Appendix B

U.S. Fish and Wildlife Service Coordination Act Report and Wetland Value Assessment Assumptions and Analysis

Final

Fish and Wildlife Coordination Act Report

Louisiana Coastal Area
Medium Diversion at White Ditch
Plaquemines Parish, Louisiana

PROVIDED TO
NEW ORLEANS DISTRICT
U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS, LOUISIANA

PREPARED BY
KEVIN ROY, SENIOR FIELD BIOLOGIST
AND
CATHERINE BREAUX, SENIOR FIELD BIOLOGIST

U.S. FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
LAFAYETTE, LOUISIANA

AUGUST 2010

U.S. FISH AND WILDLIFE SERVICE – SOUTHEAST REGION

TABLE OF CONTENTS

Page

No table of contents entries found.

ATTACHMENTS

FIGURES

TABLES

Executive Summary

The U.S. Fish and Wildlife Service (Service) has prepared this final Fish and Wildlife Coordination Act Report (FWCAR) for the proposed Louisiana Coastal Area (LCA), Medium Diversion at White Ditch Project (MDWD), Plaquemines Parish, Louisiana. The Corps of Engineers, New Orleans District (Corps) is preparing a draft Environmental Impact Statement and Feasibility Report.

This report contains a description of the existing fish and wildlife resources of the project area, discusses future with- and without-project habitat conditions, identifies fish and wildlife related impacts of the proposed project, and provides recommendations for the proposed project. This document constitutes the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). A draft report was provided to the Louisiana Department of Wildlife and Fisheries (LDWF) and the National Oceanic and Atmospheric Administration's, National Marine Fisheries Service (NOAA's NMFS) and their comments have been incorporated into this final report.

The White Ditch Diversion study area is located in Plaquemines Parish, Louisiana, east of the Mississippi River in the Breton Sound Basin. The diversion structure itself would be located along the east bank of the Mississippi River between the communities of Belair and Phoenix. The purpose of the diversion is to provide fresh water, nutrients, and sediments to the area between the Mississippi River and the River aux Chenes (former distributary of the Mississippi River). Diversion of Mississippi River water into the study area will facilitate sediment deposition, increase organic production, increase biological productivity, reduce marsh loss, and improve fish and wildlife habitat. The study area encompasses emergent marsh and shallow open water habitats. The primary area of benefit consists of marsh and open water habitats between the Mississippi River and River aux Chenes. A secondary area of benefit would occur east of the River aux Chenes. Study area wetlands support nationally important fish and wildlife resources including intermediate, brackish, and saline marshes.

During the alternatives analysis, the no-action alternative and several diversion alternatives were considered. Diversion sizes ranged from a 5,000 cubic feet per second (cfs) diversion to a 35,000 cfs diversion. Two locations along the Mississippi River and different types of diversion structures (e.g., box culverts, siphons, gated structures) were also investigated. Also investigated were certain types of outfall management features to distribute diversion flows more evenly throughout the study area. Outfall management features included enlargement of existing channels, plugs, weirs, and culverts. In addition, any material dredged to enlarge existing channels would be used beneficially to create marsh and forested ridge habitat.

The tentatively selected plan (TSP) diversion structure consists of ten 15 foot by 15 foot box culverts capable of passing flows as high as 35,000 cfs located in an area of the river with the potential for high sediment load to promote sediment distribution through the structure. The outfall management features consist of excavating 230 acres of marsh and shallow water area to create a new channel and enlarge existing channels and distributaries to better distribute diversion flows of up to 35,000 cfs. This excavated material will be placed on organic marsh soils and aquatic substrates to create approximately 31 acres of ridges lining the outfall channels

and following the historic Bayou Garelle distributary channel and 385 acres of created marsh in locations adjacent to the outfall channels and distributary network. There will be weirs placed as flow constrictors to retain as much fresh water and sediment as possible within the study area.

The TSP 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.

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.

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.

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.

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.

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).

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.

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.

9. Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, 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.

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.

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.

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.

INTRODUCTION

The U.S. Army Corps of Engineers, New Orleans District (Corps) is preparing a draft Environmental Impact Statement (DEIS) for the proposed Louisiana Coastal Area (LCA), Medium Diversion at White Ditch Project (MDWD), Plaquemines Parish, Louisiana.

This report contains a description of the existing fish and wildlife resources of the project area, discusses future with- and without-project habitat conditions, identifies fish and wildlife-related impacts of the proposed project, and provides recommendations for the proposed project. This document constitutes the final report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). A draft report was provided to the Louisiana Department of Wildlife and Fisheries (LDWF) and the National Oceanic and Atmospheric Administration's, National Marine Fisheries Service (NOAA's NMFS), and their comments have been incorporated into this final report.

DESCRIPTION OF THE STUDY AREA

The MDWD study area is located in Plaquemines Parish, Louisiana, east of the Mississippi River in the Breton Sound Basin (Figure 1). The diversion structure itself would be located along the east bank of the Mississippi River between the communities of Belair, Louisiana and Phoenix, Louisiana. The purpose of the diversion is to provide fresh water, nutrients, and sediments to the area between the Mississippi River and the River aux Chenes. Diversion of Mississippi River water into the study area will facilitate sediment deposition, increase organic production, increase biological productivity, reduce marsh loss, and improve fish and wildlife habitat. The study area encompasses emergent marsh and shallow open water habitats. The primary area of benefit consists of marsh and open water habitats between the Mississippi River and River aux Chenes. A secondary area of benefit would occur east of the River aux Chenes. Study area wetlands support nationally important fish and wildlife resources including fresh, intermediate, brackish, and saline marshes.

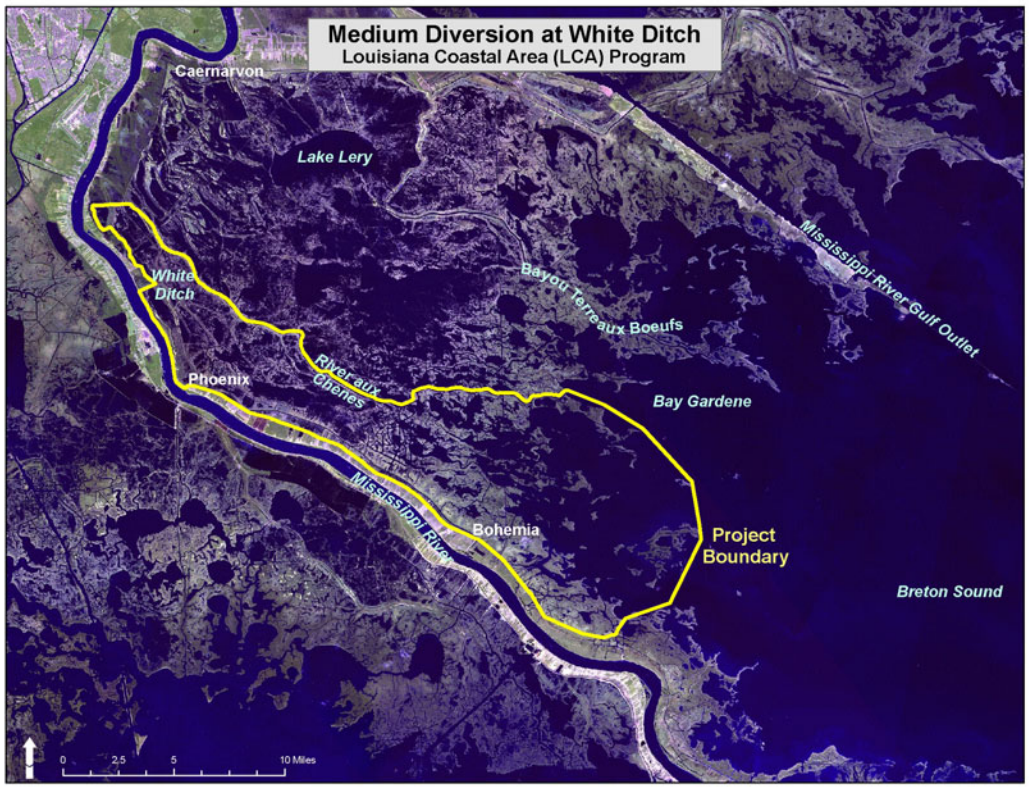
The project area encompasses over 98,000 acres of intermediate to saline intertidal wetland habitats. The study area boundary follows distinct landscape features beginning in the north with the confluence of the non-Federal back levee and the forty-arpent canal, extending south (i.e., paralleling the Mississippi River) along the non-Federal back levee, the Mississippi River Mainline levee, the New Orleans to Venice Federal back levee and along the left descending natural bank of the Mississippi River, then it proceeds to the west; past American Bay, California Bay, and through Breton Sound, near Bay Gardene to the south; into and along River aux Chenes which forms the eastern boundary and returns back to the beginning point. The area has been significantly impacted by recent tropical storms and hurricanes and is somewhat isolated from the effects of the Caernarvon freshwater diversion, located at the northern end of the Breton Sound Basin.

There are two discrete project areas that were 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 benefitted by the diverted freshwater. The footprint of both of these areas depends upon the overall size and capacity of the diversion structure recommended.

The area 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. Channel construction, subsidence, erosion, saltwater intrusion, and storm-related damages have all significantly altered the natural environment, causing extensive losses of wetland habitats.

Figure 1. Medium Diversion at White Ditch Study Area, Plaquemines Parish, Louisiana.



FISH AND WILDLIFE RESOURCES

Wildlife Resources

The coastal wetlands in the study area provide important and essential fish and 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. Fresh and intermediate marshes support the greatest concentrations of wintering waterfowl in coastal Louisiana. Wintering waterfowl use is high in parts of the Breton Sound basin which includes the MDWD study area. 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.

Coastal Louisiana's wetlands also support millions of neotropical and other migratory avian species such as rails, gallinules, shorebirds, wading birds and numerous songbirds. Louisiana coastal wetlands provide neotropical migratory birds essential stopover habitat on their annual migration route. Wading bird colonies are present where suitable habitat is found in the area and numbers have been steady or increasing in those areas.

The wetlands of the study area provide habitat for many different furbearers, rabbits, and deer. Game mammals and furbearers are generally associated with forested wetlands. The wetlands of the Breton Sound basin were historically important for the production of furbearers. In recent years, fur production has been on a downward trend. This decline is largely attributed to saltwater intrusion and a corresponding reduction in carrying capacity for fur animals such as muskrat and nutria (Kerlin 1979).

According to Dundee and Rossman (1989), several amphibians and reptiles occupy a wide variety of habitats throughout the basin. American alligator abundance has been increasing in the upper portions of the basin and declining in the lower portions, but overall has declined as fresh marsh converted to intermediate and brackish marsh. The eastern portion of Plaquemines Parish, which includes the MDWD study area, suffered major habitat damage from Hurricanes Katrina and Rita in 2005, resulting in a severe reduction in alligator nest production in 2006.

Fisheries Resources

Louisiana’s coastal estuaries are the most productive in the Nation. The majority of the MDWD study area is considered estuarine habitat. Even though extensive areas of marsh have been lost in coastal Louisiana, commercial harvest and recreational catches of most estuarine fishery species have not diminished (NMFS 2006). It is important to note that recreational catch and commercial landings are fishery dependent data. The increase in Louisiana landings may reflect the expansion of the commercial fishing industry, the growing efficiency in harvest technologies, and the growing demand for seafood over the past century. One hypothesis to explain continued high fisheries production is that as marshes have deteriorated, tremendous amounts of organic detritus have been released into the estuarine system, consequently driving high levels of primary productivity. High primary productivity increases the resources available for secondary productivity. Additionally, an increase in marsh to water interface (i.e., marsh edge), and the

formation of shallow, protected lagoons and ponds, has resulted in prime areas for growth and development of estuarine species (Browder et al. 1985; Browder et al. 1989; Minello and Rozas 2002). At the same time, saltwater intrusion into previously low-salinity areas has increased the amount of estuarine area available to estuarine and marine fishery species (Chesney et al. 2000; Zimmerman et al. 2000). However, this intrusion can exacerbate marsh loss in those areas (Chabreck and Linscombe 1982; McKee and Mendelssohn 1989).

The American oyster is indigenous to coastal Louisiana and provides a rich ecological and commercial resource. This organism is unique in that it does not migrate like other estuarine species. Salinity plays a key role in oyster sustainability. Typically, they proliferate in salinities ranging from 5 to 15 parts per thousand. Fresher waters fail to support biological function, and more saline waters promote disease and predation. Production of oysters in Louisiana has been relatively stable for the last 50 years, with harvest from public beds replacing the decreasing harvest from private leases. The Louisiana oyster industry has been experiencing many stressors over the past several decades that threaten the long-term sustainability of both the industry and the resource. Increasing coastal land loss is reducing the amount of marsh that provides shelter to reefs, and saltwater intrusion is exacerbating disease and predation.

Essential Fish Habitat

The project is located within an area identified as Essential Fish Habitat (EFH) by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA, Magnuson-Stevens Act; P.L. 104-297). The updated and revised 2006 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council, identifies EFH in the project area to be estuarine emergent wetlands, submerged aquatic vegetation, mud, sand, shell, and rock substrates, and estuarine water column. Under the MSFCMA, wetlands and associated estuarine waters in the project area are identified as EFH for various Federally managed species including: juvenile brown and white shrimp; eggs, larvae/postlarvae, and juvenile Gulf stone crab; and larvae/postlarvae, juvenile, and adult red drum.

In addition to being designated as EFH for these species, 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). (NMFS 2008)

In the future without the project, estuarine marsh is the primary type of EFH impacted by continued wetland loss and deterioration. Although an increase in some types of EFH (i.e., mud bottom and estuarine water column) would occur, adverse impacts would occur to more productive types of EFH (i.e., estuarine emergent wetlands). The loss of estuarine emergent wetlands would result in negative impacts to juvenile brown and white shrimp; eggs,

larvae/postlarvae, and juvenile Gulf stone crab; and larvae/postlarvae, juvenile and adult red drum.

Threatened and Endangered Species and Species of Concern

Within the MDWD study area there are two endangered species, pallid sturgeon (*Scaphirhynchus albus*) and West Indian manatee (*Trichechus manatus*) under the Federal jurisdiction of the USFWS and/or the NMFS and several species of concern, including bald eagle (*Haliaeetus leucocephalus*), brown pelican (*Pelecanus occidentalis*) and other colonial wading birds protected under the Migratory Bird Treaty Act (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.) and/or the Bald and Golden Eagle Act (54 Stat. 250, as amended, 16 U.S.C. 668a-d).

Species of Concern

Colonial nesting birds

The proposed project would be located in an area where colonial nesting waterbirds may be present. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial 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.

Brown Pelican

Brown pelicans were delisted (due to recovery) on December 17, 2009, and are no longer protected under the ESA, but they are still protected by the Migratory Bird Treaty Act (MBTA). Brown pelicans may occasionally feed in the shallow estuarine waters found within the project area; however, no nesting colonies are known to occur there.

Bald Eagle

The project-area forested wetlands may provide nesting habitat for the bald eagle, which has officially been removed from the List of Endangered and Threatened Species as of August 8, 2007. Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water in the southeastern Parishes. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Although the bald eagle has been removed from the threatened and endangered species list, it continues to be protected under the Migratory Bird Treaty Act (MBTA) and the Bald and Gold

Eagle Protection Act (BGEPA). The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations regarding how to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. Those guidelines recommend maintaining: (1) a specified distance between the activity and the nest (buffer area); (2) natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. A copy of the NBEM Guidelines is available at: http://www.fws.gov/migratorybirds/issues/BaldEagle/NationalBaldEagleManagementGuidelines.pdf. If after consulting those guidelines you need further assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, please contact this office.

Threatened and Endangered Species

Pallid Sturgeon

Recent evidence raises the possibility that the Federally endangered pallid sturgeon could occur in the Mississippi River adjacent to the project area. The pallid sturgeon is an ancient species of fish that requires large, turbid, free-flowing riverine habitat with rocky or sand substrate. They are usually found on the bottoms of the rivers on sand flats or gravel bars, and apparently prefer areas with strong currents in or near the main channel. It is one of the largest and rarest fish in the Mississippi and Missouri River basins. Pallid sturgeon are opportunistic feeders that eat insects, crustaceans, mollusks, annelids, fish and eggs of other fish. Scant information exists on the range and habitat preferences of pallid sturgeon for this part of the Mississippi River. Most data are from populations in upper Missouri and other Midwest rivers, and also the Atchafalaya River in Louisiana, however, it is possible that limited numbers of the species also exists in the Red River. Surveys are currently being conducted to determine the presence/absence of this species in the lower reaches of the Mississippi River, including the reach adjacent to the MDWD study area.

West Indian Manatee

Federally listed as an endangered species, West Indian manatees occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

If project construction has not been initiated within 1 year, follow-up consultation should be accomplished prior to making expenditures for construction. If the scope or location of the proposed work is changed, consultation should be reinitiated as soon as such changes are made.

ALTERNATIVES UNDER CONSIDERATION

During the alternatives analysis, the no-action alternative and several diversion alternatives were considered. Diversion sizes ranged from a 5,000 cubic feet per second (cfs) to a 100,000 cfs diversion. Five locations along the Mississippi River and different types of diversion structures (e.g., box culverts, siphons) were also investigated. Also investigated were certain types of outfall management features to better distribute diversion flows and retain as much fresh water and sediment as possible within the study area. Outfall management features included enlargement of existing channels, guide levees, distributaries, culverts, and channel constrictions. In addition, any material dredged to enlarge existing channels would be used beneficially to create marsh and ridge habitat.

Preliminary screening eliminated the 45,000, 75,000 and 100,000 cfs alternatives from further consideration as well as all but two diversion locations. Therefore, an initial array of alternatives was further evaluated for selection of a final array. Each diversion alternative was evaluated under the assumption that the diversion would be open at all times unless the flow of the Mississippi River dropped below 300,000 cfs. The initial array of alternatives is found in the table below. Diversion size indicates the maximum flow that could occur through the diversion structure.

Table 1: Initial Array of Alternatives.

Location/Alternative	Maximum Diversion Flow
No Action	
Location 2 - White Ditch	5,000 cfs
Location 2 - White Ditch	10,000 cfs
Location 2 - White Ditch	15,000 cfs
Location 2 - White Ditch	35,000 cfs
Location 3 – Phoenix	5,000 cfs
Location 3 – Phoenix	10,000 cfs
Location 3 – Phoenix	15,000 cfs
Location 3 - Phoenix	35,000 cfs

The Medium Diversion at White Ditch Project Delivery Team (PDT) met on December 1, 2009, to select the final array of alternatives to be evaluated. Based on the results of the incremental cost/cost-effectiveness analysis, three alternatives were selected for the final array; 1) a 10,000 cfs diversion at Location 3, 2) a 15,000 cfs diversion at Location 3, and 3) a 35,000 cfs diversion at Location 3. Those three alternatives, along with the No Action Alternative, were selected for the final array. Subsequently, a 5,000 cfs diversion at Location 3 was added to the final array because it was determined to be a cost-effective alternative and was the least expensive.

The PDT met again on January 6, 2010, to review the results of the second incremental cost/cost-effectiveness analysis that was conducted on the final array. The purpose of that meeting was to select the Tentatively Selected Plan (TSP). Based on the results of the incremental cost/cost-effectiveness analysis and consideration of the Corps' Principles and Guidelines Criteria (i.e., acceptability, completeness, effectiveness, and efficiency), the 35,000 cfs diversion near Phoenix, Louisiana was selected as the TSP.

The TSP (Figure 2) diversion structure consists of ten 15 foot by 15 foot box culverts capable of flows as high as 35,000 cfs located in an area of the river with the potential for high sediment load to promote sediment distribution through the structure. The intent of the diversion is to have an operational plan which included a March-April diversion pulse (open structure) and a flow of 1,000 cfs during the remainder of the year as long as Mississippi River flows exceeded 300,000 cfs. This operational plan was selected over an open operation plan utilized earlier for several reasons; 1) a spring pulse reduces impacts from over-freshening that would occur to estuarine-dependent fisheries; 2) open operation, while achieving no net loss of wetlands, would not achieve the project goal of maintaining a gradient of marsh types in the study area, 3) a pulsed operation is preferred by the public/stakeholders because of its reduced impacts to marine fisheries and oyster production in the estuary. This operation would also closely resemble the natural overbank flooding the occurred prior to the construction of the Mississippi River levees.

Figure 2. Tentatively Selected Plan for Medium Diversion at White Ditch Feasibility Study, a 35,000 cfs diversion near Phoenix, Louisiana.

The outfall management features consist of excavating 230 acres of marsh and shallow water area to creating a new channel and enlarge existing channels and distributaries to better

distribute diversion flows of up to 35,000 cfs. This excavated material will be placed on organic marsh soils and aquatic substrates to create approximately 31 acres of ridges lining the outfall channels and following the historic Bayou Garelle distributary and 385 acres of created marsh in locations adjacent to the outfall channels and distributary. There will be weirs placed as flow constrictors to retain as much fresh water and sediment as possible within the study area (Figure 2).

EVALUATION METHOD

Direct impacts and benefits to coastal marsh habitats were quantified by acreage and habitat quality (i.e., average annual habitat units or AAHUs) by the Service and are presented in Table 1. The Service used the Wetland Value Assessment (WVA) methodology to quantify benefits/ impacts. The WVA is used to evaluate proposed Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects, and is similar to the Service's HEP, in that habitat quality and quantity (acreage) are measured for baseline conditions, and predicted for future without-project and future with-project conditions. As with HEP, the WVA provides a quantitative estimate of project-related impacts to fish and wildlife resources; however, the WVA is based on separate models for fresh/intermediate marsh, brackish marsh, and saline marsh. WVAs and assumptions for the TSP are available in Attachment A. WVA and assumption information on the final array of alternatives are available for review at the Service's Lafayette, Louisiana, field office.

To determine wetland benefits (net acres) for each alternative, the Sediment and Nutrient Delivery Model-Version 2 (SAND2), developed by the Engineering Research and Development Center (ERDC) and Mr. Ron Boustany of the Natural Resources Conservation Service (NRCS) was utilized by the Habitat Evaluation Team (HET). The SAND2 model estimates the benefits resulting from the introduction of sediments and nutrients into the study area. Model predictions are based on diversion flows into the project area and nutrient and sediment concentrations of the diversion water. The model derives an estimate of the wetland acreage sustained and/or created as a function of nutrients and sediments introduced into the system.

The final array was evaluated by the HET using the WVA (Table 2). The SAND2 model was run for each final alternative and results (wetland acres) utilized in the WVA. Each final alternative was evaluated under an operational plan which included a March-April diversion pulse (open structure) and a flow of 1,000 cfs during the remainder of the year as long as Mississippi River flows exceeded 300,000 cfs.

Table 2: Benefits for Final Array of Alternatives, in Average Annual Habitat Units (AAHUs).

Alternative	Maximum Diversion Flow	Net Average Annual Habitat Units
Location 3 – Phoenix	5,000 cfs	5,141
Location 3 – Phoenix	10,000 cfs	5,865
Location 3 – Phoenix	15,000 cfs	7,654
Location 3 – Phoenix	35,000 cfs	13,215

PROJECT IMPACTS

Construction of the 35,000 cfs diversion structure 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. Implementation of the TSP would directly impact 651 acres of existing marsh, open water, and bottomland hardwood habitats. According to the WVA, the TSP would result in the direct loss of -45 AAHUs (-120 acres) at the end of 50 years, of intermediate marsh and bottomland hardwood habitats due to the channel excavation/enlargement, ridge construction, and diversion structure (Table 3). However, the placement of excavated material will create 228 net acres (155 AAHUs) of fresh marsh and 31 acres (27 AAHUs) of ridge which is expected to be suitable for the re-establishment of bottomland hardwoods (Table 3).

Table 3: Potential Estimated Impacts (AAHUs and Net Acres) for the Tentatively Selected Plan (35,000 cfs diversion).

Project Feature	**AAHUs**	**Net Acres**
Marsh Creation	155.20	228
Channel Enlargement	-31.25	-96
Ridge Footprint	-11.37	-19
Ridge Creation	27.36	31
Bottomland Hardwood	-2.50	-5
Total Net AAHUs and Net Acres	**137.44**	**139**
Diversion Benefits by Marsh Type	**AAHUs**	**Net Acres**
Fresh/Intermediate	8,802.11	21,472
Brackish	3,965.54	10,244
Saline	447.42	3,291
Total Net AAHUs and Net Acres	**13,215.07**	**35,007**
Total Net AAHUs and Net Acres	**13,352.51**	**35,146**

Operation of the 35,000 cfs diversion would provide an inflow of fresh water, 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 portion of the project area currently classified as intermediate marsh would be converted to fresh marsh within approximately 5 years following project implementation. No loss of marsh acreage is expected to occur in the project area with this alternative. Additionally, the SAND2 model runs conducted in support of the WVA, projected that the TSP would produce an overall net gain in fresh/intermediate, brackish, and saline marsh of approximately 35,006 acres and 13,215 AAHUs by year 50 after project

implementation (Table 3). Overall project benefits total 13,353 net AAHUs and 35,146 net acres at the end of the project life.

Wildlife Resources

Construction of the diversion structure and associated outfall management features of the 35,000 cfs alternative may disrupt or displace wildlife in the immediate vicinity. However, the long-term impact of construction is expected to be beneficial to overall habitat quality. The WVA analysis of project features projected a net benefit of 137 AAHUs (Table 3).

By the proposed diversion having a spring pulse (March-April), the salinity gradient is maintained while sustaining and enhancing existing marsh in the study area. The TSP would result in improved habitat conditions for several species of wildlife including migratory and resident waterfowl, shorebirds, wading birds, and furbearers. Migratory waterfowl utilizing the project area would benefit from a greater food supply resulting from the increased abundance and diversity of emergent, submerged, and floating-leaved species. Enhanced marsh and marsh edge would provide increased foraging opportunities for shorebirds and wading birds. Small fishes and crustaceans are often found in greater densities along vegetated marsh edge (Castellanos and Rozas 2001, Rozas and Minello 2001), and many of those species are important prey items for wading birds such as the great blue heron, little blue heron, great egret, black-crowned night-heron, and snowy egret.

Furbearers (such as muskrat) which feed on vegetation would benefit from the increased marsh acreage in the project area. Representative furbearers such as the mink, river otter, and raccoon have a diverse diet and feed on many different species of fishes and crustaceans. Those species often feed along vegetated shorelines which provide cover for many of their prey species.

The WVA analysis of the potential effects of the diversion projected a net benefit of 13,215 AAHUs for operation of the diversion, for a total projected net benefit of 13,353 AAHUs including benefits projected for the outfall management features (Table 3).

Fishery Resources

There would be negative impacts to fisheries resulting from channel and ridge construction of the TSP, but there would be positive impacts from marsh creation. The channel constrictions included as an outfall management feature would have some negative impact on fisheries access to the area.

Implementation of the TSP following the operational plan evaluated in the hydraulic modeling and WVA (open operation in March and April; 1,000 cfs the remainder of the year) is expected to freshen the entire project area and beyond River aux Chenes to a substantial portion of the Caernarvon subbasin while the diversion is at full flow and for several weeks after the return to maintenance flow operation. The overall effect of the diversion is that it is expected to decrease salinities throughout the project area and convert a substantial portion of the intermediate zone to fresh marsh within the first several years after project implementation. Water levels, velocities, and turbidity in outfall areas are 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 may occur during operation of the structure.

High nutrient levels could result in blooms of algae and phytoplankton, and subsequent decomposition of these organisms could decrease dissolved oxygen levels of water bodies within the project area. These changes could result in localized adverse impacts to estuarine fishery productivity, particularly when the diversion is at full flow. The operational plan used to evaluate the TSP 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.

Freshwater fishery species, such as crawfish, catfish, largemouth bass, and other sunfish should benefit from implementation of the diversion. 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, may be displaced from the northwestern portion of the project area.

By following the operational plan to have a spring pulse (March-April) and flow 1,000 cfs during the remainder of the year, estuarine-dependent fisheries may be enhanced by helping combat high salinity spikes without an over-freshening while increasing organic production, increasing biological productivity and improving fisheries habitat. The introduction of freshwater to the MDWD project area would ensure that the project area continues to provide important nursery functions beyond the 50-year project life. However some species, such as oysters, may be slightly displaced to lower parts of the study area.

Historically, salinity appears to be the chief controlling factor in the number of plankton species present, while temperature, competition, and predation control the numbers of individuals present (Day et al. 1989). Therefore, introduction of large amounts of river water (pulsing) into estuarine systems may have dramatic short-term impacts on plankton populations in adjacent coastal waters (Hawes and Perry 1978).

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.

It should be noted that the TSP represents a diversion that is several times greater in maximum flow capacity than any other diversion constructed to date in coastal Louisiana. At a maximum flow of 35,000 cfs, the TSP is more than three times greater than the Davis Pond Freshwater Diversion at 10,700 cfs. The effects on marine fishery species of diverting such large volumes of water are not completely understood and no effort to quantify those impacts has been undertaken thus far.

Essential Fish Habitat

Direct impacts of channel and ridge construction would disturb and displace managed species in the construction footprint. The marsh creation near the outfall would result in the loss of mud bottom and estuarine water column as emergent marsh would replace those habitat types. Although adverse impacts would occur to some types of EFH, more productive types of EFH (i.e., estuarine emergent wetlands) would be created and enhanced with the diversion. The accretion of sediment and input of nutrients is expected to benefit estuarine EFH within and beyond the immediate outfall area of the diversion. The TSP is projected to increase SAV (from 25% to 70% in fresh/intermediate marsh areas and from 15% to 40% in the brackish marsh areas during the project life) in the project area and decrease emergent marsh loss across all marsh zones (intermediate, brackish, and saline) by approximately 35,146 net acres 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.

Threatened and Endangered Species

Possible entrainment of the endangered pallid sturgeon in the Mississippi River in the immediate vicinity of the diversion inflow may occur during operation of the structure. In terms of potential impact to the sturgeon, the Corps is responsible for determining whether the proposed plan is likely (or not likely) to adversely affect any listed species and/or critical habitat, and for requesting the Service's concurrence with that determination. As such, by letter dated July 15, 2010, the Corps requested initiation of formal consultation in accordance with Section 7 of the ESA. Section 7 allows the Service 90 calendar days to conclude formal consultation and an additional 45 calendar days to prepare a biological opinion. Although this report constitutes the final report of the Secretary of Interior, formal Section 7 consultation will continue as a separate effort.

FISH AND WILDLIFE CONSERVATION AND MITIGATION MEASURES

Coastal marshes are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Because of the Services' close coordination with the USACE on this project, and because the project is expected to have an overall benefit to the marshes of the MDWD Area, the Service has no conservation measures to offer at this time.

SERVICE POSITION AND RECOMMENDATIONS

The TSP 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.

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.

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.

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.

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.

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).

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.

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.

9. Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, 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.

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.

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.

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.

LITERATURE CITED

Browder, J.A., H.A. Barley, and K.S. Davis. 1985. A probabilistic model of the relationship between marshland-water interface and marsh disintegration. Ecological Modeline 29:245-260.

Browder, J.A., L.N. May, A. Rosental, J.G. Gosselink, and R.H. Baumann. 1989. Modeling future trends in wetland loss and brown shrimp production in Louisiana using thematic mapper imagery. Remote Sensing of the Environment 28:45-59.

Castellanos, D.L. and L. P. Rozas. 2001. Nekton use of submerged aquatic vegetation, marsh, and shallow unvegetated bottom in the Atchafalaya River delta, a Louisiana tidal freshwater ecosystem. Estuaries. Vol. 24, No. 2, p. 184-197.

Chabreck, R.H., and G. Linscombe. 1982. Changes in vegetative types in Louisiana coastal marshes over a ten-year period. Louisiana Academy of Sciences 45:98-102.

Chesney, E.J., D.M. Balz, and R.G. Thomas. 2000. Louisiana estuarine and coastal fisheries and habitats: Perspectives from a fish's eye view. Ecological Applications 10:350-366.

Day, J. W., Jr., C. A. S. Hall, W. M. Kemp, A. Yanez-Arancibia. 1989. Estuarine Ecology. John Wiley and Sons, New York. 558 pp.

Dundee, H.A., and D.A. Rossman. 1989. The amphibians and reptiles of Louisiana. Louisiana State University Press, Baton Rouge. 300 pp.

Hawes, S. R., and H. M. Perry. 1978. Effects of 1973 floodwaters on plankton populations in Louisiana and Mississippi. Gulf Research Reports 6(2):109-124.

Kerlin, C.W. 1979. Letter to Jack A. Stephens, Director-Secretary St. Bernard Parish Planning Commission regarding the impact of the Mississippi River-Gulf Outlet (MRGO) on St. Bernard Parish's wetlands and water bodies (31 May). In Report of the Environmental Subcommittee to the MRGO Technical Committee, March 16, 2000. 20 pp.

McKee, K.L., and I.A. Mendelssohn. 1989. Response of a freshwater marsh plant community to increased salinity and increased water levels. Aquatic Botany 34:301-316.

Minello, T. J. and L. P. Rozas. 2002. Nekton in gulf coast wetlands: fine-scale distributions, landscape patterns, and restoration implications. Ecological Applications, 12(2), pp. 441-455.

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands. 2nd Edition. Van Nostrand Reinhold, New York, USA. 722 pp.

National Marine Fisheries Service (NMFS). 2006. Commercial Landings of Fish and Shellfish by U.S. Fishing Craft, 2006. Accessed 16 May, 2008 from http://www.st.nmfs.noaa.gov/st1/fus/fus06/02_commercial 2006.pdf.

National Marine Fisheries Service (NMFS). 2008. Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies, Gulf of Mexico Region. Habitat Conservation Division, St. Petersburg, Florida. August 2008.

Rozas, L. P. and T. J. Minello. 2001. Marsh terracing as a wetland restoration tool for creating fishery habitat. Wetlands. Vol. 21, No. 3, pp. 327-341.

U.S. Fish and Wildlife Service, Ecological Services, Lafayette, Louisiana. Final Fish and Wildlife Coordination Act Report, Near-Term Ecosystem Restoration Plan for the Louisiana Coastal Area. October 2004.

Zimmerman, R.J., T.J. Minello, and L.P. Rozas. 2000. Salt marsh linkages to productivity of penaeid shrimps and blue crabs in the ecology. Kluwer Academic Publishers, Dordrecht.

ATTACHMENT A

WETLAND VALUE ASSESSMENT ASSUMPTIONS AND ANALYSIS

Louisiana Coastal Area
Medium Diversion at White Ditch
Plaquemines Parish, Louisiana

Assumptions for Diversion WVAs

WVAs have been prepared to determine the benefits due to the diversion of water from the Mississippi River. The benefited area encompasses the authorized Medium Diversion at White Ditch study area. Benefits/impacts of the outfall management features (e.g., channel enlargement) are included in separate WVAs.

Habitats within the benefited area include intermediate, brackish, and saline marsh and associated open water. Habitat and land-water data were generated by USGS for the study area. Separate WVAs will be conducted for each marsh type and each diversion size (i.e., 5k, 10k, 15k, and 35k cfs). Acreages of marsh and water within each marsh type were determined using the 2006 TM/2001 marsh type data. Non-wetland habitat acreages and areas benefited/impacted by the outfall management features were removed from the analysis. TY0 for the study is 2015. Therefore, marsh loss was applied for 9 years to the 2006 marsh acreages to achieve baseline (2015) acreages. The 1985-2006 loss rate (-274.5 ac/yr) was determined by linear regression using land-water data for the entire study area. Marsh loss within each marsh type was assumed to be proportional to the percentage of each marsh type within the study area. The intermediate marsh area varies by diversion size because the acreage impacted by the outfall management features is different for each diversion size.

Diversion Size	Intermediat e Marsh	Intermediat e Water	Brackish Marsh	Brackish Water	Saline Marsh	Saline Water	**Total**
5k	19,909	15,277	11,935	6,425	6,922	36,845	**97,313**
10k	19,890	15,245	11,935	6,425	6,922	36,845	**97,262**
15k	19,846	15,215	11,935	6,425	6,922	36,845	**97,188**
35k	19,768	15,102	11,935	6,425	6,922	36,845	**96,997**

FWOP Intermediate Marsh Assumptions (same for all diversion sizes)

V1 – Background loss rate (-274.5 ac/yr) applied throughout the 50-yr project life.

V2 – A baseline value of 25% is proposed. 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 area covered under this WVA. SAV cover is assumed to decrease over the project life to 15% as the area deteriorates. The percent marsh in the area drops from 57% to 41% which could allow greater fetch in open water areas and increase turbidity. In addition, salinity is assumed to increase somewhat from 4.4 ppt to 5 ppt as marsh deteriorates to the south and increase tidal influence and exchange in this area.

V3 – Based on an examination of 2008 aerial photography, the area is classified as consisting of interspersion classes 2 and 3. Class 2 is found within the upper portion of the area and along the western boundary adjacent to the flood protection levee. The remainder of the area appears to fit the Class 3 interspersion type. Acreages within each class were calculated using GIS. As the area deteriorates over time, a downward shift in interspersion classes should occur. Some Class 3 will shift into Class 4 and some Class 2 will shift to Class 3.

V4 – The baseline value of 30% was determined from surveys conducted by NRCS for the CWPPRA White Ditch Siphon Project. Those surveys encompassed a great deal of this area and offer the best baseline data available for determining this value. In addition, the mean value from the three CWPPRA project WVAs conducted in this area is 31%. As marsh deteriorates throughout this area, it was assumed that shallow open water would decrease slightly to 20%.

V5 – The baseline value of 4.4 ppt was determined from three Coastal Reference Monitoring System stations within the project area. That value is the mean during the growing season (March-November) from 2008-2009 and ranged from 3.7 ppt in the upper portion of the area to 5.7 near the lower end. Due to marsh deterioration to the south, salinity is assumed to increase somewhat to 5.0 ppt over the project life.

V6 – There are some areas that are under structural marsh management resulting in a reduction in fisheries access. According to the Monsecour Siphon Project WVA, a total of 1,175 acres are under management. The table below contains structure ratings for each area under management.

Acreage	Structure	Structure Rating
297 ac	Flap-gated culvert	0.2
696 ac	Weir with boat bay	0.5
182 ac	Plug	0.0001
	Weighted Access Value	**0.35**

The weighted access value for the entire area is 0.98.

FWOP Brackish Marsh Assumptions (same for all diversion sizes)

V1 – Background loss rate (-274.5 ac/yr) applied throughout the 50-yr project life.

V2 – A baseline value of 15% is proposed. That value is based on best professional judgment as no SAV cover data has been collected in this area and there are no previous project WVAs that have been conducted in this area. It is assumed that SAV cover would be somewhat less in this area as compared to the intermediate area which was assigned a cover value of 25%. SAV cover is assumed to decrease over the project life to 5% as the area deteriorates and salinities and tidal exchange increase. The percent marsh in the area drops from 65% to 49% which could allow greater fetch in open water areas and increase turbidity. In addition, salinity is assumed to increase somewhat from 6.6 ppt to 8.0ppt as marsh deteriorates to the south and increase tidal influence and exchange in this area.

V3 – Based on an examination of 2008 aerial photography, the area is classified as consisting of interspersion classes 1, 3, and 4. Class 1 is found along the western boundary adjacent to the flood protection levee and extends nearly to the southern study area boundary. Marshes within that area remain very well intact. The remainder of the area appears to fit either the Class 3 or Class 4 interspersion classes. Acreages within each class were calculated using GIS. As the area deteriorates over time, a downward shift in interspersion classes would occur.

V4 – The baseline value of 20% is proposed and based on best professional judgment. It is assumed that water depths are somewhat deeper in this area as compared to the intermediate area

which has a baseline value of 30%. Brackish marshes tend to be somewhat deeper than fresher marsh types which are located farther inland. As marsh deteriorates throughout this area, it was assumed that shallow open water would decrease from 20% to 10%.

V5 – The baseline value of 6.6 ppt was determined from three Coastal Reference Monitoring System stations. Two of those stations are actually located outside the project area but within brackish marsh in the Breton Sound Basin north of the study area. That value is the annual mean from 2008-2009 and ranged from 5.0 ppt to 9.9 ppt. Due to marsh deterioration to the south, salinity is assumed to increase somewhat to 8.0 ppt over the project life.

V6 – Based on an examination of aerial photography, there appear to be no restrictions to fisheries access in this area. Therefore, the access value is 1.0.

FWOP Saline Marsh Assumptions (same for all diversion sizes)

V1 – Background loss rate (-274.5 ac/yr) applied throughout the 50-yr project life.

V2 – A baseline value of 2% is proposed. That value is based on best professional judgment as no SAV cover data has been collected in this area and there are no previous project WVAs that have been conducted in this 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. There is assumed to be no SAV cover at the end of the project life as only 9% of the area will be marsh.

V3 – Based on an examination of 2008 aerial photography, the area is classified as consisting of interspersion classes 4 and 5. The majority of the area is Class 5 with large open water areas and isolated remnants of marsh. However, some Class 4 is found in the southern and northern portions of the area. As the area deteriorates over time, the entire area would be Class 5.

V4 – The baseline value of 5% is proposed and based on best professional judgment. It is assumed that water depths are much deeper in this area as compared to the intermediate and brackish areas. This area consists of very large open water areas which are typically greater than 1.5 ft deep. As marsh deteriorates throughout this area, it was assumed that shallow open water would decrease from 5% to 1%. Perhaps there would still be some shallow water in the few remaining remnants of marsh.

V5 – One Coastal Reference Monitoring System station is located within the saline marsh area. Mean annual salinity for 2008-2009 was 10.3 ppt. However, that station is located within an isolated area of marsh and much of the saline zone encompasses large open water areas at the lower extent of the estuary where salinities are believed to be higher. Therefore, a baseline of 13 ppt was used to better represent average conditions across this large open area. Due to marsh deterioration in the area, salinity is assumed to increase to 15.0 ppt over the project life.

V6 – Based on an examination of aerial photography, there appear to be no restrictions to fisheries access in this area. Therefore, the access value is 1.0.

FWP Assumptions

V1 – Marsh acreages for each target year were taken from the SAND2 model output. 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. That transition was assumed to occur at TY5 for all diversion sizes. 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.

For the 5,000 cfs diversion, loss continues to occur according to SAND2 model output. Loss was distributed proportionately among the various marsh types.

For the 10,000 cfs diversion, SAND2 model output indicates no marsh loss with some marsh gain occurring over the project life. Results indicate that 1,675 acres of marsh gain would occur. It was assumed that all of this marsh gain would occur within the fresh marsh zone.

For the 15,000 cfs diversion, SAND2 model output indicates no marsh loss with substantial marsh gain occurring over the project life. Results indicate that 6,347 acres of marsh gain would occur. It was assumed that all of this marsh gain would occur in the fresh marsh zone.

For the 35,000 cfs diversion, SAND2 model output indicates no marsh loss and tremendous marsh gain over the project life. Results indicate that 21,282 acres of marsh gain would occur. It was assumed that marsh gain would occur throughout the project area across all four marsh zones. Beginning in the fresh marsh zone, marsh gain was allowed to continue in each marsh zone until the percent marsh reached approximately 98%. It was assumed that some open water would remain and that the area would not completely fill with marsh. Under that scenario, very little marsh gain occurs in the saline zone.

V2 – SAV cover was assumed to increase from baseline conditions for all diversion sizes in the fresh, intermediate, and brackish marsh zones. SAV cover was not assumed to increase as diversion size increased. It was assumed that maintenance flow conditions (1,000 cfs for all alternatives) would be more important than the diversion pulse in determining SAV cover. Based on research (Rozas et al., 2005) conducted in the Caernarvon Diversion outfall management area, an SAV cover value of 70% was assumed for the fresh and intermediate zones. That research indicated SAV cover of 66% in areas influenced by the diversion. Most sample sites occurred in the intermediate marsh zone. SAV cover was assumed to be 30% in the brackish zone based on best professional judgment. No increase in SAV cover was assumed to occur in the saline marsh zone.

V3 – Values were based on the amount of marsh projected (SAND2 model results) within each zone in comparison to the baseline values determined within each area.

V4 – Within the fresh/intermediate zone, shallow open water was assumed to decrease to 25% from the baseline value of 30% under the 5,000 cfs diversion because marsh loss continues to occur. However, shallow open water was assumed to increase with increasing diversion size which would deliver greater amounts of sediment. Since most of this zone fills with marsh under the 35,000 cfs diversion, it was assumed that most of the open water (95%) would be shallow. In the brackish zone, shallow open water was assumed to decrease to 15% from the baseline value of 20% under the 5,000 cfs diversion because marsh loss continues to occur. For the 10,000 and 15,000 cfs diversions, it was assumed that sediment delivery would keep pace with subsidence and maintain the baseline amount of shallow open water. As with the fresh/intermediate zone, most of the brackish zone fills with marsh under the 35,000 cfs diversion; therefore, a value of 95% was assumed.

In the saline zone, shallow open water was assumed to decrease to 2% from the baseline value of 5% under the 5,000 cfs diversion because marsh loss continues to occur. The 10,000 and 15,000 cfs diversions provide enough sediments and nutrients to stop marsh loss within this zone. Therefore, it was assumed that the baseline amount of shallow open water would be maintained. Under the 35,000 cfs diversion, some minor marsh growth is expected to occur within this zone. Because only the finest sediments would reach the saline zone and because of its openness to the bay, it was assumed that the percent shallow open water would remain at the baseline value of 5%.

V5 – Year-long hydrological model simulations were not run due to time constraints. Model runs consisted of a March-April open operation for all diversion sizes. During that period, even the 5,000 cfs diversion freshened all of the fresh-intermediate and brackish zones and reduced salinity in the saline zone to an average of approximately 1 ppt. Model results were also provided for a 65-day period after the open operation (pulse) ended and maintenance flow (1,000 cfs) was initiated. An additional model run was conducted with the model grid set initially at 7 ppt (cold start run) and maintenance flow of 1,000 cfs. That run was conducted to simulate the effect of the maintenance flow after salinities returned to "normal" after the open operation period. All modeling results were utilized to determine FWP salinities. Changes in salinity were assumed to occur at TY1 and remain throughout the project life.

Based on modeling results, fresh conditions (0 ppt) will exist throughout the fresh marsh area 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. A mean salinity during the growing season was then assumed to be approximately 0.5 ppt which is within the optimal range for fresh marsh.

For the intermediate marsh area, modeling results indicated 0 ppt during the 2-month pulse and for approximately one month afterwards. The following month, salinities average approximately 0.8 ppt. Salinities averaged approximately 3 ppt during the remaining 4 months of the growing season. The weighted mean salinity during the growing season is 1.6 ppt.

For the brackish area, salinities were 0 ppt during the pulse, 2 ppt in the following month, and 4 ppt the next month. Based on the results of the cold start run, salinity would average approximately 6.6 ppt during the remainder of the year. The weighted mean annual salinity is 5 ppt.

For the saline area, salinities averaged approximately 1 ppt during the pulse, 5 ppt in the month following and 10 ppt in the next month. Based on the results of the cold start run, salinity would average approximately 13 ppt during the remainder of the year. The weighted mean annual salinity is 10 ppt.

V6 – For all diversion sizes, only the fresh marsh area would experience a reduction in fisheries access due to the outfall management features (i.e., channel constriction structures). The channel constrictions resemble a rock weir with a boat bay and would therefore have an access value of 0.6. Based on an examination of aerial photography it was determined than an area of 13,962 acres, 13,911 acres, 13,837 acres and 13,647 acres would be impacted by the channel constrictions for the 5,000, 10,000, 15,000, and 35,000 cfs diversions, respectively. For each diversion size, the area impacted by the outfall management features was removed as those areas were evaluated under a separate WVA. In addition, an area of 1,175 acres has a FWOP access value of 0.35 (see FWOP discussion). That area would have an access value of 0.21 (0.35x0.6). The remainder of the fresh area has an access value of 1.0. The weighted access value for FWP for each diversion size is found in the table below.

Diversion Size	Access Value = 1.0	Access Value = 0.6	Access Value = 0.21	Weighted Access Value
5k	8,137	13,962	1,175	0.72
10k	7,538	13,911	1,175	0.71
15k	7,568	13,837	1,175	0.71
35k	7,647	13,647	1,175	0.72

Benefits Summary

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**

Literature Cited

Rozas, P.R., T.J. Minello, I. Munuera-Fernandez, B. Fry, B. Wissel. 2005. Macrofaunal distributions and habitat change following winter-spring releases of freshwater into the Breton Sound estuary, Louisiana (USA). Estuarine Coastal and Shelf Science 65 (2005) pp. 319-336.

WVA Assumptions for Project Features

WVAs were prepared to determine the benefits/impacts for the diversion structure and outfall management features. These WVAs are "footprint" WVAs in which the area directly benefited/impacted is used as the project area. Features include 1) ridge creation, 2) marsh creation, 3) outfall channels, 4) diversion structure, and 5) channel constrictions. Marsh and ridge are created using material from the outfall channels. Separate WVAs were done for each

feature and for each diversion size. There are no footprint impacts from the channel constrictions. However, they do impact fisheries access (V6) in the marsh and open water areas. The area impacted by each project feature is found in Table 1.

Habitats impacted are intermediate marsh, intermediate open water, and bottomland hardwoods. Shape files of the impacted areas (except for the diversion structure) were provided to USGS and habitat and land-water data were generated for each feature for each diversion size. Acreages of marsh and water were determined using 2006 TM/2001 marsh type data. The area impacted by the diversion structure was determined by Corps biologists. TY0 for the study is 2015. Therefore, marsh loss was applied for 9 years to the 2006 marsh acreages to achieve baseline (2015) acreages. The 1985-2006 loss rate (-0.28%/yr) was determined by linear regression using land-water data for the entire study area.

Table 1. Acreages impacted by habitat type for each project feature.

5,000 cfs Diversion - 2015 footprint acres	Ridge Creation	Marsh Creation	Outfall Channels	Diversion Structure
Intermediate marsh	22	59	63	
Water	10	80	97	
Bottomland hardwoods				2.5
Total	**32**	**139**	**160**	**2.5**

10,000 cfs Diversion - 2015 footprint acres	Ridge Creation	Marsh Creation	Outfall Channels	Diversion Structure
Intermediate marsh	22	64	73	
Water	10	112	101	
Bottomland hardwoods				2.5
Total	**32**	**176**	**174**	**2.5**

15,000 cfs Diversion - 2015 footprint acres	Ridge Creation	Marsh Creation	Outfall Channels	Diversion Structure
Intermediate marsh	22	99	82	
Water	10	136	107	
Bottomland hardwoods				5
Total	**32**	**235**	**189**	**5**

35,000 cfs Diversion - 2015 footprint acres	Ridge Creation	Marsh Creation	Outfall Channels	Diversion Structure
Intermediate marsh	22	151	110	
Water	9	234	120	
Bottomland hardwoods				5
Total	**31**	**385**	**230**	**5**

Ridge Creation Assumptions (same for all diversion sizes)

Under FWOP, the ridge footprint area consists of intermediate marsh and open water. Therefore the intermediate marsh model was used. Under FWP, no marsh exists as the entire footprint is ridge habitat. The coastal chenier/ridge model was used for FWP.

Marsh model - FWOP

V1 – Background loss rate applied throughout the 50-yr project life.

V2 – Baseline value was 5% from the Monsecour Siphon Project WVA which was prepared by CWPPRA in 2009. SAV cover is assumed to be somewhat higher in this area because most of the open water is adjacent to marsh edge which tends to be shallower and contain more SAV. SAV cover was assumed to decrease over the project life as marsh deteriorates in the area.

V3 – Baseline value determined from aerial photography. Marsh loss within this small footprint over the project life is not likely to result in a change in interspersion.

V4 – Based on this footprint being in shallow water next to marsh edge, it was assumed that a high percentage (90%) of the open water is less than 1.5 ft. It was assumed to decrease slightly over the project life as the area deteriorates.

V5 – Baseline value of 3.7 ppt was taken from the Monsecour Siphon Project WVA which determined the mean salinity during the growing season based on data from CRMS stations in the area. Salinity is assumed to increase somewhat over the project life as marsh deteriorates and tidal influence moves farther inland.

V6 – Based on aerial photography, there are no restrictions to fisheries access.

Ridge Model

Under FWP, 32 acres (31 acres for 35k diversion) of ridge habitat is created. It is assumed that the ridge will be planted with woody species and that no loss of ridge habitat will occur over the project life. The assumptions used for the ridge model have been developed by the CWPPRA Environmental Workgroup (EnvWG) for ridge restoration projects and assume plantings with 6 native species and recruitment of additional species over the project life. Cover values were based on best professional judgment of workgroup members. It is also assumed that control of Chinese tallow tree was implemented until planted species achieve adequate canopy cover to shade out invasive species and reduce competition. Also, maintenance plantings were assumed in case planted species experienced significant mortality.

V1 – Tree Canopy Cover – Canopy cover of 20% was assumed at TY8 because at that time many of the planted species would achieve sufficient height to provide some canopy cover. Assumed to increase to 80% by TY20 and remain at that value to TY50.
V2 – Shrub/Midstory Cover – A shrub/midstory layer would be present by TY3, increase to 65% by TY15, but then decrease somewhat as canopy cover increases.

V3 – Species Diversity – Six species would be planted initially and natural recruitment of other species would occur over the project life.

Marsh Creation Assumptions (same for all diversion sizes)

The marsh creation footprint consists of intermediate marsh and open water. Therefore the intermediate marsh model was used for FWOP. Under FWOP, the area deteriorates as no restoration action occurs. Under FWP, the entire footprint is filled with dredged material and marsh is created. The created marsh is considered fresh marsh with the diversion in operation and the fresh marsh model was used.

V1 – For FWOP, the background loss rate was applied throughout 50-yr project life. For FWP, assumptions for marsh creation projects developed by the CWPPRA EnvWG were assumed – a 50% reduction in the background loss rate was applied.

V2 – The baseline value was 5% from the Monsecour Siphon Project WVA which was prepared by CWPPRA in 2009. The baseline value is assumed to be somewhat higher (15%) because the Monsecour Siphon project area encompasses over 12,000 acres and extends southward into areas more open to tidal exchange and somewhat higher salinity. Under FWOP, cover is assumed to decrease over the project life as marsh deteriorates in the area. Under FWP, very little open water exists within the footprint, even at TY50. However, SAV cover is assumed to be high within the open water areas within the marsh creation platform due to the operation of the diversion. A cover value of 70% is suggested per research done in the Caernarvon Diversion outfall management area (Rozas et al., 2005).

V3 – Baseline value determined from aerial photography. Under FWOP, marsh loss within this small footprint over the project life is not likely to result in a change in interspersion. Under FWP, the marsh creation sites are classified as Class 5 at TY1, Class 3 at TY3, and Class 1 at TY5. Class 1 is maintained throughout the project life.

V4 – Based on surveys conducted by NRCS for the CWPPRA White Ditch Siphon Project, the percent shallow open water is 30%. Under FWOP, that value is assumed to decrease as the area deteriorates and subsidence occurs. Under FWP, the value is assumed to remain high as very little loss of the created marsh is expected to occur and water depths will likely be very shallow within the marsh platform.

V5 – Baseline value of 3.7 ppt was taken from the Monsecour Siphon Project WVA which determined the mean salinity during the growing season based on data from CRMS stations in the area. Salinity is assumed to increase somewhat under FWOP as marsh deteriorates and tidal influence moves farther inland. The FWP salinity is assumed to be 0.5 ppt as this area will be within the immediate outfall of the diversion. A mean salinity of 0.0 ppt was not assumed because there will be periods when the diversion is not in operation and salinities will likely increase during those periods.

V6 – Based on aerial photography, there are no restrictions to fisheries access under FWOP. Under FWP, the marsh creation platform will have no access at TY1 but will at TY3 as the platform subsides. The channel constrictions along River aux Chenes and at the end of the outfall channel will reduce fisheries access into the project area. Based on the design info provided, those structures are closest to a rock weir with a boat bay which has an access value of 0.6.

Outfall Channel Assumptions (same for all diversion sizes)

The channel footprint area consists of intermediate marsh and open water. Therefore the intermediate marsh model was used for FWOP. Under FWOP, marsh in the area deteriorates as no restoration action occurs. Under FWP, the entire footprint is dredged to create outfall channels and the footprint remains open water throughout the project life. Although there is no marsh, the fresh marsh model is used for FWP due to the fresher conditions resulting from diversion operation.

V1 – For FWOP, the background loss rate is applied throughout project life. Under FWP, no marsh exists.

V2 – SAV cover is assumed to be very low in this area because a large portion of the footprint is in an existing distributary channel. A baseline value of 5% is proposed and assumed to decrease (2%) as marsh around the area deteriorates. It is assumed that no SAV would exist FWP as the entire footprint will be an outfall channel.

V3 – Baseline value determined from aerial photography. Marsh loss within this small footprint over the project life is not likely to result in a change in interspersion. The entire footprint will be open water (Class 5) under FWP.

V4 – For baseline, it is proposed to use a value (20%) somewhat lower than used for the marsh creation footprint because a portion of the footprint is in an existing distributary channel which has little shallow water. It was assumed to decrease over the project life as the area deteriorates. Under FWP, the footprint will be an outfall channel with little water less than 1.5 feet deep. A value of 1% is suggested to account for shallow water along the channel edges.

V5 – Baseline value of 3.7 ppt was taken from the Monsecour Siphon Project WVA which determined the mean salinity during the growing season based on data from CRMS stations in the area. Salinity is assumed to increase somewhat over the project life as marsh deteriorates and tidal influence moves farther inland. Under FWP, salinity is assumed to average 0.5 ppt.

V6 – No restrictions to fisheries access are present under FWOP. The channel constrictions have an access rating of 0.6 for FWP.

Diversion Structure Bottomland Hardwoods Impacts

It is anticipated that construction of the proposed structure would impact adjacent bottomland hardwoods (BLH) in the amount of 2.5 acres under the 5,000 and 10,000 cfs alternatives and 5.0 acres under the 15,000 and 35,000 cfs alternatives. A WVA was not completed for the proposed structure location; however, a proportional calculation of Annual Average Habitat Units (AAHUs) was created utilizing data obtained from a WVA performed in 2008 for a borrow site (Q6a) with similar habitat characteristics located less than ½ mile south of the proposed White Ditch Medium Diversion structure site.

The reference site (i.e. borrow site Q6a) used for the BLH AAHU proportional calculation was a 16.0 acre site located on the flood side portion of the east bank Mississippi River Levee at River

Mile 60 (center point: Latitude 29°38'55.487"N, Longitude 89°56'58.861"W) in Plaquemines Parish, Louisiana. Similar to the White Ditch Diversion structure site, the reference site is an immature, semi-open, light-seeded tree species dominated, frequently flooded forest. Aerial photography from the White Ditch Diversion structure site and the reference site were compared and determined to have similar habitat features and site species composition.

On September 30, 2008, personnel from the Service and Corps of Engineers, New Orleans District, visited borrow site Q6a and delineated two plots. Plot 1 was located on a ridge on the river side of the proposed Q6a site of which approximately 6.5 acres or 41% of the proposed site occurs as a portion of the ridge. Plot 2 was located on a lower/slough portion of the proposed Q6a site of which approximately 9.5 acres or 59% of the proposed site occurs as a portion of the slough. Utilizing the WVA Bottomland Hardwood Model, an AAHU value was calculated for each plot, weighted accordingly for its respective size and location with respect to the overall borrow site, and subsequently combined to give a total AAHU value for the 16.0 acre site.

Q6a Borrow Site (16.00 Acres) ► **-8.01 AAHUs**

- Plot 1 = -6.41 AAHUs (41% of the site)
  = **-2.63 AAHUs**
- Plot 2 =-9.12 AAHUs (59% of the site)
  = **-5.38 AAHUs**

A proportional calculation was performed to determine the per acre AAHU value for the Q6a borrow site and the resulting per acre AAHU value was then multiplied by the respective acreages contained under each diversion alternative to obtain a final AAHU value.
-8.01 AAHUs / 16.0 acres = **0.50 AAHUs/acre**
-0.50 AAHUs x 2.5 acres = **-1.25 AAHUs** (5,000 and 10,000 cfs diversions)
-0.50 AAHUs x 5.0 acres = **-2.50 AAHUs** (15,000 and 35,000 cfs diversions)

Benefits Summary

Feature	5,000 cfs	10,000 cfs	15,000 cfs	35,000 cfs
Marsh Creation	54.59	72.52	92.19	155.20
Outfall Channel Impacts	-15.99	-19.08	-21.89	-31.25
Ridge Impacts	-11.33	-11.33	-11.33	-11.37
Ridge Creation	28.24	28.24	28.24	27.36
Bottomland Hardwood Impacts	-1.25	-1.25	-2.5	-2.5
Total Net AAHUs	**54.26**	**69.10**	**84.71**	**137.44**