.6.2.2.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide wetland vegetation loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Implementing Alternative 1 would result in a small incremental reduction to the rate of loss of wetland vegetation resources in the overall region.

5.6.2.3 Alternative 2 – 10,000 cfs max Diversion

5.6.2.3.1 Direct

Construction of the 10,000 cfs diversion and associated outfall management features would have an initial negative impact on existing wetland vegetation within the construction footprint, primarily through the excavation of outfall channels and placement of excavated material on existing marsh. However, this placement of excavated material would provide a base for the regeneration of approximately 208 acres of wetland vegetation, 32 acres of which (ridge creation) is expected to be suitable for the re-establishment of bottomland hardwoods.

5.6.2.3.2 Indirect

Operation of the 10,000 cfs diversion alternative would provide an inflow of freshwater, sediments and nutrients to the project area and support the re-establishment and nourishment of wetland vegetation in the project area. It was anticipated that a small portion (less than 14%; see discussion in Alternative 4) of the project area currently classified as intermediate marsh would be converted to fresh marsh within approximately 5 years following project implementation. The expectation of this alternative is to create approximately 5,936 AAHUs and 40,419 acres. No net loss of acreage of wetland vegetation in the project area is expected to occur with this alternative over the 50-year period following project construction. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

5.6.2.3.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide wetland vegetation loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Implementing Alternative 2 would result in a reduction to the rate of loss of wetland vegetation resources in the overall region.

5.6.2.4 Alternative 3 – 15,000 cfs max Diversion

5.6.2.4.1 Direct

Construction of the 15,000 cfs diversion and associated outfall management features would have an initial negative impact on existing wetland vegetation within the construction footprint, primarily through the excavation of outfall channels and placement of excavated material on existing marsh. However, this placement of excavated material would provide a base for the regeneration of approximately 267 acres of wetland vegetation, 32 acres of which (ridge creation) is expected to be suitable for the re-establishment of bottomland hardwoods.

5.6.2.4.2 Indirect

Operation of the 15,000 cfs diversion alternative would provide an inflow of freshwater, sediments and nutrients to the project area and support the re-establishment and nourishment of wetland vegetation in the project area. It was anticipated that a small portion (less than 14%; see discussion in Alternative 4) of the project area currently classified as intermediate marsh would be converted to fresh marsh within approximately 5 years following project implementation. The expectation of this alternative is to create approximately 7,742 AAHUs and 45,046 acres. No loss of overall acreage of wetland vegetation in the project area is expected to occur with this alternative, and some net gain in wetland vegetation is anticipated over the 50-year planning horizon. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

5.6.2.4.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide wetland vegetation loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Implementing Alternative 4 would result in an incremental increase in wetland vegetation resources in the overall region.

5.6.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.6.2.5.1 Direct

Construction of the 35,000 cfs diversion and associated outfall management features would have an initial negative impact on existing wetland vegetation within the construction footprint, primarily through the excavation of outfall channels and placement of excavated material on existing marsh. However, this placement of excavated material would provide a base for the regeneration of approximately 416 acres of wetland vegetation, 31 acres of which (ridge creation) is expected to be suitable for the re-establishment of bottomland hardwoods.

5.6.2.5.2 Indirect

Operation of the 35,000 cfs diversion alternative would provide an inflow of freshwater, sediments and nutrients to the project area and support the re-establishment and nourishment of wetland vegetation in the project area. It was anticipated that approximately 14% of the project area and 4% of the expanded area of influence currently classified as intermediate marsh would be converted to fresh marsh within approximately 5 years following project implementation. Substantial net gains compare to no net loss in acreage of wetland vegetation in the project area is expected to occur with this alternative. This gain is approximately 13,355 AAHUs and 59,902 acres. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

5.6.2.5.3 Cumulative

Cumulative impacts would be the synergistic combination of the project with coast wide wetland vegetation loss and degradation, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. Implementing Alternative 3 would result in a small incremental increase in wetland vegetation resources in the overall region.

5.6.3 Upland Vegetation Resources

There would be no upland vegetation resources in the project area.

5.6.4 Submerged Aquatic Vegetation (SAV)

5.6.4.1 No Action Alternative (Future Without Project Conditions)

5.6.4.1.1 Direct

Under the No Action Alternative, no direct impacts to SAV would occur. Baseline SAV coverage was estimated at approximately 15% of open water areas in the vicinity of the proposed construction footprint (25% in the overall project area). Existing SAV in the project footprint would continue to degrade and die off as increased salinities enter the study area and marsh continues to decrease in acreage.

5.6.4.1.2 Indirect

Under the No Action Alternative, no input of sediment, freshwater and nutrients to the project area would occur. This would result in the persistence of existing conditions including continued erosion of marsh soils, and continued fragmentation and conversion of existing intermediate, brackish and saline marsh to shallow open-water habitats. Both man-made and natural processes would contribute to the continued loss of vegetated habitats, including: continued erosion and subsidence, increased saltwater intrusion, increased water velocities, and increased turbidity. Over the next 50 years, SAV is projected to be reduced from the estimated baseline of 25% of open water areas to approximately 15% as the area deteriorates.

5.6.4.1.3 Cumulative

Cumulative impacts would be the same effect of the No Action Alternative with the additive combination of coast wide SAV loss, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. The proposed projects have borrow areas, channel dredging, and marsh restoration sites in and adjacent to Lake Lery that would impact SAV from dredging and filling. CFDM could result in a conversion of some intermediate marsh to fresh marsh in areas adjacent to the MDWD project area. The Duffy (1997) study showed that SAV abundance (Eurasian watermilfoil and coontail) has increased in the Breton Sound Basin in response to diversions. The introduction of nutrients would likely increase the productivity of the nearby SAV, but any potential effects on productivity within the MDWD project area would be unknown at this time.

5.6.4.2 Alternative 1 – 5,000 cfs max Diversion

5.6.4.2.1 Direct

Direct impacts to SAV would be expected to result from construction of outfall management features. Baseline SAV coverage is anticipated to decrease to near 0% in the outfall channel footprint. In the marsh creation footprint, little open water would remain, but any remnants would likely experience an increase in the percentage of SAV. This is because SAV would be well adapted to the environmental conditions likely to be present after project implementation.

5.6.4.2.2 Indirect

Operation of the 5,000 cfs diversion is anticipated to result in an increase in SAV coverage in the fresh, intermediate, and brackish zones as a consequence of delivery of nutrients and sediments throughout the project area (no increase in SAV coverage was anticipated to occur in the saline zone). The Habitat Evaluation Team (HET) assumed that maintenance flow conditions (set at 1,000 cfs for all diversion alternatives), rather than maximum pulse, would be the determining factor in effects on SAV. Based on research that Rozas et al. (2005) conducted in the nearby Caernarvon Diversion outfall management area, SAV coverage in the fresh and intermediate zones is expected to increase from the baseline 25% to approximately 70%. In the brackish zone, SAV coverage was expected to increase from the estimated 15% baseline to approximately 30 percent.

5.6.4.2.3 Cumulative

The Alternative 1 outfall management features would impact some SAV during channel dredging and filling open water areas for marsh restoration. Alternative 1 would increase overall SAV abundance in the project area by maintaining a 1,000 cfs maintenance flow. Shallow waterbodies within the proposed converted intermediate to fresh marsh areas would be expected to begin filling in, creating the opportunity for SAV to establish across the project area. Cumulative impacts also include the combination of coast wide SAV loss, as well as the benefits and impacts of other state, Federal, or private projects summarized in Section 1.5. The proposed projects have borrow areas, channel dredging, and marsh restoration sites in and adjacent to Lake Lery that would impact SAV from dredging and filling. The MDWD WVA results show a conversion of some intermediate marsh to fresh marsh in areas adjacent to the MDWD project area. The Duffy (1997) study showed that SAV abundance (Eurasian watermilfoil and coontail) has increased in the Breton Sound Basin in response to diversions. The introduction of sediments and nutrients would likely increase the productivity of the nearby SAV.

5.6.4.3 Alternative 2 – 10,000 cfs max Diversion

5.6.4.3.1 Direct

Direct impacts of the 10,000 cfs diversion alternative would be essentially the same as for the 5,000 cfs alternative; however, the extent of the affected area would be greater in proportion to the increased construction footprint for this alternative.

5.6.4.3.2 Indirect

Operation of the 10,000 cfs diversion is expected to have the same effect on SAV in the overall project area as the 5,000 cfs alternative. The HET assumed that maintenance flow conditions (set at 1,000 cfs for all diversion alternatives), rather than maximum pulse, would be the determining factor in effects on SAV.

5.6.4.3.3 Cumulative

Cumulative impacts of Alternative 2 would be similar to cumulative impacts described for Alternative 1, except Alternative 2 outfall management features would impact more SAV during construction.

5.6.4.4 Alternative 3 – 15,000 cfs max Diversion

5.6.4.4.1 Direct

Direct impacts of the 15,000 cfs diversion alternative would be essentially the same as for the 5,000 cfs alternative; however, the extent of the affected area would be greater in proportion to the increased construction footprint for this alternative.

5.6.4.4.2 Indirect

Operation of the 15,000 cfs diversion is expected to have the same effect on SAV in the overall project area as the 5,000 cfs alternative. The HET assumed that maintenance flow conditions (set at 1,000 cfs for all diversion alternatives), rather than maximum pulse, would be the determining factor in effects on SAV.

5.6.4.4.3 Cumulative

Cumulative impacts of Alternative 3 would be similar to cumulative impacts described for Alternative 1, except Alternative 3 outfall management features would impact more SAV during construction.

5.6.4.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.6.4.5.1 Direct

Direct impacts of the 35,000 cfs diversion alternative would be essentially the same as for the 5,000 cfs alternative; however, the extent of the affected area would be greater in proportion to the increased construction footprint for this alternative.

5.6.4.5.2 Indirect

Operation of the 35,000 cfs diversion is expected to have the same effect on SAV in the overall project area as the 5,000 cfs alternative. The HET assumed that maintenance flow conditions (set at 1,000 cfs for all diversion alternatives), rather than maximum pulse, would be the determining factor in effects on SAV.

5.6.4.5.3 Cumulative

Cumulative impacts of Alternative 4 would be similar to cumulative impacts described for Alternative 1, except Alternative 4 outfall management features would impact more SAV during construction.

5.6.5 Invasive Species – Vegetation

5.6.5.1 No Action Alternative (Future Without Project Conditions)

5.6.5.1.1 Direct

Under the No Action Alternative, invasive plant species known to occur in the project area would not be affected.

5.6.5.1.2 Indirect

Indirect impacts to invasive plant species anticipated under the No Action Alternative would be essentially the same as for noninvasive native plant species.

5.6.5.1.3 Cumulative

Cumulative impacts would be the same effect of the No Action Alternative with the additive combination of coast wide invasive species distribution from other state, Federal, or private projects summarized in Section 1.5. The proposed projects have borrow areas, channel dredging, and marsh restoration sites in and adjacent to Lake Lery that would impact and potentially distribute invasive species from dredging and filling. The Duffy (1997) study showed that SAV abundance (Eurasian watermilfoil and coontail) has increased in the Breton Sound Basin in response to diversions. The introduction of nutrients would likely increase the productivity of the nearby invasive species in the surrounding area.

5.6.5.2 Alternative 1 – 5,000 cfs max Diversion

5.6.5.2.1 Direct

Direct impacts to invasive plant species resulting from construction of the 5,000 cfs diversion alternative would be expected to be essentially the same as anticipated for other wetland vegetation and SAV in the construction footprint.

5.6.5.2.2 Indirect

Operation of the 5,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Under the operational plan used for the evaluation of alternatives, during the majority of the growing season the diversion inflow was assumed to be 1,000 cfs for all alternatives. This continuous inflow of freshwater has the potential to promote increased growth of freshwater invasive exotics such as water hyacinth in outfall and distributary channels.

5.6.5.2.3 Cumulative

Cumulative impacts would be the same effect of Alternative 1 with the additive combination of coast wide invasive species distribution from other state, Federal, or private projects summarized in Section 1.5. The proposed projects have borrow areas, channel dredging, and marsh restoration sites in and adjacent to Lake Lery that would impact and potentially distribute invasive species from dredging and filling. The Duffy (1997) study showed that SAV abundance (Eurasian watermilfoil and coontail) has increased in the Breton Sound Basin in response to diversions. The introduction of nutrients would likely increase the productivity of the nearby invasive species in the surrounding area. The MDWD project, even if generally beneficial to native marsh plant communities and animal populations, it could have the unintended consequence of increasing the spatial coverage and density of invasive plant species.

5.6.5.3 Alternative 2 – 10,000 cfs max Diversion

5.6.5.3.1 Direct

Direct impacts to invasive plant species resulting from construction of the 10,000 cfs diversion alternative would be expected to be essentially the same as anticipated for other wetland vegetation and SAV in the construction footprint.

5.6.5.3.2 Indirect

Operation of the 10,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Under the operational plan used for the evaluation of alternatives, during the majority of the growing season the diversion inflow was assumed to be 1,000 cfs for all alternatives. This continuous inflow of freshwater has the potential to promote increased growth of freshwater invasive exotics such as water hyacinth in outfall and distributary channels.

5.6.5.3.3 Cumulative

Cumulative impacts of Alternative 2 would be similar to cumulative impacts described for Alternative 1.

5.6.5.4 Alternative 3 – 15,000 cfs max Diversion

5.6.5.4.1 Direct

Direct impacts to invasive plant species resulting from construction of the 15,000 cfs diversion alternative would be expected to be essentially the same as anticipated for other wetland vegetation and SAV in the construction footprint.

5.6.5.4.2 Indirect

Operation of the 15,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Under the operational plan used for the evaluation of alternatives, during the majority of the growing season the diversion inflow was assumed to be 1,000 cfs for all alternatives. This continuous inflow of freshwater has the potential to promote increased growth of freshwater invasive exotics such as water hyacinth in outfall and distributary channels.

5.6.5.4.3 Cumulative

Cumulative impacts of Alternative 3 would be similar to cumulative impacts described for Alternative 1.

5.6.5.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.6.5.5.1 Direct

Direct impacts to invasive plant species resulting from construction of the 35,000 cfs diversion alternative would be expected to be essentially the same as anticipated for other wetland vegetation and SAV in the construction footprint.

5.6.5.5.2 Indirect

Operation of the 35,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Under the operational plan used for the evaluation of alternatives, during the majority of the growing season the diversion inflow was assumed to be 1,000 cfs for all alternatives. This continuous inflow of freshwater has the potential to promote increased growth of freshwater invasive exotics such as water hyacinth in outfall and distributary channels.

5.6.5.5.3 Cumulative

Cumulative impacts of Alternative 4 would be similar to cumulative impacts described for Alternative 1.

5.7 WILDLIFE AND HABITAT

5.7.1 No Action Alternative (Future Without Project Conditions)

5.7.1.1 Direct

Under the No Action Alternative, no construction of diversion structure or associated outfall management features would occur.

5.7.1.2 Indirect

Indirect impacts of the No Action Alternative would result in the persistence of existing conditions including the continued degradation of existing wetlands used as foraging, nesting, and over-wintering habitat to open-water habitats; and the decline in habitat quality as wetlands continue to deteriorate and fragment. As interior wetlands convert to open water, there would be an expected loss of species richness.

5.7.1.3 Cumulative

Cumulative impacts would be the synergistic effect of implementing the No Action Alternative with the additive combination of coast wide wildlife habitat losses and degradation, as well as the benefits and impacts of other state and Federal projects in the vicinity.

5.7.2 Alternative 1 – 5,000 cfs max Diversion

5.7.2.1 Direct

Construction of the diversion structure and associated outfall management features of the 5,000 cfs diversion alternative could disrupt or displace wildlife in the immediate vicinity. 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. While some species could be permanently displaced from the construction footprint by channel excavation and placement of excavated material in nearby marsh and shallow water areas, the long-term impact of construction is expected to be beneficial to overall habitat quality. The WVA analysis of outfall management features projected a net benefit of 58.04 AAHUs for the outfall management features associated with this alternative.

5.7.2.2 Indirect

Implementation of the 5,000 cfs diversion alternative would introduce river sediments, freshwater, and nutrients into the project area. Indirect impacts to wildlife resources resulting from the diversion would include the creation, restoration, and protection of wetland habitats utilized by resident and migratory wildlife for nesting, rearing of young, resting, and foraging activities. An increase in wetland acreage would provide increased nesting, brood-rearing, and foraging habitat for resident and migrant avian species. Wetland creation/nourishment and shoreline protection would also help to increase and preserve important stopover habitat for neotropical migrants and wintering habitat for waterfowl. The WVA analysis of the potential effects of the diversion projected a net benefit of 5,399.43 AAHUs for operation of the diversion, for a total projected net benefit of 5,457.48 AAHUs including benefits projected for the outfall management features.

5.7.2.3 Cumulative

Implementation of the 5,000 cfs diversion alternative would have positive synergistic effects on wildlife resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential wildlife habitats. Migratory birds could increase their use of the project area as critical migratory habitat is protected, created, and nourished. Local populations of game animals, furbearers, reptiles, amphibians, and invasive species such as nutria would benefit from the cumulative effects of protecting, creating and nourishing important and essential transitional wetlands. However, the incremental effect of this alternative is unlikely to benefit populations of these species on a continental scale.

5.7.3 Alternative 2 – 10,000 cfs max Diversion

5.7.3.1 Direct

Construction of the diversion structure and associated outfall management features of the 10,000 cfs diversion alternative could disrupt or displace wildlife in the immediate vicinity. 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. While some species could be permanently displaced from the construction footprint by channel excavation and placement of excavated material in nearby marsh and shallow water areas, the long-term impact of construction is expected to be beneficial to overall habitat quality. The WVA analysis of outfall management features projected a net benefit of 70.79 AAHUs for the outfall management features associated with this alternative.

5.7.3.2 Indirect

Implementation of the 10,000 cfs diversion alternative would introduce river sediments, freshwater, and nutrients into the project area. Indirect impacts to wildlife resources resulting from the diversion would include the creation, restoration, and protection of wetland habitats utilized by resident and migratory wildlife for nesting, rearing of young, resting, and foraging activities. An increase in wetland acreage would provide increased nesting, brood-rearing, and foraging habitat for resident and migrant avian species. Wetland creation/nourishment and shoreline protection would also help to increase and preserve important stopover habitat for neotropical migrants and wintering habitat for waterfowl. The WVA analysis of the potential effects of the diversion projected a net benefit of 6,024.84 AAHUs for operation of the diversion, for a total projected net benefit of 6,095.63 AAHUs including benefits projected for the outfall management features.

5.7.3.3 Cumulative

Implementation of the 10,000 cfs diversion alternative would have positive synergistic effects on wildlife resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential wildlife habitats to a greater degree than Alternative 1. Migratory birds could increase their use of the project area as critical migratory habitat is protected, created and nourished. Local populations of game animals, furbearers, reptiles, amphibians, and invasive species such as nutria would benefit from the cumulative effects of protecting, creating and nourishing important and essential transitional wetlands. However, the incremental effect of this alternative is unlikely to benefit populations of these species on a continental scale.

5.7.4 Alternative 3 – 15,000 cfs max Diversion

5.7.4.1 Direct

Construction of the diversion structure and associated outfall management features of the 15,000 cfs diversion alternative could disrupt or displace wildlife in the immediate vicinity. 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. While some species could be permanently displaced from the construction footprint by channel excavation and placement of excavated material in nearby marsh and shallow water areas, the long-term impact of construction is expected to be beneficial to overall habitat quality. The WVA analysis of outfall management features projected a net benefit of 88.45 AAHUs for the outfall management features associated with this alternative.

5.7.4.2 Indirect

Implementation of the 15,000 cfs diversion alternative would introduce river sediments, freshwater, and nutrients into the project area. Indirect impacts to wildlife resources resulting from the diversion would include the creation, restoration, and protection of wetland habitats utilized by resident and migratory wildlife for nesting, rearing of young, resting, and foraging activities. An increase in wetland acreage would provide increased nesting, brood-rearing, and foraging habitat for resident and migrant avian species. Wetland creation/nourishment and shoreline protection would also help to increase and preserve important stopover habitat for neotropical migrants and wintering habitat for waterfowl. The WVA analysis of the potential effects of the diversion projected a net benefit of 7,833.06 AAHUs for operation of the diversion, for a total projected net benefit of 7,921.51 AAHUs including benefits projected for the outfall management features.

5.7.4.3 Cumulative

Implementation of the 15,000 cfs diversion alternative would have positive synergistic effects on wildlife resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential wildlife habitats to a greater degree than Alternatives 1 or 2. Migratory birds could increase their use of the project area as critical migratory habitat is protected, created and nourished. Local populations of game animals, furbearers, reptiles, amphibians, and invasive species such as nutria would benefit from the cumulative effects of protecting, creating and nourishing important and essential transitional wetlands. However, the incremental effect of this alternative is unlikely to measurably benefit populations of these species on a continental scale.

5.7.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.7.5.1 Direct

Construction of the diversion structure and associated outfall management features of the 35,000 cfs diversion alternative could disrupt or displace wildlife in the immediate vicinity. 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. While some species could be permanently displaced from the construction footprint by channel excavation and placement of excavated material in nearby marsh and shallow water areas, the long-term impact of construction is expected to be beneficial to overall habitat quality. The WVA analysis of outfall management features projected a net benefit of 152.25 AAHUs for the outfall management features associated with this alternative.

5.7.5.2 Indirect

Implementation of the 35,000 cfs diversion alternative would introduce river sediments, freshwater, and nutrients into the project area. Indirect impacts to wildlife resources resulting from the diversion would include the creation, restoration, and protection of wetland habitats utilized by resident and migratory wildlife for nesting, rearing of young, resting, and foraging activities. An increase in wetland acreage would provide increased nesting, brood-rearing, and foraging habitat for resident and migrant avian species. Wetland creation/nourishment and shoreline protection would also help to increase and preserve important stopover habitat for neotropical migrants and wintering habitat for waterfowl. The WVA analysis of the potential effects of the diversion projected a net benefit of 13,423.01 AAHUs for operation of the diversion, for a total projected net benefit of 13,575.26 AAHUs, including benefits projected for the outfall management features. Nutria currently exist in the project area and would be expected to negatively impact marsh vegetation in the project area under this and all other alternatives, including the No Action Alternative. The existing State bounty program will continue to function as a control measure on the proliferation of nutria, and the long-term restoration of healthy marsh in the project area is expected to enhance existing natural controls (alligator predation) on nutria populations.

5.7.5.3 Cumulative

Implementation of the 35,000 cfs diversion alternative would have positive synergistic effects on wildlife resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential wildlife habitats to the greatest degree of the four alternatives evaluated in detail. Migratory birds could increase their use of the project area as critical migratory habitat is protected, created and nourished. Local populations of game animals, furbearers, reptiles, amphibians, and invasive species such as nutria would benefit from the cumulative effects of protecting, creating and nourishing important and essential transitional wetlands. However, the incremental effect of this alternative is unlikely to measurably benefit populations of these species on a continental scale.

5.8 AQUATIC RESOURCES

5.8.1 Benthic

These resources would be institutionally significant because of the NEPA of 1969; the Coastal Zone Management Act; and the Estuary Protection Act. These resources would be technically significant because benthic animals would be directly or indirectly involved in most physical and chemical processes that occur in estuaries (Day et al. 1989). Benthic resources would be publicly significant because members of the epibenthic community (mussels, etc.) provide commercial and recreational fisheries as well as creating oyster reef habitats used by many marine and estuarine organisms.

5.8.1.1 No Action Alternative (Future Without Project Conditions)

5.8.1.1.1 Direct

Without construction or operation of the project features, or diversion of river water and sediments into the White Ditch Project Area, no direct impacts would occur to the present benthic community.

5.8.1.1.2 Indirect

As stated in the LCA Study – Main Report, under the no action alternative, marine (saltwater) influences would continue to take hold and convert freshwater wetlands into intermediate, brackish, and saline marsh. As freshwater inputs continue to decline and allow marine influences to predominate over riverine influence, salinity levels rise, resulting in the conversion of low-lying vegetated areas to open water and the redistribution of marine sediment. These actions eventually lead to conditions that expedite interior marsh loss. According to Mitsch and Gosselink (1993), the salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary. Most plant biomass dies and decays and its energy is processed through the detrital pathway by the benthic community. The bottom estuarine substrate or benthic zone regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via what is commonly called a "benthic effect" (Day et al. 1989). As detrital inputs lessen due to the loss of SAV from saltwater intrusion, the benthic community and benthic processes would shift from that of an estuarine community to a more open water marine community.

5.8.1.1.3 Cumulative

Over the long term, without renewed inputs of freshwater, sediment, and nutrients to restore and maintain emergent marsh habitat, the project area is likely to convert from a predominately estuarine habitat to a predominately marine habitat. The benthic community which support the estuarine system processes would be adversely affected by the reduction and eventual loss of this habitat. The species richness (variety of organisms) of the benthic community typically declines as one progresses from ocean waters upstream into lower salinities, and often reaches a minimum between 4 and 6 ppt (Day et al. 1989). Hence, it is expected that increases in marine benthic community species diversity would occur in the project area as marsh loss continues.

5.8.1.2 Alternative 1 – 5,000 cfs max Diversion

5.8.1.2.1 Direct

For the 5,000 cfs diversion alternative, the existing benthic communities in the footprint of the proposed construction and dredging activities would be destroyed. This area would encompass 144 acres of intermediate marsh and 187 acres of shallow open water. Temporary increases in turbidity, temperatures, and biological oxygen demand (BOD), as well as temporary decreases in DO would contribute to further mortality and displacement of the benthic community in the project area. In addition, ridge creation would result in approximately 32 acres becoming unavailable for benthic aquatic fauna. However, following construction, benthic organisms would likely recolonize aquatic habitats in the project area, and the enhancement of freshwater marsh habitat by the diversion should be beneficial to numerous benthic species. Introduction of additional freshwater into estuarine systems could have short-term impacts on benthic populations in receiving waters as well. Introduction of freshwater flows from proposed features would be expected to change benthic abundance, species composition, and species distribution. Changes in benthic species assemblages would likely be similar to what is observed along present day estuarine salinity gradients except that increased freshwater flows would shift the benthic community, displacing marine species in favor of fresher and more estuarine, euryhaline species. In addition, some benthic organisms from the Mississippi River would be expected to be entrained in the immediate vicinity of the diversion inflow while it is in operation.

5.8.1.2.2 Indirect

Each of the 5,000, 10,000, 15,000, and 35,000 alternatives would freshen the entire project area, with maximum flows being diverted in March–April, and a base flow of 1,000 cfs the remainder of the year. Diversion of freshwater, sediments, and nutrients for the 5,000 cfs alternative is expected to increase SAV and decrease marsh loss compared to the No Action Alternative. Increased SAV would create more biomass and detrital inputs for the benthic community to process, furthering estuarine processes for the benefit of the salt marsh community. The detritus export by the benthic community and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

The diversion of freshwater is expected to decrease salinities throughout the project area, particularly during full flow in March and April and the weeks immediately following. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. The overall decrease in salinity is expected to displace benthic species less tolerant of freshwater. In addition, the increase in sediment inputs over the project area could disrupt the benthic community and benthic processes where accretion occurs. Nutrient inputs would likely impact the chemical and biological processes of the benthic community, increasing blooms of phytoplankton, and subsequently decomposition.

5.8.1.2.3 Cumulative

The reintroduction of freshwater, sediments, and nutrients from the Mississippi River is expected to restore and maintain emergent marsh habitat over the long term in the project area. The increase in marsh habitat and SAV would increase production of detritus and thereby, increase opportunity for the estuarine benthic community to process energy through the detrital pathway. According to Mitsch and Gosselink

(1993), the salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary. They point out that the detritus material exported from the marsh is more important to the estuary than the phytoplankton-based production in the estuary. The cumulative impacts would include the shifting of the benthic abundance, species composition, and species distribution toward those adapted to fresher habitats, and increasing chemical, physical, and biological processes performed by the benthic community. The enhancement of the benthic community through restoration and maintenance of emergent marsh habitat would also benefit fish and other aquatic organisms that depend on estuarine habitat and detritus export to meet all or part of their life cycles.

The cumulative impacts to the benthic resources would have a positive effect, particularly when evaluated in concert with other Federal, state, local, and private conservation and restoration efforts. The positive synergistic effect on the benthic resources in the project area would be greatest for the 35,000 cfs alternative as compared the lower volume alternatives.

5.8.1.3 Alternative 2 – 10,000 cfs max Diversion

5.8.1.3.1 Direct

Direct impacts under the 10,000 cfs diversion alternative include the complete loss of existing benthic communities in the footprint of the proposed construction and dredging activities. This area would include 159 acres of intermediate marsh and 223 acres of shallow open water. Temporary increases in turbidity, temperatures, and BOD, as well as temporary decreases in DO would contribute to further mortality and displacement of the benthic community in the project area. In addition, ridge creation would result in approximately 32 acres becoming unavailable for benthic aquatic fauna. However, following construction, benthic organisms would likely recolonize aquatic habitats in the project area, and the enhancement of freshwater marsh habitat by the diversion should be beneficial to numerous benthic species. Introduction of additional freshwater into estuarine systems could have short-term impacts on benthic populations in receiving waters as well. Introduction of freshwater flows from proposed features would be expected to change benthic abundance, species composition, and species distribution. Changes in benthic species assemblages would likely be similar to what is observed along present day estuarine salinity gradients except that increased freshwater flows would shift the benthic community, displacing marine species in favor of fresher and more estuarine, euryhaline species.

In addition, some benthic organisms from the Mississippi River would be expected to be entrained in the immediate vicinity of the diversion inflow while it is in operation.

5.8.1.3.2 Indirect

Each of the 5,000, 10,000, 15,000, and 35,000 alternatives would freshen the entire project area, with maximum flows being diverted in March–April, and a base flow of 1,000 cfs the remainder of the year. Diversion of freshwater, sediments, and nutrients at a maximum of 10,000 cfs is expected to increase SAV and decrease marsh loss to a greater degree than Alternative 1. Increased SAV would create more biomass and detrital inputs for the benthic community to process, furthering estuarine processes for the benefit of the salt marsh community. The detritus export by the benthic community and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

The diversion of freshwater is expected to decrease salinities throughout the project area, particularly during full flow in March–April and the weeks immediately following. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. The overall decrease in salinity is expected to displace benthic species less tolerant of freshwater. In addition, the increase in sediment inputs over the project area could disrupt the benthic community and benthic processes where accretion occurs. Nutrient inputs would likely impact the chemical and biological processes of the benthic community, increasing blooms of phytoplankton, and subsequently decomposition.

5.8.1.3.3 Cumulative

The reintroduction of freshwater, sediments, and nutrients from the Mississippi River is expected to restore and maintain emergent marsh habitat over the long term in the project area. The increase in marsh habitat and SAV would increase production of detritus and thereby, increase opportunity for the estuarine benthic community to process energy through the detrital pathway. According to Mitsch and Gosselink (1993), the salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary. They point out that the detritus material exported from the marsh is more important to the estuary than the phytoplankton-based production in the estuary. The cumulative impacts would include the shifting of the benthic abundance, species composition, and species distribution toward those adapted to fresher habitats, and increasing chemical, physical, and biological processes performed by the benthic community. The enhancement of the benthic community through restoration and maintenance of emergent marsh habitat would also benefit fish and other aquatic organisms that depend on estuarine habitat and detritus export to meet all or part of their life cycles.

The cumulative impacts to the benthic resources would have a positive effect, particularly when evaluated in concert with other Federal, state, local, and private conservation and restoration efforts. The positive synergistic effect on the benthic resources in the project area would be greater for the 35,000 cfs alternative than for the lower volume alternatives.

5.8.1.4 Alternative 3 – 15,000 cfs max Diversion

5.8.1.4.1 Direct

Direct impacts under the 15,000 cfs diversion alternative include the complete loss of existing benthic communities in the footprint of the proposed construction and dredging activities (203 acres of intermediate marsh and 253 acres of shallow open water). Temporary increases in turbidity, temperatures, and BOD, as well as temporary decreases in DO would contribute to further mortality and displacement of the benthic community in the project area. In addition, ridge creation would result in approximately 32 acres becoming unavailable for benthic aquatic fauna. However, following construction, benthic organisms would likely recolonize aquatic habitats in the project area, and the enhancement of freshwater marsh habitat by the diversion should be beneficial to numerous benthic species. Introduction of additional freshwater into estuarine systems could have short-term impacts on benthic populations in receiving waters as well. Introduction of freshwater flows from proposed features would be expected to change benthic abundance, species composition, and species distribution. Changes in benthic species assemblages would likely be similar to what is observed along present day estuarine salinity gradients except that increased freshwater flows would shift the benthic community, displacing marine species in favor of fresher and more estuarine, euryhaline species.

In addition, some benthic organisms from the Mississippi River would be expected to be entrained in the immediate vicinity of the diversion inflow while it is in operation.

5.8.1.4.2 Indirect

Each of the 5,000, 10,000, 15,000, and 35,000 alternatives would freshen the entire project area, with maximum flows being diverted in March–April, and a base flow of 1,000 cfs the remainder of the year. Diversion of freshwater, sediments, and nutrients at a maximum of 10,000 cfs is expected to increase SAV and decrease marsh loss to a greater degree than Alternatives 1 or 2. Increased SAV would create more biomass and detrital inputs for the benthic community to process, furthering estuarine processes for the benefit of the salt marsh community. The detritus export by the benthic community and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

The diversion of freshwater is expected to decrease salinities throughout the project area, particularly during full flow in March–April and the weeks immediately following. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. The overall decrease in salinity is expected to displace benthic species less tolerant of freshwater. In addition, the increase in sediment inputs over the project area could disrupt the benthic community and benthic processes where accretion occurs. Nutrient inputs would likely impact the chemical and biological processes of the benthic community, increasing blooms of phytoplankton, and subsequently decomposition.

5.8.1.4.3 Cumulative

The reintroduction of freshwater, sediments, and nutrients from the Mississippi River is expected to restore and maintain emergent marsh habitat over the long term in the project area. The increase in marsh habitat and SAV would increase production of detritus and thereby, increase opportunity for the estuarine benthic community to process energy through the detrital pathway. According to Mitsch and Gosselink (1993), the salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary. They point out that the detritus material exported from the marsh is more important to the estuary than the phytoplankton-based production in the estuary. The cumulative impacts would include the shifting of the benthic abundance, species composition, and species distribution toward those adapted to fresher habitats, and increasing chemical, physical, and biological processes performed by the benthic community. The enhancement of the benthic community through restoration and maintenance of emergent marsh habitat would also benefit fish and other aquatic organisms that depend on estuarine habitat and detritus export to meet all or part of their life cycles.

The cumulative impacts to the benthic resources would have a positive effect, particularly when evaluated in concert with other Federal, state, local, and private conservation and restoration efforts. The positive synergistic effect on the benthic resources in the project area would be greatest for the 35,000 cfs alternative when compared to the lower volume alternatives.

5.8.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.8.1.5.1 Direct

Under the 35,000 cfs diversion alternative, the existing benthic communities in the footprint of the proposed construction and dredging activities would be lost. This area would encompass 283 acres of intermediate marsh and 363 acres of shallow open water. Temporary increases in turbidity, temperatures, and BOD, as well as temporary decreases in DO would contribute to further mortality and displacement of the benthic community in the project area. In addition, ridge creation would result in approximately 31 acres becoming unavailable for benthic aquatic fauna. However, following construction, benthic organisms would likely recolonize aquatic habitats in the project area, and the enhancement of freshwater marsh habitat by the diversion should be beneficial to numerous benthic species. Introduction of additional freshwater into estuarine systems could have short-term impacts on benthic populations in receiving waters as well. Introduction of freshwater flows from proposed features would be expected to change benthic abundance, species composition, and species distribution. Changes in benthic species assemblages would likely be similar to what is observed along present day estuarine salinity gradients except that increased freshwater flows would shift the benthic community, displacing marine species in favor of fresher and more estuarine, euryhaline species.

In addition, some benthic organisms from the Mississippi River would be expected to be entrained in the immediate vicinity of the diversion inflow while it is in operation.

5.8.1.5.2 Indirect

Each of the 5,000, 10,000, 15,000, and 35,000 alternatives would freshen the entire project area, with maximum flows being diverted in March–April, and a base flow of 1,000 cfs the remainder of the year. Diversion of freshwater, sediments, and nutrients at a maximum of 35,000 cfs is expected to increase SAV and decrease marsh loss to the greatest degree of all the alternatives evaluated in detail. Increased SAV would create more biomass and detrital inputs for the benthic community to process, furthering estuarine processes for the benefit of the salt marsh community. The detritus export by the benthic community and the shelter found along marsh edges make salt marshes important nursery areas for many commercially important fish and shellfish.

The diversion of freshwater is expected to decrease salinities throughout the project area, particularly during full flow in March–April and the weeks immediately following. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. The overall decrease in salinity is expected to displace benthic species less tolerant of freshwater. In addition, the increase in sediment inputs over the project area could disrupt the benthic community and benthic processes where accretion occurs. Nutrient inputs would likely impact the chemical and biological processes of the benthic community, increasing blooms of phytoplankton, and subsequently decomposition.

5.8.1.5.3 Cumulative

The reintroduction of freshwater, sediments, and nutrients from the Mississippi River is expected to restore and maintain emergent marsh habitat over the long term in the project area. The increase in marsh habitat and SAV would increase production of detritus and thereby, increase opportunity for the estuarine benthic community to process energy through the detrital pathway. According to Mitsch and Gosselink (1993), the salt marsh is a major producer of detritus for both the salt marsh system and the adjacent estuary. They point out that the detritus material exported from the marsh is more important to the estuary than the phytoplankton-based production in the estuary. The cumulative impacts would include the shifting of the benthic abundance, species composition, and species distribution toward those adapted to fresher habitats, and increasing chemical, physical, and biological processes performed by the benthic community. The enhancement of the benthic community through restoration and maintenance of emergent marsh habitat would also benefit fish and other aquatic organisms that depend on estuarine habitat and detritus export to meet all or part of their life cycles.

The cumulative impacts to the benthic resources would have a positive effect, particularly when evaluated in concert with other Federal, state, local, and private conservation and restoration efforts. The positive synergistic effect on the benthic resources in the project area would be greatest for this alternative when compared to the lower volume alternatives.

5.8.2 Plankton

This resource is institutionally significant because of the NEPA of 1969, 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 would be responsible for at least 40 percent of the photosynthesis occurring on the earth; plankton would be 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 part of the lowest trophic food level for many larger organisms important to commercial and recreational fishing. 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). Further, the abundance of certain zooplankton could be indicative of good fishing areas.

5.8.2.1 No Action Alternative (Future Without Project Conditions)

The No Action Alternative would result in the persistence of existing conditions including the continued degradation and eventual loss of salt marsh and concomitant loss of long-term estuarine sustainability. None of the potential negative effects of freshwater inflows to the project area would result.

5.8.2.1.1 Direct

Current rates of salt marsh loss would be expected to continue or increase with no additional input of sediment, freshwater and nutrients from river water to the project area. No direct impacts to existing salt marsh vegetation resulting from construction of the proposed diversion and associated features would occur. No opportunities for beneficial reuse of marsh soil and substrate excavated for construction would be realized.

5.8.2.1.2 Indirect

Under the No Action Alternative, both man-made and natural processes would contribute to continued loss of habitat/vegetation as the salt marshes convert to more open water conditions. This in turn would lead to additional reductions in salt marsh plankton production and thus a loss in primary and secondary food sources for salt marsh fish and wildlife. Plankton assemblages that currently inhabit the project area would experience reductions in population as salinities increased. Further, under the No Action Alternative it would be anticipated that the continued loss of salt marsh would eventually result in a decrease of available nutrients and detritus, ultimately affecting plankton population dynamics. No indirect benefits or impacts would occur as a result of construction and freshwater diversion into the salt marsh.

In addition, there is a public health concern associated with the No Action Alternative. For example, phytoplankton in more saline environments can cause blooms of *Karenia breve* (formerly known as *Gymnodinium breve*), a dinoflagellate that has been associated with red tides. Red tides would be so named because the prolific growth stains the water red. Toxins associated with red tides would be capable of killing fish and shellfish. Red tide populations well below the fish kill level pose a serious problem for public health through shellfish contamination. Bivalve shellfish, especially oysters, clams, and coquinas, can accumulate so many toxins that they become toxic to humans. Public health concerns also emerge from studies that show that the presence of airborne toxins have an impact on the human respiratory system. Freshwater diversion has been utilized in some instances to attempt to reduce the spread of red tides into coastal waters.

5.8.2.1.3 Cumulative

Cumulative impacts to plankton resources would primarily be related to the incremental impact of all past, present, and future actions affecting plankton resources. Both man-made and natural processes would contribute to the continued loss of vegetated habitats, including: continued erosion and subsidence, increased saltwater intrusion, increased water velocities, and increased herbivory. It is predicted that within the foreseeable future the lack of any reintroduction of nutrients and sediments to the estuarine system would continue to produce conditions for significant losses of all marsh types throughout the project area. As a result open-water habitats would continue to grow allowing for further intrusion of saltwater into the marsh. This loss of emergent salt marsh habitat would have significant changes on plankton communities and the organisms that depend on them for their life history requirements. Plankton populations would continue to convert from primarily estuarine-dependent plankton species assemblages and biomass to more marine and open water plankton species.

5.8.2.2 Alternative 1 – 5,000 cfs max Diversion

5.8.2.2.1 Direct

Direct impacts, primarily during the construction phase, of Alternative 1 would be similar to Alternative 4; however, the extent of the affected area would be greater in proportion to the increased construction footprint. Operation of the 5,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Impacts would result from the placement of three 15-ft x 15-ft box culverts. Additionally, there would be direct impacts to plankton associated with the 32 acres of ridge and terrace creation and 139 acres of marsh creation — all developed utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater, nutrient and sediments.

5.8.2.2.2 Indirect

Indirect impacts would also be similar to Alternative 4. Primary differences would be associated with the period and depth of freshwater inundation. Increases in submersed aquatic vegetation (SAV) would likely contribute to and be correlated with changes in plankton production and composition, especially in the fresh, intermediate, and brackish zones (see submersed aquatic vegetation section 1.1.1). Changes in plankton as a result of freshwater inundation would be expected to positively influence EFH within and beyond the immediate outfall area of the diversion. Sediment delivery to the system would likely fall short of the project goal.

5.8.2.2.3 Cumulative

Cumulative impacts to plankton resources would primarily be related to the synergistic effect of all past, present, and future actions affecting plankton resources. Alternative 1 would have positive synergistic effects on estuarine plankton resources when combined with other Federal, state, local, and private restoration efforts. Notably, any future management actions would likely have cumulative impacts relative to plankton species abundances, composition, and distribution.

5.8.2.3 Alternative 2 – 10,000 cfs max Diversion

5.8.2.3.1 Direct

Direct impacts, primarily during the construction phase, of Alternative 1 would be similar to Alternative 4; however, the extent of the affected area would be greater in proportion to the increased construction footprint. Operation of the 10,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Impacts would result from the placement of three 15-ft x 15-ft box culverts. Additionally, there would be impacts to plankton associated with the 32 acres of ridge and terrace creation and 176 acres of marsh creation – all developed utilizing dredged material from an adjacent 167 acres of canal being reconfigured to convey freshwater, nutrient and sediments.

5.8.2.3.2 Indirect

Indirect impacts would also be similar to Alternative 4. Primary differences would be associated with the period and depth of freshwater inundation. Increases in submersed aquatic vegetation (SAV) would likely contribute to and be correlated with changes in plankton production and composition, especially in the fresh, intermediate, and brackish zones (see submersed aquatic vegetation section 1.1.1). Changes in plankton as a result of freshwater inundation would be expected to positively influence EFH within and beyond the immediate outfall area of the diversion. Sediment delivery to the system would likely fall short of the project goal.

5.8.2.3.3 Cumulative

Cumulative impacts to plankton resources would primarily be related to the synergistic effect of all past, present, and future actions affecting plankton resources. Alternative 4 would have positive synergistic effects on estuarine plankton resources when combined with other Federal, state, local, and private restoration efforts. Notably, any future management actions would likely have cumulative impacts relative to plankton species abundances, composition, and distribution.

5.8.2.4 Alternative 3 – 15,000 cfs max Diversion

5.8.2.4.1 Direct

Direct impacts, primarily during the construction phase, of Alternative 1 would be similar to Alternative 4; however, the extent of the affected area would be greater in proportion to the increased construction footprint. Operation of the 15,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. Impacts would result from the placement of ten 15-ft x 15-ft box culverts. Additionally, there would be impacts to plankton associated with the 32 acres of ridge and terrace creation and 235 acres of marsh creation — all developed utilizing dredged material from an adjacent 182 acres of canal being reconfigured to convey freshwater, nutrient and sediments.

5.8.2.4.2 Indirect

Indirect impacts would also be similar to Alternative 4. Primary differences would be associated with the period and depth of freshwater inundation. Increases in submersed aquatic vegetation (SAV) would likely contribute to and be correlated with changes in plankton production and composition, especially in the fresh, intermediate, and brackish zones (see submersed aquatic vegetation section 1.1.1). Changes in plankton as a result of freshwater inundation would be expected to positively influence EFH within and beyond the immediate outfall area of the diversion. Sediment delivery to the system would likely fall short of the project goal.

5.8.2.4.3 Cumulative

Cumulative impacts to plankton resources would primarily be related to the synergistic effect of all past, present, and future actions affecting plankton resources. Alternative 4 would have positive synergistic effects on estuarine plankton resources when combined with other Federal, state, local, and private restoration efforts. Notably, any future management actions would likely have cumulative impacts relative to plankton species abundances, composition, and distribution.

5.8.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.8.2.5.1 Direct

Operation of the 35,000 cfs diversion alternative would introduce fresh river water, sediment and nutrients into the constructed outfall channels and existing distributary channels within the project area. During actual construction activities of project features there would be short-term direct impacts to plankton populations due to increases in turbidity, low DO, and introduction of dredged sediments into shallow open water areas. Impacts would result from the placement of ten 15-ft x 15-ft box culverts. Additionally, there would be impacts to plankton associated with the 31 acres of ridge and terrace creation and 385 acres of marsh creation — all developed utilizing dredged material from an adjacent 223 acres of canal being reconfigured to convey freshwater, nutrient and sediments. There would be long-term loss of shallow water habitats in some areas due to dredge disposal activities. However, overall, there is an abundance of shallow open-water habitat in the project area available for use by plankton.

5.8.2.5.2 Indirect

Increases in freshwater flows and associated sediments and nutrients, along with changes in the salinity gradient from proposed features would be expected to change plankton species assemblage, composition, and distribution within a relatively short time frame. Plankton population dynamics would respond to associated changes in nutrient cycling, enrichment, and fluxes, especially under different annual flow regimes. Changes in plankton species assemblages would likely resemble what is observed along present day estuarine salinity gradients as increased freshwater flows displace marine species in favor of fresher and more estuarine, euryhaline species. Additionally, hypoxic conditions would be expected to occur less often with the introduction of freshwater to the system which would contribute to increased abundances of plankton, especially zooplankton. For example, while some zooplankton would be euryhaline, others have distinct salinity preferences. Therefore, introduction of river water into estuarine systems can have dramatic short-term impacts on plankton populations in adjacent coastal waters (Hawes and Perry, 1978). Under this alternative, it is anticipated that the longer inundation period and more sediment would lead to more plankton production – correlated with growth and establishment of more aquatic vegetation. In addition, changes in plankton as a result of freshwater inundation would be expected to positively influence EFH within and beyond the immediate outfall area of the diversion.

Increases in submersed aquatic vegetation (SAV) would contribute to changes in plankton production and composition especially in the fresh, intermediate, and brackish zones (see submersed aquatic vegetation section 1.1.1). Increased plant growth would result in greater production of organic detritus and production of phytoplankton and zooplankton would increase particularly in areas where turbidity is not limiting. These increases in plankton production would benefit larval and juvenile fishes and other aquatic animals and, as a result, the harvest of sport and commercial finfish and shellfish that depend on these microorganisms would increase.

Indirect impacts to plankton resources would primarily be related to increases in the export of dissolved organic compounds and detritus from enhanced marsh habitats that would benefit local plankton populations by increasing the planktonic food web. It is unknown whether proposed diversion flows and associated nutrients would result in noxious blooms of blue-green algae, but there is likely some upper limit to the assimilation of nutrients into estuarine waters, beyond which blooms would occur. Potentially, freshwater diversion would increase sediments in the project area with accompanying minor increases in trace metals and also increase agrochemicals. This nutrient enrichment could potentially lead to increased algal blooms.

5.8.2.5.3 Cumulative

Cumulative impacts to plankton resources would primarily be related to the synergistic effect of all past, present, and future actions affecting plankton resources. Alternative 4 would have positive synergistic effects on estuarine plankton resources when combined with other Federal, state, local, and private restoration efforts. It is anticipated that intertidal restoration efforts would result in greater resources for phytoplankton and zooplankton due to export of dissolved organic compounds and detritus. Notably, any future management actions would likely have cumulative impacts relative to plankton species abundances, composition, and distribution.

Additionally, public concerns have been raised regarding potential excessive changes in the salinity gradient that would convert the existing estuarine habitats into purely freshwater and intermediate types. Although there would be many proponents of freshwater and sediment diversions, some members of the public would be concerned about possible unintended consequences of implementing this type of restoration feature. Commercial and recreational fishermen would be concerned that the change in the salinity regime often associated with a freshwater diversion, would cause loss or displacement of current recreational and commercially valuable fishery species. As mentioned, in addition to altering salinity, diversions could increase the amount of nutrients supplied to lakes and bays. Increased nutrients create the possibility of algal blooms, which would be potentially detrimental to many aquatic organisms including fish, shellfish, and invertebrates, and could contribute to the formation of hypoxic zones.

5.8.3 Other Aquatic Resources

No other aquatic communities would be anticipated to be significantly impacted by implementation of any one of the alternatives in the MDWD project area.

5.9 FISHERIES

Although freshwater fisheries and long-term estuarine sustainability would be expected to benefit from freshwater diversions, the potential for short-term losses to estuarine fisheries (e.g., oysters) must also be considered in the evaluation of project alternatives.

5.9.1 No Action Alternative (Future Without Project Conditions)

5.9.1.1 Direct

Under the No Action Alternative no direct impacts to freshwater, estuarine or marine fisheries would occur. Current rates of marsh loss would be expected to continue with no additional input of sediment, freshwater and nutrients from river water to the project area. Louisiana coastal marshes including the MDWD project area would be recognized as an important and productive fisheries nursery habitat, and conversion to open water reduces availability of this habitat. Moreover, juvenile fish and invertebrates would be important food sources for migratory birds, such as wading birds and waterfowl, and the conversion of marsh to open water can only reduce food abundance for these species.

5.9.1.2 Indirect

Continued conversion of emergent marsh to open water is expected to have long-term adverse impacts to many fish species that depend on estuarine wetlands in the project area to meet life stage requirements. Freshwater fish species that currently inhabit the project area would experience reductions in population as salinities increase. Over time, indirect impacts of the No Action Alternative would result in a substantial decrease in the quality of EFH in the project area, including nursery habitat and marsh edge in the project area, and reduce the area’s ability to support federally managed species. The abundances of aquatic organisms would decrease, indirectly impacting species that would be linked in the food web to directly affected species. The reduction in emergent wetlands would also result in shifts in predator/prey relationships, a decline in fishery productivity, and reduced recreational fishing opportunities.

5.9.1.3 Cumulative

Over the long term, without reintroduction of Mississippi River flows of sediment and nutrients to restore and maintain emergent marsh habitat, the project area is likely to convert from a predominately estuarine habitat to a predominately marine habitat, and populations of fish and other aquatic organisms that depend on estuarine habitat in the project area to meet all or part of their life cycles would be adversely affected by the reduction and eventual loss of this habitat.

5.9.2 Alternative 1 – 5,000 cfs diversion

5.9.2.1 Direct

Construction of the 5,000 cfs alternative is expected to have substantial but localized impacts to fisheries resources in the immediate vicinity of the outfall management features. Sessile or slow moving individuals or species in the construction footprint would likely suffer complete, albeit temporary, losses during excavation of outfall channels and placement of excavated material into marsh creation areas. No direct impacts to oyster would be anticipated to result from construction of Alternative 1, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters. Construction activities would temporarily increase turbidity and BOD, and decrease DO. These temporary conditions would likely displace more mobile fisheries species from the construction areas. Following construction, displaced fish would likely return to the project area and some sessile or slow-moving species would recolonize enlarged channels. The notched weirs included as an outfall management feature could have some modifying impact on fisheries access to the area causing species to use other routes. As reflected in the WVA assessment (included with Appendix B), aquatic organism access under with project conditions is expected to be approximately 60 percent of optimum (without project access is assumed to be at optimum level, or 100 percent). Negative impacts to fisheries resulting from construction of this alternative would be less than for the 10,000, 15,000, and 35,000 cfs alternatives (except for restrictions on fish access due to notched weirs, which would be the same for all alternatives), but positive impacts from marsh creation using excavated material would also be less than those expected for the larger diversion alternatives.

5.9.2.2 Indirect

Implementation of the 5,000 cfs alternative following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area while the diversion is at full flow and for several weeks after the return to maintenance flow operation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. Entrainment of eggs, larvae or fry of Mississippi River fish species in the immediate vicinity of the diversion inflow could occur during operation of the structure. To mitigate for these impacts, one or more of the box culverts could be modified to accommodate fish passage.

The notched weirs are expected to slow channel flow velocities and retain sediment and some nutrients within the project area. While these structures will reduce channel cross-sections where they are located, they are not anticipated to completely block fisheries access between the project area and River aux Chenes. Additional details on the expected effects of notched weirs is provided in the WVA analysis at the end of Appendix B. The impact to natural oyster settlement and growth will be less than the 35,000 cfs alternative due to the quicker recovery from the lower pulse. See Section 5.15.15.2 for a discussion on impacts to oyster leases.

Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish should benefit from implementation of the diversion.

Freshwater inflow is an important component of circulation and flushing processes in estuaries that assist in the transportation of planktonic organisms, nutrients, and detritus to the Gulf of Mexico. Over the long term, operation of the diversion is expected to help support the aquatic food web of marine fishery species. An aquatic model will be conducted during PED to help evaluate potential impacts (see Section 3.8.9).

5.9.2.3 Cumulative

Implementation of the 5,000 cfs diversion alternative would have positive synergistic effects on fishery resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential estuarine wetland habitats used by fishery populations for spawning, cover, nursery, and other life stage requirements. Localized increases in important fishery habitats could contribute to increased productivity on a local (basin) scale. However, the incremental effect of this alternative is unlikely to benefit populations of these species on a continental scale.

5.9.3 Alternative 2 – 10,000 cfs max Diversion

5.9.3.1 Direct

Construction of the 10,000 cfs alternative is expected to have substantial but localized impacts to fisheries resources in the immediate vicinity of the outfall management features. Sessile or slow moving individuals or species in the construction footprint would likely experience complete, albeit temporary, losses during excavation of outfall channels and placement of excavated material into marsh creation areas. No direct impacts to oysters would be anticipated to result from construction of Alternative 2, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters. Construction activities would temporarily increase turbidity, temperatures and BOD; and decrease DO. These temporary conditions would likely displace more mobile fisheries species from the construction area. Following construction, displaced fish would likely return to the project area and some sessile or slow-moving species would recolonize enlarged channels. The notched weirs included as an outfall management feature could have some negative impact on fisheries access to the area. As reflected in the WVA assessment (included with Appendix B), aquatic organism access under with project conditions is expected to be approximately 60 percent of optimum (without-project access is assumed to be at optimum level, or 100 percent). Negative impacts to fisheries resulting from construction of this alternative would be less than for the 15,000 and 35,000 cfs alternatives (except for restrictions on fish access due to notched weirs, which would be the same for all alternatives), but positive impacts from marsh creation using excavated material would also be less than those expected for the larger diversion alternatives.

5.9.3.2 Indirect

Implementation of the 10,000 cfs alternative following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area and beyond River aux Chenes to a portion of the Caernarvon sub basin while the diversion is at full flow and for several weeks after the return to maintenance flow operation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. Entrainment of eggs, larvae or fry of Mississippi River fish species in the immediate vicinity of the diversion inflow could occur during operation of the structure. To mitigate for these impacts, one or more of the box culverts could be modified into a fish passage.

The notched weirs are expected to slow channel flow velocities and retain sediment and some nutrients within the project area. While these structures will reduce channel cross-sections where they are located, they are not anticipated to completely block fisheries access between the project area and River aux Chenes. Additional details on the expected effects of notched weirs is provided in the WVA analysis at the end of Appendix B. The impact to natural oyster settlement and growth will be less than the 35,000 cfs alternative due to the quicker recovery from the lower pulse. See Section 5.15.15.2 for a discussion on impacts to oyster leases.

Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish should benefit from implementation of the diversion. However, decreases in salinity resulting from operation of the diversion could disrupt nursery functions of some marine species by affecting food and habitat availability. Some fishery species would be impacted by anticipated decreases in salinity and water temperature, and increased turbidity during maximum flow periods. Less freshwater tolerant species, such as brown shrimp and spotted seatrout, could be displaced from the northwestern portion of the project area. An aquatic model will be conducted during PED to help evaluate potential impacts (see Section 3.8.9).

5.9.3.3 Cumulative

Implementation of the 10,000 cfs diversion alternative would have positive synergistic effects on fishery resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential estuarine wetland habitats used by fishery populations for spawning, cover, nursery, and other life stage requirements. Localized increases in important fishery habitats could contribute to increased productivity on a local (basin) scale. However, the incremental effect of this alternative is unlikely to benefit populations of these species on a continental scale.

5.9.4 Alternative 3 – 15,000 cfs max Diversion

5.9.4.1 Direct

Construction of the 15,000 cfs alternative is expected to have substantial but localized impacts to fisheries resources in the immediate vicinity of the outfall management features. Sessile or slow moving individuals or species in the construction footprint would likely experience complete, albeit temporary, losses during excavation of outfall channels and placement of excavated material into marsh creation areas. No direct impacts to oysters would be anticipated to result from construction of Alternative 3, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters. Construction activities would temporarily increase turbidity, temperatures and BOD; and decrease DO. These temporary conditions would likely displace more mobile fisheries species from the construction area. Following construction, displaced fish would likely return to the project area and some sessile or slow-moving species would recolonize enlarged channels. The notched weirs included as an outfall management feature could have some negative impact on fisheries access to the area. As reflected in the WVA assessment (included with Appendix B), aquatic organism access under with project conditions is expected to be approximately 60 percent of optimum (without project access is assumed to be at optimum level, or 100 percent). Negative impacts to fisheries resulting from construction of this alternative would be less than for the 35,000 cfs alternative (except for restrictions on fish access due to notched weirs, which would be the same for all alternatives), but positive impacts from marsh creation using excavated material would also be less than those expected for the larger diversion alternatives.

5.9.4.2 Indirect

Implementation of the 15,000 cfs alternative following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area and beyond River aux Chenes to a portion of the Caernarvon sub basin while the diversion is at full flow and for several weeks after the return to maintenance flow operation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. Entrainment of eggs, larvae or fry of Mississippi River fish species in the immediate vicinity of the diversion inflow could occur during operation of the structure. To mitigate for these impacts, one or more of the box culverts could be modified to accommodate fish passage.

The notched weirs are expected to slow channel flow velocities and retain sediment and some nutrients within the project area. While these structures will reduce channel cross-sections where they are located, they are not anticipated to completely block fisheries access between the project area and River aux Chenes. Additional details on the expected effects of notched weirs is provided in the WVA analysis at the end of Appendix B. The impact to natural oyster settlement and growth will be less than the 35,000 cfs alternative due to the quicker recovery from the lower pulse. See Section 5.15.15.2 for a discussion on impacts to oyster leases.

Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish should benefit from implementation of the diversion. However, decreases in salinity resulting from operation of the diversion could disrupt nursery functions of some marine species by affecting food and habitat availability. Some fishery species would be impacted by anticipated decreases in salinity and water temperature, and increased turbidity during maximum flow periods. Less freshwater tolerant species, such as brown shrimp and spotted seatrout, could be displaced from the northwestern portion of the project area.

Freshwater inflow is an important component of circulation and flushing processes in estuaries that assist in the transportation of planktonic organisms, nutrients, and detritus to the Gulf of Mexico. Over the long term, operation of the diversion is expected to help support the aquatic food web of marine fishery species. An aquatic model will be conducted during PED to help evaluate potential impacts (see Section 3.8.9).

5.9.4.3 Cumulative

Implementation of the 15,000 cfs diversion alternative would have positive synergistic effects on fishery resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential estuarine wetland habitats used by fishery populations for spawning, cover, nursery, and other life stage requirements. Localized increases in important fishery habitats could contribute to increased productivity on a local (basin) scale. However, the incremental effect of this alternative is unlikely to measurably benefit populations of these species on a continental scale.

5.9.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.9.5.1 Direct

Construction of the 35,000 cfs alternative is expected to have substantial but localized impacts to fisheries resources in the immediate vicinity of the outfall management features. Sessile or slow moving individuals or species in the construction footprint would likely experience complete, albeit temporary, losses during excavation of outfall channels and placement of excavated material into marsh creation areas. No direct impacts to oysters would be anticipated to result from construction of Alternative 4, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters. Construction activities would temporarily increase turbidity, temperatures and BOD; and decrease DO. These temporary conditions would likely displace more mobile fisheries species from the construction area. Following construction, displaced fish would likely return to the project area and some sessile or slow-moving species would recolonize enlarged channels. The notched weirs included as an outfall management feature could have some negative impact on fisheries access to the area. As reflected in the WVA assessment (included with Appendix B), aquatic organism access under with project conditions is expected to be approximately 60 percent of optimum (without project access is assumed to be at optimum level, or 100 percent). Negative impacts to fisheries resulting from construction of this alternative would be greater than for the 5,000, 10,000, and 15,000 cfs alternatives (except for restrictions on fish access due to notched weirs, which would be the same for all alternatives), but positive impacts from marsh creation using excavated material would also be greater than those expected for the smaller diversion alternatives.

5.9.5.2 Indirect

Implementation of the 35,000 cfs alternative following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area and beyond River aux Chenes to a substantial portion of the Caernarvon sub basin while the diversion is at full flow and for several weeks after the return to maintenance flow operation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. Entrainment of eggs, larvae or fry of Mississippi River fish species in the immediate vicinity of the diversion inflow could occur during operation of the structure. To mitigate for these impacts, one or more of the box culverts could be modified to accommodate fish passage.

The notched weirs are expected to slow channel flow velocities and retain sediment and some nutrients within the project area. While these structures will reduce channel cross-sections where they are located, they are not anticipated to completely block fisheries access between the project area and River aux Chenes. Additional details on the expected effects of notched weirs is provided in the WVA analysis at the end of Appendix B.

Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish should benefit from implementation of the diversion. However, decreases in salinity resulting from operation of the diversion could disrupt nursery functions of some marine species by affecting food and habitat availability. Some fishery species would be impacted by anticipated decreases in salinity and water temperature, and increased turbidity during maximum flow periods. Less freshwater tolerant species, such as brown shrimp and spotted seatrout, could be displaced from the northwestern portion of the project area. Comparison of Figures 4.6 and 5.3 demonstrates that there is very little potential to impact natural oyster settlement or growth. See Section 5.15.15.2 for a discussion on impacts to oyster leases. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

Freshwater inflow is an important component of circulation and flushing processes in estuaries that assist in the transportation of planktonic organisms, nutrients, and detritus to the Gulf of Mexico. Over the long term, operation of the diversion is expected to help support the aquatic food web of marine fishery species. An aquatic model will be conducted during PED to help evaluate potential impacts (see Section 3.8.9).

5.9.5.3 Cumulative

Implementation of the 35,000 cfs diversion alternative would have positive synergistic effects on fishery resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion. This alternative would protect, create and nourish important and essential estuarine wetland habitats used by fishery populations for spawning, cover, nursery, and other life stage requirements. Localized increases in important fishery habitats could contribute to increased productivity on a local (basin) scale. However, the incremental effect of this alternative is less likely to measurably benefit populations of these species on a continental scale.

5.10 ESSENTIAL FISH HABITAT (EFH)

5.10.1 No Action Alternative (Future Without Project Conditions)

5.10.1.1 Direct

The No Action Alternative (no construction of river diversion structure or associated outfall management features) would have no direct impact on EFH.

5.10.1.2 Indirect

Indirect impacts of not implementing wetland creation/nourishment and shoreline protection features would result in the persistence of existing conditions resulting in the conversion of categories of EFH, such as estuarine marsh and SAV, to marine water column and mud, sand, or shell substrates is expected to continue. Over time, the No Action Alternative would result in the conversion of emergent marsh to open water. Substantial decreases in the quality of EFH in the project area would reduce the area's ability to support federally managed species.

5.10.1.3 Cumulative

Cumulative impacts would be the synergistic effect of the No Action Alternative on EFH with the additive combination of similar EFH degradation and losses throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal projects in the vicinity. Continued conversion of existing marsh to shallow open-water habitats anticipated with the No Action Alternative would contribute to declining quality of EFH, particularly nursery habitat for larval and juvenile fish and shrimp species.

5.10.2 Alternative 1 – 5,000 cfs max Diversion

5.10.2.1 Direct

Direct impacts associated with construction of the 5,000 cfs diversion and associated outfall management features include the disturbance and displacement of managed species in the construction footprint (144 acres of intermediate marsh and 187 acres of shallow open water). Adult and juvenile fish would be expected to move out of the area during construction. Ridge creation would result in approximately 32 acres becoming unavailable for fishery species, and notched weirs at River aux Chenes and at the end of the outfall channel could reduce fisheries access into the project area. However, this loss of EFH would be offset by expected increases in the quality of EFH in the marsh creation sites.

5.10.2.2 Indirect

Implementation of the 5,000 cfs diversion following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area while the diversion is at full flow and for several weeks after the return to maintenance flow operation. The accretion of sediment and input of nutrients is expected to benefit estuarine EFH within and beyond the immediate outfall area of the diversion. This alternative is projected to increase SAV in the project area and decrease emergent marsh loss across all marsh zones (intermediate, brackish, and saline) over the 50-year planning horizon. These changes in the project area would not only increase the areal extent of EFH, but would also improve the quality of EFH for several managed species.

Diversion of freshwater, sediments and nutrients into the project area under the evaluated operational plan is expected to decrease salinities throughout the project area, particularly within the existing intermediate marsh zone. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. High nutrient levels could result in blooms of algae and phytoplankton, and subsequent decomposition of these organisms could decrease DO levels of water bodies within the project area. These changes could result in localized adverse impacts to marine fishery productivity, particularly when the diversion is at full flow. The operational plan used to evaluate all diversion alternatives was developed to avoid or minimize these adverse impacts to marine fisheries and EFH while maximizing sediment and nutrient input to the extent practicable to meet project objectives. While this alternative has similar potential for negative impacts to marine fisheries and EFH as the 10,000, 15,000, and 35,000 diversions, its capacity for positive impacts to these resources would be less than for the larger alternatives.

5.10.2.3 Cumulative

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. Implementation of this alternative would be expected to have a positive synergistic effect on EFH in the project area, but to a lesser extent than the effect anticipated for the larger diversion alternatives.

5.10.3 Alternative 2 – 10,000 cfs max Diversion

5.10.3.1 Direct

Direct impacts associated with construction of the 10,000 cfs diversion and associated outfall management features include the disturbance and displacement of managed species in the construction footprint (159 acres of intermediate marsh and 223 acres of shallow open water). Adult and juvenile fish would be expected to move out of the area during construction. Ridge creation would result in approximately 32 acres becoming unavailable for fishery species, and notched weirs at River aux Chenes and at the end of the outfall channel could reduce fisheries access into the project area. However, this loss of EFH would be offset by expected increases in the quality of EFH in the marsh creation sites.

5.10.3.2 Indirect

Implementation of the 10,000 cfs diversion following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area while the diversion is at full flow and for several weeks after the return to maintenance flow operation. The accretion of sediment and input of nutrients is expected to benefit estuarine EFH within and beyond the immediate outfall area of the diversion. This alternative is projected to increase SAV in the project area and decrease emergent marsh loss across all marsh zones (intermediate, brackish, and saline) over the 50-year planning horizon. These changes in the project area would not only increase the aerial extent of EFH, but would also improve the quality of EFH for several managed species.

Diversion of freshwater, sediments and nutrients into the project area under the evaluated operational plan is expected to decrease salinities throughout the project area, particularly within the existing intermediate marsh zone. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. High nutrient levels could result in blooms of algae and phytoplankton, and subsequent decomposition of these organisms could decrease DO levels of water bodies within the project area. These changes could result in localized adverse impacts to marine fishery productivity, particularly when the diversion is at full flow. The operational plan used to evaluate all diversion alternatives was developed to avoid or minimize these adverse impacts to marine fisheries and EFH while maximizing sediment and nutrient input to the extent practicable to meet project objectives. While this alternative has similar potential for negative impacts to marine fisheries and EFH as the 15,000 and 35,000 diversions, its capacity for positive impacts to these resources is less than for the larger alternatives.

5.10.3.3 Cumulative

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. Implementation of this alternative would be expected to have a positive synergistic effect on EFH in the project area, but to a lesser extent than the effect anticipated for the larger diversion alternatives.

5.10.4 Alternative 3 – 15,000 cfs max Diversion

5.10.4.1 Direct

Direct impacts associated with construction of the 15,000 cfs diversion and associated outfall management features include the disturbance and displacement of managed species in the construction footprint (203 acres of intermediate marsh and 253 acres of shallow open water). Adult and juvenile fish would be expected to move out of the area during construction. Ridge creation would result in approximately 32 acres becoming unavailable for fishery species, and notched weirs at River aux Chenes and at the end of the outfall channel could reduce fisheries access into the project area. However, this loss of EFH would be offset by expected increases in the quality of EFH in the marsh creation sites.

5.10.4.2 Indirect

Implementation of the 15,000 cfs diversion following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area while the diversion is at full flow and for several weeks after the return to maintenance flow operation. The accretion of sediment and input of nutrients is expected to benefit estuarine EFH within and beyond the immediate outfall area of the diversion. This alternative is projected to increase SAV in the project area and decrease emergent marsh loss across all marsh zones (intermediate, brackish, and saline) over the 50-year planning horizon. These changes in the project area would not only increase the aerial extent of EFH, but would also improve the quality of EFH for several managed species.

Diversion of freshwater, sediments and nutrients into the project area under the evaluated operational plan is expected to decrease salinities throughout the project area, particularly within the existing intermediate marsh zone. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. High nutrient levels could result in blooms of algae and phytoplankton, and subsequent decomposition of these organisms could decrease DO levels of water bodies within the project area. These changes could result in localized adverse impacts to marine fishery productivity, particularly when the diversion is at full flow. The operational plan used to evaluate all diversion alternatives was developed to avoid or minimize these adverse impacts to marine fisheries and EFH while maximizing sediment and nutrient input to the extent practicable to meet project objectives. While this alternative has similar potential for negative impacts to marine fisheries and EFH as the 35,000 diversion, its capacity for positive impacts to these resources is less than for the larger alternative.

5.10.4.3 Cumulative

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. Implementation of this alternative would be expected to have a positive synergistic effect on EFH in the project area, but to a lesser extent than the effect anticipated for the largest diversion alternative.

5.10.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.10.5.1 Direct

Direct impacts associated with construction of the 35,000 cfs diversion and associated outfall management features include the disturbance and displacement of managed species in the construction footprint (283 acres of intermediate marsh and 363 acres of shallow open water). Adult and juvenile fish would be expected to move out of the area during construction. Ridge creation would result in approximately 31 acres becoming unavailable for fishery species, and notched weirs at River aux Chenes and at the end of the outfall channel could reduce fisheries access into the project area. However, this loss of EFH would be offset by expected increases in the quality of EFH in the marsh creation sites.

5.10.5.2 Indirect

Implementation of the 35,000 cfs diversion following the operational plan evaluated in the hydraulic modeling and WVA analysis (full flow in March–April; 1,000 cfs rest of year) is expected to freshen the entire project area while the diversion is at full flow and for several weeks after the return to maintenance flow operation. The accretion of sediment and input of nutrients is expected to benefit estuarine EFH within and beyond the immediate outfall area of the diversion. This alternative is projected to increase SAV in the project area and decrease emergent marsh loss across all marsh zones (intermediate, brackish, and saline) over the 50-year planning horizon. These changes in the project area would not only increase the aerial extent of EFH, but would also improve the quality of EFH for several managed species.

Diversion of freshwater, sediments and nutrients into the project area under the evaluated operational plan is expected to decrease salinities throughout the project area, particularly within the existing intermediate marsh zone. A substantial portion of this zone is expected to convert to fresh marsh within the first several years after project implementation. Water levels, velocities, and turbidity in outfall areas would be all expected to increase during full flow conditions. High nutrient levels could result in blooms of algae and phytoplankton, and subsequent decomposition of these organisms could decrease DO levels of water bodies within the project area. These changes could result in localized adverse impacts to marine fishery productivity, particularly when the diversion is at full flow. The operational plan used to evaluate all diversion alternatives was developed to avoid or minimize these adverse impacts to marine fisheries and EFH while maximizing sediment and nutrient input to the extent practicable to meet project objectives. While this alternative has similar potential for negative impacts to marine fisheries and EFH as the 5,000, 10,000, or 15,000 diversions, its capacity for positive impacts to these resources is greater than for the smaller alternatives.

5.10.5.3 Cumulative

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. Implementation of this alternative would be expected to have a higher positive synergistic effect on EFH in the project area than the effect anticipated for the smaller diversion alternatives.

5.11 THREATENED AND ENDANGERED SPECIES

5.11.1 No Action Alternative (Future Without Project Conditions)

5.11.1.1 Direct

No federally listed threatened or endangered species would be known to occur within the project area boundary (USFWS, 2010). The No Action Alternative (no construction of a river diversion structure and associated outfall management features in the project area) would have no direct impacts on listed species or their critical habitat in the project area.

5.11.1.2 Indirect

The primary consequence of not implementing a river diversion in the project area would be the continued degradation and loss of estuarine wetland habitats used by many different fish and wildlife species for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements. The loss and deterioration of transitional wetland habitats over time could continue to indirectly affect, to an undetermined degree, all listed species that could potentially utilize the Breton Sound basin including: Gulf sturgeon, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, brown pelican, piping plover, and the West Indian manatee.

5.11.1.3 Cumulative

Adverse cumulative impacts associated with the No Action Alternative would be the additive effect of the continued deterioration of habitat quality and quantity in the project area with continued coastal land losses and deterioration of critical habitats in other parts of southeastern Louisiana and the Gulf Coast. Cumulative effects on listed species would be offset, to some degree, by the positive impacts of implementing other state and Federal projects.

5.11.2 Alternative 1 – 5,000 cfs max Diversion

5.11.2.1 Direct

Direct impacts associated with construction of the 5,000 cfs diversion and associated outfall management features could potentially include disturbance and displacement of individuals of some threatened or endangered species that could potentially occur within the project area boundary. The construction footprint for this alternative is limited in size relative to the project area (<1.0 percent) and does not encroach on critical habitat for any listed species. For these reasons, construction of the proposed diversion and associated outfall management features would not jeopardize the continued existence of any listed species or destroy or adversely modify critical habitat.

5.11.2.2 Indirect

Implementation of the 5,000 cfs diversion alternative would divert water, sediments and nutrients from the Mississippi River into the project area. Water diversions are used for flood control, water supply, and habitat restoration in the lower Mississippi River (LMR) but their impacts on imperiled sturgeon populations are unknown. Corps-sponsored sampling efforts have shown catch data that suggests that pallid sturgeon populations decline as you progress further downstream (RM 0 to RM 320). Pallid and shovelnose sturgeon, as well as evidence of recruitment, are noticeably present with RM 80–160 of the LMR. The proposed diversion at Violet will be located at RM 85. This falls within a reach of the MRGO that ERDC has shown has a population of pallid sturgeon that are showing signs of recruitment. This increased presence of adult, sub-adult, post-larval, and larval pallid sturgeon within the LMR suggests that there is an increased potential of entrainment of small sized sturgeon in diversions. The extent of impacts to this sturgeon population from entrainment in water diversion structures is currently not quantifiable. Further population analysis is needed to be able to project the size of the LMR pallid population and what impact pallid sturgeon entrainment has on this population. Given this current information CEMVN concludes that there is a risk of entrainment of pallid sturgeon by this diversion structure and that therefore the proposed MDWD project “May Affect” the species. Appendix A presents a Biological Assessment that describes those factors used in determining the potential impacts of the proposed action on pallid sturgeon. No critical habitat for pallid sturgeon has been identified in the vicinity of the White Ditch project area.

5.11.2.3 Cumulative

Cumulative impacts to listed species would be related to the incremental impacts of the anticipated restoration features being constructed within the vicinity of the proposed action. The combination of this effort with the numerous other restoration projects occurring in southeastern Louisiana will be the slowing of the rate of shoreline retreat and restoring some of the delicate wetland habitats within the area. These coastal habitats are requisites for some portion of the life cycle of all of the listed species that occur within the project area. The improvement of this habitat will reduce at least one stressor that is hindering the recovery of these T&E species. Cumulative impacts to the pallid sturgeon resulting from entrainment by freshwater diversion structures cannot be determined at this time. Further population analysis is needed to be able to determine what the additive effect entrainment from all the existing and proposed freshwater and sediment diversion structures being constructed in the lower Mississippi River would have on the species.

5.11.3 Alternative 2 – 10,000 cfs max Diversion

5.11.3.1 Direct

Impacts would be similar to Alternative 1 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 1. Direct impacts associated with construction of the 10,000 cfs diversion and associated outfall management features could potentially include disturbance and displacement of individuals of some threatened or endangered species that could potentially occur within the project area boundary. The construction footprint for this alternative is limited in size relative to the project area (<1.0 percent) and does not encroach on critical habitat for any listed species. For these reasons, construction of the proposed diversion and associated outfall management features would not jeopardize the continued existence of any listed species or destroy or adversely modify critical habitat.

5.11.3.2 Indirect

Impacts would be similar to Alternative 1 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 1. Implementation of the 10,000 cfs diversion alternative would divert water, sediments and nutrients from the Mississippi River into the project area. This could potentially result in the entrainment of larval and YOY, and adult fish into the marsh and open water of the project area, particularly when the diversion is flowing at full capacity. Entrainment of larval YOY, and adult fish could potentially include individual specimens of federally listed species such as the pallid sturgeon, if these would be present in the immediate vicinity of the diversion intake. Appendix A presents a Biological Assessment that describes those factors used in determining the potential impacts of the proposed action on pallid sturgeon. No critical habitat for pallid sturgeon has been identified in the vicinity of the White Ditch project area. While there is a potential for individuals of the species to be adversely affected by entrainment during operation of the diversion, the proposed project is not considered likely to jeopardize the continued existence of pallid sturgeon in the lower Mississippi River.

5.11.3.3 Cumulative

Impacts would be similar to Alternative 1 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 1. Implementation of the diversion project is anticipated to have positive synergistic effects on listed species when combined with other Federal, state, local, and private restoration efforts. Cumulative impacts to listed species would be related to the incremental impacts of the anticipated restoration of wetland habitat, compared to all past, present, and future restoration activities that have or would increase and enhance all coastal wetland habitats.

5.11.4 Alternative 3 – 15,000 cfs max Diversion

5.11.4.1 Direct

Impacts would be similar to Alternative 2 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 2. Direct impacts associated with construction of the 15,000 cfs diversion and associated outfall management features could potentially include disturbance and displacement of individuals of some threatened or endangered species that could potentially occur within the project area boundary. With the increased diversion size there is a corresponding increase in the likelihood of entraining a larval, YOY or adult pallid sturgeon that may be in the project area.

5.11.4.2 Indirect

Impacts would be similar to Alternative 2 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 2.

5.11.4.3 Cumulative

Impacts would be similar to Alternative 2 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 2.

5.11.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.11.5.1 Direct

Impacts would be similar to Alternative 2 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 2. On May 14, 2010, CEMVN sent a letter to the USFWS requesting the initiation of consultation regarding potential impacts from the Recommended Plan to the pallid sturgeon. A response letter from the USFWS was received on July 1, 2010, requesting that CEMVN provide additional data regarding the proposed action and the pallid sturgeon species, and that CEMVN initiation formal consultation with the USFWS. In a July 15, 2010, dated letter, CEMVN provided all supplemental data, as requested by the USFWS, and requested that formal consultation for the MDWD project be initiated. On July 16, 2010, the USFWS responded via letter acknowledging the receipt of the supplemental data provided and initiated the formal consultation process. Consultation was completed on September 23, 2010, for the MDWD project. The USFWS Biological Opinion can be found in Appendix A. The document concludes:

> *"After reviewing the current status of the pallid sturgeon, the effects of the current freshwater diversions and the proposed Medium Diversion at White Ditch, and the cumulative effects, it is the Service's biological opinion that construction and subsequent operation of a new freshwater diversion at White Ditch between RM 64 and 59 is not likely to jeopardize the continued existence of the species. No critical habitat has been designated for the pallid sturgeon; therefore, none will be affected."*
>
> ***REASONABLE AND PRUDENT MEASURES***
>
> *The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of pallid sturgeon by entrainment through the medium diversion at White Ditch.*
>
> 1. *Gate operations should minimize velocity through the structure by maximizing the open cross-section, especially at Mississippi River stages of 6 feet mean sea level or less (equates to velocities at the culvert face of 7.2 fps or less).*
>
> 2. *Any gate operation that would significantly increase or decrease the velocity (change greater than 500 cfs) should be implemented over several hours to allow fish sufficient time to migrate back to the river or swim away from the structure.*
>
> 3. *Once the end of the annual discharge period is reached minimal gate openings should be maintained for several days to allow passage of any sturgeon that may have emigrated downstream.*
>
> 4. *The downstream edge of the culverts should have a slope to act as a ramp and/or sufficient erosion protection that would prevent scour from forming a vertical ledge greater than 6 inches at the downstream end of the culvert.*

5. *In channel refuge consisting of several submerged wing dikes (or similar structures) on both banks should be constructed no further downstream than 75 feet from the structure. Minimal spacing between the structures should be 10 feet but can be moved to account for scour. The maximum suggested height is 24 inches, but the length extending into the channel is not yet determined.*

6. *The downstream side walls should be angled towards the culverts so they will guide fish back into the culverts at lower velocities.*

7. *The two outer most culverts should have fish passage baffles constructed on the floor of the culverts.*

8. *Monitoring to determine take and to reduce potential take by returning pallid sturgeon to the river should be undertaken*

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall execute the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. *Manuals (or other similar documents) written to guide the daily operations and maintenance activities of the diversion should be written in cooperation with the Service. Any proposed changes to such document would require re-initiation of consultation under Section 7 of the ESA*

2. *Detailed design of wing dikes and the scour protection to prevent development of a vertical ledge should be coordinated with the Service. After construction annual inspection (i.e., measurements) should be taken at the downstream edge of the culvert to determine need to for maintenance. If maintenance is required funding should be immediately requested.*

3. *Design of downstream side walls and detailed design of the fish passage baffles should be coordinated with the Service.*

4. *Three days of sampling effort will be made each quarter. Sampling will consist of at minimum utilizing otter trawls, gillnets (i.e., 27.4 meter by 1.8 meter, six mesh panel ranging from 23 to 76 centimeters), and trotlines (61 meters long with 60 dropper lines at 0.9 meter intervals using 2/0 hooks baited with worms). Up to eight trotlines will be fished on the bottom overnight and two gillnets will also be fish overnight. All procedures and protocols for handling sturgeon should be followed and are available at: www.fws.gov/mountainpraire/endspp/protocoisIPallidSturgeonHandiingProtocol2008B.pdf*

All pallid sturgeon captures should be measured and tagged according to the protocol; if permitted and when feasible, ageing and endoscopy to determine sex and reproductive *stage should also be conducted. All pallid sturgeon captured should be returned to the Mississippi River as soon as practicable. The number and size of each pallid sturgeon caught by date and gear type should be provided to the Service. Unsuccessful sampling efforts should also be reported by date and gear type.*

Upon locating a dead or injured pallid sturgeon that may have been harmed or destroyed as a direct or indirect result of the proposed project, the Corps and/or contractor shall be responsible for notifying the Service's Lafayette, Louisiana, Field Office (337/291-3100) and the LDWF's Natural Heritage Program (225/765-2821). Care shall be taken in handling an injured sturgeon to ensure effective treatment or disposition and in handling dead specimens to preserve biological materials in the best possible state for later analysis. Disposition of dead sturgeon is also addressed in the protocols."

5.11.5.2 Indirect

Impacts would be similar to Alternative 3 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 3.

5.11.5.3 Cumulative

Impacts would be similar to Alternative 3 except this alternative includes additional restoration measures and a larger diversion structure not identified in Alternative 3.

5.12 CULTURAL AND HISTORIC RESOURCES

A cultural resources survey of the Oak River landscape features was completed by contractors employed by the USACE New Orleans District. Three archaeological sites and one standing structure (Site 16PL193) were identified during the survey. In consultation with the Louisiana State Historic Preservation Officer (SHPO), two of the archaeological sites and the standing structure were determined to be not eligible for inclusion in the National Register of Historic Places. The remaining archaeological site was determined to be National Register eligible. In consultation with the Chitimacha Tribe of Louisiana and the SHPO, it was decided that the White Ditch diversion would probably have no adverse effect on this historic property as it is located just outside the project area. However, it was also agreed that the site would be monitored to determine what effect the project has on the site and if the effect was adverse then a treatment plan would be devised by the New Orleans District through consultation with the Chitimacha Tribe of Louisiana and the SHPO. One other site, Fort De La Boulaye, is located outside the project area and will not be affected by the White Ditch Diversion.

Two additional areas within the overall project area remain to be surveyed. These would be the Bayou Garelle and the batture of the Mississippi River. Field conditions during the investigative period for this study effort have prevented these two areas from being surveyed for cultural resources.

5.12.1 No Action Alternative (Future Without Project Conditions)

5.12.1.1 Direct

Under the No Action Alternative, no archeological sites would be impacted by construction activities.

5.12.1.2 Indirect

All archaeological sites within the project area would continue to be affected by erosion and subsidence.

5.12.1.3 Cumulative

Archaeological sites in southeast Louisiana would be all subjected to the same natural forces, subsidence and erosion from natural wave action, storm surge and wakes created by motor boats. Eventually most sites, unless protected would disappear from the archaeological record.

5.12.2 Alternative 1 – 5,000 cfs max Diversion

5.12.2.1 Direct

Construction of the 5,000 cfs diversion alternative and associated outfall management features would not be expected to adversely affect archaeological sites.

5.12.2.2 Indirect

Indirect impacts of implementing the 5,000 cfs diversion alternative on archaeological sites would be expected to be the same as for the No Action Alternative.

5.12.2.3 Cumulative

Cumulative impacts of the 5,000 cfs diversion alternative would be expected to be the same as for the No Action Alternative.

5.12.3 Alternative 2 – 10,000 cfs max Diversion

5.12.3.1 Direct

Construction of the 10,000 cfs diversion alternative and associated outfall management features would not be expected to adversely affect archaeological sites.

5.12.3.2 Indirect

Indirect impacts of implementing the 10,000 cfs diversion alternative on archaeological sites would be expected to be the same as for the No Action Alternative.

5.12.3.3 Cumulative

Cumulative impacts of the 10,000 cfs diversion alternative would be expected to be the same as for the No Action Alternative.

5.12.4 Alternative 3 – 15,000 cfs max Diversion

5.12.4.1 Direct

Construction of the 15,000 cfs diversion alternative and associated outfall management features would not be expected to adversely affect archaeological sites.

5.12.4.2 Indirect

Indirect impacts of implementing the 15,000 cfs diversion alternative on archaeological sites would be expected to be the same as for the No Action Alternative.

5.12.4.3 Cumulative

Cumulative impacts of the 15,000 cfs diversion alternative would be expected to be the same as for the No Action Alternative.

5.12.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.12.5.1 Direct

Construction of the 35,000 cfs diversion alternative and associated outfall management features would not be expected to adversely affect archaeological sites.

5.12.5.2 Indirect

Indirect impacts of implementing the 35,000 cfs diversion alternative on archaeological sites would be expected to be the same as for the No Action Alternative.

5.12.5.3 Cumulative

Cumulative impacts of the 35,000 cfs diversion alternative would be expected to be the same as for the No Action Alternative.

5.13 AESTHETICS

5.13.1 No Action Alternative (Future Without Project Conditions)

5.13.1.1 Direct

The visual complexity surrounding the project area is related to its geomorphic structures including ridge, swamp and marsh. All of these elements would be critical systems inclusive to the White Ditch Study Area. Together, all of these elements provide a pleasing aesthetic view shed to the public, especially from atop the existing levee system. Direct impacts would evolve from the natural conditions of the area and the associated changes to these geomorphic structures.

5.13.1.2 Indirect

Indirect impacts can also be derived from the conversion of wetland and marshlands into open water. These landscape types would be excellent habitat for a variety of wildlife and fisheries. Excellent examples of habitat and their associated wildlife typically provide the viewer with focal points and accents (typically made up of both the landscape and the wildlife) that make a view shed dynamic, scenic and memorable. If loss of these habitats persists, then this is just one more element of the viewscape that is lost along with it.

5.13.1.3 Cumulative

Cumulative impacts of the No Action Alternative in this instance include the incremental impacts to aesthetic resources (not only in the project area, but to the hydrologic basin, Louisiana, and the U.S.) resulting from the past, present and reasonably foreseeable future impacts associated with conversion and loss of marsh, wetland and/or swamps. Without implementation of wetland creation and other protection measures, continued conversion of existing fragmented wetlands to open-water habitats would persist. Degradation of the land would convert existing view sheds of marsh and wetland to more open water views. Open waters would be somewhat less desirable because they lack those vertical and horizontal features which provide a viewer with the necessary elements of form, line, texture and color that make a view scenic and memorable.

5.13.2 Alternative 1 – 5,000 cfs max Diversion

5.13.2.1 Direct

Direct Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion. However, in terms of direct impacts to aesthetics, these elements translate into how quickly the study area can rebuild itself with the inflow of sediments and are not as relevant as the actual location of the diversion itself.

5.13.2.2 Indirect

Indirect Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion.

5.13.2.3 Cumulative

Cumulative Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion.

5.13.3 Alternative 2 – 10,000 cfs max Diversion

5.13.3.1 Direct

Direct Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion. However, in terms of direct impacts to aesthetics, these elements translate into how quickly the study area can rebuild itself with the inflow of sediments and are not as relevant as the actual location of the diversion itself.

5.13.3.2 Indirect

Indirect Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion.

5.13.3.3 Cumulative

Cumulative Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion.

5.13.4 Alternative 3 – 15,000 cfs max Diversion

5.13.4.1 Direct

Direct Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion. However, in terms of direct impacts to aesthetics, these elements translate into how quickly the study area can rebuild itself with the inflow of sediments and are not as relevant as the actual location of the diversion itself.

5.13.4.2 Indirect

Indirect Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion.

5.13.4.3 Cumulative

Cumulative Impacts to Aesthetic Resources would be similar to those presented under the Recommended Plan. Differences between the plans include velocities and flow rates of the diversion.

5.13.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.13.5.1 Direct

The visual resources of the project corridor would be temporarily impacted by construction activities related to implementing the proposed action and by transport activities needed to move equipment and materials to and from the site. Boating and other water traffic would most likely not be affected.

The creation of artificial, manmade features could decrease the natural, scenic quality in any area. In the case of the proposed action, the diversion is an un-natural element and could work to decrease the scenic quality. However, the potential benefits of reclaimed land mass and marsh area, and the need to protect this marsh area outweigh the visual impacts of developing the diversion.

5.13.5.2 Indirect

With the implementation of the proposed action, the creation, or re-creation, of marsh and wetland would indirectly impact the study area by increasing habitat for desirable land based wildlife. On the flip side, as another indirect impact, open-water habitat would be decreased over time.

5.13.5.3 Cumulative

Long term negative impacts to the aesthetic (visual) resources would be negligible. Landscapes converted or reorganized into natural or, in some cases, seminatural visual conditions similar to the proposed project could be considered as visually superior. As a cumulative impact, the proposed scenario is desirable throughout the hydrologic basin, Louisiana, and the U.S. for reclaiming lost land mass.

5.14 RECREATION

The following discussion addresses the potential recreational resource impacts of each MDWD Alternative. There would be five alternatives for the project including No Action.

5.14.1 No Action Alternative (Future Without Project Conditions)

5.14.1.1 Direct

Recreational resources in the region that would most likely be affected under the No Action Alternative would be those related to loss of wetlands and habitat diversity.

Continued wetland fragmentation and the eventual conversion to shallow open-water habitat would likely have negative consequences on a variety of recreational resources in the project area. Wildlife abundance is directly related to the amount of wetlands present. As wetland deterioration and high rates of land loss continues throughout the area, wildlife abundance would continue to decrease. Continued loss of essential fish and wildlife habitat, especially marsh-edge habitat and transitional habitat between estuarine and marine environments, would most likely result in a reduction in productivity. Lower quality fishery spawning, nursery, and foraging habitat would likely translate to a decline in recreational fishing, shrimping, and crabbing catch rates in the future.

The local abundance of resident, transitional wetland-dependent wildlife, would likely decrease as these species relocate to find more suitable transitional wetland habitats. Migratory birds would be required to find other, more suitable stopover habitats on their trans-Gulf migrations. With the continued conversion of transitional estuarine wetlands to open water, estuarine fishery abundance and diversity would be expected to decline over time. With continued habitat deterioration, recreational waterfowl hunting would likely decline with reduced bag limits much of it due to higher salinity levels and the loss of SAV.

Likewise, as usage of the study area by migratory birds declines, so would the opportunities for viewing. Ridge habitat would also decline resulting in fewer opportunities for deer and small game hunting.

5.14.1.2 Indirect

Long term potential indirect impacts could include loss of associated recreational support facilities such as marinas and bait shops that would be the basis for most recreational use. This would result in a reduction in economic activity associated with recreation uses.

5.14.1.3 Cumulative

Cumulative impacts would be the impacts on the environment which result from the incremental impact of the no action plan when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Existing and planned projects in the project vicinity include the twenty year old Caernarvon Diversion and a proposed Caernarvon modification. Cumulative effects of these projects on recreational resources in the White Ditch project area would be expected to be minimal. Turbidity created by the Caernarvon Diversion could infiltrate the southern part of the White Ditch project area during the high water pulse periods, which could be seen during certain tidal flows. The effects on recreational resources would be expected to be minimal and temporary.

Effects from the No Action Alternative would result in substantial changes in recreation opportunities and potential loss of much of the recreational resource base in the project area, as described in the direct and indirect impact sections.

5.14.2 Alternative 1 – 5,000 cfs max Diversion

5.14.2.1 Direct

Recreational uses in the study area such as fishing and hunting could be affected due to the implementation and operations of the freshwater diversion.

During high flow pulse periods, large influxes of freshwater into the existing habitat in the project area would increase turbidity and flow and reduce salinity levels in the project area. During these high pulse periods and afterward, recreational activities would likely be curtailed.

Due to lower salinity levels and turbidity, saltwater fish species would likely migrate to more desirable locations. In turn, catch rates would potentially decrease in the project area during these high flow periods.

While some habitat transition based on decreased salinity levels is anticipated, overall benefits associated with marsh creation, and improved aquatic habitat for fisheries and waterfowl should result in improved recreational experiences during normal flow conditions. Decreases in salinity within the intermediate marsh zone could potentially enhance conditions for freshwater fish species within this portion of the project area.

Waterfowl hunting within the study area would likely improve due to reduced salinity levels and increased SAV. In addition, deer and other small game hunting could improve over time due to stabilization and improved ridge habitat.

Channel dredging and placement of dredged material for marsh creation and ridge restoration would displace resident fish and wildlife and could temporarily disrupt fishing and hunting activity in the construction zone. Following construction, the created marsh, restored ridges, and enlarged outfall channels could increase or enhance recreational resources within and adjacent to the construction footprint. Marsh creation could benefit recreation by providing additional land for birding and hunting. The marsh could also attract ducks and serve as a duck hunting area. The increase in habitat value would likely result in increased species of fish and mammal wildlife usage of the area. This would enhance the productivity of the marsh and sustain its longevity. Marsh creation could also be beneficial for protecting interior areas, including any recreational structures, from the negative effects of storm surges.

In terms of recreational user days, no substantial change through year 5 is anticipated. After the two month high flow pulse, water quality changes should, over time return to normal. There could be an increase in user day values due to decreased salinity levels, and increased marsh acres and habitat units. The net AAHUs would be expected to increase by 5,457. The increase in marsh acres is projected to increase compared to future without project conditions. The increase is anticipated to be incremental until project year 20; however, no increases would be anticipated after project year 20.

5.14.2.2 Indirect

Potential indirect impacts from the proposed action would primarily consist of effects on recreational fishing from increased turbidity to the water bodies outside of the study area. These impacts could include fish species temporarily migrating away from these disturbed conditions.

5.14.2.3 Cumulative

Implementation of the 5,000 cfs alternative would be expected to have positive synergistic effects on recreation resources when combined with other Federal, state, local, and private restoration efforts, including the Caernarvon diversion and its proposed modification. The incremental effects of this alternative have the potential to support and sustain wetland-dependent recreation opportunities, provide for a more stable localized recreation economy, and could result in a slight increase in local recreation-related employment and income.

The cumulative impacts would create and maintain critical marsh habitat within the project area necessary for the viable protection of market fisheries and aquatics resources. The impacts should stabilize or potentially improve recreational opportunities in the area.

This alternative would support and sustain a greater number of freshwater-based recreational opportunities such as duck hunting and bass fishing, while maintaining saltwater fishing opportunities.

5.14.3 Alternative 2 – 10,000 cfs max Diversion

5.14.3.1 Direct

Alternative 2 incorporates a 10,000 cfs maximum flow diversion which is twice the flow of Alternative 1. Impacts would be similar to Alternative 1 but could affect a larger area. The increase in flow rate would be directly related to the increase in freshwater distributed through the project area. Therefore, the direct effects to the surrounding marsh and aquatic habitats would likely cover a larger area and potentially result in a prolonged recovery time once the 2-month pulse is complete.

Several fish species would be deterred from the turbid water, and as a result, would travel elsewhere. Turbidity from the high pulse flows would also deter the waterfowl and other wildlife during the high water levels. There would be a benefit to introducing freshwater into these areas, as long as the increased currents do not contribute to marsh fragmentation in other areas. Bankline stabilization and notched weirs would need to be monitored carefully to protect adjacent marsh habitats.

A slight reduction in recreational user days is possible through year 10 due to increased turbidity and flow during the pulse period and longer recovery time. However beyond year 10, a slight increase above without project conditions in recreation user days is anticipated due to improved quality and quantity of habitat.

The increase in marsh acres is projected to be greater than the increase projected for Alternative 1. The net AAHUs would be expected to rise to 6,096. The increase is incremental until project year 20; however, there would be no increases after project year 20.

5.14.3.2 Indirect

This alternative would have similar indirect impacts to those described under Alternative 1. The main difference is that indirect impacts associated with increased turbidity to water bodies outside of study area would potentially be experienced in a larger area due to the increased water flows under the pulse condition.

5.14.3.3 Cumulative

This alternative would have similar cumulative impacts to those described under Alternative 1.

5.14.4 Alternative 3 – 15,000 cfs max Diversion

5.14.4.1 Direct

Alternative 3 incorporates a 15,000 cfs maximum flow diversion which is three times the flow of Alternative 1. Impacts would be similar to Alternative 1 but could affect a larger area. The increase in flow rate would be directly related to the increase in freshwater distributed through the project area. Therefore, the direct effects to the surrounding marsh and aquatic habitats would cover a large area and result in a prolonged recovery time once the 2-month pulse is achieved.

Several fish species would be deterred from the turbid water, and as a result, would migrate to a more desirable location. Turbidity from the high pulse flows would also deter the waterfowl and other wildlife during the high water levels. There would be a benefit to introducing freshwater into these areas, as long as the increased velocities do not contribute to marsh fragmentation in other areas. Bankline stabilization and notched weirs would need to be monitored carefully to protect the adjacent marsh habitats.

While freshwater-based recreational opportunities such as waterfowl hunting and bass fishing could improve, brackish and saltwater-based recreation activities such as fishing and shrimping could migrate further south and east in the project area possibly increasing the access distance to such opportunities.

A slight reduction in recreational user days is possible through year 10 due to increased turbidity and flow during the pulse period and longer recovery time. However beyond year 10, a slight increase above without project conditions in recreation user days is anticipated due to improved quality and quantity of habitat.

The increase in marsh acres is projected to be greater than increases anticipated for Alternatives 1 or 2. The net AAHUs would be expected to rise to 7,922. The increase is incremental until project year 20; however, there would be no increases after project year 20.

5.14.4.2 Indirect

This alternative would have similar indirect impacts to those described under Alternative 2.

5.14.4.3 Cumulative

This alternative would have similar cumulative impacts to those described under Alternative 1 with the exception that saltwater-based recreational opportunities could shift further south and east in the project area potentially increasing the access distance to such opportunities.

5.14.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.14.5.1 Direct

The maximum flow of Alternative 4 is seven times greater than that of Alternative 1.

Impacts would be similar to Alternative 1 but could affect a larger area. The increased flows from the diversion could cause high surge and back flow. The channels should be monitored carefully as to ensure they do not flood and cause direct impacts to recreational facilities and surrounding structures. The turbidity impacts would likely be substantial and potentially be temporarily detrimental to fish and waterfowl use in much of the project area specifically during and after the pulse.

While freshwater-based recreational opportunities could increase in the project area, brackish and saltwater-based recreational opportunities could decline. In turn, a substantial reduction in recreational user days would be anticipated over the initial 20 years of the project.

The increase in marsh acres is projected to be greater than increases expected for Alternatives 1, 2, or 3. The increase is incremental until project year 20; however, there would be no increases after project year 20.

5.14.5.2 Indirect

This alternative would have similar indirect impacts to those described under Alternative 2.

5.14.5.3 Cumulative

This alternative would have similar cumulative impacts to those described under Alternative 1 with the exception that saltwater-based recreational opportunities could shift further south and east in the project area potentially increasing the access distance to such opportunities.

5.15 SOCIOECONOMICS AND HUMAN RESOURCES

5.15.1 Displacement of Population and Housing

5.15.1.1 No Action Alternative (Future Without Project Conditions)

5.15.1.1.1 Direct

There would be no direct impacts to population and housing around this diversion site if the proposed diversion was not constructed.

5.15.1.1.2 Indirect

There would be no indirect impacts to population and housing around this diversion site if the proposed action was not implemented.

5.15.1.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to population and housing consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the Federal Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS), and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects. As noted in the FPEIS for the LCA study, regional trends show population increases in urban and suburban areas, and retreat from rural and coastal areas such as the White Ditch project area.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

The exception to the foregoing would be the cumulative indirect impacts associated with the completion of the GNOHSDRRS in its entirety. The lower flood risk that accrues to the much of the New Orleans metropolitan area upon completion of the GNOHSDRRS could enhance the desirability of living within the protected areas. As a result, a shift in the dispersion of population within the New Orleans Metropolitan Statistical Area, or beyond, could occur. Also, to the extent that the completion of the GNOHSDRRS encourages regional economic growth, any additional jobs thus created could manifest itself in either in-migration to the area or an increase in commuting activity.

5.15.1.2 Alternative 1 – 5,000 cfs Diversion

5.15.1.2.1 Direct

There would be no direct impacts to population and housing around this diversion site if Alternative 1 is constructed.

5.15.1.2.2 Indirect

Indirect impacts to population and housing in the study area if Alternative 1 is implemented, if any, would be anticipated to be negligible and indistinguishable from other local and regional influences on population growth and decline.

5.15.1.2.3 Cumulative

Cumulative impacts that include Alternative 1 would be expected to be similar to the No Action Alternative.

5.15.1.3 Alternative 2 – 10,000 cfs max Diversion

5.15.1.3.1 Direct

There would be no direct impacts to population and housing around this diversion site if Alternative 2 is constructed.

5.15.1.3.2 Indirect

Indirect impacts to population and housing in the study area associated with implementation of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.1.3.3 Cumulative

Cumulative impacts that include Alternative 2 would be expected to be similar to the No Action Alternative.

5.15.1.4 Alternative 3 – 15,000 cfs max Diversion

5.15.1.4.1 Direct

There would be no direct impacts to population and housing around this diversion site if Alternative 3 is constructed.

5.15.1.4.2 Indirect

Indirect impacts to population and housing in the study area associated with implementation of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.1.4.3 Cumulative

Cumulative impacts that include Alternative 3 would be expected to be similar to the No Action Alternative.

5.15.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.1.5.1 Direct

There would be no direct impacts to population and housing around this diversion site if Alternative 4 is implemented.

5.15.1.5.2 Indirect

Indirect impacts to population and housing in the study area associated with implementation of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.1.5.3 Cumulative

Cumulative impacts that include Alternative 4 would be expected to be similar to the No Action Alternative.

5.15.2 Employment, Business, and Industrial Activity

5.15.2.1 No Action Alternative (Future Without Project Conditions)

5.15.2.1.1 Direct

There would be no direct impacts to employment, business, and industry in the Phoenix vicinity if the proposed diversion is not constructed.

5.15.2.1.2 Indirect

There would be no indirect impacts to employment, business, and industry in the vicinity of the White Ditch study area if the proposed action is not implemented.

5.15.2.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to employment, business and industry consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs. Cumulative indirect impacts associated with the completion of the GNOHSDRRS in its entirety could occur. The lower flood risk that accrues to the much of the New Orleans metropolitan area upon completion of the GNOHSDRRS could have the effect of spurring additional economic growth in the region than would otherwise occur. As a result, an increase in the number of firms and the output of business and industry would likely manifest itself in such growth.

5.15.2.2 Alternative 1 – 5,000 cfs Diversion

5.15.2.2.1 Direct

There could be minor temporary increases in local employment and related business activity during the construction period if Alternative 1 is implemented.

5.15.2.2.2 Indirect

Over the 50-year period of analysis Alternative 1 is expected to protect, create and nourish emergent wetlands that would benefit, to some undetermined level, local employment in wetland-dependent jobs such as commercial and recreational fisheries, and ecotourism; as well as provide benefits for supporting economic activities such as marinas, bait and tackle shops, and others.

5.15.2.2.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts for employment, business and industry consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects. Cumulative impacts that include the proposed action would be no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

Alternative 1 would incrementally add to these other activities and programs help support coast wide wetland-dependent employment. However, this incremental effect would be insignificant compared to cumulative impacts to employment and income described under the No Action Alternative.

5.15.2.3 Alternative 2 – 10,000 cfs max Diversion

5.15.2.3.1 Direct

There could be minor temporary increases in local employment and related business activity during the construction period if Alternative 2 is implemented.

5.15.2.3.2 Indirect

Over the 50-year period of analysis Alternative 2 is expected to protect, create and nourish emergent wetlands that would benefit, to some undetermined level, local employment in wetland-dependent jobs such as commercial and recreational fisheries, and ecotourism; as well as provide benefits for supporting economic activities such as marinas, bait and tackle shops, and others.

5.15.2.3.3 Cumulative

Cumulative impacts of Alternative 2 would be expected to be incrementally greater than Alternative 1, but similarly insignificant compared to cumulative impacts to employment and income described under the No Action Alternative.

5.15.2.4 Alternative 3 – 15,000 cfs max Diversion

5.15.2.4.1 Direct

There could be minor temporary increases in local employment and related business activity during the construction period if Alternative 3 is implemented.

5.15.2.4.2 Indirect

Over the 50-year period of analysis Alternative 3 is expected to protect, create and nourish emergent wetlands that would benefit, to some undetermined level, local employment in wetland-dependent jobs such as commercial and recreational fisheries, and ecotourism; as well as provide benefits for supporting economic activities such as marinas, bait and tackle shops, and others.

5.15.2.4.3 Cumulative

Cumulative impacts of Alternative 3 would be expected to be incrementally greater than Alternative 3, but would be not anticipated to be significant compared to cumulative impacts to employment and income described under the No Action Alternative.

5.15.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.2.5.1 Direct

There could be minor temporary increases in local employment and related business activity during the construction period if Alternative 4 is implemented.

5.15.2.5.2 Indirect

Over the 50-year period of analysis Alternative 4 is expected to protect, create and nourish emergent wetlands that would benefit, to some undetermined level, local employment in wetland-dependent jobs such as commercial and recreational fisheries, and ecotourism; as well as provide benefits for supporting economic activities such as marinas, bait and tackle shops, and others.

5.15.2.5.3 Cumulative

Cumulative impacts of Alternative 4 would be expected to be incrementally greater than Alternative 3, but would be not anticipated to be significant compared to cumulative impacts to employment and income described under the No Action Alternative.

5.15.3 Community Cohesion

5.15.3.1 No Action Alternative (Future Without Project Conditions)

5.15.3.1.1 Direct

Without implementation of the proposed action there would be no direct impacts to community cohesion in the vicinity of the proposed diversion site.

5.15.3.1.2 Indirect

Without implementation of the proposed action there would be no indirect impacts to community cohesion in the vicinity of the proposed diversion site.

5.15.3.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to community cohesion consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs. Cumulative indirect impacts associated with the completion of the GNOHSDRRS in its entirety could occur. The lower flood risk that accrues to the much of the New Orleans metropolitan area upon completion of the GNOHSDRRS could have the effect of enhancing community cohesion. The reason for this is that the lower incidence of flooding reduces the likelihood that patterns of social interaction and communication within the community would be interrupted or permanently altered.

5.15.3.2 Alternative 1 – 5,000 cfs Diversion

5.15.3.2.1 Direct

There would be no direct impacts to community cohesion around this diversion site if Alternative 1 is implemented.

5.15.3.2.2 Indirect

There would be no indirect impacts to community cohesion around this diversion site if Alternative 1 is implemented.

5.15.3.2.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts for community cohesion consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Cumulative impacts that include the proposed action would be no greater than the sum of those impacts indicated individually for each project component.

5.15.3.3 Alternative 2 – 10,000 cfs max Diversion

5.15.3.3.1 Direct

There would be no direct impacts to community cohesion around this diversion site if Alternative 2 is implemented.

5.15.3.3.2 Indirect

There would be no indirect impacts to community cohesion around this diversion site if Alternative 2 is implemented.

5.15.3.3.3 Cumulative

Cumulative impacts for Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.3.4 Alternative 3 – 15,000 cfs max Diversion

5.15.3.4.1 Direct

There would be no direct impacts to community cohesion around this diversion site if Alternative 3 is implemented.

5.15.3.4.2 Indirect

There would be no indirect impacts to community cohesion around this diversion site if Alternative 3 is implemented.

5.15.3.4.3 Cumulative

Cumulative impacts for Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.3.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.3.5.1 Direct

There would be no direct impacts to community cohesion around this diversion site if Alternative 4 is implemented.

5.15.3.5.2 Indirect

There would be no indirect impacts to community cohesion around this diversion site if Alternative 4 is implemented.

5.15.3.5.3 Cumulative

Cumulative impacts for Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.4 Environmental Justice

5.15.4.1 No Action Alternative (Future Without Project Conditions)

5.15.4.1.1 Direct

Minority and/or low-income communities have not been identified in the study area of Plaquemines Parish. In a future without project scenario, no anticipated disproportionately high or adverse human health or environmental effects on minority or low-income populations would occur, as no property would be acquired for construction of the proposed project within the study area.

5.15.4.1.2 Indirect

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

5.15.4.1.3 Cumulative

There would be no cumulative impacts on minority and/or low-income communities within the study area per 2000 U.S. Census information and requirements of E.O. 12898. The No Action Alternative would not contribute to any additional EJ issues when combined with other Federal, state, local, and private restoration efforts.

5.15.4.2 Alternative 1 – 5,000 cfs Diversion

5.15.4.2.1 Direct

No minority populations have been identified within the study area of Plaquemines Parish. Per 2000 U.S. Census information and requirements of E.O. 12898, this area is not an Environmental Justice community. Direct impacts from construction activities such air quality, noise, traffic, safety, etc., would occur in the study area; but as there would be no permanent residences along the proposed project area, no direct impacts on human health or environmental effects would be expected for this Alternative.

5.15.4.2.2 Indirect

Under Alternative 1 no indirect impacts on human health or environmental effects within the study area would occur.

5.15.4.2.3 Cumulative

No minority and/or low-income communities have been identified within the proposed study area per 2000 U.S. Census information and requirements of E.O. 12898. Cumulative impacts would be the synergistic effect of implementing Alternative 1 with the additive combination of impacts and benefits for overall net acres created, nourished, and protected by other Federal, state, local and private activities and restoration efforts as summarized in Section 1 of this report The cumulative impacts of Alternative 1 would be similar to those described for the No Action Alternative.

5.15.4.3 Alternative 2 – 10,000 cfs max Diversion

5.15.4.3.1 Direct

Direct impacts of Alternative 2 would be similar to Alternative 1.

5.15.4.3.2 Indirect

Indirect impacts of Alternative 2 would be similar to Alternative 1.

5.15.4.3.3 Cumulative

Cumulative impacts of Alternative 2 would be similar to Alternative 1

5.15.4.4 Alternative 3 – 15,000 cfs max Diversion

5.15.4.4.1 Direct

Direct impacts of Alternative 3 would be similar to Alternative 1.

5.15.4.4.2 Indirect

Indirect impacts of Alternative 3 would be similar to Alternative 1.

5.15.4.4.3 Cumulative

Cumulative impacts of Alternative 3 would be similar to Alternative 1

5.15.4.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.4.5.1 Direct

Direct impacts of Alternative 4 would be similar to Alternative 1.

5.15.4.5.2 Indirect

Indirect impacts of Alternative 4 would be similar to Alternative 1.

5.15.4.5.3 Cumulative

Cumulative impacts of Alternative 4 would be similar to Alternative 1.

5.15.5 Infrastructure

5.15.5.1 No Action Alternative (Future Without Project Conditions)

5.15.5.1.1 Direct

There would be no direct impacts to infrastructure if the proposed diversion was not constructed.

5.15.5.1.2 Indirect

Under the No Action Alternative, continuing loss of marsh soils and vegetation in the project area over the 50-year planning horizon could potentially result in increased vulnerability of existing infrastructure to the erosive force of wind and wave action from the Gulf of Mexico. Beyond this, no indirect impacts to infrastructure would be anticipated if the proposed action was not implemented.

5.15.5.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to infrastructure consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the Federal Greater New Orleans Hurricane and Storm Damage Risk Reduction System (GNOHSDRRS), and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.5.2 Alternative 1 – 5,000 cfs Diversion

5.15.5.2.1 Direct

There would be short-term impacts to flood control infrastructure during construction of a box culvert diversion structure either through or under the existing levee if Alternative 1 is implemented. Temporary impacts to transportation infrastructure could occur if the existing highway system is partially closed during construction. Construction practices would be implemented to avoid and minimize any potential construction-related adverse impacts to existing infrastructure (e.g., pipelines, etc.), and to ensure that the integrity of the Federal levee is not compromised at any time during or after construction.

5.15.5.2.2 Indirect

No long-term indirect negative or positive impacts to existing infrastructure in the project area would be anticipated to occur if Alternative 1 is implemented.

5.15.5.2.3 Cumulative

Cumulative impacts of Alternative 1 on existing infrastructure in the project area would be similar to those anticipated for the No Action Alternative.

5.15.5.3 Alternative 2 – 10,000 cfs max Diversion

5.15.5.3.1 Direct

Direct impacts to infrastructure resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.5.3.2 Indirect

Indirect impacts to infrastructure resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.5.3.3 Cumulative

Cumulative impacts of Alternative 2 on existing infrastructure in the project area would be similar to those anticipated for the No Action Alternative.

5.15.5.4 Alternative 3 – 15,000 cfs max Diversion

5.15.5.4.1 Direct

Direct impacts to infrastructure resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.5.4.2 Indirect

Indirect impacts to infrastructure resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.5.4.3 Cumulative

Cumulative impacts of Alternative 3 on existing infrastructure in the project area would be similar to those anticipated for the No Action Alternative.

5.15.5.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.5.5.1 Direct

Direct impacts to infrastructure resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.5.5.2 Indirect

Indirect impacts to infrastructure resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.5.5.3 Cumulative

Cumulative impacts of Alternative 3 on existing infrastructure in the project area would be similar to those anticipated for the No Action Alternative.

5.15.6 Business and Industry

5.15.6.1 No Action Alternative (Future Without Project Conditions)

5.15.6.1.1 Direct

Without construction of the proposed action there would be no direct impacts to business and industry in the vicinity of the project area.

5.15.6.1.2 Indirect

Without implementation of the proposed action there would be no indirect impacts to business and industry in the vicinity of the project area.

5.15.6.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to business and industry consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects. Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

Cumulative indirect impacts associated with the completion of the GNOHSDRRS in its entirety could occur. The lower flood risk that accrues to the much of the New Orleans metropolitan area upon completion of the GNOHSDRRS could have the effect of spurring greater economic growth in the region than would otherwise occur. It follows that increases in business and industry would ensue given additional economic growth. In addition, the lower incidence of flooding that the GNOHSDRRS is designed to achieve would have the effect of preserving, if not enhancing, property values within the protected areas.

5.15.6.2 Alternative 1 – 5,000 cfs Diversion

5.15.6.2.1 Direct

During construction of the diversion structure there could be a short-term disruption to fuel and storage facilities located along the Mississippi River. However, such disruption would be minimal. There could be some disruption to pipelines located along the diversion site during construction, but no long-term impact is expected to affect pipeline operations.

5.15.6.2.2 Indirect

There would be no indirect impacts to business and industry around this diversion site if Alternative 1 is implemented.

5.15.6.2.3 Cumulative

Cumulative impacts of Alternative 1 on business and industry in the project area would be similar to those anticipated for the No Action Alternative.

5.15.6.3 Alternative 2 – 10,000 cfs max Diversion

5.15.6.3.1 Direct

Direct impacts to business and industry resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.6.3.2 Indirect

Indirect impacts to business and industry resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.6.3.3 Cumulative

Cumulative impacts of Alternative 2 on business and industry in the project area would be similar to those anticipated for the No Action Alternative.

5.15.6.4 Alternative 3 – 15,000 cfs max Diversion

5.15.6.4.1 Direct

Direct impacts to business and industry resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.6.4.2 Indirect

Indirect impacts to business and industry resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.6.4.3 Cumulative

Cumulative impacts of Alternative 3 on business and industry in the project area would be similar to those anticipated for the No Action Alternative.

5.15.6.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.6.5.1 Direct

Direct impacts to business and industry resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.6.5.2 Indirect

Indirect impacts to business and industry resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.6.5.3 Cumulative

Cumulative impacts of Alternative 4 on business and industry in the project area would be similar to those anticipated for the No Action Alternative.

5.15.7 Traffic and Transportation

5.15.7.1 No Action Alternative (Future Without Project Conditions)

5.15.7.1.1 Direct

Without implementation of the proposed action there would be no direct impacts to transportation resources in the vicinity of the proposed Phoenix diversion site.

5.15.7.1.2 Indirect

Without implementation of the proposed action there would be no indirect impacts to transportation resources in the vicinity of the proposed Phoenix diversion site.

5.15.7.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to transportation resources consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects. Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

The potential exists for cumulative indirect impacts associated with the completion of the GNOHSDRRS in its entirety. The lower flood risk that accrues to the much of the New Orleans metropolitan area upon completion of the GNOHSDRRS could have the effect of spurring additional economic growth in the region than would otherwise occur. An increase in the demand for transportation resources usually follows gains in economic activity and would thus be expected given any additional economic growth in the region.

5.15.7.2 Alternative 1 – 5,000 cfs Diversion

5.15.7.2.1 Direct

Activities associated with construction of the diversion structure and outfall management features of Alternative 1 could result in increased activity by trucks along LA HWY 39. However, the relatively remote location of the diversion site tends to render the potential for such traffic congestion effects to a relatively low magnitude. Wear and tear on roadways used to transport materials to construction sites would be expected to remain proportionate to the quantity of traffic emanating from all local and regional activities.

5.15.7.2.2 Indirect

There would be no indirect impacts to transportation in the project area and vicinity if Alternative 1 is implemented.

5.15.7.2.3 Cumulative

Cumulative impacts to traffic and transportation resulting from implementation of Alternative 1 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.7.3 Alternative 2 – 10,000 cfs max Diversion

5.15.7.3.1 Direct

Direct impacts to traffic and transportation resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.3.2 Indirect

Indirect impacts to traffic and transportation resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.3.3 Cumulative

Cumulative impacts to traffic and transportation resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.4 Alternative 3 – 15,000 cfs max Diversion

5.15.7.4.1 Direct

Direct impacts to traffic and transportation resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.4.2 Indirect

Indirect impacts to traffic and transportation resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.4.3 Cumulative

Cumulative impacts to traffic and transportation resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.7.5.1 Direct

Direct impacts to traffic and transportation resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.5.2 Indirect

Indirect impacts to traffic and transportation resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.7.5.3 Cumulative

Cumulative impacts to traffic and transportation resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.8 Public Facilities and Services

5.15.8.1 No Action Alternative (Future Without Project Conditions)

5.15.8.1.1 Direct

There would be no direct impacts to the availability of public facilities and services if the proposed action is not implemented.

5.15.8.1.2 Indirect

There would be no indirect impacts to the availability of public facilities and services if the proposed action is not implemented.

5.15.8.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to the availability of public facilities and services consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects. Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.8.2 Alternative 1 – 5,000 cfs Diversion

5.15.8.2.1 Direct

There would be no long-term direct impacts to public utilities and services around this diversion site if Alternative 1 is constructed.

5.15.8.2.2 Indirect

There would be no indirect impacts to public utilities and services in the project area and vicinity if Alternative 1 is implemented.

5.15.8.2.3 Cumulative

Cumulative impacts of Alternative 1 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.8.3 Alternative 2 – 10,000 cfs max Diversion

5.15.8.3.1 Direct

Direct impacts associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.8.3.2 Indirect

Indirect impacts of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.8.3.3 Cumulative

Cumulative impacts of Alternative 2 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.8.4 Alternative 3 – 15,000 cfs max Diversion

5.15.8.4.1 Direct

Direct impacts associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.8.4.2 Indirect

Indirect impacts of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.8.4.3 Cumulative

Cumulative impacts of Alternative 3 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.8.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.8.5.1 Direct

Direct impacts associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.8.5.2 Indirect

Indirect impacts of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.8.5.3 Cumulative

Cumulative impacts of Alternative 4 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.9 Tax Revenues and Property Values

5.15.9.1 No Action Alternative (Future Without Project Conditions)

5.15.9.1.1 Direct

Without construction of the proposed action there would be no direct impacts to tax revenues and property values in the vicinity of the proposed diversion site.

5.15.9.1.2 Indirect

Without implementation of the proposed action there would be no indirect impacts to tax revenues and property values in the project area and vicinity.

5.15.9.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to tax revenues and property values consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects. Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

Under the no action scenario, cumulative indirect impacts associated with the completion of the GNOHSDRRS in its entirety could occur. The lower flood risk that accrues to the much of the New Orleans metropolitan area upon completion of the GNOHSDRRS could have the effect of spurring additional economic growth in the region than would otherwise occur. It follows that increases in tax revenues would ensue given additional economic growth. In addition, the lower incidence of flooding that the GNOHSDRRS is designed to achieve would have the effect of preserving, if not enhancing, property values within the protected areas.

5.15.9.2 Alternative 1 – 5,000 cfs Diversion

5.15.9.2.1 Direct

There would be no direct impacts to tax revenue and property around this diversion site if Alternative 1 is constructed.

5.15.9.2.2 Indirect

There would be no indirect impacts to tax revenue and property in the project area and vicinity if Alternative 1 is implemented.

5.15.9.2.3 Cumulative

Cumulative impacts of Alternative 1 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.9.3 Alternative 2 – 10,000 cfs max Diversion

5.15.9.3.1 Direct

Direct impacts associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.9.3.2 Indirect

Indirect impacts of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.9.3.3 Cumulative

Cumulative impacts of Alternative 2 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.9.4 Alternative 3 – 15,000 cfs max Diversion

5.15.9.4.1 Direct

Direct impacts associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.9.4.2 Indirect

Indirect impacts of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.9.4.3 Cumulative

Cumulative impacts of Alternative 3 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.9.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.9.5.1 Direct

Direct impacts associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.9.5.2 Indirect

Indirect impacts of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.9.5.3 Cumulative

Cumulative impacts of Alternative 4 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.10 Disruption of Desirable Community and Regional Growth

5.15.10.1 No Action Alternative (Future Without Project Conditions)

5.15.10.1.1 Direct

Without construction of the proposed action there would be no direct impacts to community and regional growth in the vicinity of the proposed diversion site.

5.15.10.1.2 Indirect

Without implementation of the proposed action there would be no indirect impacts to community and regional growth in the project area and vicinity.

5.15.10.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts to community and regional growth consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.10.2 Alternative 1 – 5,000 cfs Diversion

5.15.10.2.1 Direct

There would be no direct impacts to community and regional growth around this diversion site if Alternative 1 is constructed.

5.15.10.2.2 Indirect

There would be no indirect impacts to community and regional growth in the project area and vicinity if Alternative 1 is implemented.

5.15.10.2.3 Cumulative

Cumulative impacts resulting from implementation of Alternative 1 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.10.3 Alternative 2 – 10,000 cfs max Diversion

5.15.10.3.1 Direct

Direct impacts associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.10.3.2 Indirect

Indirect impacts of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.10.3.3 Cumulative

Cumulative impacts of Alternative 2 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.10.4 Alternative 3 – 15,000 cfs max Diversion

5.15.10.4.1 Direct

Direct impacts associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.10.4.2 Indirect

Indirect impacts of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.10.4.3 Cumulative

Cumulative impacts of Alternative 3 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.10.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.10.5.1 Direct

Direct impacts associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.10.5.2 Indirect

Indirect impacts of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.10.5.3 Cumulative

Cumulative impacts of Alternative 4 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11 Land Use Socioeconomics

5.15.11.1 Agriculture

5.15.11.1.1 No Action Alternative (Future Without Project Conditions)

5.15.11.1.1.1 Direct

There would be no direct impacts on commercial agriculture in the vicinity of the freshwater diversion site if the proposed diversion is not constructed.

5.15.11.1.1.2 Indirect

There would be no indirect impacts on commercial agriculture in the project area and vicinity if the proposed action is not implemented.

5.15.11.1.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on commercial agriculture consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct and indirect cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.11.1.2 Alternative 1 – 5,000 cfs Diversion

5.15.11.1.2.1 Direct

There would be no substantial direct impacts on commercial agriculture in the vicinity of the diversion site if Alternative 1 is constructed.

Any alligator nesting sites located within the construction footprint could be temporarily disrupted during construction activities if these activities occur during nest-building and incubation periods. Excavation of outfall channels could permanently disrupt nesting activity within the footprint of this feature. However, creation of marsh and ridges using material dredged during construction and maintenance of outfall channels also could directly provide additional nesting habitat.

5.15.11.1.2.2 Indirect

There would be no substantial indirect impacts on commercial agriculture in the project area and vicinity if Alternative 1 is implemented.

Maximum flows from this alternative would be planned to occur in the March–April timeframe and would return to maintenance flows (1,000 cfs) by the beginning of May. This would be just prior to the season for alligator mating and nesting in this region. Water levels would not be substantially elevated during maximum flow operation and would not measurably differ from without-project levels during maintenance flow operations. For these reasons, no impacts to alligator reproductive cycles or egg production would be anticipated to result from implementation of this alternative.

5.15.11.1.2.3 Cumulative

Cumulative impacts of Alternative 1 on commercial agriculture would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.1.3 Alternative 2 – 10,000 cfs max Diversion

5.15.11.1.3.1 Direct

Direct impacts associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.1.3.2 Indirect

Indirect impacts resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.1.3.3 Cumulative

Cumulative impacts of Alternative 2 on commercial agriculture would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.1.4 Alternative 3 – 10,000 cfs max Diversion

5.15.11.1.4.1 Direct

Direct impacts associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.1.4.2 Indirect

Indirect impacts resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.1.4.3 Cumulative

Cumulative impacts of Alternative 3 on commercial agriculture would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.11.1.5.1 Direct

Direct impacts associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.1.5.2 Indirect

Indirect impacts resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

During maximum flow, large areas of the marsh extending from approximately 1 mile south and west of Bayou Garelle and the main outfall channel, extending to the northern extent of the project boundary, and being contained by the River aux Chenes and Mississippi River ridges would be inundated on the order of 0.3 to 0.6 foot during maximum diversion operations. Maximum flows from this alternative would be planned to occur in the March–April timeframe and would return to maintenance flows (1,000 cfs) by the beginning of May at the latest, just prior to the season for alligator mating and nesting in this region. These areas would quickly drain out to their naturally inundated area on the order of 5 to 7 days (going from maximum diversions to the proposed 1,000 cfs maintenance flow).

There would not be a measurable difference in water levels during the 1,000 cfs maintenance flows. Tidal conditions would be the driver of stages within the project area during this time and would not measurably differ from without-project levels during maintenance flow operations. For these reasons, no impacts to alligator reproductive cycles or egg production would be anticipated to result from implementation of this alternative.

5.15.11.1.5.3 Cumulative

Cumulative impacts of Alternative 4 on commercial agriculture would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.2 Forestry

5.15.11.2.1 No Action Alternative (Future Without Project Conditions)

5.15.11.2.1.1 Direct

There would be no direct impacts on commercial forestry production in the project area and vicinity if the proposed diversion is not constructed.

5.15.11.2.1.2 Indirect

There would be no indirect impacts on commercial forestry production in the project area and vicinity if the proposed action is not implemented.

5.15.11.2.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on commercial forestry production consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.11.2.2 Alternative 1 – 5,000 cfs Diversion

5.15.11.2.2.1 Direct

There would be no substantial direct impacts on commercial forestry production around the diversion site if Alternative 1 is constructed.

5.15.11.2.2.2 Indirect

There would be no substantial indirect impacts on commercial forestry production in the project area and vicinity if Alternative 1 is implemented.

5.15.11.2.2.3 Cumulative

Cumulative impacts of Alternative 1 on commercial forestry production would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.2.3 Alternative 2 – 10,000 cfs max Diversion

5.15.11.2.3.1 Direct

Direct impacts on commercial forestry production associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.2.3.2 Indirect

Indirect impacts on commercial forestry production resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.2.3.3 Cumulative

Cumulative impacts of Alternative 2 on commercial forestry production would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.2.4 Alternative 3 – 15,000 cfs max Diversion

5.15.11.2.4.1 Direct

Direct impacts on commercial forestry production associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.2.4.2 Indirect

Indirect impacts on commercial forestry production resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.2.4.3 Cumulative

Cumulative impacts of Alternative 3 on commercial forestry production would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.11.2.5.1 Direct

Direct impacts on commercial forestry production associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.2.5.2 Indirect

Indirect impacts on commercial forestry production resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.2.5.3 Cumulative

Cumulative impacts of Alternative 4 on commercial forestry production would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.3 Public Lands

5.15.11.3.1 No Action Alternative (Future Without Project Conditions)

5.15.11.3.1.1 Direct

There would be no direct impacts on public lands in the project area and vicinity if the proposed diversion is not constructed.

5.15.11.3.1.2 Indirect

There would be no indirect impacts on public lands in the project area and vicinity if the proposed action is not implemented.

5.15.11.3.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on public lands consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.11.3.2 Alternative 1 – 5,000 cfs Diversion

5.15.11.3.2.1 Direct

There would be no substantial direct impacts on public lands around the diversion site if Alternative 1 is constructed.

5.15.11.3.2.2 Indirect

There would be no substantial indirect impacts on public lands in the project area and vicinity if Alternative 1 is implemented.

5.15.11.3.2.3 Cumulative

Cumulative impacts of Alternative 1 on public lands would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.3.3 Alternative 2 – 10,000 cfs max Diversion

5.15.11.3.3.1 Direct

Direct impacts on public lands associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.3.3.2 Indirect

Indirect impacts on public lands resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.3.3.3 Cumulative

Cumulative impacts of Alternative 2 on public lands would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.3.4 Alternative 3 – 15,000 cfs max Diversion

5.15.11.3.4.1 Direct

Direct impacts on public lands associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.3.4.2 Indirect

Indirect impacts on public lands resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.3.4.3 Cumulative

Cumulative impacts of Alternative 3 on public lands would be expected to be similar to those anticipated for the No Action Alternative.

5.15.11.3.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.11.3.5.1 Direct

Direct impacts on public lands associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.3.5.2 Indirect

Indirect impacts on public lands resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.11.3.5.3 Cumulative

Cumulative impacts of Alternative 4 on public lands would be expected to be similar to those anticipated for the No Action Alternative.

5.15.12 Water Use and Supply

5.15.12.1 No Action Alternative (Future Without Project Conditions)

5.15.12.1.1 Direct

There would be no direct impacts on water use and supply in the project area and vicinity if the proposed diversion is not constructed.

5.15.12.1.2 Indirect

There would be no indirect impacts on water use and supply in the project area and vicinity if the proposed action is not implemented.

5.15.12.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on water use and supply consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct and indirect cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.12.2 Alternative 1 – 5,000 cfs Diversion

5.15.12.2.1 Direct

Construction of Alternative 1 could require replacement of a water supply pipeline at the diversion site to continue providing water services to the Pointe à la Hache and Phoenix communities. Short-term impacts to water delivery could potentially occur during replacement; however, no long-term interruptions to delivery of water supply would be anticipated.

5.15.12.2.2 Indirect

Implementation of Alternative 1 is not anticipated to have any indirect impacts to water supply and use in the project area and vicinity.

5.15.12.2.3 Cumulative

Cumulative impacts on water supply and use resulting from implementation of Alternative 1 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.12.3 Alternative 2 – 10,000 cfs max Diversion

5.15.12.3.1 Direct

Direct impacts of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.12.3.2 Indirect

Indirect impacts of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.12.3.3 Cumulative

Cumulative impacts on water supply and use resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.12.4 Alternative 3 – 15,000 cfs max Diversion

5.15.12.4.1 Direct

Direct impacts of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.12.4.2 Indirect

Indirect impacts of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.12.4.3 Cumulative

Cumulative impacts on water supply and use resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.12.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.12.5.1 Direct

Direct impacts of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.12.5.2 Indirect

Indirect impacts of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.12.5.3 Cumulative

Cumulative impacts on water supply and use resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.13 Navigation

5.15.13.1 No Action Alternative (Future Without Project Conditions)

5.15.13.1.1 Direct

There would be no direct impacts on navigation in the project area and vicinity if the proposed diversion is not constructed.

5.15.13.1.2 Indirect

There would be no indirect impacts on navigation in the project area and vicinity if the proposed action is not implemented.

5.15.13.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on navigation consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct and indirect cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.13.2 Alternative 1 – 5,000 cfs Diversion

5.15.13.2.1 Direct

Construction of Alternative 1 could disturb current flow patterns in the Mississippi River adjacent to the diversion site, requiring merchant vessels to compensate for the diverted current. The potential for disruption in current patterns during construction is not anticipated to be substantial enough to require alteration of the navigation channel or disruption in traffic on the waterway.

5.15.13.2.2 Indirect

Under the operation plan evaluated in this feasibility study and SEIS, implementation of Alternative 1 would involve diversion of Mississippi River flows into the project area at a rate of 5,000 cfs for up to 60 days in the spring (March–April) and at a rate of up to 1,000 cfs the remaining days of the year. Diversion of river sediment and water with this operating plan is unlikely to increase the potential for sedimentation and shoaling in the Mississippi River downstream of the diversion, or to require additional or increased dredging. Based on the small size of the diversion relative to the average Mississippi River flows and the limited number of days when the diversion would be operated at maximum capacity, no indirect adverse impacts would be expected to result from this alternative. Additional discussion of the potential effects of the White Ditch diversion project would be provided in Appendix N of this report.

Channels and canals within the project area could be affected by project implementation. The alternative would introduce sediment into the project area for the purpose of creating marsh. Most of this sediment would accumulate in open water areas where there is little to no flow. However, some could accumulate in channels and canals. It could potentially become necessary to perform maintenance dredging on some channels and canals.

5.15.13.2.3 Cumulative

Cumulative impacts of Alternative 1 on navigation consists simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

The unconstructed Myrtle Grove diversion would be directly across the river from the proposed White Ditch structure. The combination effect of these two structures working in such close proximity to each other on opposite sides of the river could create changes in the Mississippi River.

Other existing and proposed diversions on the Mississippi River could collectively have impacts on flows and sediments. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole could have effects on flows and stages from the Mississippi River. System-wide coordination of diversion operations would likely be necessary.

5.15.13.3 Alternative 2 – 10,000 cfs max Diversion

5.15.13.3.1 Direct

Direct impacts to navigation resulting from construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.13.3.2 Indirect

Under the operation plan evaluated in this feasibility study and SEIS, implementation of Alternative 2 would involve diversion of Mississippi River flows into the project area at a rate of 10,000 cfs for up to 60 days in the spring (March–April) and at a rate of up to 1,000 cfs the remaining days of the year. Diversion of river sediment and water with this operating plan is unlikely to increase the potential for sedimentation and shoaling in the Mississippi River downstream of the diversion, or to require additional or increased dredging.

While the potential for indirect impacts of Alternative 2 is greater than for Alternative 1 based on the difference in maximum flow capacity, because of the comparatively small size of the diversion relative to the average Mississippi River flows and the limited number of days when the diversion would be operated at maximum capacity, no indirect adverse impacts would be expected to result from this alternative. Additional discussion of the potential effects of the White Ditch diversion project would be provided in Appendix N of this report.

Channels and canals within the project area could be affected by project implementation. The alternative would introduce sediment into the project area for the purpose of creating marsh. Most of this sediment would accumulate in open water areas where there is little to no flow. However, some could accumulate in channels and canals. It could potentially become necessary to perform maintenance dredging on some channels and canals.

5.15.13.3.3 Cumulative

Cumulative impacts of Alternative 1 on navigation consists simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

The unconstructed Myrtle Grove diversion would be directly across the river from the proposed White Ditch structure. The combination effect of these two structures working in such close proximity to each other on opposite sides of the river could create changes in the Mississippi River.

Other existing and proposed diversions on the Mississippi River could collectively have impacts on flows and sediments. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole could have effects on flows and stages from the Mississippi River. System-wide coordination of diversion operations would likely be necessary.

5.15.13.4 Alternative 3 – 15,000 cfs max Diversion

5.15.13.4.1 Direct

Direct impacts to navigation resulting from construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.13.4.2 Indirect

Under the operation plan evaluated in this feasibility study and SEIS, implementation of Alternative 3 would involve diversion of Mississippi River flows into the project area at a rate of 15,000 cfs for up to 60 days in the spring (March–April) and at a rate of up to 1,000 cfs the remaining days of the year. Diversion of river sediment and water with this operating plan is unlikely to increase the potential for sedimentation and shoaling in the Mississippi River downstream of the diversion, or to require additional or increased dredging.

While the potential for indirect impacts of Alternative 3 is greater than for Alternatives 1 or 2 based on the difference in maximum flow capacity, because of the comparatively small size of the diversion relative to the average Mississippi River flows and the limited number of days when the diversion would be operated at maximum capacity, no substantial indirect adverse impacts would be expected to result from this alternative. Additional discussion of the potential effects of the White Ditch diversion project would be provided in Appendix N of this report.

Channels and canals within the project area could be affected by project implementation. The alternative would introduce sediment into the project area for the purpose of creating marsh. Most of this sediment would accumulate in open water areas where there is little to no flow. However, some could accumulate in channels and canals. It could potentially become necessary to perform maintenance dredging on some channels and canals.

5.15.13.4.3 Cumulative

Cumulative impacts of Alternative 1 on navigation consists simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

The unconstructed Myrtle Grove diversion would be directly across the river from the proposed White Ditch structure. The combination effect of these two structures working in such close proximity to each other on opposite sides of the river could create changes in the Mississippi River.

Other existing and proposed diversions on the Mississippi River could collectively have impacts on flows and sediments. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole could have effects on flows and stages from the Mississippi River. System-wide coordination of diversion operations would likely be necessary.

5.15.13.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.13.5.1 Direct

Direct impacts to navigation resulting from construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.13.5.2 Indirect

Under the operation plan evaluated in this feasibility study and SEIS, implementation of Alternative 4 would involve diversion of Mississippi River flows into the project area at a rate up to 35,000 cfs for up to 60 days in the spring (March–April) and at a rate of up to 1,000 cfs the remaining days of the year. Diversion of river sediment and water with this operating plan is unlikely to substantially increase the potential for sedimentation and shoaling in the Mississippi River downstream of the diversion, or to require additional or increased dredging over the 50-year planning horizon.

While the potential for indirect impacts of Alternative 4 is greater than for Alternatives 1, 2, or 3 based on the difference in maximum flow capacity, because of the small size of the diversion relative to the average Mississippi River flows during the maximum capacity operation period, and the limited number of days when the diversion would be operated at maximum capacity, no substantial indirect adverse impacts would be expected to result from this alternative. Additional discussion of the potential effects of the White Ditch diversion project would be provided in Appendix N of this report.

Channels and canals within the project area could be affected by project implementation. The alternative would introduce sediment into the project area for the purpose of creating marsh. Most of this sediment would accumulate in open water areas where there is little to no flow. However, some could accumulate in channels and canals. It could potentially become necessary to perform maintenance dredging on some channels and canals.

5.15.13.5.3 Cumulative

Cumulative impacts of Alternative 1 on navigation consists simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

The unconstructed Myrtle Grove diversion would be directly across the river from the proposed White Ditch structure. The combination effect of these two structures working in such close proximity to each other on opposite sides of the river could create changes in the Mississippi River.

Other existing and proposed diversions on the Mississippi River could collectively have impacts on flows and sediments. While many of the projects along the Mississippi River would be considered small diversions (100–5,000 cfs), the collective impacts of the whole could have effects on flows and stages from the Mississippi River. System-wide coordination of diversion operations would likely be necessary.

5.15.14 Man-Made Resources

5.15.14.1 Oil, Gas, Utilities

5.15.14.1.1 No Action Alternative (Future Without Project Conditions)

5.15.14.1.1.1 Direct

There would be no direct impacts on oil, gas, and utilities in the project area and vicinity if the proposed diversion is not constructed.

5.15.14.1.1.2 Indirect

There would be no indirect impacts on oil, gas, and utilities in the project area and vicinity if the proposed action is not implemented.

5.15.14.1.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on oil, gas, and utilities consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion projects.

Under the no action scenario, direct cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.14.1.2 Alternative 1 – 5,000 cfs Diversion

5.15.14.1.2.1 Direct

Construction of Alternative 1 could require avoidance or relocation or of several wells located near the construction footprint of the diversion. There would be no pipelines located within or near the construction footprint. Construction activities would not be expected to result in direct impact to utilities or oil services within the diversion area.

5.15.14.1.2.2 Indirect

No indirect impacts on oil or gas utilities would be expected to occur in the project area and vicinity if Alternative 1 is not implemented.

5.15.14.1.2.3 Cumulative

Cumulative impacts on oil or gas utilities resulting from implementation of Alternative 1 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.14.1.3 Alternative 2 – 10,000 cfs max Diversion

5.15.14.1.3.1 Direct

Direct impacts on oil or gas utilities associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.1.3.2 Indirect

Indirect impacts to oil or gas utilities resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.1.3.3 Cumulative

Cumulative impacts on oil or gas utilities resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.14.1.4 Alternative 3 – 15,000 cfs max Diversion

5.15.14.1.4.1 Direct

Direct impacts on oil or gas utilities associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.1.4.2 Indirect

Indirect impacts to oil or gas utilities resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.1.4.3 Cumulative

Cumulative impacts on oil or gas utilities resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.14.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.14.1.5.1 Direct

Direct impacts on oil or gas utilities associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.1.5.2 Indirect

Indirect impacts to oil or gas utilities resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.1.5.3 Cumulative

Cumulative impacts on oil or gas utilities resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for the No Action Alternative.

5.15.14.2 Flood Control and Hurricane Protection

5.15.14.2.1 No Action Alternative (Future Without Project Conditions)

5.15.14.2.1.1 Direct

There would be no direct impacts on flood control and hurricane protection in the project area and vicinity if the proposed diversion is not constructed.

5.15.14.2.1.2 Indirect

There would be no indirect impacts on flood control and hurricane protection in the project area and vicinity if the proposed action is not implemented.

5.15.14.2.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on flood control and hurricane protection consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Under the no action scenario, cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

5.15.14.2.2 Alternative 1 – 5,000 cfs Diversion

5.15.14.2.2.1 Direct

Construction of Alternative 1 would involve construction of a diversion structure through/under the Federal Mississippi River levee, and excavation of outfall management channels leading away from the diversion structure on the east side of the Federal levee. Construction activity would not directly affect any non-Federal levees located to the north or south of the construction site. Construction specifications would include measures to ensure that the integrity of the levee is not compromised and the level of protection during high river stages or storm surges is not lessened at any time during or after construction. For these reasons, no adverse impacts to flood control and hurricane protection would be expected to result from construction of this alternative.

5.15.14.2.2.2 Indirect

Indirect effects within the project area resulting from operation of Alternative 1 would include an increase in water levels within interior distributaries such as River aux Chenes and Bayou Garelle, and minor increased inundation of low-lying lands, particularly when the diversion is operated at maximum capacity. These hydrologic alterations would be expected to distribute and deposit river sediments throughout the project area. No significant adverse effects on existing Federal or non-Federal levees would be expected to result from implementation of this alternative.

5.15.14.2.2.3 Cumulative

Cumulative impacts would be the synergistic effect of Alternative 1 on flow and water levels with the added combination of similar wetland degradation and wetland loss impacts to flow and water levels throughout coastal Louisiana, as well as the benefits and impacts of other state and Federal coastal restoration projects in the vicinity.

Cumulative indirect impacts of this alternative combined with other state and Federal coastal restoration projects could potentially benefit existing and proposed flood control and hurricane protection projects by decreasing the vulnerability of protective works to wind and wave erosion from hurricane and tropical storm surges.

Operations of the White Ditch structure would need to be done in consideration with the existing Caernarvon diversion, as well as the proposed CWPPRA project for the rehabilitation and expansion of the existing siphon at White Ditch. Coordinated operations of all three structures would be necessary to optimize potential benefits within the Breton Sound Basin. Uncoordinated efforts could lead to prolonged inundation, or excessively elevated water levels on Federal and non-Federal levees in the project area and vicinity.

5.15.14.2.3 Alternative 2 – 10,000 cfs max Diversion

5.15.14.2.3.1 Direct

Direct impacts to flood control and hurricane protection in the project area and vicinity associated with construction of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.2.3.2 Indirect

While the maximum inflow capacity of this alternative is incrementally greater than that of Alternative 1, indirect impacts on flood control and hurricane protection resulting from implementation of Alternative 2 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.2.3.3 Cumulative

Cumulative impacts to flood control and hurricane protection resulting from implementation of Alternative 2 would be expected to be similar to, though incrementally greater than, those anticipated for Alternative 1.

5.15.14.2.4 Alternative 3 – 15,000 cfs max Diversion

5.15.14.2.4.1 Direct

Direct impacts to flood control and hurricane protection in the project area and vicinity associated with construction of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.2.4.2 Indirect

While the maximum inflow capacity of this alternative is incrementally greater than that of Alternative 1, indirect impacts on flood control and hurricane protection resulting from implementation of Alternative 3 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.2.4.3 Cumulative

Cumulative impacts to flood control and hurricane protection resulting from implementation of Alternative 3 would be expected to be similar to, though incrementally greater than, those anticipated for Alternative 1.

5.15.14.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.14.2.5.1 Direct

Direct impacts to flood control and hurricane protection in the project area and vicinity associated with construction of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.2.5.2 Indirect

While the maximum inflow capacity of this alternative is incrementally greater than that of Alternative 1, indirect impacts on flood control and hurricane protection resulting from implementation of Alternative 4 would be expected to be similar to those anticipated for Alternative 1.

5.15.14.2.5.3 Cumulative

Cumulative impacts to flood control and hurricane protection resulting from implementation of Alternative 4 would be expected to be similar to, though incrementally greater than, those anticipated for Alternative 1.

5.15.15 Natural Resources

5.15.15.1 Commercial Fisheries

5.15.15.1.1 No Action Alternative (Future Without Project Conditions)

5.15.15.1.1.1 Direct

There would be no direct impacts on natural resources and commercial fisheries within the project area and vicinity if the proposed diversion is not constructed.

5.15.15.1.1.2 Indirect

Without implementation of the proposed diversion, indirect impacts on natural resources and commercial fisheries would occur as a result of continuing loss of emergent wetland and increase in shallow open water. Increased saltwater intrusion into some of the upper portions of the project area would be anticipated as marshes continued to degrade. In time, this would result in a shift in the populations of fishes and invertebrates, with more saline-dominated species replacing freshwater species in previously intermediate-to-fresh areas. Over the 50-year planning horizon, essential fish habitat for many commercial fishery species would likewise decline, leading to a net loss in fisheries population size and diversity.

5.15.15.1.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on commercial fisheries consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Under the no action scenario, cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

Without the contribution of the proposed White Ditch diversion, continued wetland habitat losses would incrementally decrease the productivity of Louisiana's coastal fisheries. The commercial fishing and seafood industry could potentially suffer losses in employment as estuaries that would be necessary to produce shrimp, oysters, and other valuable species, erode. Job losses could occur in the areas reliant on fishing, harvesting, processing, and shipping of the seafood catch. Thus, changes in existing fisheries habitat caused by wetland loss, saltwater intrusion, and reduced salinity gradients would likely increase the risk of a decline in the supply of nationally distributed seafood products from Louisiana's coast.

5.15.15.1.2 Alternative 1 – 5,000 cfs Diversion

5.15.15.1.2.1 Direct

Construction of the outfall management features required for Alternative 1 could have a direct impact on natural resources and commercial fishing in the immediate vicinity of the construction site as a result of excavation of material for channel construction, placement of excavated material to create marsh and ridge habitat, and construction notched flow restrictors at selected canal connections to River aux Chenes.

During and after construction, direct impacts to commercial fisheries of Alternative 1 would primarily be related to reduced or impeded access to fishing areas.

5.15.15.1.2.2 Indirect

Implementation of Alternative 1 would have indirect impacts on commercial fisheries by affecting the location of target species. Changes in salinity levels in the project area as a result of project operation (see Section 5.3, Water Quality) would change the distribution of fish and shellfish species based on their salinity tolerance. Changes in fisheries distribution would in turn impact commercial fishing patterns and locations. There is also a potential for some indirect impact on commercial seafood processing facilities located on the West Bank of Plaquemines Parish if Alternative 1 is implemented.

Over the 50-year planning horizon, implementation of Alternative 1 is expected to benefit commercial fisheries by decreasing the rate of loss of marsh and associated critical nursery habitat in the project area compared to the No Action Alternative. Alternative 1 is projected to provide a net benefit of approximately 5,197 AAHUs over the period of analysis, thereby benefitting the nationally important commercial fishing industry in the area.

5.15.15.1.2.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on commercial fisheries consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of freshwater diversion sites.

Cumulative impacts on commercial fisheries resulting from implementation of Alternative 1 would incrementally increase the availability of marsh and estuarine habitat essential to support several commercially targeted species of fish and shellfish at critical life stages. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. It is likely that the construction of levees, water control structures and hurricane protection features, which can result in direct loss of habitat, alter water flow, and have the potential to block fisheries access to habitat, would continue and/or increase, as coastal residents protect themselves and their property from hurricane damage and flooding. Implementation of Alternative 1 would contribute to an overall benefit to commercial fisheries compared to the future with no action.

5.15.15.1.3 Alternative 2 – 10,000 cfs max Diversion

5.15.15.1.3.1 Direct

Construction of the outfall management features required for Alternative 2 could have a direct impact on natural resources and commercial fishing in the immediate vicinity of the construction site as a result of excavation of material for channel construction, placement of excavated material to create marsh and ridge habitat, and construction of notched restrictors at selected canal connections to River aux Chenes. During and after construction, direct impacts to commercial fisheries of Alternative 2 would primarily be related to reduced or impeded access to fishing areas.

5.15.15.1.3.2 Indirect

Implementation of Alternative 2 would have indirect impacts on commercial fisheries by affecting the location of target species. Changes in salinity levels in the project area as a result of project operation (see Section 5.3, Water Quality) would change the distribution of fish and shellfish species based on their salinity tolerance. Changes in fisheries distribution would in turn impact commercial fishing patterns and locations. There is also a potential for some indirect impact on commercial seafood processing facilities located on the West Bank of Plaquemines Parish if Alternative 2 is implemented.

Over the 50-year planning horizon, implementation of Alternative 2 is expected to benefit commercial fisheries by decreasing the rate of loss of marsh and critical nursery habitat in the project area compared to the No Action Alternative. Alternative 2 is projected to provide a net benefit of approximately 5,936 AAHUs over the period of analysis, thereby benefitting the nationally important commercial fishing industry in the area.

5.15.15.1.3.3 Cumulative

Cumulative impacts on commercial fisheries resulting from implementation of Alternative 2 would incrementally increase the availability of marsh and estuarine habitat essential to support several commercially targeted species of fish and shellfish at critical life stages. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. It is likely that the construction of levees, water control structures and hurricane protection features, which can result in direct loss of habitat, alter water flow, and have the potential to block fisheries access to habitat, would continue and/or increase, as coastal residents protect themselves and their property from hurricane damage and flooding. Implementation of Alternative 2 would contribute to an overall benefit to commercial fisheries compared to the future with no action.

5.15.15.1.4 Alternative 3 – 15,000 cfs max Diversion

5.15.15.1.4.1 Direct

Construction of the outfall management features required for Alternative 3 could have a direct impact on natural resources and commercial fishing in the immediate vicinity of the construction site as a result of excavation of material for channel construction, placement of excavated material to create marsh and ridge habitat, and construction notched restrictors at selected canal connections to River aux Chenes. During and after construction, direct impacts to commercial fisheries of Alternative 3 would primarily be related to reduced or impeded access to fishing areas.

5.15.15.1.4.2 Indirect

Implementation of Alternative 3 would have indirect impacts on commercial fisheries by affecting the location of target species. Changes in salinity levels in the project area as a result of project operation (see Section 5.3, Water Quality) would change the distribution of fish and shellfish species based on their salinity tolerance. Changes in fisheries distribution would in turn impact commercial fishing patterns and locations. There is also a potential for some indirect impact on commercial seafood processing facilities located on the West Bank of Plaquemines Parish if Alternative 2 is implemented.

Over the 50-year planning horizon, implementation of Alternative 3 is expected to benefit commercial fisheries by restoring marsh and critical nursery habitat in the project area compared to the No Action Alternative. Alternative 3 is projected to provide a net benefit of approximately 7,742 AAHUs over the period of analysis, thereby benefitting the nationally important commercial fishing industry in the area.

5.15.15.1.4.3 Cumulative

Cumulative impacts on commercial fisheries resulting from implementation of Alternative 3 would incrementally increase the availability of marsh and estuarine habitat essential to support several commercially targeted species of fish and shellfish at critical life stages. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. It is likely that the construction of levees, water control structures and hurricane protection features, which can result in direct loss of habitat, alter water flow, and have the potential to block fisheries access to habitat, would continue and/or increase, as coastal residents protect themselves and their property from hurricane damage and flooding. Implementation of Alternative 3 would contribute to an overall benefit to commercial fisheries compared to the future with no action.

5.15.15.1.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.15.1.5.1 Direct

Construction of the outfall management features required for Alternative 4 could have a direct impact on natural resources and commercial fishing in the immediate vicinity of the construction site as a result of excavation of material for channel construction, placement of excavated material to create marsh and ridge habitat, and construction notched restrictors at selected canal connections to River aux Chenes. During and after construction, direct impacts to commercial fisheries of Alternative 4 would primarily be related to reduced or impeded access to fishing areas.

5.15.15.1.5.2 Indirect

Implementation of Alternative 4 would have indirect impacts on commercial fisheries by affecting the location of target species. Changes in salinity levels in the project area as a result of project operation (see Section 5.3, Water Quality) would change the distribution of fish and shellfish species based on their salinity tolerance. Changes in fisheries distribution would in turn impact commercial fishing patterns and locations. There is also a potential for some indirect impact on commercial seafood processing facilities located on the West Bank of Plaquemines Parish if Alternative 2 is implemented.

Over the 50-year planning horizon, implementation of Alternative 4 is expected to benefit commercial fisheries by restoring marsh and critical nursery habitat in the project area compared to the No Action Alternative. Alternative 4 is projected to provide a net benefit of approximately 13,355 AAHUs over the period of analysis, thereby benefitting the nationally important commercial fishing industry in the area.

5.15.15.1.5.3 Cumulative

Cumulative impacts on commercial fisheries resulting from implementation of Alternative 4 would incrementally increase the availability of marsh and estuarine habitat essential to support several commercially targeted species of fish and shellfish at critical life stages. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. It is likely that the construction of levees, water control structures and hurricane protection features, which can result in direct loss of habitat, alter water flow, and have the potential to block fisheries access to habitat, would continue and/or increase, as coastal residents protect themselves and their property from hurricane damage and flooding. Implementation of Alternative 4 would contribute to an overall benefit to commercial fisheries compared to the future with no action.

5.15.15.2 Oyster Leases

5.15.15.2.1 No Action Alternative (Future Without Project Conditions)

5.15.15.2.1.1 Direct

There would be no direct impacts to oyster leases in the project area and vicinity if the proposed diversion is not constructed.

5.15.15.2.1.2 Indirect

Without implementation of the proposed diversion, indirect impacts on natural resources and oyster leases would occur as a result of continuing loss of emergent wetland and increase in shallow open water. Increased saltwater intrusion into some of the upper portions of the project area would be anticipated as marshes continued to degrade. In time, this would result in a shift in oyster population toward the middle and upper reaches of the estuary. At the same time, currently productive oyster leases in the lower portions of the project area could degrade in time if salinity shifts above the optimal range. Over the 50-year planning horizon, optimal habitat for oyster production would likewise decline, leading to a net loss in oyster lease productivity and harvest.

5.15.15.2.1.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on oyster leases consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Under the no action scenario, cumulative impacts remain no greater than the sum of those impacts indicated individually for each project component of the aforementioned programs.

Without the contribution of the proposed White Ditch diversion, continued wetland habitat losses would incrementally decrease the productivity of Louisiana's coastal fisheries, including oyster beds. The commercial fishing and seafood industry could potentially suffer losses in employment as estuaries that would be necessary to produce shrimp, oysters, and other valuable species, erode. Job losses could occur in the areas reliant on fishing, harvesting, processing, and shipping of the seafood catch. Thus, changes in existing fisheries habitat caused by wetland loss, saltwater intrusion, and reduced salinity gradients would likely increase the risk of a decline in the supply of nationally distributed seafood products from Louisiana's coast.

5.15.15.2.2 Alternative 1 – 5,000 cfs Diversion

5.15.15.2.2.1 Direct

No measurable direct impacts to oyster leases would be anticipated to result from construction of Alternative 1, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters and where no leases currently exist, as determined from examination of state databases.

5.15.15.2.2.2 Indirect

Indirect impacts to oyster leases around this diversion site if Alternative 1 is implemented could include increased rate of mortality and decrease in productivity in oyster leases located closest to the diversion site, during the period when the diversion is at full operational capacity and for up to 2 months after the return to maintenance flow conditions. This could result in a loss of revenue for commercial oyster harvesters.

The operational plan proposed and evaluated in this feasibility study and SEIS limits the period of full flow to no more than 2 months (60 days) in the spring timeframe (March–April was used in the analysis). It was formulated in part to avoid or minimize the potential for incidental adverse effects (e.g. mortality, interference with reproduction) to oysters and other invertebrate or fishery species that require brackish or saline environments. Hydraulic modeling of the project area indicated that the return to maintenance flows for the remainder of the year (10 months) should maintain brackish and saline zones in the project area, though at somewhat reduced average salinities. The number of leases impacted should be less than for the 35,000 cfs alternative because the recovery time should be quicker. For these reasons, indirect adverse impacts to oyster leases would not be anticipated to be significant.

Over the 50-year planning horizon, potential beneficial effects to oyster populations could result if reduced salinities resulting from diversion operation were to increase the spatial extent of habitats experiencing salinities in the optimal range for oyster production. Continued water quality and biological monitoring of the project area before and after project construction should assist in refining the operation plan as needed to meet project objectives for restoring marsh while maintaining a functioning salinity regime in the estuary.

5.15.15.2.2.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on oyster leases consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Cumulative impacts on oyster leases resulting from implementation of Alternative 1 would incrementally increase the ability of marsh and estuarine habitat essential to maintain salinity gradients and protect against excessive salinities that could be detrimental to the long-term viability of oyster populations in coastal Louisiana. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. Implementation of Alternative 1 would contribute to an overall long-term benefit to commercial fisheries, including oyster harvesting, compared to the future with no action.

5.15.15.2.3 Alternative 2 – 10,000 cfs max Diversion

5.15.15.2.3.1 Direct

No measurable direct impacts to oyster leases would be anticipated to result from construction of Alternative 2, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters and where no leases currently exist, as determined from examination of state databases.

5.15.15.2.3.2 Indirect

Indirect impacts to oyster leases around this diversion site if Alternative 2 is implemented could include increased rate of mortality and decrease in productivity in oyster leases located closest to the diversion site, during the period when the diversion is at full operational capacity and for up to 2 months after the return to maintenance flow conditions. This could result in a loss of revenue for commercial oyster harvesters.

The operational plan proposed and evaluated in this feasibility study and SEIS limits the period of full flow to no more than 2 months (60 days) in the spring timeframe (March–April was used in the analysis). It was formulated in part to avoid or minimize the potential for incidental adverse effects (e.g. mortality, interference with reproduction) to oysters and other invertebrate or fishery species that require brackish or saline environments. Hydraulic modeling of the project area indicated that the return to maintenance flows for the remainder of the year (10 months) should maintain brackish and saline zones in the project area, though at somewhat reduced average salinities. For these reasons, indirect adverse impacts to oyster leases would not be anticipated to be significant. The number of leases impacted should be less than for the 35,000 cfs alternative because the recovery time should be quicker.

Over the 50-year planning horizon, potential beneficial effects to oyster populations could result if reduced salinities resulting from diversion operation were to increase the spatial extent of habitats experiencing salinities in the optimal range for oyster production. Continued water quality and biological monitoring of the project area before and after project construction should assist in refining the operation plan as needed to meet project objectives for restoring marsh while maintaining a functioning salinity regime in the estuary.

5.15.15.2.3.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on oyster leases consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Cumulative impacts on oyster leases resulting from implementation of Alternative 2 would incrementally increase the ability of marsh and estuarine habitat essential to maintain salinity gradients and protect against excessive salinities that could be detrimental to the long-term viability of oyster populations in coastal Louisiana. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. Implementation of Alternative 2 would contribute to an overall long-term benefit to commercial fisheries, including oyster harvesting, compared to the future with no action.

5.15.15.2.4 Alternative 3 – 15,000 cfs max Diversion

5.15.15.2.4.1 Direct

No measurable direct impacts to oyster leases would be anticipated to result from construction of Alternative 3, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters and where no leases currently exist, as determined from examination of state databases.

5.15.15.2.4.2 Indirect

Indirect impacts to oyster leases around this diversion site if Alternative 3 is implemented could include increased rate of mortality and decrease in productivity in oyster leases located closest to the diversion site, during the period when the diversion is at full operational capacity and for up to 2 months after the return to maintenance flow conditions. This could result in a loss of revenue for commercial oyster harvesters.

The operational plan proposed and evaluated in this feasibility study and SEIS limits the period of full flow to no more than 2 months (60 days) in the spring timeframe (March–April was used in the analysis). It was formulated in part to avoid or minimize the potential for incidental adverse effects (e.g. mortality, interference with reproduction) to oysters and other invertebrate or fishery species that require brackish or saline environments. Hydraulic modeling of the project area indicated that the return to maintenance flows for the remainder of the year (10 months) should maintain brackish and saline zones in the project area, though at somewhat reduced average salinities. For these reasons, indirect adverse impacts to oyster leases would not be anticipated to be significant. The number of leases impacted should be less than for the 35,000 cfs alternative because the recovery time should be quicker.

Over the 50-year planning horizon, potential beneficial effects to oyster populations could result if reduced salinities resulting from diversion operation were to increase the spatial extent of habitats experiencing salinities in the optimal range for oyster production. Continued water quality and biological monitoring of the project area before and after project construction should assist in refining the operation plan as needed to meet project objectives for restoring marsh while maintaining a functioning salinity regime in the estuary.

5.15.15.2.4.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on oyster leases consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Cumulative impacts on oyster leases resulting from implementation of Alternative 3 would incrementally increase the ability of marsh and estuarine habitat essential to maintain salinity gradients and protect against excessive salinities that could be detrimental to the long-term viability of oyster populations in coastal Louisiana. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. Implementation of Alternative 3 would contribute to an overall long-term benefit to commercial fisheries, including oyster harvesting, compared to the future with no action.

5.15.15.2.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.15.15.2.5.1 Direct

No measurable direct impacts to oyster leases would be anticipated to result from construction of Alternative 4, primarily because the construction footprint is located in the upper portion of the project area, where existing salinity conditions would be not favorable for oysters and where no leases currently exist, as determined from examination of state databases.

5.15.15.2.5.2 Indirect

Indirect impacts to oyster leases around this diversion site if Alternative 4 is implemented could include increased rate of mortality and decrease in productivity in oyster leases located closest to the diversion site, during the period when the diversion is at full operational capacity (Figure 5.2) and for up to 2 months after the return to maintenance flow conditions. This could result in a loss of revenue for commercial oyster harvesters.

The operational plan proposed and evaluated in this feasibility study and SEIS limits the period of full flow to no more than 2 months (60 days) in the spring timeframe (March–April was used in the analysis). It was formulated in part to avoid or minimize the potential for incidental adverse effects (e.g. mortality, interference with reproduction) to oysters and other invertebrate or fishery species that require brackish or saline environments. Hydraulic modeling (Figure 5.3) of the project area indicated that the return to maintenance flows for the remainder of the year (10 months) should maintain brackish and saline zones in the project area, though at somewhat reduced average salinities. There will be approximately three oyster leases in the study area and another five in the extended boundary that could be impacted by the project. For these reasons, indirect adverse impacts to oyster leases would not be anticipated to be significant. If this diversion were operated fully open outside the 2-month window that is described in the document, then there could be significantly different impacts with some potentially being very negative.

Over the 50-year planning horizon, potential beneficial effects to oyster populations could result if reduced salinities resulting from diversion operation were to increase the spatial extent of habitats experiencing salinities in the optimal range for oyster production. Continued water quality and biological monitoring of the project area before and after project construction should assist in refining the operation plan as needed to meet project objectives for restoring marsh while maintaining a functioning salinity regime in the estuary.

5.15.15.2.5.3 Cumulative

Unless otherwise indicated, cumulative socioeconomic impacts on oyster leases consist simply of the sum of the direct and indirect impacts for this alternative added to all other local and regional activities, including construction of the GNOHSDRRS, and existing and in-progress elements of the LCA Ecosystem Restoration program, including development of Freshwater Diversion sites.

Cumulative impacts on oyster leases resulting from implementation of Alternative 4 would incrementally increase the ability of marsh and estuarine habitat essential to maintain salinity gradients and protect against excessive salinities that could be detrimental to the long-term viability of oyster populations in coastal Louisiana. This incremental effect combined with existing and planned restoration efforts in the state (e.g., CWPPRA, the Community-based Restoration Program sponsored by the NMFS Restoration Center, various state and local efforts, and others) would continue to aid fisheries habitat. Implementation of Alternative 4 would contribute to an overall long-term benefit to commercial fisheries, including oyster harvesting, compared to the future with no action.

5.16 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTES

5.16.1 No Action Alternative (Future Without Project Conditions)

The condition with the No Action Alternative regarding the potential for HTRW is dependent on site-specific HTRW discovery. Based on the Phase I in the project action area, there is reason to believe that the potential to encounter HTRW problems would be low.

5.16.2 Alternative 1 – 5,000 cfs max Diversion

5.16.2.1 Direct

Direct impacts would be slightly lower than Alternative 2.

5.16.2.2 Indirect

Indirect impacts would be slightly lower Alternative 2.

5.16.2.3 Cumulative

Cumulative impacts would be slightly lower Alternative 2.

5.16.3 Alternative 2 – 10,000 cfs max Diversion

5.16.3.1 Direct

Direct impacts would be slightly lower than Alternative 3.

5.16.3.2 Indirect

Indirect impacts would be slightly lower Alternative 3.

5.16.3.3 Cumulative

Cumulative impacts would be slightly lower Alternative 3.

5.16.4 Alternative 3 – 15,000 cfs max Diversion

5.16.4.1 Direct

Direct impacts would be lower than Alternative 4.

5.16.4.2 Indirect

Indirect impacts would be lower than Alternative 4.

5.16.4.3 Cumulative

Cumulative impacts would be lower than Alternative 4.

5.16.5 Alternative 4 – 35,000 cfs max Diversion (Recommended Plan)

5.16.5.1 Direct

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the potential for direct impacts to the project area from implementation of Alternative 4 would be low and would likely continue to be low into the future.

5.16.5.2 Indirect

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the potential for direct impacts to the project area from implementation of Alternative 4 would be low and would likely continue to be low into the future.

5.16.5.3 Cumulative

Consistent with ER 1165-2-132, an HTRW investigation of the project area was conducted. Based upon findings from this investigation, the potential for direct impacts to the project area from implementation of Alternative 4 would be low and would likely continue to be low into the future.

5.17 UNAVOIDABLE ADVERSE EFFECTS

Wetland impacts were avoided and minimized to the extent possible in the preliminary design of the Recommended Plan. With avoidance and minimization of wetland impacts the Recommended Plan would impact approximately 277 acres of intermediate marsh, 363 acres of shallow open water and 5 acres of bottomland hardwoods for construction of the diversion and approximately 223 acres of intermediate marsh and shallow open water would be impacted from excavation of the channel. The diversion channel is the best way to divert water from the Mississippi River to American Bay, California Bay and Breton Sound near Bay Gardens to the south. The creation of approximately 385 acres of intermediate marsh habitat and creation of 32 acres of ridge habitat would mitigate for wetland impacts resulting from construction activities. There would be no other unavoidable adverse impacts as a result of the implementation of reasonable alternatives for this project.

5.18 RELATIONSHIP OF SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

NEPA Section 102(2)(c)(iv) and 40 CFR 1502.16 requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. This section describes how the Proposed Action would affect the short-term use and the long-term productivity of the environment.

In reference to the Proposed Action, "short-term" refers to the temporary phase of construction of the proposed project, while "long-term" refers to the operational life of the proposed project and beyond. Section 5 of this document evaluates the direct, indirect and cumulative effects that could result from the Proposed Action.

Construction of the Proposed Action would result in short-term construction-related impacts within parts of the project area and would include to some extent interference with local traffic, minor limited air emissions, and increases in ambient noise levels, disturbance of fisheries and wildlife, increased storm runoff, and disturbance of recreational and other public facilities. These impacts would be temporary and would occur only during construction, and would not be expected to alter the long-term productivity of the natural environment.

The Proposed Action would assist in the long-term productivity of the Breton Sound ecological community by improving the water quantity, water quality, nutrients, and sediments. This in turn would facilitate the growth and productivity of emergent intermediate marsh. The Proposed Action would also result in enhancing the long-term productivity of the natural communities throughout the region. These long-term beneficial effects of the Proposed Action would outweigh the impacts to the environment resulting primarily from project construction.

5.19 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

NEPA requires that environmental analysis include identification of "any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." The proposed action would require the expenditure of human and fiscal resources and the potential modification of natural resources. Construction would require the expenditure of materials that are generally not retrievable. Considerable amounts of fossil fuels, labor, and construction materials such as cement, aggregate, iron, and rock would be expended. Large amounts of labor and natural resources would be necessary in the fabrication and preparation of construction materials. However, although these materials are generally not retrievable, they are not in short supply and their use would not have an adverse effect upon their continued availability. Other impacts that could have a longer effect can be reduced through appropriate measures and best management practices (e.g., silt fencing to control erosion). In addition, construction would require a large, one-time investment of Federal funds that are not retrievable. The commitment of these resources is based on the concept that residents both within the project area, as well as the region and nation, would benefit by improvements in the quality of the marsh system. No irreversible or irretrievable commitment has occurred which would have the effect of foreclosing the formulation or implementation of any reasonable and prudent alternative. No commitment of resources has occurred that would prejudice the selection of any alternative before making a final decision on this project.

5.20 MITIGATION

Project plans and alternatives were developed in accordance with Corps planning guidance at ER 1105-2-100, which directs that ecosystem restoration projects be designed to avoid the need for compensatory fish and wildlife mitigation. Formulation of project alternatives, including diversion site location, design of structures, and operating plans, was conducted in compliance with this guidance. Also in accordance with Corps planning guidance, net ecosystem benefits expected to accrue if the proposed project is implemented could not be used as wetland banks or mitigation credit by the non-Federal sponsor. The possible addition of fish passages during the PED may be used to offset impacts to fishery resource and to an endangered species.

5.21 ENVIRONMENTAL CONSEQUENCES SUMMARY

Environmental Resources	Alternative Description				
	No Action	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
1) Soils and Water Bottoms	Continued advanced degradation of soils within the SA and increase in acreage of water bottoms.	Direct impact to 153 acres of marsh and water bottom for construction of diversion, canal and ridge habitat. Beneficially creating 139 acres marsh, nourish.	Direct impacts to 167 acres of marsh and water bottom Creation of 176 acres of marsh, 32 acres of ridge/terrace.	Direct impacts to 182 acres of marsh and water bottom Create 235 acres marsh; 32 acres ridge/terrace.	Direct impact to 477 acres of marsh and water bottom for construction of diversion, canal and ridge habitat. Beneficially creating 385 acres marsh, nourish 35,000 acres and create 31 acres of ridge/terrace habitat.
2) Hydrology: Flows and Water Levels	Persistence of existing conditions including lack of hydrologic connectivity to the Mississippi River. Salinity intrusion would persist and marsh habitat would continue to decline and convert to open water.	No effect on Mississippi River flows anticipated. Increased hydrologic connectivity that provide freshwater, nutrients and sediment to marsh, improving productivity, accretion and improve conditions conducive to SAV development.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
3) Hydrology: Sedimentation and Erosion	Continued lack of sediment inputs into SA.	Diversion of 5,000 cfs would deliver 74,000 tons of sediment/yr. Increase sediment introduction could fill-in shallow water bodies adjacent to Bayou Garelle. Increased delivery of freshwater to the marsh would deliver nutrients and sediments that would enhance productivity and increase SAV growth. Cumulative effects of multiple diversion could alter sedimentation patterns of Mississippi River.	Diversion of 10,000 cfs would deliver 108,000 tons of sediment/yr. Increase sediment introduction could fill-in shallow water bodies adjacent to Bayou Garelle. Increased delivery of freshwater to the marsh would deliver nutrients and sediments that would enhance productivity and increase SAV growth. Cumulative effects of multiple diversion could alter sedimentation patterns of Mississippi River.	Diversion of 15,000 cfs would deliver 143,000 tons of sediment/yr. Increase sediment introduction could fill-in shallow water bodies adjacent to Bayou Garelle. Increased delivery of freshwater to the marsh would deliver nutrients and sediments that would enhance productivity and increase SAV growth. Cumulative effects of multiple diversion could alter sedimentation patterns of Mississippi River.	Diversion of 35,000 cfs would deliver 279,000 tons of sediment/yr. Increase sediment introduction could fill-in shallow water bodies adjacent to Bayou Garelle. Increased delivery of freshwater to the marsh would deliver nutrients and sediments that would enhance productivity and increase SAV growth. Cumulative effects of multiple diversion could alter sedimentation patterns of Mississippi River.
4) Hydrology: Groundwater	Nearby human populations and industry continue to increase resulting in increased groundwater demands and decrease in groundwater resources. Continued decreasing marsh habitat no longer functions as effectively as natural water quality filtration system to aquifers.	Minor variations in groundwater seepage due to head gradients created by the diversion. Restoration of marsh acts as natural water quality filtration system to the aquifers.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
5) Water Quality	Conversion of intermediate vegetation to open water reduces natural water quality filtration. Water bodies in study area meet designated uses.	Temporary negative impacts (e.g., increased turbidity, decreased dissolved oxygen) during construction. Restoration of the marsh contributes to improvements in water quality.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
6) Water Quality: Salinity	Taking no action would result in continued salinity intrusion and loss of wetland productivity and conversion to open water.	Implementing this alternative would result in direct benefits to the estuary in combating salinity intrusion and wetland loss.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
7) Air Quality	Plaquemines Parish is in attainment.	Temporary impacts to air quality associated with construction.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
8) Noise	Limited increases in noise due to limited transportation, development, and navigation in the study area.	Temporary increases in noise levels during construction activities.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
9) Vegetation Resources	Continued loss of wetland habitat, SAVs and bottomland hardwood resources due to increased saltwater intrusion, flood duration, impoundment, and herbivory. Invasive species would continue to thrive.	Direct impacts to 477 acres marsh and water bottom from construction. Benefits include restoring 32 acres of ridge habitat and 139 acres of marsh and nourishment of 10,603 cumulative acres of existing vegetation. Diversion of freshwater would provide sediment and nutrients for improved marsh productivity, accretion) increase in SAV. Net average annualized habitat unit is 55.51.	Direct impacts to 477 acres marsh and water bottom from construction. Benefits include restoring 32 acres of ridge habitat and 139 acres of marsh and nourishment of existing vegetation throughout project area. Diversion of freshwater would provide sediment and nutrients for improved marsh productivity, accretion) increase in SAV. Net average annualized habitat unit is 70.35.	Direct impacts to 631acres marsh and water bottom and 5 acres bottomland hardwoods from construction. Benefits include restoring 32 acres of ridge habitat and 235 acres of marsh and nourishment of existing vegetation throughout project area. Diversion of freshwater would provide sediment and nutrients for improved marsh productivity, accretion increase in SAV. Net average annualized habitat unit is 87.21.	Direct impacts to 863 acres of marsh and water bottom and 5 acres of bottomland hardwoods for construction. Create 385 acres of marsh, 32 acres ridge/terrace habitat and nourish existing marsh throughout project area. Diversion of freshwater would provide sediment and nutrients for improved marsh productivity, accretion, increased SAV. Net average annualized habitat unit is 139.94.
10) Wildlife	Continued decline in quality of wildlife habitat adversely impacts wetland dependent wildlife populations.	Temporary impacts to wildlife due to construction activities. Improvement and creation of habitat for wetland dependent wildlife. Increases in populations of wildlife dependent on ridge habitat.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
11) Fisheries	Persistence of existing conditions including low oxygen that could lead to fish kills and low species diversity in the study area. Loss of wetland habitats used by fish species for shelter, feeding, and life cycle requirements.	Localized and temporary impacts to fisheries during construction. Overall increases in productivity and fisheries populations in the study area. Displacement of some fish species due to changes in salinity.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
12) Aquatic Resources	A shift in plankton and benthic populations to species assemblages that prefer open water, marine habitats as marsh converts to open water and salinity intrusion continues.	Localized and temporary impacts to aquatic resources during construction. Increases in populations due to increases in productivity in the marsh.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
13) Essential Fish Habitat (EFH)	Loss of more valuable productive EFH due to continued subsidence, erosion and salinity intrusion as marsh converts to open water. Potential decrease in habitat for juvenile stages of red drum and white shrimp.	Improved marsh productivity providing a higher quality EFH. Increase in habitat for juvenile stages of red drum and white shrimp.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
14) Threatened and Endangered Species	Continued degradation, conversion, and eventual loss of important wetland habitats used by threatened and endangered species.	Potential entrainment of pallid sturgeon in the intake structures. Potential creation of structures beneficial to pallid sturgeon. Potential to improve environment for gulf sturgeon. Ridge habitat would be beneficial to bald eagles and other raptors.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
15) Cultural Resources	No impacts to cultural resources should occur within the study area as a result of the No Action Alternative.	No impacts to cultural resources should occur within the study area as a result of this alternative. Potential protection of cultural resources due to deposition of sediment and restoration of wetlands.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
16) Aesthetics	Continued wetland loss and conversion of existing wetlands to open-water habitats resulting in decreased structural complexity and habitat diversity.	Improvement of the visual aesthetics of the study area through restoration marsh and ridge habitat.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
17) Recreation	Continued degradation of existing wetlands would diminish the wildlife habitat of the area, which in turn would adversely impact the recreational opportunities of the study area. Decreasing annual dollar revenues.	Localized and temporary impacts to recreation during construction. Overall, this alternative would serve to maintain and improve natural habitat, thereby maintaining and increasing recreational opportunities within the study area and leading to a substantial increase in recreational economic value. $57,284 annual dollar revenues based on unit day values.	Impacts similar to Alternative 1 however recreational economic value would be $60,704 annual dollar revenues based on unit day values.	Impacts similar to Alternative 1 however recreational economic value would be $67,496 annual dollar revenues based on unit day values.	Impacts similar to Alternative 1 however recreational economic value would be $40,517 annual dollar revenues based on unit day values.
19) Socioeconomics: Population and Housing	There would be no impacts to populations or housing under the No Action Alternative.	There would be no impacts to populations or housing under Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
20) Socioeconomics: Employment, Business, and Industrial Activity	Continued natural habitat degradation would have localized impacts on fishery- and wildlife-related employment and industries.	No direct, indirect or cumulative impacts anticipated from implementation of this alternative.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
21) Socioeconomics: Availability of Public Facilities and Services	No impacts to the availability of public facilities and services should occur within the study area as a result of the No Action Alternative.	No impacts to the availability of public facilities and services should occur within the study area as a result of the proposed action.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.	Impacts similar to Alternative 2.
22) Socioeconomics: Transportation	There would be no direct, indirect or cumulative impacts anticipated from taking no action.	Impacts on transportation resources would include temporary increase in demand of the transportation network during construction. Overall, the proposed action would slow or reverse the trend of wetland degradation, thereby facilitating travel within the study area.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
23) Socioeconomics: Disruption of Desirable Community and Regional Growth (including Community Cohesion)	Continued natural habitat degradation would have localized impacts on fishery- and wildlife-related employment and industries, which could impede community and regional growth.	There would be no direct, indirect or cumulative impacts anticipated from implementation of this alternative.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
24) Socioeconomics: Tax Revenues and Property Values	There would be no direct, indirect or cumulative impacts anticipated from taking no action.	There would be no direct, indirect or cumulative impacts anticipated from implementation of this alternative.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
25) Socioeconomics: Infrastructure	Continued wetland degradation, including coastal land loss, would impact infrastructure along and leading to the coastline, affecting both relocations and maintenance.	Potential impacts to water management infrastructure from construction of Diversion.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
26) Socioeconomics: Environmental Justice	There would be no direct, indirect or cumulative impacts anticipated from taking no action.	There would be no direct, indirect of cumulative impacts anticipated from implementation of this alternative.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
27) Socioeconomics: Navigation	There would be no impacts to navigation as a result of the No Action Alternative.	Implementation of this alternative could cause direct impacts to flow from Mississippi River, indirect impacts resulting from potential to increase shoaling.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
28) Socioeconomics: Agriculture	There would be no impacts to agriculture as a result of the No Action Alternative.	There would be no direct, indirect of cumulative impacts anticipated from implementation of this alternative.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
29) Socioeconomics: Forestry	There would be no impacts to forestry from taking no action.	Implementing this alternative would directly impact 2.5 acres of Bottomland hardwoods. Benefits include the restoration of 32 acres of ridge habitat that would be conducive to bottomland hardwood regeneration.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
30) Socioeconomics: Public Lands	Continued loss of public land and access resulting from marsh degradation and conversion of marsh to open water.	There would be no direct, indirect of cumulative impacts anticipated from implementation of this alternative.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
31) Socioeconomics: Water Use and Supply	There would be no direct, indirect or cumulative impacts anticipated from taking no action.	Implementation of this alternative could have direct and indirect impacts to water supply pipeline.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
32) Socioeconomics: Oil, Gas, and Utilities	The effects of land loss and degradation could lead to increased costs for maintaining and repairing existing oil, gas, and utilities in the study area.	Implementation of this alternative could have direct and indirect impacts to water supply pipeline.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
33) Socioeconomics: Flood Control and Hurricane Protection	There would be no direct, indirect or cumulative impacts anticipated from taking no action.	Implementing this alternative could have direct and indirect impact on existing levees in the area.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
34) Socioeconomics: Commercial Fisheries	Persistence of existing conditions including the continued conversion of existing wetlands to open-water habitats, restricted water circulation, and decreased water quality could result in declines in commercial fisheries.	Overall increases in fisheries productivity due to increased nutrient inputs and wetland building processes. The potential short term displacement of some commercial fisheries and indirect impacts to local commercial seafood processing facilities.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.

Environmental Resources	Alternative Description				
	No Action	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
	No Action/Without Project Condition.	Location 3 – 5,000 cfs diversion. Consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 139 acres of marsh creation utilizing dredged material from an adjacent 153 acres of canal being reconfigured to convey freshwater.	Location 3 – 10,000 cfs diversion consisting of three 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 176 acres of marsh creation using dredged material from adjacent 167 acres of canal reconfiguration to convey freshwater.	Location 3 – 15,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 235 acres of marsh creation utilizing dredged material from an adjacent 182 acres of canal reconfiguration to convey freshwater.	Location 3 – 35,000 cfs diversion consisting of ten 15-ft x 15-ft box culverts, 32 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal reconfiguration to convey freshwater.
35) Socioeconomics: Oyster Leases	There would be no direct, indirect or cumulative impacts anticipated from taking no action.	Implementing this alternative could result in direct and indirect adverse impacts to oyster leases and significant loss of revenue for parties holding those leases.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.	Impacts similar to Alternative 1.
36) HTRW	An HTRW Phase I in the study area was performed on the study area, and identified a low probability of encountering contaminants of concern.	Potential for impacts to the SA from implementation of Alternative 1 is low and would likely continue to be low into the future.	Potential for impacts to the SA from implementation of Alternative 1 is low and would likely continue to be low into the future.	Potential for impacts to the SA from implementation of Alternative 1 is low and would likely continue to be low into the future.	Potential for impacts to the SA from implementation of Alternative 1 is low and would likely continue to be low into the future.

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6.0 PUBLIC INVOLVEMENT

6.1 NEPA SCOPING

Scoping is a critical component of the overall public involvement program to solicit input from affected Federal, State, and local agencies, Indian Tribes, and interested stakeholders. The NEPA scoping process is designed to provide an early and open means of determining the scope of issues (problems, needs, and opportunities) to be identified and addressed in the Draft Environmental Impact Statement (DEIS). Scoping is the process used to: a) identify the affected public and agency concerns; b) facilitate an efficient DEIS preparation process; c) define the issues and alternatives that will be examined in detail in the DEIS; and d) save time in the overall process by helping to ensure that relevant issues are adequately addressed. Scoping is a process, not an event or a meeting; it continues throughout the EIS (draft and final) process and may involve meetings, telephone conversations, and/or written comments.

A notice of intent (NOI) to prepare a draft EIS for the LCA MDWD Restoration Feasibility Study (MDWD Study) was published in the *Federal Register* (volume 73, number 246) on December 22, 2008

A project kick-off meeting was held on December 12, 2008, and a public scoping meeting was organized and hosted in accordance with NEPA on February 5, 2009. A scoping meeting announcement requesting comments on the scope of the MDWD Study was mailed to Federal, State, and local agencies; and interested groups and individuals on January 7, 2009. The media advisory announcing the scoping meeting was provided to 350 media outlets. An advertisement for the public scoping meeting appeared in the following publications:

- *Baton Rouge Advocate*, January 30, 2009
- *St. Bernard Voice*, January 30, 2009
- *Times-Picayune*, January 31, 2009
- *Plaquemines Gazette*, February 3, 2009

The public scoping meeting was held on:

Thursday, February 5, 2009
Phoenix High School
13073 Highway 15
Phoenix, LA 70040

The schedule for the scoping meeting was:

6:00 – 7:00 p.m. Open House
7:00 – 7:30 p.m. Presentations
7:30 – 8:00 p.m. Question and Answer Session
8:00 – 8:50 p.m. Open Forum for Comments
8:50 – 9:00 p.m. Wrap-up

The open house session provided attendees with an opportunity to visit a series of poster stations staffed by project team members and subject matter experts regarding the following topics: the LCA plan, the NEPA process and milestones, an overview of the study and its goals and objectives, as well as maps of the study area.

Following the open house, there was a brief presentation on the MDWD planned for the area and a description of the NEPA process. During this segment, the LCA Environmental Manager and both the USACE and CPRA 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 draft EIS for the MDWD study.

The question and answer portion focused on the study process and any other general questions presented by attendees. Following this portion, the floor was opened for scoping comments. Individuals were invited to present their verbal scoping comments to be recorded without interruption. The floor remained open until no further scoping comments were given. During the wrap-up, attendees were reminded to pick up self mailing comment cards, should they wish to submit additional comments at a later date, and to drop off the meeting evaluation forms at the registration table.

A transcript of comments recorded at the scoping meeting was prepared by a court reporter. The scoping comments were documented in a Scoping Report and describe the public's concerns about the restoration effort and strategies for restoration efforts. See Appendix A for the Scoping Report. The Scoping Report presents and summarizes the scoping comments expressed at the public scoping meeting, as well as all other scoping comments received during the comment period beginning December 22, 2008, and ending February 18, 2009. The Scoping Report indicates where in the draft EIS individual comments should be addressed. This Scoping Report was provided to all scoping participants who provided their address, and is published on the www.lca.gov Web site.

Approximately 26 people attended the MDWD scoping meeting. Names of those who signed in are listed in the Scoping Report. A total of 16 multi-part comments were received during the comment period, of which one was received via E-mail and two were copies of letters. Fourteen individuals expressed comments at the scoping meeting. A total of three written comments (letter, email, Web site) were received during the comment period.

A scoping comment may contain several specific statements directed at multiple areas of concern. Hence, a single comment could potentially be generally addressed in multiple sections of the draft EIS. A total of 95 specific comments were expressed.

The comments were categorized according to their applicability to the EIS. EIS categories include: Purpose and Need; Alternatives; Affected Environment; Environmental Consequences; and Consultation, Coordination, and Compliance with Regulations. Although, an individual scoping comment may be categorized under more than one EIS subject matter heading, no comment was assigned more than three categories.

Purpose and Need

A majority of comments received in this category stressed the need for introducing more sediment into the study area. In addition, several comments indicated that the storm surge was the root cause of the problems in this area: *"The problem is the surge. If you can contain the sediment, you can protect the surge from destroying what you built."* One respondent stressed a significant problem to be hyacinths in the area: *"A significant problem within the marshes is hyacinths. Hyacinths come into the open water, which also has dugg grass. They cover the dugg grass and kill it. When the storm comes in, it kills the hyacinths and then you are ultimately left with nothing but mud at the bottom."*

Alternatives

A number of respondent comments fell into this category. Converting the project to a sediment diversion as opposed to a freshwater diversion was the most common suggestion. *"It is extremely important that this effort become a sediment diversion and the Corps reviews how sediments deposited initially by nature create a marsh."* One commenter suggested adding new sections to the EIS to describe potential impacts to the resources that could be impacted by the proposed project: *"NOAA's National Marine Fisheries Service (NMFS) recommends the supplemental environmental impact statement (SEIS) include separate sections titled, "Essential Fish Habitat"* and *"Marine Fishery Resources" that identify the EFH and fisheries resources of the study area. These sections should describe the potential impacts, both positive and negative, to those resources that could be caused by the proposed river diversion."* Other comments included constructing a controlled diversion as an "enhanced artificial crevasse" for large discharge and sediment pulses and designing a structure with a large operational range for river stages.

Affected Environment

Most comments relating to the natural resources in the project area focused on EFH and the water bodies that provide nursery and foraging habitats: *"Aquatic and tidally influenced wetland habitats in portions of the study area are designated as essential fish habit for various federally managed species, including white shrimp, brown shrimp, red drum, lane snapper, dog snapper, and gulf stone crab."*

Environmental Consequences

Several comments indicated the USACE consider the erosion effects from the water: "Should consider choking down areas to slow the water flow in and out so that the sediment can go up the bankline instead of being washed out." Respondents also indicated the importance of sediment on the environment and this project and stressed a need to keep it intact: "Sediment is extremely important at the opening of the diversion as is the distribution of that sediment so that it does not fall out 100 to 1,000 years from now at the opening." In addition, concerns about impacts to oyster beds and other marine fisheries dominated the comments received: "NMFS believes adverse impacts to marine fishery productivity could be caused by structure operations, especially during high flow periods. These impacts include: 1) displacement of less freshwater tolerant, or cold water tolerant, marine fishery species from large areas of wetlands and water bodies that serve as nursery and foraging areas; 2) destruction of productive oyster reefs that serve as habitat and a food sources for some fishery species; 3) increased turbidity and associated decreases in coverage of submerged aquatic vegetation in some areas; and 4) potential low dissolved oxygen levels in areas water bodies caused by decomposition of large quantities of algae and/or phytoplankton resulting from high nutrient levels in diverted river water."

Consultation, Coordination, and Compliance with Regulations

The majority of comments received in this area concerned this project and the history of other projects: "Request the Corps analyze what was done on the Caernarvon diversion project as it destroyed the land in 20 years, but it should have naturally eroded in 100 years." Additional comments included the need for the USACE to implement an evaluation program and to include additional sections within the report regarding Essential Fish Habitat, Marine Fishery Resources, and Essential Fish Habitat sub-categories.

Table 6.1 displays the categorization of specific comments by EIS subject matter. The majority of the comments addressed Alternatives followed by Affected Environment and Consultation, Coordination, and Compliance with Regulations (tie); Purpose and Need; and Affected Environment.

Table 6.1: Categorization of Scoping Comments by Draft EIS Subject Matter

PN = Purpose and Need, ALT = Alternatives, AE = Affected Environment, EC = Environmental Consequences, and CC = Consultation, Coordination, and Compliance with Regulations

Source of Scoping Comment	PN	ALT	AE	EC	CC	Totals
Scoping Meeting	10	13	7	13	11	54
Scoping Comment Letters	3	16	5	3	8	35
Scoping Comments E-mails	2	0	2	2	0	6
Totals	15	29	14	18	19	95

NOTE: A single scoping comment may be categorized under multiple DPEIS subject matter headings.

6.2 OTHER PUBLIC COMMENTS

6.2.1 Federal and State Agencies

A project kick-off meeting was held on January 13, 2009, to present the study authority, purpose, goals and objectives. Federal, State and local agencies from Louisiana participated in the discussions. Representatives of Federal and State agencies were invited to be members of the Project Delivery Team (PDT) and the Habitat Evaluation Team (HET). The PDT facilitates the interagency collaboration and coordination necessary for study execution. Agency team members provide guidance and recommendations throughout the planning process to assure the successful delivery of a quality product.

The HET is part of the PDT and is composed of resource agency representatives. The HET performs planning and technical assessments consistent with their agency responsibilities and expertise. The HET has been involved at all stages of the planning process, and has assisted with the development, evaluation, and analysis of project alternatives. The HET has participated in the public information/involvement program, exchanged study information, provided recommendations, and assisted in the resolution of any interagency issues that may have surfaced in the study process. The HET was an integral part of the Wetland Values Assessment process to determine the habitat value of the alternatives.

Federal and State agencies are also involved through the NEPA process, with some agencies serving as official cooperating agencies and other agencies with official coordination and consultation roles.

6.2.2 Land Owner, Non-Governmental Organization (NGO), Parish and Other Involvement

The following meetings were held to provide opportunities for landowners, NGOs, the Parish and other interested parties to see progress on the project and to solicit feedback from the attendees. Federal and state agencies frequently attended as well.

April 28, 2009

On April 28, 2009, a presentation about the proposed project was given to the Maritime Navigation Safety Association (MNSA) board members. Approximately 20 people attended the MNSA meeting. Attendees included board members, Coastal Protection and Restoration Authority (CPRA) managers for the Myrtle Grove Diversion project and representatives from the Environmental Defense Fund. The MDWD presentation focused on the development and schedule of the project as well as the initial array of measures. Since the project was still relatively early in the feasibility process at the time of the presentation, few specifics were known. The project manager did specifically seek feedback from the Board and committed to keeping them engaged with progress on the project. Numerous suggestions were received regarding the importance of introducing sediments into the project area along with recommendations for coordinating the MDWD with the Myrtle Grove Diversion project.

May 29, 2009

On May 29, 2009, site visits with eight local landowners, one land manager, and a representative from the Plaqueminnes Parish Coastal Zone Management Department were conducted. The USACE was represented by the project manager and two other members of the PDT. The proposed project was discussed and land owner comments and concerns were solicited. Comments and concerns included the need to maintain access for oil and gas lessees, control of invasive species and potential destruction of private property by the project. Several landowners also recommended potential features including using many smaller structures instead of one large structure and levee removal.

July 16, 2009

On July 16, 2009, a presentation was given about the proposed project to the LCA Science and Technology board members. The meeting was assembled to present updates on numerous coastal restoration efforts to the board and to solicit their input for review of the projects.

Approximately 50 people attended the LCA meeting. Attendees included board members, CPRA managers for this and other LCA projects as well as representatives from numerous stakeholder, consulting, and other interest groups. The MDWD presentation focused on the development of an initial array of alternatives and the numerous measures being considered. Feedback was specifically sought from the Board and a commitment to keeping them engaged with progress on the project was stressed. The Board asked several questions about the project including how habitat benefits are realized and what efforts are being considered to control invasive species. There was also discussion about the limits of the WRDA authorization and how benefits from the project could easily reach beyond the current project boundary.

July 22, 2009

On July 22, 2009, the project manager gave a presentation about the proposed project to the Plaquemines Parish Coastal Zone Advisory Committee. The monthly meeting was assembled to discuss several coastal issues within the Parish and a specific request was made for an update on the MDWD project. Approximately 15 people attended the meeting. Attendees included board members, the MDWD CPRA manager, the H&H lead, the CZM director as well as other interested stakeholders and landowners. The presentation focused on the development of an initial array of alternatives and the numerous measures being considered. The project manager did specifically seek feedback from the Committee and pledged to keep them engaged with progress on the project. The Committee asked several questions about the project including what efforts are being considered to control invasive species and how the salinity isohalines will be determined. A land manager spoke at length about the ill effects of the project and insisted that some of the mistakes made on other diversion projects were not repeated. There was also discussion about what the Committee could do to help advance the project and support it.

July 29, 2009

On July 29, 2009, the PM attended a modeling meeting hosted by the CPRA in conjunction with their contractors in an effort to coordinate development of the MDWD with the proposed Myrtle Grove Water Diversion (MG). Both MDWD and MG are looking at and evaluating large-scale freshwater diversions (up to 100,000 cfs) at several locations on the Mississippi River, some of which could be directly across from each other, east bank and west bank. Twenty five people were present at this meeting.

August 27, 2009

On August 27, 2009, an update was given about the proposed project features to the Delacroix Corporation chairman and land manager. This update was a secondary discussion after meeting with Delacroix and other land owners to acquire right-of-entry (ROE) for the MRGO Ecosystem Restoration project.

Seven people attended the ROE meeting. Attendees included the Delacroix president, attorney and land manager, two additional landowner reps, a COE real estate rep and an MRGO Eco rep. The MDWD discussion focused on the development of a final array of alternatives that included the potential elimination of three diversion sites as well as the different types and capacities for diversion structures. The Delacroix president indicated his support for a large scale diversion structure that focused on introducing as much sediment as possible into the project area and that he would be happy to see such a project implemented as quickly as possible. He also indicated that other landowners in the area would also likely be interested in maximizing sediment introduction. Graphics of potential diversion locations with outfall management features were handed out for review. Discussion also ensued about the potential for a nearby landowner to be especially interested in utilizing their property for placement of the diversion.

September 14, 2009

On September 14, 2009, the project manager and the URS modeling contractor met with representatives from the Delacroix Corporation and the Plaquemines Parish Government to discuss issues related to the topography, hydrology, bathymetry, and general condition of the White Ditch project area. The purpose was to help inform the contractor of the unique project area characteristics in developing and refining the hydraulic model to be used to estimate and simulate the effects of a diversion structure on the marsh.

Six people attended the meeting. Attendees included two Delacroix land managers and field staff, the Plaquemines Parish Local Coastal Program Manager, Dr. Reed and Mr. MacInnes. The MDWD discussion focused on the numerous elements that will affect the final calibration of the hydraulic model including general marsh elevation, water depths across the project area including canals, bayous, converted open water, ponds and lakes, general salinities, the flow of water across the marsh, areas that have become water from marsh, etc. Considerable time was spent discussing the effects on water hyacinth a diversion might have and the numerous problems the invasive species causes.

The land managers also discussed some of the potential options for a diversion structure with outfall management features that could be constructed. Significant discussion focused on the operations of a structure and how that is more important than what is built. They reiterated some of the problems associated with the Caernarvon diversion and its flows, suggesting that a diversion should be run minimally if even at all throughout the fall and winter. They supported the idea of a sediment diversion but also suggested that the large amounts of water that would be diverted could have a severe negative effect on the existing marsh if the structure is operated at high capacities for too long.

An outfall proposal was suggested that could help deliver beneficial sediments, nutrients, and freshwater through an area experiencing high marsh-loss rates. The land managers felt this modification could have a beneficial impact on the surrounding marshes.

November 13, 2009

On November 13, 2009, a focus group of 16 participants was interviewed about potential effects of a freshwater diversion on recreation resources. Information discussed included the general effects of the diversion, effects of culverts on fish access, effects of dredging, effects of marsh creation, and effects of ridge restoration. A more-detailed discussion of these effects can be found in section 5.14.

March 26, 2010

A brief update on the current status of the project was presented to the Delacroix Corporation. Details of the project were discussed, including the size, location, and potential operating scheme of the diversion. Draft graphics were handed out and an update on the project schedule was provided.

March 31, 2010

A presentation was given to the Plaquemines Parish Coastal Zone Advisory Committee meeting held at 6:00 p.m. in Belle Chasse, Louisiana. Eleven members of the Committee and representatives from the Parish Government and public were in attendance. The presentation focused on all project details including the plan formulation, hydraulic modeling results, proposed operating scheme, size, location, and potential effects. There was active participation at the meeting and numerous questions were asked about project details.

6.2.3 Public Comments on the Draft SEIS

Copies of this draft SEIS will be made available to all interested parties through mailings, advertisements, media advisories, public meetings, and websites. All comments received during the 45-day public comment period on the draft SEIS are documented and responded to in Appendix G. All commenters will be sent a Notice of Availability of this Integrated Feasibility Study and SEIS after its completion.

7.0 COORDINATION AND COMPLIANCE

This chapter documents the coordination and compliance efforts for this project regarding statutory authorities including: environmental laws, regulations, executive orders, policies, rules, and guidance. Consistency of the Recommended Plan and other Louisiana coastal restoration efforts is also addressed.

7.1 USACE PRINCIPLES AND GUIDELINES (P&G)

The guidance for conducting Civil Works planning studies (ER 1105-2-100) is based on the P&G adopted by the Water Resources Council. The P&G are composed of two parts: The Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies and the Economic and Environmental Guidelines for Water and Related Land Resources Implementation Studies. The P&G require the systematic formulation of alternative plans to ensure all reasonable alternatives are evaluated. The P&G also include guidance on the development and structure of the studies and reports for projects requiring specific authorization.

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

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

7.2 ENVIRONMENTAL COORDINATION AND COMPLIANCE

Following completion of the final integrated report, the Assistant Secretary of the Army for Civil Works will issue a written Record of Decision (ROD) concerning the proposed action. The ROD will be issued within a framework of laws, regulations, 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. Relevant State of Louisiana statutory authorities are listed in Table 7.2. Full compliance with statutory authorities will be accomplished upon review of the final integrated feasibility report and Supplemental Environmental Impact Statement by appropriate agencies and the public and the signing of a ROD, in compliance with the Fish and Wildlife Coordination Act (1958).

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 of 1978
- Anadromous Fish Conservation Act of 1965
- Archaeological Resources Protection Act of 1979
- Archaeological and Historical Preservation Act of 1974
- Bald Eagle Protection Act of 1940
- Clean Air Act of 1970
- Clean Water Act of 1977
- Coastal Barrier Improvement Act of 1990
- Coastal Barrier Resources Act of 1982
- Coastal Wetlands Planning, Protection, and Restoration Act of 1990
- Coastal Zone Management Act of 1972
- Coastal Zone Protection Act of 1996
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980
- Consultation and Coordination with Indian Tribal Governments (EO 13175) of 2000
- Deepwater Port Act of 1974
- 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
- Estuaries and Clean Waters Act of 2000
- Estuary Protection Act of 1968
- Estuary Restoration Act of 2000
- Exotic Organisms (EO 11987) of 1977
- Farmland Protection Policy Act of 1981
- Federal Actions to Address Environmental Justice in Minority Populations & Low-Income Populations (EO 12898, 12948) of 1994, as amended
- Federal Compliance with Pollution Control Standards (EO 12088) of 1978
- Federal Emergency Management (EO 12148) of 1979
- 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 of 1958
- Flood Control Act of 1944
- Floodplain Management (EO 11988) of 1977
- Food Security Act of 1985
- Greening of the Government Through Leadership in Environmental Management (EO 13148) of 2000
- Historic Sites Act of 1935
- Historical and Archaeological Data-Preservation Act of 1974
- Indian Sacred Sites (EO 13007) of 1996
- Invasive Species (EO 13112) of 1999
- Land & Water Conservation Fund Act of 1965
- Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended
- Marine Mammal Protection Act of 1972
- Marine Protected Areas (EO 13158) of 2000
- Marine Protection, Research, and Sanctuaries Act of 1972
- Migratory Bird Conservation Act of 1929
- Migratory Bird Treaty Act of 1918
- Migratory Bird Habitat Protection (EO 13186) of 2001
- National Environmental Policy Act of 1969
- National Historic Preservation Act of 1966
- National Invasive Species Act of 1996
- Native American Graves Protection and Repatriation Act of 1990
- Neotropical Migratory Bird Conservation Act of 2000
- Noise Control Act of 1972
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1996
- North American Wetlands Conservation Act of 1989
- Oil Pollution Act of 1990
- Outer Continental Shelf Lands Act of 1953
- Pollution Prevention Act of 1990
- Prime or Unique Farmlands, 1980 CEQ Memorandum
- Protection and Enhancement of the Cultural Environment (EO 11593) of 1971
- Protection and Enhancement of Environmental Quality (EO 11991) of 1977
- Protection of Children from Environmental Health Risks and Safety Issues (EO 13045) of 1997
- Protection of Cultural Property (EO 12555) of 1986
- Protection of Wetlands (EO 11990) of 1977
- Reclamation Projects Authorization and Adjustments Act of 1992
- Recreational Fisheries (EO 12962) of 1995
- Resource Conservation and Recovery Act of 1976
- Responsibilities of Federal Agencies to Protect Migratory Birds (EO 13186) of 2001
- Rivers and Harbors Acts of 1899, 1956
- River and Harbor and Flood Control Act of 1970
- Safe Drinking Water Act of 1974
- Submerged Land Act of 1953
- Sustainable Fisheries Act of 1996
- Toxic Substances Control Act of 1976
- Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646)
- Water Resources Development Acts of 1976, 1986, 1990, 1992, and 2007
- Water Resources Planning Act of 1965
- Watershed Protection & Flood Prevention Act of 1954
- Water Pollution Control Act Amendments of 1961
- Wild and Scenic River Act of 1968
- Wilderness Act of 1964

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

7.2.1 U.S. Fish and Wildlife Coordination Act

The USACE has coordinated with the U.S. Fish and Wildlife Service, NMFS, and LDWF per the Fish and Wildlife Coordination Act (16 U.S.C. 661-667e; the Act of March 10, 1934; Ch. 55; 48 Stat. 401), as amended by the Act of June 24, 1936). A Final Coordination Act Report has been received and the comments incorporated into the project plan. The Fish and Wildlife Coordination Act authorizes the Secretaries of Agriculture and Commerce to provide assistance to and cooperate with Federal and State agencies to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife.

The amendments enacted in 1946 require consultation with the Fish and Wildlife Service and the fish and wildlife agencies of states where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted . . . or otherwise controlled or modified" by any agency under a Federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources."

Service Position and Recommendations

The Recommended Plan will benefit the fish and wildlife resources of the MDWD area by providing fresh water, nutrients, and sediments to the study area thus facilitating sediment deposition, increasing organic production, increasing biological productivity, and reducing marsh loss. Approximately 13,353 AAHUS and 35,146 net acres of fresh/intermediate, brackish, and saline marsh and ridge habitats would benefit by the proposed project at the end of the project life. The Service supports implementation of a 35,000 cfs diversion at White Ditch provided the following fish and wildlife recommendations are implemented concurrently with project implementation:

1. Future hydrological modeling should be conducted with longer-duration simulations (i.e., 13-month simulations) to allow more complete projections of salinity change within the study area. In addition, modeling of different operational plans should be conducted. We recommend the following operational plans be evaluated; 1) March–April open operation with a 1,000 cfs maintenance flow the remainder of the year, 2) March open operation with a 1,000 cfs maintenance flow the remainder of the year, and 3) March 1 to March 14 open operation with a 1,000 cfs maintenance flow the remainder of the year.

USACE Response to Recommendation #1: Concur. Modeling of alternative operational plans will be conducted during PED phase.

2. To determine potential impacts to marine fishery resources in the study area, models which simulate changes in nekton community composition based on changes in salinity should be utilized. For example, the Ecopath/Ecosim (www.ecopath.org) models have been utilized to simulate changes in the nekton community in the Caernarvon Diversion outfall area. Hydrological modeling output could be used as input for the Ecopath/Ecosim models or other similar models. The Corps will investigate the use of other aquatic models and will not limit themselves to use of Ecopath/Ecosim.

USACE Response to Recommendation #2: Concur. Fishery modeling and habitat change modeling will be performed during the PED phase. The cost and schedule for this will be incorporated into the PMP being developed by the Corps for the PED Phase. At this time a SOW is being developed as part of the Donaldsonville to the Gulf project to look a various models and develop a white paper on the best use of them. The intent of these models is to support adaptive management of this project.

3. The best available data and modeling tools should be utilized to select a more precise location near Phoenix, Louisiana for the diversion structure to maximize the capture of suspended sediment. The State of Louisiana Office of Coastal Protection and Restoration (OCPR) is funding the development of a 3-dimensional river model which could greatly assist in determining the optimal location for the diversion structure.

USACE Response to Recommendation #3: Concur. The precise location of the diversion structure will be determined during the PED phase.

4. The Service has concerns regarding the Monitoring and Adaptive Management Plan and its ability to ensure the goals and objectives are measured and achieved. The Corps should work with the Service, NOAA's NMFS, and the LDWF during future planning efforts to address our concerns.

USACE Response to Recommendation #4: Concur. The Corps appreciates the assistance of the Service in continued development of the Monitoring and Adaptive Management Plan.

5. If a proposed project feature is changed significantly or is not implemented within one year of the Endangered Species Act consultation letter, we recommend that the Corps reinitiate coordination with each office to ensure that the proposed project would not adversely affect any Federally listed threatened or endangered species or their habitat.

USACE Response to Recommendation #5: Concur. The Corps will reinitiate coordination with the Service and NMFS if project features change significantly or if the project is not implemented within a year after issuance of the Biological Opinion for this project.

6. Avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. A qualified biologist should inspect the proposed work site for the presence of undocumented wading bird nesting colonies and bald eagles during the nesting season (i.e., February 16 through October 31 for wading bird nesting colonies, and October through mid-May for bald eagles).

USACE Response to Recommendation #6: Concur. The proposed inspection will be scheduled during the PED phase.

7. To minimize disturbance to colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present). 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.

USACE Response to Recommendation #7: Concur. These restrictions will be included in project plans and specifications.

8. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary and those results should be forwarded to this office.

USACE Response to Recommendation #8: Concur. Should a bald eagle nest be discovered in the vicinity of construction activities, the Corps will conduct an on-line evaluation as directed and utilize the results to determine whether additional consultation with the Service is necessary, and will forward the results of the evaluation to the Lafayette Field Office.

9. Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

USACE Response to Recommendation #9: Concur. Seasonal restrictions on land clearing will be stipulated in project plans and specifications when practicable.

10. Further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) should be coordinated with the Service and other State and Federal natural resource agencies, and shall be provided an opportunity to review and submit recommendations on the all work addressed in those reports.

USACE Response to Recommendation #10: Concur. Close coordination will be maintained with the Service and NMFS during the PED phase.

11. A report documenting the status of implementation, maintenance and adaptive management measures should be prepared every three years by the managing agency and provided to the Corps, the Service, NMFS, U.S. Environmental Protection Agency (EPA), Louisiana Department of Natural Resources (LDNR), OCPR, and LDWF. That report should also describe future management activities, and identify any proposed changes to the existing management plan.

USACE Response to Recommendation #11: Concur. The Corps will coordinate with the listed agencies to ensure preparation of the recommended report.

12. The Service recommends a comprehensive examination of the river and all existing and proposed diversions to coordinate their operation and ensure that their operation will maximize their restoration capabilities. The ongoing Mississippi River Hydrodynamic and Delta Management Study should be utilized to address this issue. The Service and other natural resource agencies should be involved in this study.

USACE Response to Recommendation #12: Concur. The Corps will continue to coordinate with the Service and other natural resource agencies to facilitate their involvement in the ongoing Mississippi River Hydrodynamic and Delta Management Study.

13. The Service recommends establishment of a committee similar to the Caernarvon Interagency Advisory Committee to review the operation and its results of the MDWD and when necessary, provide recommendations regarding any future operational and maintenance changes. The Service and other natural resource agencies should be on this committee.

USACE Response to Recommendation #13: Concur. The Corps will work with OCPR, the Service and other natural resource agencies to establish an advisory committee for the White Ditch project.

7.2.2 Clean Water Act – Section 404(b)(1)

The USACE is responsible for administering regulations under Section 404(b)(1) of the CWA. Potential project-related impacts subject to these regulations, such as the discharge of dredged material into wetlands to create marsh and ridge habitat, have been evaluated in compliance with Section 404(b)(1) of the CWA (Appendix D).

The evaluation of potential impacts to water quality indicated that, on the basis of the guidelines, the proposed disposal sites for the discharge of dredged material comply with the requirement of these guidelines, with the inclusion of appropriate and practicable methods to minimize adverse effects to the aquatic ecosystem. The 404(b)(1) will be signed after the receipt of the 401 Water Quality Certificate from the State of Louisiana.

7.2.3 Section 122 of the Rivers and Harbors Act

Section 122 of the Rivers and Harbors Act of 1970 (Public Law 91-611, 84 STAT. 1823) requires that consideration be given to possible adverse economic, social and environmental effects. It also requires that final decisions on the project be made in the best overall public interest, taking into consideration the need for flood control, navigation and associated purposes; and the associated costs of eliminating or minimizing the following adverse affects:

- Air, water and noise pollution;
- Destruction or disruption of man-made and natural resources, aesthetic values, community cohesion, and availability of public facilities and services;
- Adverse employment effects;
- Tax and property value losses;
- Injurious displacement of people, businesses and farms;

- Disruption of desirable community and regional growth.

Alternative 4 (Recommended Plan) would have no significant impacts on Section 122 identified economic, social or environmental resources.

7.2.4 Coastal Zone Management Act of 1972

Section 307 of the Coastal Zone Management Act (CZM) of 1972 (16 U.S.C. 1456(c)(1)(A)) directs Federal agencies proposing activities or development projects (including civil work activities), whether within or outside the coastal zone, must assure that those activities or projects are consistent, to the maximum extent practicable, with the approved state coastal zone management program. A Consistency Determination is included with this report (Appendix E) and has been submitted to Louisiana Department of Natural Department of Natural Resources (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. Concurance with our determination was received from LDNR on July 29, 2010.

7.2.5 Endangered Species Act of 1973

Threatened and endangered species protected under the ESA, as amended, are present in the project area. No critical habitats for those species would be directly affected, and no indirect adverse impacts are expected to such habitats. As provided by the implementing regulations of the ESA, biological assessments have been prepared and provided to the USFWS and NMFS to address the potential for the proposed action to affect listed species. The biological assessments conclude that only one species, the pallid sturgeon, may be adversely affected by the proposed action. The USACE will continue to consult with the USFWS concerning the potential impacts to pallid sturgeon as necessary to comply with the ESA. Formal consultation with USFWS began on July 16, 2010, and the Biological Opinion (BO) ending it was signed on September 23, 2010. The BO can be found in Appendix A. All Reasonable and Prudent Measures as well as Terms and Conditions provided in the USFWS biological opinion will be implemented if feasible.

7.2.6 Magnuson-Stevens Fishery Conservation and Management Act of 1996; and the Magnuson-Stevens Act Reauthorization of 2006 (Essential Fish Habitat)

As directed by the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 104-297), the USACE has coordinated with NMFS and that agency's experts on various marine organisms as well as EFH. The NMFS provided a letter dated February 10, 2009, to help guide the development of the FS/SEIS for the proposed action (Appendix C). The NMFS identified white shrimp, brown shrimp, red drum, lane snapper, dog snapper, and Gulf stone crab as species managed by the Gulf of Mexico Fishery Management Council that have EFH in the proposed action area. They also listed estuarine emergent wetlands, mud, sand and shell substrates, and estuarine and marine water column as primary categories of EFH in the proposed action area. In accordance with NMFS recommendation by letter dated January 26, 2010, the USACE (MVN) commits to undertake and obtain output from ecological simulation modeling and analysis of State fisheries data to assess the effects of this project individually as well as cumulatively with other projects involving the Breton estuary, as part of project Planning, Engineering, and Design efforts, for use in developing an operation plan prior to implementation that will be applied under an adaptive management plan. The analysis of potential impacts of the Recommended Plan on EFH is described in Section 4.7 Essential Fish Habitat in the project vicinity.

7.2.7 Clean Air Act – Air Quality Determination

Compliance with the Clean Air Act (42 U.S.C.A. §§7401) has been fully coordinated with the Air Quality Section of the LDEQ (see also Section 4.2.4 Air Quality). As required by Louisiana Administrative Code, Title 33 (LAC 33:III.1405 B), an air quality applicability determination was made for the Recommended Plan. This included consideration of the proposed action 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 (Section 5.4). 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.

7.2.8 National Historic Preservation Act of 1966

In compliance with Section 106 of the NHPA, as amended, and 36 CFR 800, Federal agencies are required to identify and consider potential effects that their undertakings might have on significant historic properties, district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. Additionally, a Federal agency shall consult with any tribe that attaches religious and cultural significance to such properties. Agencies shall afford the State Historic Preservation Office (SHPO) and tribes a reasonable opportunity to comment before decisions are made. Accordingly, coordination of the proposed action with the SHPO and tribes has been initiated.

7.2.9 Farmland Protection Policy Act (Prime and Unique Farmlands)

The purpose of the Farmland Protection Policy Act (7 U.S.C. 658) is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to non-agricultural uses. There are no farmlands within the study area. Hence, there would be no unnecessary or irreversible conversion of farmland to non-agricultural uses.

7.2.10 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. This Executive Order requires environmental analyses of Federal actions required by NEPA or other established environmental review processes to 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. Implementation of the Recommended Plan would result in a net increase in migratory bird habitat.

7.2.11 Executive Order 12898 – Environmental Justice

Concern with EJ issues can be traced to Title VI, Section 601 of the Civil Rights Act of 1964 (Public Law 88-352):

> *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, President Clinton issued Executive Order 12898 regarding Federal actions to address EJ issues in minority populations and low-income populations:

> *To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands.*

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, and will continue to be considered through project implementation. As part of the NEPA process, a scoping input request was provided to the public and interested parties. The scoping comments did not identify any potential EJ issues. The USACE is committed to ensuring that any potential EJ issues are addressed as the study proceeds. The proposed ecosystem restoration measures would equally impact all potential users in the area. There would be no potential EJ issues from implementing the Recommended Plan.

7.2.12 Executive Order 13112 – Invasive Species

On February 3, 1999, President Clinton issued Executive Order 13112 to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause by establishing the National Invasive Species Council. The 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 will use relevant programs and authorities to prevent the introduction of invasive species and 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 will be taken in conjunction with the actions.

7.2.13 Executive Order 11990 – Floodplain Management

Executive Order 11988 – Floodplain Management directs all Federal agencies to avoid, if possible, development and other activities in the 100-year base floodplain. Where the base floodplain cannot be avoided, special considerations and studies for new facilities and structures are needed.

Design and siting are to be based on scientific, engineering, and architectural studies; consideration of human life, natural processes, and cultural resources; and the planned lifespan of the project. Federal agencies are required to:

- Reduce the risk of flood loss
- Minimize the impact of floods on human safety, health, and welfare
- Restore and preserve the natural and beneficial values served by floodplains in carrying out agency responsibility

The proposed action area is located in LCA Subprovince 1 in the Breton Sound hydrologic basin in Plaquemines Parish, Louisiana; in Zone A (no base flood elevation determined) of the Special Flood Hazard Areas inundated by 100-year flood (source: National Flood Insurance Program, Firm Flood Insurance Rate Map, Plaquemines Parish, Louisiana, Unincorporated Areas, Community-Panel Number 220139 0165B and 220139 0170B, effective date September 30, 1993, Federal Emergency Management Agency). Consistent with Executive Order 11988, implementing the Recommended Plan would have no significant impacts on the risk of flood loss. Implementing the Recommended Plan would have no significant flooding impacts on human safety, health and welfare. Implementing the Recommended Plan, ecosystem restoration of over 98,000 acres of intermediate to brackish intertidal wetland habitats within portions of the Breton Sound estuarine area, would contribute to restoring and preserving the natural and beneficial values served by floodplains.

7.2.14 Executive Order 11988 – Protection of Wetlands

President Jimmy Carter issued Executive Order 11990: Protection of Wetlands on May 24, 1977 (42 FR 26961, 3 CFR, 1977 Comp., p. 121) in order to avoid, to the extent possible, the long and short term adverse impacts associated with the destruction or modification of wetlands. Executive Order 11990 directs that each Federal agency shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Consistent with Executive Order 11990, the following factors have been considered as part of the alternative plan formulation process in developing the Recommended Plan for ecosystem restoration and avoiding potential effects on the survival and quality of wetlands:

a) public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion;

b) maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and

c) other uses of wetlands in the public interest, including recreational, scientific, and cultural uses.

7.2.15 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 will be in accordance with the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Uniform Act), as amended in 42 USC 4601-4655, and the Uniform Regulations contained in 49 C.F.R. Part 24. The Uniform Act sets forth procedures for the acquisition of private property for public use and specifically requires that the acquiring agency appraise the real property interests it wishes to acquire and provide the owner a written summary of the basis for the amount established as just compensation.

7.2.16 Louisiana State Rare, Threatened, and Endangered Species, and Natural Communities Coordination

The USACE reviewed the database maintained by the Louisiana National Heritage Program (LNHP) that provides the most recent listing and locations for rare, threatened and endangered species of plants and animals and natural communities within the State of Louisiana. The proposed action would not adversely impact any rare, threatened or endangered species, or unique natural communities. The proposed action would increase the extent of fresh marsh within portions of the study area, which is identified as a rare and imperiled natural community for certain regions of the state (see also Section 5.6 Vegetation Resources).

7.2.17 Clean Water Act – Section 401 Water Quality

Under provisions of the CWA (33 U.S.C. § 1251), any project that involved placing dredged or fill material in waters of the United States or wetlands, or mechanized clearing of wetlands would require a water quality certification from the LDEQ, Office of Environmental Services. A final Supplemental Environmental Impact Statement addressing impacts of all activities associated with the proposed White Ditch Diversion Project has been prepared. The document includes an assessment of impacts of excavation, dredging, and disposal operations. Application for certification has been submitted by the U.S. Army Engineer District, New Orleans, to the LDEQ, Office of Environmental Services, in accordance with statutory authority contained in LRS: 30:2074 A(3) and provisions of Section 401 of the CWA (P.L. 92-500, as amended).

Under provisions of the CWA (33 U.S.C. § 1251), any project that involves placing dredged or fill material in waters of the United States or wetlands, or mechanized clearing of wetlands would require a water quality certification from the LDEQ, Office of Environmental Services. A public notice for the proposed action has been issued. Along with a copy of this final FS/EIS, an application for water quality certification has been provided to the LDEQ, stating that the proposed placement of fill material into waters of the state will not violate established water quality standards. Issuance of an LDEQ state Water Quality Certification is anticipated on October 4, 2010, prior to the start of the 30-day review period. The 401 Water Quality Certificate will be available for review and placed on www.LCA.Gov when it is issued.

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8.0 CONCLUSIONS AND DETERMINATIONS

8.1 AREAS OF CONTROVERSY AND UNRESOLVED ISSUES

During the scoping meeting and throughout the alternative identification and evaluation a number of issues have been raised regarding diversions in general and those under consideration in the study area. Every effort has been made to address these concerns and clearly identify the impacts, both beneficial and detrimental of the alternatives considered. Through public review of the document most of these issues clarified and resolved. However, it is also likely that if construction and operation of the Recommended Plan were to occur, these issues would continue to be raised. They are summarized as follows:

- Joint operation of the proposed White Ditch Diversion with the existing Caernarvon Diversion would be key to maintaining the condition of the overall Breton Sound ecosystem. These two projects should not be operated independently of one another. Modeling results and monitoring data suggests that Caernarvon has the ability to substantially freshen the Breton Sound even without freshwater inputs from another source. In order for Breton Sound salinities to rebound after the March–April pulse from the White Ditch Diversion, flow from Caernarvon would have to be closely controlled. This will mean a change to the current operational plan. It will be crucial that future modeling during PED for White Ditch and during Feasibility for the LCA Modification to Caernarvon investigate joint operation. The LCA 4 Modification to Caernarvon will consider and account for the proposed Medium Diversion at White Ditch project during its analysis. Additionally the existing and proposed operational plans for both White Ditch and Caernarvon are subject to refinement based on any newly acquired data. If significant changes are required, these would be properly disclosed to the public through the NEPA process.
- Potential negative impacts to oysters from over-freshening of the basin. An evaluation of the impacts to the salinity regimes in the study area was conducted and the areas most important to commercial oyster harvesting could experience significant changes as a result of the project, especially if an unfavorable operational regime is implemented. During the PED phase, detailed and extensive aquatic modeling using the fisheries modeling software will be used to thoroughly evaluate the potential impacts to fisheries resources, including commercially important species such as oysters. These results could assist in further refinement of the proposed operational regime.
- Converting the estuary to fresh/intermediate marsh. Fresh and intermediate marsh types are an important habitat type in coastal areas and specifically the study area. The loss of these areas has diminished the ecological integrity of the study area. The restoration of fresh and intermediate marsh types will not exceed historic trends and is not expected to displace significant areas of brackish or saline marsh. Additionally the Recommended Plan has the potential to create new areas of brackish and saline marsh through restoration of the functional processes that create and sustain them.
- Creating 'flotant' marsh that is not anchored and provides no surge protection. The short duration of the pulse (March–April) operating regime has the potential to saturate existing marsh. However, due to the relatively short pulsing season, significant habitat switching is not expected to occur.

- Direct sediment delivery with dredging from the river. The cost of this approach would be excessive. While building marsh directly would have an immediate benefit, it would not restore the processes needed to sustain marsh within the study area.
- Impacts to pallid sturgeon. At this time, surveys are being conducted to determine whether pallid sturgeon are present and whether the Recommended Plan will impact the species. Preliminary indications are that the species is not present; however, the USFWS has not yet made a formal determination. That information will be available before a public review draft of the report is completed.
- Creating access and/or land use problems for private landowners. The Recommended Plan will have immediate impacts in the area being considered for the location of the structure. Access during construction may be limited but this would be temporary.
- Did we pick the best spot on the river to capture sediment? Based on the available information the supply of sediment at the Phoenix Location would be adequate to meet the goals and objectives of the project and operational requirements of the structure. The information used to predict project benefits in the ERDC-Sand2 Model came from data obtained from the Belle Chasse station, which represented the longest continuous dataset from a nearby location. When comparing the ERDC-Sand2 Model inputs to data that have been collected within the project area itself, it is seen that the programs estimates are conservative. Data collected by the USGS in the outfall canal of the existing White Ditch Siphon suggests that more sediment is available to enter into the project area than represented by the Belle Chasse Data. Using the Belle Chasse Data, it is expected that the Recommended Plan will deliver approximately 16,600 tons of sediment per day into the project area during the March–April Pulse. Using the USGS sediment loads and the same pulse operation, approximately 17,900 tons of sediment per day could enter the project area. This results in a potential 8% increase in sediment loads from what are currently being projected.

  Current research being done by the University of Texas in conjunction with the State of Louisiana also suggests that there will be further increased sediment concentrations specifically at the Phoenix site. The Phoenix location of the Recommended Plan was selected because there is a "back-current" in flows on the Mississippi River. This will enhance the amount of sediment available in the area of the diversion as the back-current will continually pull sediments into the diversion.

  Additional analysis will be conducted during PED to determine the best orientation and placement of the structure within close proximity of its presently proposed location. The project would not move from the Phoenix Location.
- Relative Sea-Level Rise (RSLR). Extensive consideration of RSLR occurred during formulation. Further, the impacts of the moderate and high sea-level rise scenarios on the Recommended Plan were evaluated but it should be noted that no evaluated alternative is able to entirely offset the high rate of sea-level rise.
- Induced shoaling effects and other effects to the navigation/shipping industry. No impacts are expected to the day-to-day activities of the navigation/shipping industry. A qualitative analysis of induced shoaling effects is included in Appendix N. Further analysis is recommended during design to accurately assess and minimize, through the diversion structure design, potential impacts.

- The Recommended Plan for this project exceeds the cost authorization presented in the 2004 LCA Report. The District Commander recommends seeking additional authorization in order to construct the Recommended/NER plan; however, the need to request additional authorization has the potential to impact the project construction schedule.
- Fishery modeling and habitat change modeling will be performed during the PED phase. The cost and schedule for this will be incorporated into the PMP being developed by the USACE for the PED Phase. At this time, a SOW is being developed as part of the Donaldsonville to the Gulf project to look at various models and develop a white paper on the best use of them. The intent of these models is to support adaptive management of this project.

- The impacts of the Deepwater Horizon oil spill on coastal Louisiana are uncertain at this time (August 2010). 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 MDWD 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 Deepwater Horizon Oil spill can be found in several governmental sources. The USFWS Situation Report for August 2, 2010 (http://www.fws.gov/home/dhoilspill/pdfs/MondayAugust22010.pdf) indicates the following environmental-related Deepwater Horizon oil spill information: 563 personnel are actively engaged in the response, working to protect wildlife and their habitats, including 36 national wildlife refuges. They are also assessing the damage from the oil spill in preparation for the work that will be needed to restore the Gulf of Mexico. Some 1,643 visibly oiled birds have been collected alive by the U.S. Fish and Wildlife Service, the states and our partners in response to the Deepwater Horizon oil spill. Of those, 594 birds have been rehabilitated and released. Another 1,451 visibly oiled birds have been collected dead. Aerial operations over Louisiana observed an oil sheen covering 300 acres in the northeastern portion of Barataria Bay. A heavily oiled coastline covering about one-half mile was found at Bayou Chalond and heavy oil and tar balls were observed on landfall east of Point-Au-Fer and along Timbalier Island. Beached bird surveys were conducted in Texas, Louisiana, Mississippi, Alabama and Florida. Aerial missions are scheduled for Southwest Pass, Chandeleur Islands, Biloxi Marsh, Barataria Bay, Terrebonne, Marsh Islands, Atchafalaya Delta, Point-Au-Fer and Timbalier Bay.

  – Overall number of personnel responding: approximately 30,100
  – Total vessels responding: more than 4,500
  – Total boom deployed: more than 2,155 miles
  – Boom available: more than 856 miles

- Oily water recovered: more than 34.7 million gallons
- Estimated 11.14 million gallons of oil burned
- Estimated total of more than 1.84 million gallons of dispersant used including:
  + Estimated more than 1.07 million gallons surface dispersant used
  + Estimated more than 771,000 gallons of sub-sea dispersant used
- Estimated approximately 632 miles of Gulf Coast shoreline is currently oiled-approximately 365 miles in Louisiana, 111 miles in Mississippi, 68 miles in Alabama, and 88 miles in Florida.

The USACE, New Orleans District Regulatory Branch has considered and responded to approximately 55 emergency permits related to the Deepwater Horizon oil spill. 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. 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 CONCLUSIONS

The Recommended Plan would create and nourish approximately 20,315 acres of fresh, intermediate, brackish and saline wetlands. This alternative involves construction of a structure capable of diverting up to 35,000 cfs consisting of ten 15-ft x 15-ft box culverts. Additionally, the project will have 31 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal being reconfigured to convey freshwater, nutrient and sediments. Restoration of freshwater, nutrient and sediment inputs to the project area will result in the creation and nourishment of a variety of marsh types within the study area. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area. The project will be operated in a pulsed manner diverting up to 35,000 cfs during March and April and up to 1,000 cfs the rest of the year.

The Recommended Plan is the plan that best meets the Louisiana Coastal Area goals and objectives as well as those identified for the study area in partnership with the State of Louisiana. The Recommended Plan is also the plan that best meets the P&G's four criteria of completeness, effectiveness, efficiency, and acceptability, as well as the Environmental Operating Principles of environmental sustainability, interdependence, balance and synergy, accountability, knowledge, respect, and assessing and mitigating cumulative impacts.

8.3 RECOMMENDATIONS

The District Commander has considered all the significant aspects of this study including the environmental, social, and economic effects, the engineering feasibility, and the comments received from other resource agencies, the Non-Federal Sponsors, and the public and has determined that the Recommended Plan presented in this report is in the overall public interest and a justified expenditure of Federal funds. As a comprehensive approach to restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them by reversing the trend of degradation and deterioration to the area between the Mississippi River and the River aux Chenes ridges, the District Commander recommends the construction of a diversion structure capable of diverting up to 35,000 cfs consisting of ten 15-x-15-ft box culverts. Additionally, 31 acres of ridge and terrace creation, 385 acres of marsh creation utilizing dredged material from an adjacent 223 acres of canal being reconfigured to convey freshwater, nutrient and sediments. Notched weirs would be installed in outflow canals to restrict flow into the River aux Chenes and retain diverted water in the project area. The project will be operated in a pulsed manner diverting up to 35,000 cfs during March and April and up to 1,000 cfs the rest of the year.

The fully funded cost for the project is $387,620,000, inclusive of associated investigation, environmental, engineering and design, construction, supervision and administration, and contingency costs. The operations and maintenance of this project may be assumed by the State of Louisiana as the non-Federal sponsor. The project is funded 65% by the Federal Government and 35% by the non-Federal sponsor, and subject to the implementation requirements and responsibilities specified in Section 3.9 of this report.

The recommendation contained herein reflects the information available at this time, March 2010 price levels, and current Departmental policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program, nor the perspective of higher levels of review within the Executive Branch. Consequently, the recommendation may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation funding.

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9.0 DISTRIBUTION LIST AND OTHER

9.1 DISTRIBUTION LIST

The DEIS was distributed to Federal, state, parish, and local agencies; Tribes; businesses; libraries; museums; universities; environmental organizations, groups and individuals; and scoping participants. The complete distribution list is available upon request from the U.S. Army Corps of Engineers at the following address:

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This Integrated Feasibility Report and SEIS 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 will be available upon request from the USACE at the following address.

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9.4 GLOSSARY

Acceptability – Adequate to satisfy a need, requirement, or standard. One of the U.S. Army Corps of Engineers requirements for a project.

Adaptive management – An interdisciplinary approach acknowledging our insufficient information base for decision-making; that uncertainty and change in managed resources are inevitable; and that new uncertainties will emerge. An iterative approach that includes monitoring and involves scientists, engineers and others who provide information and recommendations that are incorporated into management actions; results are then followed with further research, recommendations and management actions, and so on.

Aggradational Process of Plant Growth – Plant root material building elevation, usually in fresh marsh.

Air Quality Determination – The Louisiana Department of Environmental Quality ensures that projects do not adversely affect air quality through this determination as a requirement of the Clean Air Act.

Alternative Plan – A set of one of more management measures within a subprovince functioning together to address one or more objectives.

Amplitude – The maximum absolute value of a periodically varying quantity.

Anadromous – Ascending rivers from the sea for 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 units resulting from the future without- and future with-project scenarios are annualized, and averaged over the project life, to determine Average Annual Habitat Units (AAHUs).

Aquaculture – The science and business of farming marine or freshwater food fish or shellfish, such as oysters, crawfish, shrimp and trout, under controlled conditions.

Astronomical Tides – Daily tides controlled by the moon, as opposed to wind-generated tides.

Barbary Soils – Soils in swamps (with logs and stumps) that are level, very poorly drained, with a thin mucky surface layer and clayey underlying material.

Benefits – Valuation of positive performance measures.

Benthic – Living on or in sea, lake, or stream bottoms.

Biomass – The total mass of living matter (plant and animal) within a given unit of environmental area.

Bottomland Hardwood Forest – Low-lying forested wetlands found along streams and rivers.

Brackish Marsh (BRM) – Intertidal plant community typically found in the area of the estuary where salinity ranges between 4–15 ppt.

Chenier Plain – Western part of coastal Louisiana with little influence from Mississippi and Atchafalaya rivers.

Clean Water Act Section 404 (b) (1) – There are several sections of this Act that pertain to regulating discharges into wetlands. The discharge of dredged or fill material into waters of the United States is subject to permitting specified under Title IV (Permits and Licenses) of this Act and specifically under Section 404 (Discharges of Dredge or Fill Material) of the Act.

Coastal Zone Consistency Determination – The U.S. Environmental Protection Agency reviews plans for activities in the coastal zone to ensure they are consistent with federally approved State Coastal Management Programs under Section 307(c)(3)(B) of the Coastal Zone Management Act.

Coast-wide Plan – Combination of alternative plans assembled to address an objective of set of objectives across the entire Louisiana Coast.

Collocated Team – A collection of scientists and professionals from the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, NOAA Fisheries, Natural Resources Conservation Service, U.S. Geological Survey, U.S. Environmental Protection Agency, Louisiana Department of Natural Resources, and Louisiana Department of Wildlife and Fisheries that are located at the USACE, New Orleans District, office and work together on the LCA Plan.

Compaction of Holocene Deposits – Deltaic mud that packs down under its own weight.

Completeness – The ability of a plan to address all of the objectives. One of the USACE four requirements for a project.

Comprehensive Plan – Same as Coast-wide Plan.

Conditional 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.

Congressional Authorization – Authorization for investigation to prepare necessary feasibility-level report to be recommended for authorization of potential future project construction by Congress.

Connectivity – Property of ecosystems that allows for exchange of resources and organisms throughout the broader ecosystem.

Continental Shelf – The edge of the continent under gulf waters; the shallow Gulf of Mexico fringing the coast.

Control Structure – A gate, lock, or weir that controls the flow of water.

Crevasse – A breach or gap in the levee or embankment of a river (natural or manmade), through which floodwaters flow.

Cumulative Impacts – The combined effect of all direct and indirect impacts to a resource over time.

Datum – A point, line, or surface used as a reference, as in surveying, mapping, or geology.

Deciduous Forest – Forest composed mostly of trees that lose their leaves in the winter.

Decomposition – Breakdown or decay of organic materials.

Degradation Phase – The phase of the deltaic cycle when sediments are no longer delivered to a delta, and it experiences erosion, dieback, or breakup of marshes.

Deltaic Cycle – Capture of the Mississippi River by a distributary that offered a shorter route to the Gulf of Mexico. After abandonment of an older delta lobe, which would cut off the primary supply of freshwater and sediment, an area would undergo compaction, subsidence, and erosion. The old delta lobe would begin to retreat as the gulf advanced, forming lakes, bays, and sounds. Concurrently, a new delta lobe would begin its advance gulfward.

Deltaic Deposits – Mud and sand deposited at the mouth of a river.

Deltaic Plain – The land formed and reworked as the Mississippi River switched channels in the eastern part of the Louisiana coastal area.

Demersal – Dwelling at or near the bottom of a body of water (e.g., a demersal fish).

Detritus – The remains of plant material that has been destroyed or broken up.

Dewatering – The process of dredged sediments compacting while losing water after being deposited.

Discharge – The volume of fluid passing a point per unit of time, commonly expressed in cubic feet per second, millions of gallons per day, or gallons per minute.

Dissolved Oxygen – Oxygen dissolved in water, available for respiration by aquatic organisms. One of the most important indicators of the condition of a water body.

Direct Impacts – Those effects that result from the initial construction of a measure (e.g., marsh destroyed during the dredging of a canal). Contrast with "Indirect Effects."

Diurnal – Relating to or occurring in a 24-hour period; daily.

Diversion – A turning aside or alteration of the natural course or flow of water. In coastal restoration this usually consists of such actions as channeling water through a canal, pipe, or conduit to introduce water and water-borne resources into a receiving area.

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 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 condition or function.

Effectiveness – Having an intended or expected effect. One of the USACE four requirements for a project.

Efficiency – The quality of exhibiting a high ratio of output to input. One of the USACE four requirements for a project.

Egress – A path or opening for going out; an exit.

Electrical Conductivity – The ability of a medium to conduct electricity. Salt water has a higher electrical conductivity than freshwater, and this property allows the measurement of salinity through a simple meter.

Embankment – A linear mound of earth or stone existing or built to hold back water or to support a roadway.

Encroachment –Entering gradually into an area not previously occupied, such as a plant species distribution changing in response to environmental factors such as salinity.

Endangered Species – Animals and plants that are threatened with extinction.

Endpoints – see Objectives

***Engineering News Record* (*ENR*)** – A magazine that provides news needed by anyone in or from the construction industry.

Enhance – To augment or increase/heighten the existing state of an area.

Entrenchment – Being firmly embedded.

Environmental Impact Statement (EIS) – A document that describes the positive and negative environmental effects of a proposed action and the possible alternatives to that action. The EIS is used by the Federal Government and addresses social issues as well as environmental ones.

Estuary – A semi-enclosed body of water with freshwater input and a connection to the sea where freshwater and saltwater mix.

Estuarine – Related to an estuary.

Evaporation – The process by which any substance is converted from a liquid state into, and carried off in, vapor; as, the evaporation of water.

Exotic Species – Animal and plant species not native to the area; usually undesirable (e.g., hyacinth, nutria, tallow tree, giant salvinia).

Faulting – A fracture in the continuity of a rock formation caused by a shifting or dislodging of the earth's crust, in which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture.

Feasibility Report – A description of a proposed action, previously outlined in a general fashion in a Reconnaissance Report, that will satisfy the Federal interest and address the problems and needs identified for an area. It must include an assessment of impacts to the environment (either in an Environmental Assessment, or the more robust Environmental Impact Statement), an analysis of alternative methods of completion, and the selection of a Recommended Plan through the use of a cost-effectiveness analysis.

Feature – A constructible increment of an alternative plan.

Federal Principals Group (FPG) –A collaboration among Federal agencies at the Washington level to facilitate the flow of information, to provide guidance and recommendations to the USACE and LDNR throughout the study process, and to facilitate resolution of any interagency issues that may be identified in the conduct of the study.

Final Array – The final grouping of the most effective coast-wide plans from which a final recommendation can be made.

Foreshore Dikes – An embankment of earth and rock built to prevent floods or erosion that is built in the area of a shore that lies between the average high tide mark and the average low tide mark.

Framework Development Team (FDT) – A group of professionals from various Federal and state agencies, academia and the public formed to provide a forum for individual members to discuss LCA Comprehensive Study activities and technical issues and to provide comments to the Senior Management Committee.

Fresh Marsh (FAM) – Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 0–3 ppt.

Furbearer – An animal whose skin is covered with fur, especially fur that is commercially valuable, such as muskrat, nutria, and mink.

Geomorphic – Related to the geological surface configuration.

Geosynclinal Down-warping – The downward bend or subsidence of the earth's crust, which allows of the gradual accumulation of sediment

Geotropically – Downward growth in response to gravity, as in plant roots.

Glycophytes – A plant that cannot live in high salinity environments, most plants.

Goals – Statements on what to accomplish and/or what is needed to address a problem without specific detail.

Gradient – A slope; a series of progressively increasing or decreasing differences in a system or organism.

Habitat – The place where an organism lives; part of physical environment in which a plant or animal lives.

Habitat Loss – The disappearance of places where target groups of organisms live. In coastal restoration, usually refers to the conversion of marsh or swamp to open water.

Habitat Units (HUs) – Represent a numerical combination of quality (HIS) and quantity (acres) 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 project life, to determine Average Annual Habitat Units (ASHUs). The "benefit" of a project can be quantified by comparing AAHUs between the future without- and future with-project scenarios. The difference is AAHUs between the two scenarios represents the net benefit attributable to the project in terms of habitat quantity and quality.

Hazardous, Toxic, and Radioactive Wastes (HTRW) – Projects features must be examined to ensure that their implementation will not result in excessive exposure to pollutants possibly located in the study area.

Headland – A point of land projecting into the sea or other expanse of water, still connected with the mainland.

Herbaceous – A plant with no persistent woody stem above ground.

Hydrodynamic – The continuous change or movement of water

Hydrology – The pattern of water movement on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hypoxia – The condition of low dissolved oxygen concentrations.

Indemnification – Insurance against or compensation for loss or damage.

Indirect Impacts – Those effects that are not as a direct result of project construction, but occur as secondary impacts due to changes in the environment brought about by the construction. Contrast with "Direct Impacts."

Infrastructure – The basic facilities, services, and installations needed for the functioning of a community or society, such as transportation and communications systems, water and power lines, and public institutions including schools, post offices, and prisons.

Ingress – An entrance or the act of entering.

Inorganic – Not derived from living organisms; mineral; matter other than plant or animal.

Interdistributary Deposits – Sand and mud deposited between the river channels or between bayous.

Intermediate Marsh (INM) – Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 2–5 ppt.

Intertidal – Alternately flooded and exposed by tides.

Invertebrates – Animals without backbones, including shrimp, crabs, oysters, and worms.

Keystone Strategy – A strategy that other strategies rely upon for successful implementation.

Land-water Ratio – The relative proportion or wetlands and uplands to water in an area.

Larvae – The stage in some animal's life cycles between egg and adult (most invertebrates).

Leeward – Sheltered from the wind; away from the wind.

Levee – A linear mound of earth or stone built to prevent a river from overflowing; a long, broad, low ridge built by a stream on its flood plain along one or both banks of its channel in time of flood.

Loamy – Soil composed of a mixture of sand, clay, silt, and organic matter.

Maintain – To keep in existing state.

Measure – A programmatic restoration feature that can be assembled with other measures to produce alternative plans. See also "Project."

Methodology – A set of practices, procedures, and rules.

Mineral Substrate – Soil composed predominately of mineral rather than organic materials; less than 20 percent organic material.

Mudflats – Flat, unvegetated wetlands subject to periodic flooding and minor wave action.

Myatt Series – Gray terrace soil, with whitish, pebbly subsoil.

National Ecosystem Restoration (NER) – USACE standard for cost-effectiveness based on ecosystem, not economic, benefits.

Near-shore Currents – Movement of water parallel to the shoreline. Usually generated by waves breaking on the shore at an angle other than perpendicular.

National Environmental Policy Act (NEPA) – Ensures that Federal agencies consider the environmental impacts of their actions and decisions. NEPA requires all Federal agencies to consider the values of environmental preservation for all significant actions and prescribes procedural measures to ensure that those values are fully respected.

Net Gain – The amount of cumulative land gain less land loss, when gain is greater than loss.

Net Loss – The amount of cumulative land gain less land loss, when gain is less than loss.

No Action Alternative – The alternative in the LCA Plan which describes the ecosystem of the coastal area if no restoration efforts/projects were done.

Nursery – A place for larval or juvenile animals to live, eat, and grow.

Objectives – More specific statements than "Goals," describing how to achieve the desired targets.

Oceanic-dumping – The discharge of wastes or pollutants into offshore waters.

Organic – Composed of or derived from living things.

Oscillations – Fluctuations back and forth, or up and down.

Oxidation of Organic Matter – The decomposition (rotting, breaking down) of plant material through exposure to oxygen.

Oxygen-depleted – Situation of low oxygen concentrations where living organisms are stressed.

Petrochemical – Any compound derived from petroleum or natural gas.

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 project rate of loss of function is "Reduce." The lowest possible scale was no further action above and beyond existing projects and programs.

Point-Bar Deposit – The shallow depositional area on the inside bank of a river bend.

Post-larval – Stage in an animal's lifecycle after metamorphosis from the larval stage, but not yet fully grown.

Potable Water – Water that is fit to drink.

ppt – parts per thousand. The salinity of ocean water is approximately 35 ppt.

Primary Consolidation/Secondary Compression – Two processes acting on a substrate that has a load applied to it to cause the sediment to increase in density, and decrease in volume.

Prime Farmland – Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion. One of the categories of concern in the EIS.

Principles – Framing statements that can be used to evaluate alternatives while considering issues that affect them. Used along with targets and assessments of ecosystem needs to provide guidance in formulation of alternative plans.

Productivity – Growth of plants and animals.

Progradation – The phase during the deltaic cycle where land is being actively accreted through deposition of river sediments near the mouth.

Programmatic Environmental Impact Statement (PEIS) – and Environmental Impact Statement that supports a broad authorization for action, contingent on more specific detailing of impacts from specific measures.

Project – A constructible increment of an alternative plan.

Project Implementation Report (PIR) – A project-specific follow-up report that expands on the information contained in a Programmatic Feasibility Report to ensure NEPA compliance, such as conducting public meetings, preparing the appropriate environmental documentation, and preparing the engineering designs as specifications necessary to build the project.

Province – A major division of the coastal zone of Louisiana. (e.g., Deltaic Plain and Chenier Plain).

Pulsing – Letting a diversion flow periodically at a high rate for a short time, rather than continuously.

Quantitative – Able to assign a specific number; susceptible to measurement.

Radiocarbon Age Determination –The use of the ratio of carbon isotopes to determine age.

Rebuild – To some extent build back a structure/landform that had once existed.

Reconnaissance Report – A document prepared as part of a major authorization that examines a problem or need and determines if sufficient methods and Federal interest exists to address the problem/need. If so, then a “Feasibility Report” is prepared, which details the solution and its impacts further.

Reduce – To diminish the rate or speed of a process.

Regional Working Group (RWG) – An interagency team formed to support the Washington-level Federal Principal’s Group and to facilitate regional level collaboration and coordination on the LCA study.

Rehabilitate – To focus on historical or pre-existing ecosystems as models or references while emphasizing the reparation of ecosystem processes, productivity and service.

Relative Sea Level Rise – The sum of the sinking of the land (subsidence) and eustatic sea level change; the change in average water level with respect to the surface.

Restore – Return a wetland to a close approximation of its condition or function prior to disturbance by modifying conditions responsible for the loss or change; re-establish the function and structure of that ecosystem.

Sangamonian Interglacial Period – the last interglacial period before the Holocene period (the current geological period).

Saline Marsh (SAW) – Intertidal herbaceous plant community typically found in that area of the estuary with salinity ranging from 12–32 ppt.

Salinity – The concentration of dissolved salts in a body of water, commonly expressed as parts per thousand.

Salt Marshes – See "Saline Marsh."

Scoping – Soliciting and receiving public input to determine issues, resources, impacts, and alternatives to be addressed in the draft EIS.

Sea-Level – Long-term average position of the sea surface.

Sediment Plume – Caused by sediment rich rainwater runoff entering the ocean. The runoff creates a visible pattern of brown water that is rich in nutrients and suspended sediments that forms a kind of cloud in the water spreading out from the coastline. Commonly forms at river and stream mouths, near sloughs, and along coasts where a large amount of rain runoff flows directly into the ocean.

Sheet Flow – Flow of water, sediment, and nutrients across a flooded wetland surface, as opposed to through channels.

Shoaling – The shallowing of an open-water area through deposition of sediments.

Slikensides – The smooth or partially polished surface of rock caused by one rock mass sliding over another in a fault plane.

Social – Relating to human society and its modes of organization.

Socioeconomic – Involving both social and economic factors.

Spoil Banks – Dredged material removed from canals and piled in a linear mound along the edge of canals.

Stabilize – To fix the level or fluctuation of; to make stable.

State Historic Preservation Office (SHPO) – The part of the Louisiana Department of Culture, Recreation, and Tourism that deals with Indian sites and other archaeological remains.

Stillstand – A period of time when sea level did not change.

Storm Overwash – The process by which sand is transposed landward over the dunes during a storm event by waves.

Storm Surge – An abnormal and sudden rise of the sea along a shore as a result of the winds of a storm.

Stough soils – Yellowish brown coarse-loamy soil.

Strategy – Ecosystem restoration concept from the Coast 2050 Plan.

Stream Gaging Data – Records of water levels in streams and rivers.

Submergence – Going under water.

Subprovince – The divisions of the two Provinces (see "Province") into smaller groupings: 1) east of the Mississippi River; 2) west of the Mississippi River to Bayou Lafourche; 3) Bayou Lafourche to Freshwater Bayou; 4) Freshwater Bayou to Sabine River.

Subsidence – The gradual downward settling or sinking of the Earth's surface with little or no horizontal motion.

Sustain – To support and provide with nourishment to keep in existence; maintain.

Tarbert Flow – Stream gage data recorded at Tarbert's Landing on the Mississippi River.

Target – A desired ecosystem state that meets and objective or set of objectives.

Terrestrial Habitat – The land area or environment where an organism lives; as distinct from water or air habitats.

Third Delta – A proposed project that would divert up to 120,000 cubic feet of water per second from the Mississippi River near Donaldsonville, Louisiana down a conveyance channel to the marshes in southern Barataria and Terrebonne Basins.

Toxicity – The measure of how poisonous something is.

Transpiration – The process by which water passes through living plants into the atmosphere.

Turbidity – The level of suspended sediments in water; opposite of clarity or clearness.

Unique Farmland – Land other than Prime Farmland (see "Prime Farmland") that is used for the production of specific high-value food and fiber crops, such as citrus, tree nuts, olives, cranberries, fruits, and vegetables.

Upconing – The tendency of underground saltwater to move closer to the surface in the vicinity of a well by drawing fresh ground water out.

Upland (UPL) – A general term for non-wetland elevated land above low areas along streams or between hills.

Water Resource Units (WRU) – Stage-damage data developed as part of the Flood Damage Estimation System (FDES) in 1980 for the Mississippi River and Tributaries (MR&T) project were used to estimate the flood damages that are expected to occur in subprovinces 1, 2, and 3. The data collected for the FDES were delineated into geographic areas with homogenous physical and hydraulic characteristics. These geographic areas were numerically coded and designated as Water Resource Units (WRUs). Within each WRU, land-use elements (structures, cropland, roads, bridges, railroads, etc.) were categorized by location, value, and corresponding depth-damage relationship. The structural damage categories included residential, commercial, industrial, public, and farm buildings.

Water Resources Development Act (WRDA) – A bill passed by Congress that provides authorization and/or appropriation for projects related to the conservation and development of water and related resources.

Weir – A dam placed across a canal or river to raise, divert, regulate or measure the flow of water.

9.5 ACRONYMS AND ABBREVIATIONS

ASA(CW)	Assistant Secretary of the Army for Civil Works
ATR	Agency Technical Review
CAA	Clean Air Act
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CIAP	Coastal Impact Assistance Program
CPRA	Coastal Protection and Restoration Authority (State of Louisiana)
CRCL	Coalition to Restore Coastal Louisiana
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
CZM	Coastal Zone Management
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ER	Engineering Regulation
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FMP	Fisheries Management Plan
GIS	Geographic Information System
GIWW	Gulf Intracoastal Waterway

GMFMC	Gulf of Mexico Fishery Management Council
HET	Habitat Evaluation Team
HSDRRS	Hurricane and Storm Damage Risk Reduction System
HTRW	Hazardous, Toxic, and Radioactive Waste
IPET	Interagency Performance Evaluation Task force
IPDT	Interagency Project Delivery Team
IWR	Institute of Water Resources
LACPR	Louisiana Coastal Protection and Restoration
LCA	Louisiana Coastal Area (*Ecosystem Restoration Study*, 2004)
LCWRP	Louisiana Coastal Wetlands Restoration Plan
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LERRD	Land, Easements, Rights-Of-Way, Relocation, and Disposal Areas
LEQA	Louisiana Environmental Quality Act
LNHP	Louisiana Natural Heritage Program
LOSCO	Louisiana Oil Spill Coordinator's Office
LPBF	Lake Pontchartrain Basin Foundation
MDWD	Medium Diversion at White Ditch
MR&T	Mississippi River and Tributaries
MSA	Metropolitan Statistical Area
MVD	USACE Mississippi Valley Division
MVN	USACE New Orleans District
MVR	USACE Rock Island District
MVS	USACE St. Louis District
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NAVD	North American Vertical Datum
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NGO	Non-Governmental Organization
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWRC	National Wildlife Research Center
CPRA	Coastal Protection and Restoration Authority
O&M	Operation and Maintenance
OMRR&R	Operation and Maintenance, Repair, Replacement and Rehabilitation
PEIS	Programmatic Environmental Impact Statement
PDT	Project Delivery Team
PPL	Project Priority List
S&T	Science and Technology

SEIS	Supplemental Environmental Impact Statement
USACE	U.S. Army Corps of Engineers
USDA-SCS	United States Department of Agriculture, Soil Conservation Service
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCRF	Wetlands Conservation and Restoration Fund
WVA	Wetland Value Assessment
WRDA	Water Resources Development Act

Appendix A

Biological Assessment

Appendix B

U.S. Fish and Wildlife Service Coordination Letter and Support (includes WVA Appendix and revised/updated information on WVA benefits and assumptions)

Appendix C

NOAA Fisheries Service Coordination Letter

Appendix D

404(b)(1) Water Quality Report

Appendix E

Louisiana Coastal Resources Program Consistency Determination

Appendix F

State Historic Preservation Officer Coordination Letter

Appendix G

Responses to Comments

Appendix H

Value Engineering Study Report

Appendix I

Monitoring and Adaptive Management Plan

Appendix J

Real Estate Plan

Appendix K

Benefit / Cost – Incremental Cost Analysis

Appendix L

Engineering Appendix

Appendix M

Hazardous, Toxic, and Radioactive Waste Initial Assessment Documentation

Appendix N

Qualitative Induced Shoaling Analysis