FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

VOLUME IV: APPENDICES C–K

COOPERATING AGENCIES:

U.S. ENVIRONMENTAL PROTECTION AGENCY
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TEXAS GENERAL LAND OFFICE
LOUISIANA DEPARTMENT OF WILDLIFE AND FISHERIES

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March 2011

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Ecological Modeling Report

APPENDIX C

ECOLOGICAL MODELING REPORT
SABINE-NECHES WATERWAY,
TEXAS AND LOUISIANA
CHANNEL IMPROVEMENT PROJECT

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September 2010

Appendix C
Ecological Modeling Report
Sabine-Neches Waterway, Texas and Louisiana
Channel Improvement Project

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LIST OF ACRONYMS

°F	degrees Fahrenheit
3-D	three dimensional
AAHU	Average Annualized Habitat Units
ATR	agency technical review
BEG	Bureau of Economic Geology
BHM	Bottomland Hardwoods Model
BU	beneficial use
CAIP	Center for Aquatic and Invasive Plants
CAP	Continuing Authorities Project
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
CEPRA	Coastal Erosion Planning and Response Act
CHL	Coastal Hydraulics Laboratory
CWPPRA	Coastal Wetlands Planning, Protection, and Restoration Act
cy	cubic yards
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Plan
dbh	diameter at breast height
DMMP	Dredged Material Management Plan
DOWSMM	desk-top off-channel wetlands salinity mitigation model
EMCM	Emergent Mash Community Model
EnvWG	Environmental Work Group
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Design Center
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FFR	Final Feasibility Report
FNAEC	Flora of North America Editorial Committee
FWOP	future without-project
FWP	future with-project
GEC	Gulf Engineers and Consultants, Inc.
GIS	geographic information system
GIWW	Gulf Intracoastal Waterway
GLO	General Land Office
GPS	Global Positioning System
HEP	Habitat Evaluation Procedures
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HS	hydrodynamic-salinity

HSI	Habitat Suitability Index
ICT	Interagency Coordination Team
IEPR	Independent External Peer Review
IH	Interstate Highway
IPCC	Intergovernmental Panel on Climate Change
LBG	Louis Berger Group
LCWCR/WCRA	Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LDWF	Louisiana Department of Wildlife and Fisheries
LPP	Locally Preferred Plan
LSU	Louisiana State University
mcy	million cubic yards
MFWP	mitigated future with project
MLLW	mean lower low water
mm	millimeters
NGS	National Geological Survey
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
NWRC	National Wetlands Research Center
O&M	operation and maintenance
PA	Placement Area
PCX	Planning Center of Expertise
PIE	Pacific International Engineering
ppt	parts per thousand
RSL	relative sea level
RSLR	relative sea-level rise
SAV	submerged aquatic vegetation
SCM	Swamp Community Model
SI	suitability index
SIV	variable suitability indices
SNND	Sabine Neches Navigation District
SNWW CIP	Sabine-Neches Waterway, Texas and Louisiana Channel Improvement Project

SRA-TX	Sabine River Authority of Texas
SWG	Galveston District, U.S. Army Corps of Engineers
TCEQ	Texas Commission on Environmental Quality
TEA	Toxicological and Environmental Associates
TIO	Texas Invasive Org
TPWD	Texas Parks and Wildlife Department
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
TY	target year
USACE	U.S. Army Corps of Engineers
USDC	U.S. Department of Commerce
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAM	TCEQ Water Availability Models
WC	Wildflower Center
WMA	Wildlife Management Area
WRDA	Water Resources Development Act
WVA	Wetland Value Assessment

1.0 INTRODUCTION

1.1 PURPOSE OF ECOLOGICAL MODELING

The U.S. Army Corps of Engineers (USACE), Galveston District, and the Sabine Neches Navigation District (SNND) are conducting a feasibility study and environmental impact assessment of navigation improvements to the Sabine-Neches Waterway, Texas and Louisiana Channel Improvement Project (SNWW CIP). As part of this study, ecological modeling was conducted to evaluate impacts and benefits of navigation features and mitigation measures. A detailed description of the purpose and scope of potential navigation improvements is provided in the Sabine-Neches Waterway Navigation Improvements Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS).

1.2 STRUCTURE OF REPORT

This report is structured as follows:

- In the remainder of Section 1, the ecological modeling team is described (Section 1.3), protected and sensitive habitats in the study area are summarized (Section 1.4), and environmental issues and concerns identified during the scoping process are discussed (Section 1.6).
- Section 2 presents a description of the ecological modeling process, including a discussion of mitigation planning requirements and study objectives (Section 2.1), the rationale for selection of the Wetland Value Assessment (WVA) models for this study (Section 2.2), an overview description of the WVA models and assumptions (sections 2.3 and 2.4), and more-detailed descriptions of the WVA models: (1) the Emergent Marsh Community Models (Section 2.6); (2) the Swamp Community Model (Section 2.7); and (3) the Bottomland Hardwood Model (Section 2.8).
- Section 3 describes the hydrodynamic-salinity (HS) modeling that was conducted to support the WVA modeling effort. Section 3.1 describes the interagency HS Modeling Workgroup. Section 3.2 provides a summary description of the HS model. Section 3.3 describes relative sea-level rise (RSLR) and freshwater inflow considerations incorporated into the HS model.
- Section 4 describes how data were developed or collected for each variable in the SNWW application of the WVA Emergent Marsh models. For example, in Section 4.1 methods used to prepare the baseline data set for Variable V_1 (Percent Emergent Vegetation) are described, and the land change projection methodologies for future without-project (FWOP), future with-project (FWP), and mitigated future-with project (MFWP) conditions are presented. Similarly, methods of data collection and projections are presented for Variables V_2 (Percent Submerged Aquatic Vegetation, V_3 Marsh Edge and Interspersion), V_4 (Percent Open Water 1.5 feet Deep), V_5 (Salinity), and V_6 (Aquatic Organism Access) in sections 4.2 through 4.6.
- Section 5 describes methods used to develop data for the SNWW application of the Swamp model for variables V_1 (Stand Structure), V_2 (Stand Maturity), V_3 (Water Regime), and V_4 (Mean High Salinity) in sections 5.1 through 5.4.
- Section 6 describes methods used to develop data for the SNWW application of the Bottomland Hardwood model for variables V_1 (Tree Species Composition), V_2 (Stand Maturity), V_3

(Understory/Midstory), V_4 (Hydrology), V_5 (Size of Contiguous Forested Area), V_6 (Surrounding Land Uses), and V_7 (Disturbance) in sections 6.1 through 6.7.

- Section 7 provides the results of the modeling of FWOP and FWP conditions for each of the hydrologic units (hydro-units) in the study area. Texas hydro-units are described in Section 7.1, Louisiana hydro-units are described in Section 7.2, and hydro-units that cross the Louisiana-Texas state boundary are described in Section 7.3.
- Section 8 presents the results of WVA modeling conducted to evaluate the effectiveness of beneficial use (BU) and mitigation measures. It includes a summary of the preliminary screening and elimination of BU and mitigation measures (sections 8.1 and 8.2). Measures adopted to avoid impacts (Dredged Material Management Plan [DMMP] Features) are described in Section 8.3. Section 8.4 summarizes the feasibility screening of mitigation measures, and Section 8.5 provides the results of the final Cost Effectiveness/Incremental Cost Analysis (CE/ICA) of mitigation measures. Mitigation measures included in the CE/ICA are categorized as marsh restoration and Gulf shore nourishment and individually described in Section 8.5.1. Measures included in the Best Buy mitigation plan, which is recommended for inclusion in the Locally Preferred Plan (LPP), are identified in Section 8.6.
- Section 9 discusses risk and uncertainty in the use of these models to determine the recommended mitigation plan.
- Section 10 is a list of references cited in the report.

1.3 MODELING TEAM

An Interagency Coordination Team (ICT) comprised of the following Federal and State resource agency representatives from Louisiana and Texas was established to (1) involve agencies in scoping and identifying environmental issues and concerns; (2) evaluate the significance of fish and wildlife resources and select resources to be evaluated; (3) recommend and review necessary environmental studies; (4) evaluate anticipated impacts; and (5) recommend and evaluate potential mitigation measures.

SNWW ICT Members

U.S. Fish and Wildlife Service (USFWS)
National Marine Fisheries Service (NMFS)
Natural Resources Conservation Service (NRCS)
Environmental Protection Agency (EPA)
Texas General Land Office (GLO)
Texas Commission on Environmental Quality (TCEQ)
Texas Parks and Wildlife Department (TPWD)
Texas Water Development Board (TWDB)
Sabine River Authority of Texas (SRA-TX)
Louisiana Department of Natural Resources (LDNR)
Louisiana Department of Environmental Quality (LDEQ)
Louisiana Department of Wildlife and Fisheries (LDWF)
SNND
USACE, Galveston District

Representatives from other local and State agencies or governments also participated in the ICT in an advisory capacity: Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana.

The SNWW ICT established the Habitat Workgroup to apply the WVA model; representatives from 14 agencies regularly attended and agreed upon data used as inputs for the model. Over 30 ICT and workgroup meetings were conducted from 2001 to 2006, and 1 meeting was held in 2009. USFWS-Louisiana Ecological Services Field Office provided assistance to ensure that WVA methodology (USFWS, 2002a, 2002b, 2002c, 2002d) was followed properly and that WVA model Excel worksheets were being used appropriately. USACE conducted an in-house quality check for worksheet accuracy. In 2009, changes in the proposed project and HS modeling necessitated a revision of the WVA modeling. Due to schedule constraints, USACE performed the modeling without ICT involvement, basing it as closely as possible on methods and assumptions used by the ICT in the original modeling. The results of this remodeling were coordinated with the ICT. A quality check was also performed for the revised worksheets.

1.4 DEFINITION OF THE STUDY AREA

The study area was defined by the ICT so as to include all areas that could be affected by potential project impacts in Texas and Louisiana (Figure 1). A brief characterization of habitats in the study is provided in Section 1.6.2. Navigation improvements are being proposed for the existing 64-mile-long deep-draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, the Port Arthur Canal, the Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont. No improvements are proposed for the Channel to Orange portion of the SNWW. Environmental effects have been analyzed for coastal wetlands in the study area, which includes Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and offshore in the Gulf of Mexico to 13 miles beyond the end of the current channel.

USACE evaluation of possible deepening and widening alternatives identified a 48-foot deepening project as the LPP and the Recommended Plan. The LPP, referred to as the SNWW 48-Foot Project, consists of deepening the SNWW to Beaumont to 48 feet and extending the Sabine Bank Channel an additional 13.2 miles into the Gulf of Mexico, tapering the Sabine Bank Channel from 800 feet wide (Station 23+300) to 700 feet wide (Station 25+800) through the end of the Sabine Bank Channel extension, deepening and widening Taylor Bayou channels and turning basins, and constructing new anchorage/ turning basins on the Neches River. In order to quantify baseline and FWOP conditions, project impacts, and mitigation, the ICT applied the WVA model.

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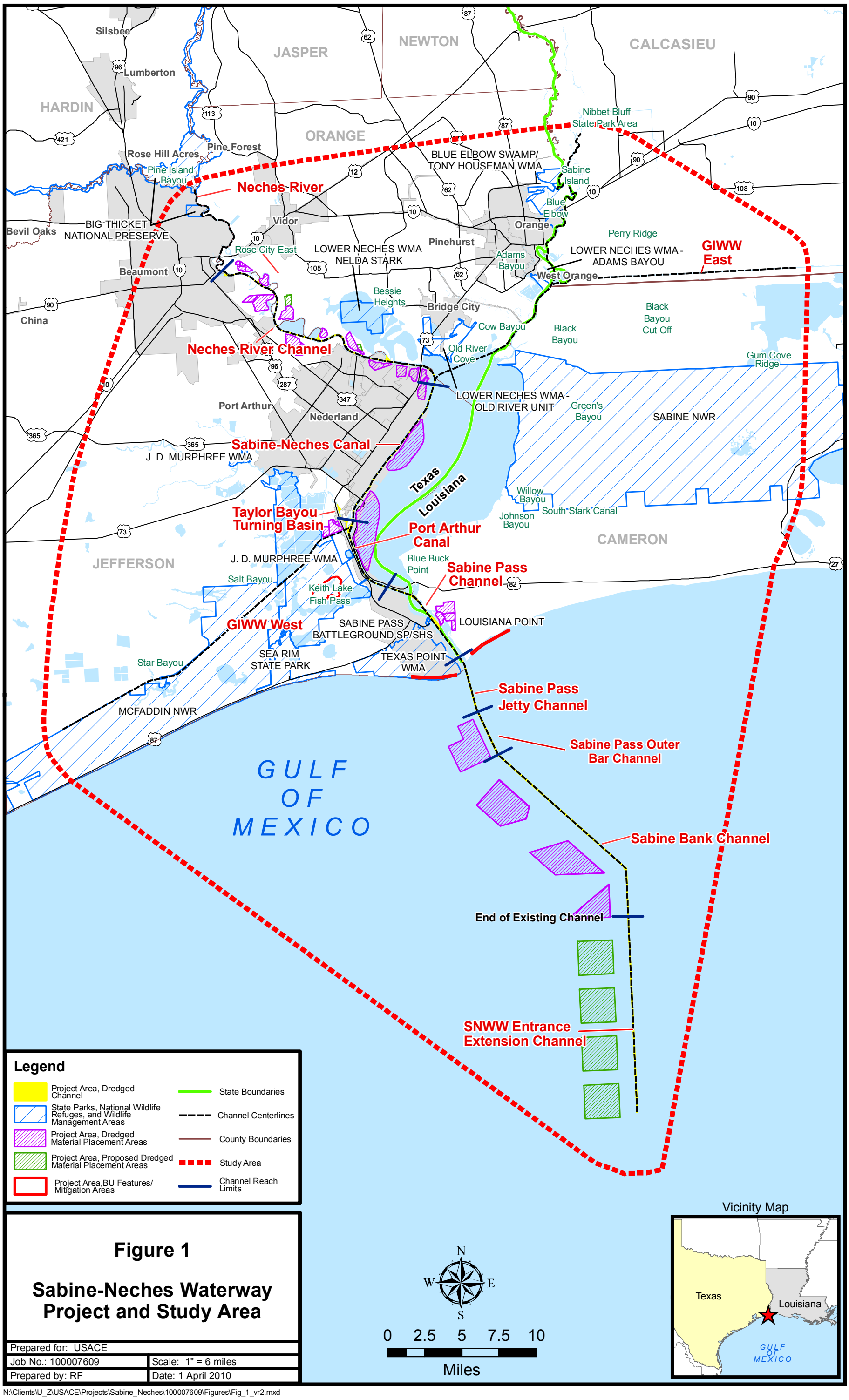

Figure 1

Sabine-Neches Waterway Project and Study Area

Prepared for: USACE	
Job No.: 100007609	Scale: 1" = 6 miles
Prepared by: RF	Date: 1 April 2010

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1.5 PROTECTED AND SENSITIVE HABITATS IN THE STUDY AREA

The SNWW study area contains a high concentration of significant coastal wetlands. The ICT identified 108,897 acres (170 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats that are addressed in this impact evaluation. Definitions of these habitat types are provided in Section 1.6.1. A summary of habitat acreage by State is provided in Table 1. Hydro-units are subdivisions of the study area that are used to facilitate discussion and impact evaluation. They are planning units that can be isolated by topography and hydrology from surrounding areas. Section 3.1.1 describes the basis for the designation of these hydro-units and explains how they were used in this study. An index of these units is provided in Table 2, and the distribution of these habitats is presented on Figure 2. Figure 3 is an area map that contains geographic place names referred to in the following descriptions.

Table 1: Summary of Habitat Acreages by State (2004)

	Fresh	Inter-mediate	Brackish	Saline	Total Marsh	Bottomland Hardwood	Swamp	Total Wetlands
Texas								
Acreage	13,580	30,336	24,047	4,898	72,861	5,458	10,157	88,476
Water	2,117	9,240	8,254	810	20,421	0	0	20,421
Totals	15,697	39,576	32,301	5,708	93,282	5,458	10,157	108,897
Louisiana								
Acreage	20,336	101,405	23,112	3,551	148,404	3,206	6,641	158,251
Water	4,772	31,872	2,049	586	39,279	0	0	39,279
Totals	25,108	133,277	25,161	4,137	187,683	3,206	6,641	197,530
Total								
Acreage	33,916	131,741	47,159	8,449	221,265	8,664	16,798	246,727
Water	6,889	41,112	10,303	1,396	59,700	0	0	59,700
Totals	40,805	172,853	57,462	9,845	280,965	8,664	16,798	306,427

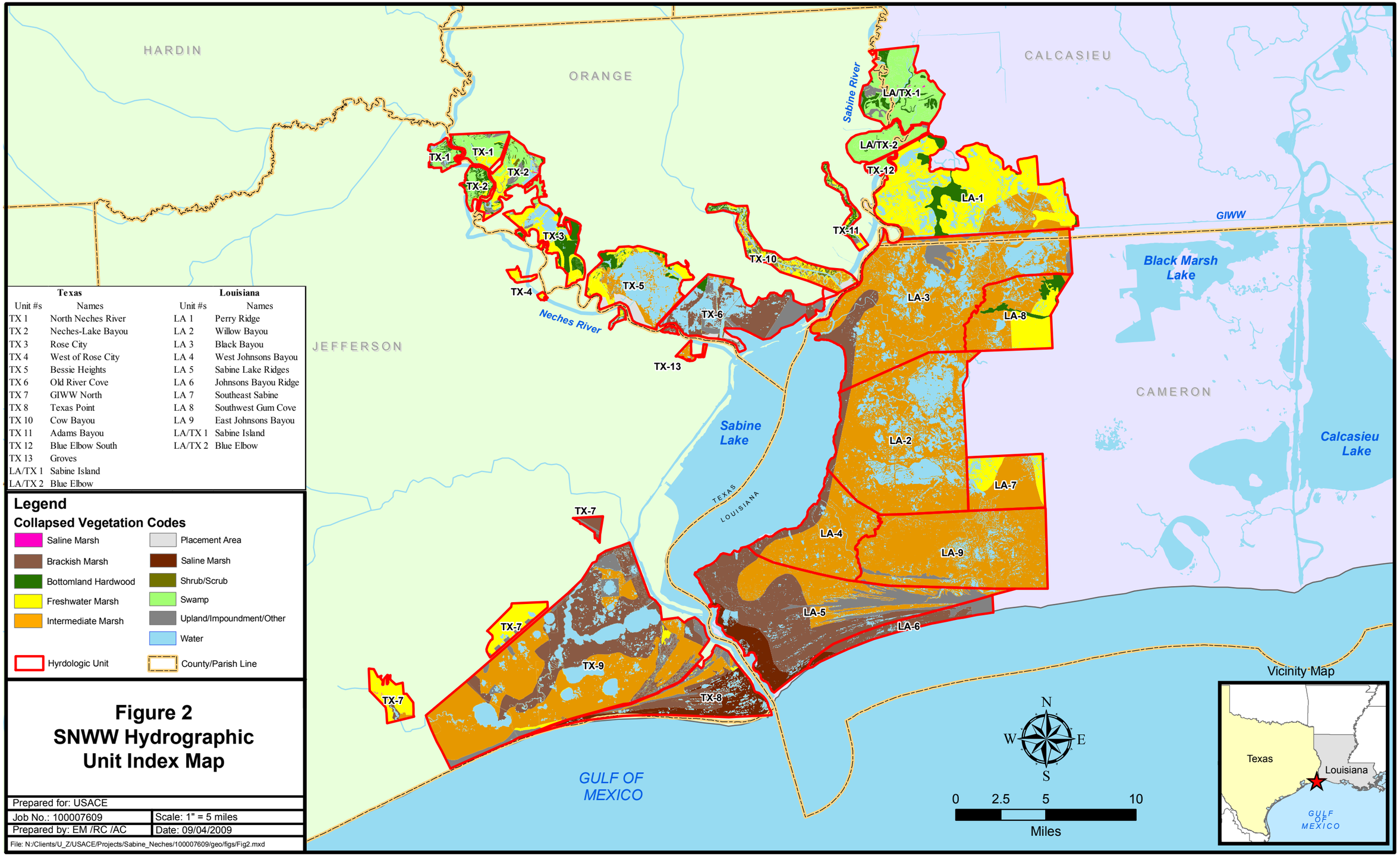
Table 2: Index of SNWW Hydrologic Units

Texas		Louisiana	
Unit #s	Names	Unit #s	Names
TX 1	North Neches River	LA 1	Perry Ridge
TX 2	Neches-Lake Bayou	LA 2	Willow Bayou
TX 3	Rose City	LA 3	Black Bayou
TX 4	West of Rose City	LA 4	West Johnson's Bayou
TX 5	Bessie Heights	LA 5	Sabine Lake Ridges
TX 6	Old River Cove	LA 6	Johnson's Bayou Ridge
TX 7	GIWW North	LA 7	Southeast Sabine
TX 8	Texas Point	LA 8	Southwest Gum Cove
TX 10	Cow Bayou	LA 9	East Johnson's Bayou
TX 11	Adams Bayou	LA/TX 1	Sabine Island
TX 12	Blue Elbow South	LA/TX 2	Blue Elbow
TX 13	Groves		
LA/TX 1	Sabine Island		
LA/TX 2	Blue Elbow		

1.5.1 Texas Portion of the Study Area

In Texas, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area:

- Approximately 10,000 acres of fresh to salt marsh in the chenier plain west of Sabine Pass, the majority of which consists of the Texas Point National Wildlife Refuge (NWR). This NWR is part of the Texas Chenier Plain NWR complex (USFWS, 2005a). A chenier plain is characterized by relict beach fronts that form high ridges that parallel the Gulf shore. The term derives from the French name for live oak trees (*chenier*), which typically are found growing atop these ridges (Loyola University, 2006). This area is indicated as hydrologic unit (hydro-unit) TX 8 on Figure 2.
- Approximately 55,700 acres of fresh to salt marsh is located west of the Sabine River between Texas Point and the mouth of the Neches River (TX 7 and 9). Much of this area is protected by the J.D. Murphree WMA and the McFaddin NWR. Managed by the TPWD, the J.D. Murphree WMA totals 24,250 acres of fresh, intermediate, and brackish water wetlands in the Texas Chenier Plain (TPWD, 2005a). It is located just inland of the Texas Point WMA and extends north of the GIWW. The eastern half (approximately 23,000 acres) of the McFaddin NWR is part of the study area. This NWR is also part of the Texas Chenier Plain NWR complex. The McFaddin NWR protects one of the largest remaining freshwater marshes on the Texas coast and thousands of acres of intermediate to brackish marsh (USFWS, 2005a). It is located adjacent to and just west of Texas Point WMA.



Texas		Louisiana	
Unit #s	Names	Unit #s	Names
TX 1	North Neches River	LA 1	Perry Ridge
TX 2	Neches-Lake Bayou	LA 2	Willow Bayou
TX 3	Rose City	LA 3	Black Bayou
TX 4	West of Rose City	LA 4	West Johnsons Bayou
TX 5	Bessie Heights	LA 5	Sabine Lake Ridges
TX 6	Old River Cove	LA 6	Johnsons Bayou Ridge
TX 7	GIWW North	LA 7	Southeast Sabine
TX 8	Texas Point	LA 8	Southwest Gum Cove
TX 10	Cow Bayou	LA 9	East Johnsons Bayou
TX 11	Adams Bayou	LA/TX 1	Sabine Island
TX 12	Blue Elbow South	LA/TX 2	Blue Elbow
TX 13	Groves		
LA/TX 1	Sabine Island		
LA/TX 2	Blue Elbow		

Legend

Collapsed Vegetation Codes

- Saline Marsh
- Brackish Marsh
- Bottomland Hardwood
- Freshwater Marsh
- Intermediate Marsh
- Placement Area
- Saline Marsh
- Shrub/Scrub
- Swamp
- Upland/Impoundment/Other
- Water
- Hyrdologic Unit
- County/Parish Line

Figure 2
SNWW Hydrographic Unit Index Map

Prepared for: USACE	
Job No.: 100007609	Scale: 1" = 5 miles
Prepared by: EM /RC /AC	Date: 09/04/2009

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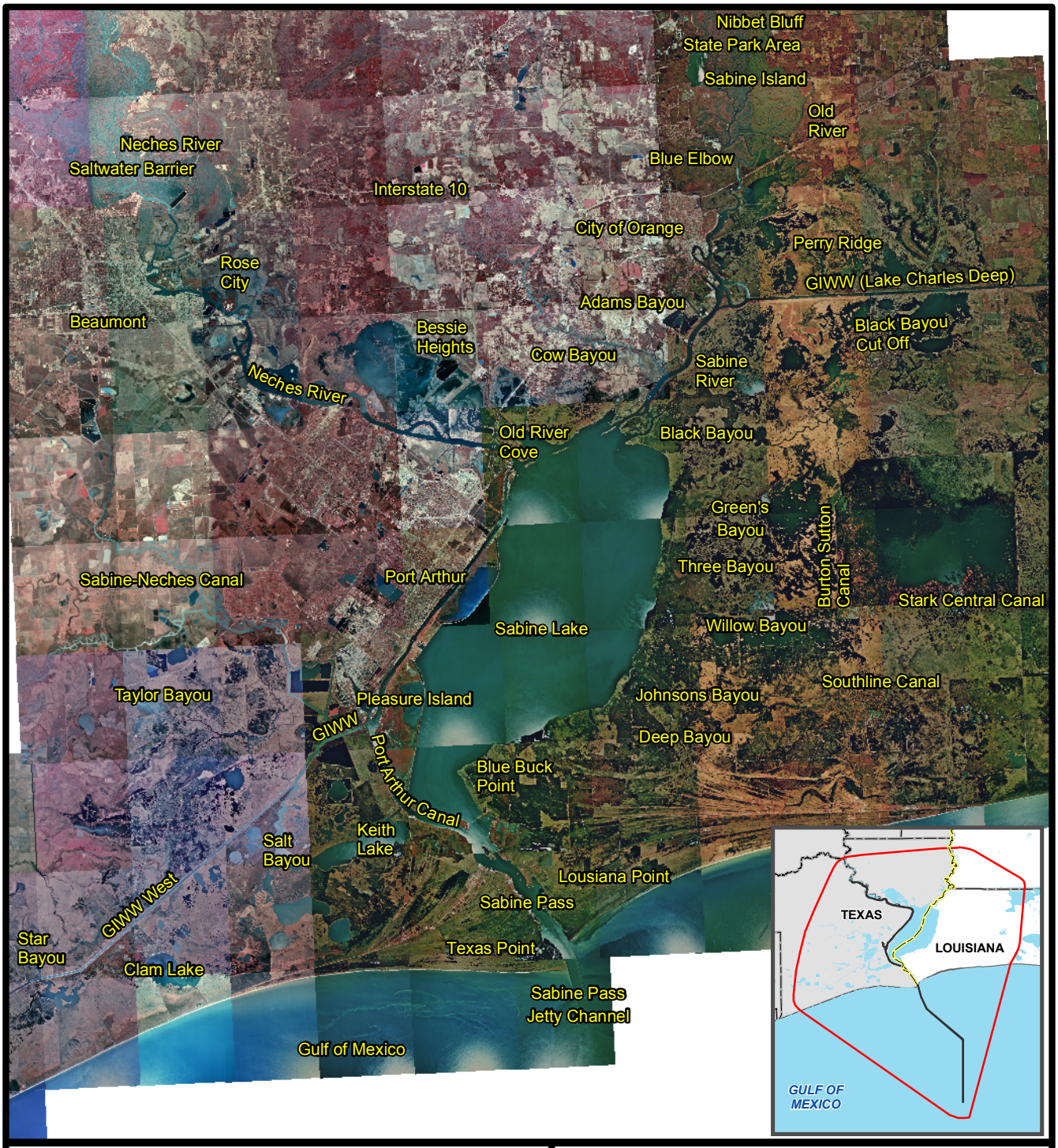

N
W E
S

0 3 6 12
Miles

Figure 3

Geographic Reference Map

Prepared for: USACE	
Job No.: 100007609	Scale: 1 inch equals 6 miles
Prepared by: Christiansen	Date: 09/08/2009

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- Approximately 22,000 acres of fresh, intermediate, and brackish marshes and 2,850 acres of cypress-tupelo swamp and bottomland hardwoods on the Neches River from the mouth of the river where it empties into Sabine Lake to the City of Beaumont (TX 3 through 6). Approximately 9,500 of these acres consist of open-water areas resulting from breaking and eroding marsh in the marshes at Rose City, Bessie Heights, and Old River Cove. The Nelda Stark Unit and Old River Unit of the Lower Neches River WMA (TPWD, 2005b) are located in this area.
- Approximately 6,500 acres of Neches River cypress-tupelo swamp and bottomland hardwoods and 2,000 acres of fresh marsh between the City of Beaumont and the new Neches River Saltwater Barrier near Pine Island Bayou (TX 1 and 2). A USACE-approved, privately operated, wetlands mitigation bank (the Neches River Cypress Swamp Preserve) is located within this area (USACE, 2005a).
- Approximately 4,750 acres of cypress-tupelo swamps, bottomland hardwood, and fresh and intermediate marshes on Cow and Adams bayous (TX 10 and 11). The Adams Bayou Unit of the Lower Neches River WMA (TPWD, 2005b) is located in this area.
- Approximately 700 acres of cypress-tupelo swamp west of the Sabine River and south of Interstate 10 (TX 12).
- Approximately 2,700 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp (LA/TX 2). Located north of Interstate 10 and west of the Sabine River, this area is owned by the Texas Department of Transportation (TxDOT) and managed as the USACE-approved Blue Elbow Swamp Mitigation Bank (USACE, 2005b). The area includes the Tony Houseman WMA, managed as a cooperative effort between the TxDOT and TPWD (2005c).
- Approximately 2,300 acres of cypress-tupelo swamp and bottomland hardwoods west of the Sabine River, across from the Sabine Island WMA in Louisiana (LA/TX 1).
- Approximately 6,000 acres of cypress-tupelo swamp, bottomland hardwood forest, and freshwater marsh below the Saltwater Barrier, on Big Thicket National Preserve lands in Texas (TX 1 and 2).

1.5.2 Louisiana Portion of the Study Area

In Louisiana, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCR/WCRA], 1998; U.S. Geological Survey [USGS]-National Wetlands Research Center [NWRC], 2004):

- Approximately 71,500 acres of saline, brackish and intermediate marshes in the Louisiana chenier plain habitat at Louisiana Point, Blue Buck Point and Johnson's Bayou areas (LA 4, 5, 6, and 9). Sensitive areas include Sabine Lake Ridges (about 33,500 acres of chenier ridge, and saline, brackish and intermediate marsh), Johnson's Bayou Ridge (about 4,000 acres of saline and brackish marshes, and chenier ridges), West Johnson's Bayou (about 13,000 acres of brackish and intermediate marsh), and East Johnson's Bayou (about 26,700 acres of chenier ridge, and fresh, intermediate, and brackish marsh).
- Approximately 44,000 acres of brackish, intermediate, and fresh coastal marsh in the western half of the Sabine NWR (LA 3 and 7). The Sabine NWR, as a whole, contains about 124,500 acres of fresh, intermediate, and brackish marsh between Calcasieu and Sabine lakes in southwest Louisiana (USFWS, 2005b). Approximately 13,750 acres of marsh within this study area has degraded to open

water. This sensitive area contains the Willow Bayou mapping unit (about 36,300 acres) and 8,000 acres in the west section of the Southeast Sabine mapping unit.

- Approximately 46,500 acres of brackish, intermediate, and fresh marsh in an area north of Willow Bayou and south of the GIWW (LA 2 and 8). This sensitive area contains the Black Bayou mapping unit (about 36,300 acres) and 10,200 acres of fresh and intermediate marsh in the Southwest Gum Cove mapping unit.
- Approximately 25,700 acres of fresh and intermediate marsh and bottomland hardwood habitat in the Perry Ridge mapping unit, north of the GIWW and east of the Sabine River (LA 1).
- About 650 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp, east of the Sabine River and north of Interstate Highway (IH) 10 (LA/TX 2).
- Approximately 7,000 acres of cypress-tupelo swamp and bottomland hardwoods in the Sabine Island WMA, north of the Blue Elbow Swamp and east of the Sabine River (LA/TX 1).

1.6 ENVIRONMENTAL ISSUES AND CONCERNS

1.6.1 Existing Conditions

1.6.1.1 Wetland Vegetation Communities

In the SNWW study area, coastal marshes occur in four distinct types. These wetland communities are differentiated by salinity, elevation, and soil regimes. Information on indicator species, salinity regime, and lists of vegetation community species provided by marsh type below was completed from references cited here (LDNR, 2002; The Nature Conservancy, 2006; USFWS, 1998; Visser and Sasser, 1998; White et al., 1987).

Salt marsh is located along the Gulf shoreline and the shores of Sabine Pass. Subjected to regular tidal inundation, low saline marsh is dominated by smooth cordgrass/oystergrass (*Spartina alterniflora*) and often accompanied by seashore saltgrass (*Distichlis spicata*), blackrush (*Juncus romerianus*), saline marsh aster (*Aster tenuifolius*), and marshhay cordgrass/wiregrass (*S. patens*). The dominant species in high salt marsh, which is subject to less-frequent tidal inundation, is glasswort (*Salicornia* spp.). Relative to other marsh types, salt marsh typically supports fewer terrestrial vertebrates although some shorebird species are common. Salinity typically averages 16 parts per thousand (ppt).

Brackish marshes in the study area grade inland from salt marsh along the Gulf shoreline and in the Sabine Pass area, line the Salt Bayou-Keith Lake watershed south of the GIWW, and fringe the northern and eastern shores of Sabine Lake. The dominant species in low brackish marsh is saltmarsh bulrush (*Scirpus robustus*); seashore saltgrass and marshhay cordgrass are co-dominant species in high brackish marsh. These species are often accompanied by marsh pea (*Vigna luteola*), waterhemp (*Amaranthus tamariscinus*), and dwarf spikerush (*Eleocharis parvula*). Brackish marshes are extremely important as nurseries for fish and shellfish. Other characteristic species include fur-bearers and shorebirds. The average salinity in the brackish marshes is 8 ppt.

Intermediate marshes are subjected to periodic pulses of salt water and maintain a year-round salinity in the range of 3 to 4 ppt. In the SNWW study area, they grade inland from brackish marshes in the Salt Bayou/Keith Lake watershed, are the major marsh type along the lower Neches River, and dominate the interior marshes east of Sabine Lake. The diversity and density of plant species are relatively high with marshhay cordgrass the most dominant species in high marsh. Co-dominant species in low marsh are seashore paspalum (*Paspalum vaginatum*), Olney bulrush (*S. americanus*), California bulrush/giant bulrush (*S. californicus*), and common reedgrass/roseau cane (*Phragmites australis*); bulltongue (*Sagittari lancifolia*) and sand spikerush (*E. montevidensis*) are also frequent. Intermediate marshes are considered extremely important for many wildlife species, such as alligators and wading birds, and serve as important nursery areas for larval marine organisms.

Freshwater marshes are heterogeneous, with local species composition governed by frequency and duration of flooding, topography, substrate, hydrology, and salinity. A large expanse of tidal fresh marsh is located between the GIWW and the Neches River, and in the riparian zone of the Neches and Sabine rivers. Tidal freshwater marsh is also present in the most interior portions of the marshes east of Sabine Lake. Co-dominant species in low marsh are maidencane (*P. hemitomen*), giant cutgrass (*Zizaniopsis milacea*), and bulltongue. Co-dominant species in high marsh are squarestem spikerush (*E. quadrangulata*) and marshhay cordgrass. Other characteristic species include American lotus (*Nelumbo lutea*), watershield (*Brasenia screben*), duckweed *(Lemna* spp.), and fanwort (*Cabomba caroliniana*). Salinity rarely increases above 2 ppt, with a year-round average of approximately 0.5 to 1 ppt. Tidal fresh marshes support extremely high densities of wildlife, such as migratory waterfowl.

Upstream of the coastal marshes in Sabine Lake estuary, the study area is dominated by dense bottomland hardwood forests and cypress-tupelo swamps. These wetland forests cover an intricate network of sloughs and sandy ridges formed within the rivers' relict meander belts. Bald cypress (*Taxodium distichum*) – tupelo-gum (*Nyssa aquatica*) swamps grow in the inundated areas between the ridges, and floodplain hardwood forest of oaks (*Quercus nigra, Q. phellos, Q. alba, Q. lyrata*), sweetgum (*Liquidambar styraciflua*), hickories (*Carya* spp.), American elm (*Ulmus americanus*), maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), American holly (*Ilex opaca*), and loblolly pine (*Pinus taeda*) grow atop the sandier ridges. In general, these are healthy, stable habitats. The hardwoods, and especially the cypress trees, have been logged repeatedly since the turn of the century and as recently, perhaps, as the 1950s (USACE, 1998). Though much of the forest is secondary growth, the swamp and bottomland hardwood habitats have medium to high value for food and cover to resident and migratory fish and wildlife.

1.6.1.2 Loss of Interior Marsh

Marshes in the study area are severely threatened, with the conversion of numerous large marshes to open water documented by various mapping studies (Barras et al., 2004). In Louisiana, a net land loss of 21 percent between 1978 and 2000 has been reported in the Chenier Plain subregion of coastal Louisiana, which includes the Louisiana portion of the Sabine estuary (USACE, 2004:MR 2-24; Appendix B). In Texas, the most-extensive losses of interior coastal wetlands in the state (12,632 acres between 1930 and

1978) have occurred in the Neches River delta. In total, over 90 percent of the emergent marshes in the Lower Neches River delta have been converted to open water (White et al., 1987; Morton and Paine, 1990), which is more than half of the total wetland loss in the State of Texas (Sutherlin, 1997). The breakup of previously intact interior marshes is apparent, and shoreline erosion is occurring around larger lakes. In the conversion of marsh to open water, topsoils and nutrients have eroded, leaving dense clay substrates that do not support marsh vegetation.

More recently, however, the rate of land loss in the Chenier Plain region appears to have ameliorated and interior marshes appear to have stabilized. Over the last 20 years, rates of loss have declined and marshes do not appear to be undergoing rapid conversion of large areas to open-water like areas to the east in Louisiana (LCWCR/WCRA, 1998; TPWD, 2003; USACE, 2004). For example, 61 percent of the total land loss in the Chenier Plain region occurred between 1978 and 1990 as compared to 39 percent between 1990 and 2000 (Barras et al., 2004)

1.6.1.3 Gulf Shoreline Recession

Shoreline recession due to gradual submergence associated with RSLR is also a major threat to marshes in the study area. National Oceanic and Atmospheric Administration (NOAA) has documented a trend of mean sea level rise at Sabine Pass of 5.66 millimeters (mm)/year from 1958 through 2006 (NOAA-U.S. Department of Commerce [USDC], 2009), one of the highest on the Gulf Coast. RSLR combines the relative effects of eustatic (or global) sea level changes and regional subsidence. Serious scientific debate continues regarding the historical rate of subsidence in this region, and its underlying causes (Berman, 2005; Morton, 2003; Morton et al., 2005; Shinkle and Dokka, 2004; Titus and Narayanan, 1995). However, there is evidence that the subsidence rate may be decreasing as the average rate of RSLR at Sabine Pass was 6.54 mm/year for period 1958 through 1999 (NOAA-USDC, 2006) as compared to the 5.66 mm/year rate through 2006 discussed above.

In the SNWW study area, prevailing winds and wave approach are from the southeast; however, low-pressure weather systems (northers) frequently move across the upper coast from the north during winter months (Anderson, 2007). The portions of the study area most affected by these prevailing wind patterns are the Gulf shoreline and the eastern shore of Sabine Lake. In Sabine Lake, fetch and wave attack associated with prevailing southeasterly winds primarily affect the western shore; an area that is protected from erosion by riprapped levees around Placement Areas (PAs) 8 and 11. These levees are quite large and sufficiently high such that the rates of RSLR predicted here will have little to no effect. Winter northers, however, do affect the unprotected eastern shore of Sabine Lake where shoreline recession averaged from 4.0 to 5.6 feet/year between 1978 and 2004 (Greco and Clark, 2005; Parchure et al., 2005). Rates of existing historical Gulf shoreline change were obtained from several recent studies Most of the Texas shoreline in the study area experienced very high rates of shoreline retreat from the 1950s through 2002, ranging from –5 to –51 feet/year (USACE, 2004; Bureau of Economic Geology [BEG], 2009). However, small reaches near the SNWW west jetty and near Sea Rim State Park are stable or accreting.

1.6.1.4 Effects of Recent Hurricanes

While this study was in preparation, three large hurricanes occurred in and near the study area. In 2005, Hurricane Katrina devastated areas to the east but did not affect this area. The same year, Hurricane Rita's storm surge at Louisiana Point was 10.6 feet as recorded by USGS sensors (Farris et al., 2007). The surged deposited 3.3 feet of new sediment on the Hackberry Beach chenier ridge and inundated thousands of acres of coastal marsh. Bar welding of nearshore sediments to the lower shore face was also evident (Guidroz et al., 2006). Immediately after the storm, hundreds of acres of marshhay cordgrass marsh in Cameron Parish appeared to have been severely impacted by extensive flooding of high-salinity waters. When the water finally subsided, the vegetation in some areas appeared dead, and the marsh had areas that were 30 to 50 percent devegetated. Over time, porewater salinity levels should decline as rainwater flushes salinity from the system (Farris et al., 2007).

In 2008, Hurricane Ike struck the north Texas Gulf Coast, with the eye passing over the city of Galveston, approximately 60 miles southwest of the study area. Ike's hurricane-force winds, record-breaking levels of storm surge, and extensive coastal and inland flooding had a direct impact on the coastal wetlands, including significant marsh loss, scouring, and compression (Federal Emergency Management Agency [FEMA], 2008). The secondary effects of saltwater intrusion, in which freshwater habitats and species are stressed by elevated soil salinities from the surge overwash and sediments, may not be fully realized for years to come.

The Chenier Plain marshes surrounding Sabine Lake will most likely experience significant long-term impacts. Under normal conditions, these marshes do not drain rapidly, and normal drainage is impaired by numerous hydrologic modifications such as the GIWW, the SNWW, roads, and other infrastructure. This infrastructure, along with the natural topography, resulted in the slow drainage of Ike's surge waters. Furthermore, it appears that drought conditions in the year following the storm exacerbated the immediate effects of the storm surge, extending the time that higher-saline waters remained on the marshes.

The marshes of Sabine Lake comprise primarily brackish and intermediate vegetation communities, which are not tolerant of the higher salinity of Ike's storm surge. The high-salinity water was either lethal to these plants or will have sublethal effects ranging from reduced seed production, vegetative stress, and increased vulnerability to disease. Hurricane Ike also further eroded the beach ridge at the McFaddin NWR, which protects the interior marshes from exposure to full-strength seawater. Other serious effects that could have lasting impacts for decades include the covering of oyster beds and fishing grounds by sediment from the retreating storm surge. Increased marsh loss could also have devastating long-term impacts on fisheries production in terms of species like red drum, white shrimp, and blue crab, as well as on use of these marshes by migrating waterfowl and wading birds.

Marshes on the west side of Cameron Parish in the SNWW study area suffered fewer adverse effects from hurricanes Rita and Katrina than did marshes farther to the east. Marsh recovery was underway when the region was hit by Hurricane Ike. For modeling purposes, it was assumed that the marshes would rebound

to existing conditions applied in the model. Marshes in the SNWW study area are located on relatively stable landforms and thus are able to recover from the short-term effects of tropical storms and hurricanes.

1.6.2 Future Without-Project Conditions

The present 40-foot channel has been in existence since the early 1970s and has had adequate time for the dense clay sediments to stabilize. Deepening will be performed by making a box cut in the bottom of the existing channel. Some slumping of the side slope at the base of the channel may occur as the deeper channel stabilizes, but no slumping is expected at the top of cut. No emergent marsh or shallow bottom is present adjacent to the top of cut. Seagrasses and other types of submerged aquatic vegetation are not found along the margins of the SNWW channel because conditions conducive for submerged aquatic vegetation (SAV) growth (i.e., calm waters and low turbidity) are not present.

Future rates of freshwater inflow and RSLR are likely to result in significant changes in the FWOP condition for the SNWW study area (National Research Council [NRC], 1987; Intergovernmental Panel on Climate Change [IPCC], 2007; Milliken et al., 2008a). FWOP forecasts of salinity, shoreline recession, interior marsh loss, and related impacts to plant and animal communities in the study area are important in establishing the baseline condition against which FWP impacts are measured.

1.6.2.1 Relative Sea Level Rise

The projected rate of RSLR at the Sabine-Neches estuary is very uncertain. The uncertainty inherent in the rates of eustatic sea level rise is evident in the wide range of various estimates from the NRC (1987) and the IPCC (2007). The confidence that any estimate will match actual future sea levels decreases over time, and significant deviations are possible, including amelioration in the rate of rise. However, it must be noted that the IPCC (2007) estimates assume that thermal expansion contributes 70 to 75 percent of the rise. Faster melting of the Greenland and Antarctica ice sheets would increase their contributions to twenty-first-century sea level rise and raise levels above those currently projected. Indeed, some recent studies of geologic terrestrial and marine records support the plausibility of higher projections of sea level rise, on the order 1.0±0.5 meters by A.D. 2100 (Rahmstorf, 2007; Carlson et al., 2008; Rohling et al., 2008).

The 2009 HS modeling for the SNWW study included an estimate of RSLR for the period of analysis, which ends in 2069. The estimated amount of RSLR applied in this study is 1.1 feet. Assumptions and methods used to obtain this estimate are presented in Section 3.3.

1.6.2.2 Freshwater Inflows

Future projections of freshwater inflows for the study area are also highly uncertain. These flows would be influenced by changes in the timing and amount of precipitation, temperature, water demand, and water supply strategies. The Texas State Climatologist has recently concluded that it is impossible to predict with confidence what precipitation trends will be in Texas over the next half century (Nielsen-

Gammon, 2009). Unlike precipitation, there is more consensus for a predicted temperature increase in Texas of close to 4 degrees Fahrenheit (°F) by 2060. Projections of future water demand and supply strategies are also very difficult to make and often involve controversial subjects such as interbasin transfer. Freshwater inflows applied in the 2009 HS modeling were based upon the 2007 Texas State Water Plan and the associated regional plan for the study area (TWDB, 2007). The 2007 State Water Plan takes into consideration existing flows in the Sabine River that are dedicated to the State of Louisiana as prescribed by the Sabine River Compact. The states of Texas and Louisiana are apportioned equal shares of the total Sabine River flow, and therefore freshwater inflows for Louisiana in the HS modeling were equivalent to Texas inflows. The plans were based upon evaluations of population projections, water demand projections, and existing water supplies available during drought. By 2060, population in the region encompassing the study area is projected to grow 36 percent. Water demands are projected to increase 41 percent. The region has surplus water available beyond its projected demands. However, the Texas Water Code requires that flow quantities adequate to support a sound ecological environment and to maintain the productivity, extent, and persistence of key aquatic habitats be maintained. Work on setting target inflows is ongoing, and therefore specific future projections of inflow cannot be made at this time. It is reasonable to assume that this law will result in the maintenance of flows similar to existing conditions.

The State of Louisiana has no statewide water plan or comprehensive water resources management program. The most recent state legislation (Act 49 of 2003) restricts planning to groundwater management, and does not include comprehensive water resource planning. The groundwater management program is just beginning, working toward the development of a statewide plan.

1.6.2.3 Gulf Shoreline Recession

Extensive shoreline retreat is projected for the Texas Gulf shoreline in the study area, based upon the historical rate of changes in sea level and local subsidence (BEG, 2009). The rate of recession of the north Texas Gulf shoreline is likely to increase with accelerated RSLR. For the Louisiana Gulf shoreline in the study area, no change is projected through the year 2050 (Barras et al., 2004). The segment of the Chenier Plain shoreline between Sabine Pass and Ocean View Beach (located 6 miles beyond the 10-mile SNWW study boundary) prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994 (USACE, 2004). However, progradation has slowed in recent years to +1.2 feet/year. The shoreline in the study area is dominated primarily by the effect of the Sabine Pass jetties, which intercept the westward-moving littoral drift and tend to trap sediment along the shoreline east of the jetties.

1.6.2.4 Interior Marsh Loss

Large areas of marsh at Texas Point and Salt Bayou in the Sabine Pass area, in the Neches River reach between Sabine Lake and IH 10, and in the extensive marshes east of Sabine Lake are already severely stressed. Marshes have been dying, due in large part to subsidence and salt-induced stress, and highly organic marsh soils have then eroded, leading to ever-increasing areas of open water in former marsh systems. This process is well illustrated by Rose City and Bessie Heights on the Neches River in Texas

and the Sabine NWR and Black Bayou marshes in Louisiana, where extensive former marshes have nearly disappeared.

The effects of the projected rate of RSLR on coastal marshes are very difficult to predict. Biomass accumulation would be expected to offset much if not all of the RSLR change in water surface elevation. "Primary productivity of salt marsh vegetation is regulated by changes in sea level, and the vegetation, in turn, constantly modifies the elevation of its habitat toward an equilibrium with sea level" (Morris et al., 2002:2876). A rise in relative sea level (RSL) brings an increase in production and biomass density that enhances sediment deposition by increasing the efficiency of sediment trapping. This can lead to an absolute increase in the elevation of the marsh platform and result in a landward migration of the marsh (Gardner et al., 1992; Gardner and Porter, 2001). This may change total wetland area, depending upon local geomorphology and anthropogenic barriers to migration, such as bulkheads, canals, etc.

FWOP projections of coastal land loss in the Louisiana portion of the SNWW study area forecast relatively stable landforms and shorelines through 2050 (Barras et al., 2004), not accounting for the effects of tropical storms and hurricanes. Similar large-scale FWOP land loss projections are not available for the Texas portion of the study area. However, a Geographic Information System (GIS) study of aerial photographs of the Salt Bayou-Keith Lake system confirmed that the open-water trend has slowed and possibly reversed itself in that area in recent years (TPWD, 2003). Texas interior marshes most at risk to the effects of RSLR are located just outside and to the west of the SNWW study area in the McFaddin NWR.

If RSLR accelerates to the extent that the coastal plant community cannot sustain an elevation within its range of tolerance, rates of primary production would decrease, resulting in an unstable and rapidly deteriorating marsh community (Morris et al., 2002). In addition, if shoreline recession cuts existing fore dune formations, large areas of interior marsh could quickly be exposed to higher-salinity Gulf waters and wave attack. In this case, large marsh areas could quickly be lost to the Gulf.

2.0 ECOLOGICAL MODELING

2.1 USACE MITIGATION PLANNING

2.1.1 USACE Mitigation Guidance

In accordance with USACE guidance (ER 1105-2-100), mitigation may include avoiding and minimizing project impacts to ecological resources, rectifying impacts by restoring the affected environment, and reducing or eliminating impacts by preservation or maintenance operations during the life of the project. After all possible actions are taken to avoid and minimize impacts to significant ecological resources, impacts are to be compensated by replacing or substituting significant resources or environments. Replacements of fish and wildlife resources will be made "in-kind." Substitutions, or replacements "out-of-kind," are also acceptable mitigation if they are at least equal in value and significance as the resources lost. Impacts to wetlands must be fully mitigated and meet the goal of no net loss to wetlands. Mitigation for bottomland hardwoods should be made in-kind to the extent possible. However, the availability of existing restorable forests and the cost and feasibility of accomplishing in-kind replacement often make this impractical. Compensation for bottomland hardwoods can also include increased management of existing forests to compensate for the loss of biological productivity. After identifying measures to avoid or minimize impacts to the greatest extent possible, the recommended plan and the LPP plan must contain sufficient mitigation to ensure that there will be no more than negligible adverse impacts on significant ecological resources (Section 906(d), Water Resources Development Act [WRDA] 86).

2.1.2 SNWW Mitigation Objectives

The following mitigation planning objectives were established by the ICT for the SNWW study.

- Minimize salinity impacts to the SNWW affected area
- Maximize the use of dredged material in marsh restoration measures
- Meet goal of no net loss of wetlands
- Replace lost habitat quality on a one-to-one basis as measured by Average Annualized Habitat Units (AAHUs)
- Replace habitats in-kind to the extent practicable
- Mitigate losses in the state where they occur to the extent practicable
- Share dredged material from Sabine Pass equally between Louisiana and Texas

2.2 SELECTION OF WETLAND VALUE ASSESSMENT MODEL

In order to comply with USACE guidance that requires that compensation be evaluated using a habitat unit that quantifies the value of habitat quality and quantity over time, the ICT selected the WVA model to identify and evaluate significant ecological resources that may be affected by SNWW navigation improvements.

The WVA was chosen as the most appropriate ecological model for the SNWW project based on a number of factors. The WVA model is a suite of ecological, habitat-based, community models known primarily from its use by a multiagency team of Federal and State agencies in Louisiana (the Environmental Work Group [EnvWG]) that prioritizes proposals for coastal restoration projects under the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The WVA methodology employs a community approach that assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality. Using this methodology, several habitat-specific community models have been developed by the EnvWG, and three have been selected for use in this study: the Emergent Marsh Community Model (EMCM), the Swamp Community Model (SCM), and the Bottomland Hardwoods Model (BHM). The EMCM can be applied to four coastal marsh communities – fresh, intermediate, brackish, and saline marsh. Hereafter in this report, the term "WVA model" applies to the three components of the WVA model suite (EMCM, SCM, and BHM) that are used in this study.

Although WVA was developed specifically to apply to habitat types present along the Louisiana coast, the same types of coastal habitat (chenier plain, emergent coastal marsh, bottomland hardwoods, and cypress-tupelo swamp) extend into the Sabine-Neches coastal watershed in Texas. In addition, the areas contain the same fish and wildlife communities, similar soils, and topography, and the Sabine-Calcasieu basins share an interconnected hydrology. Furthermore, the types of variables measured by the WVA community models are sensitive to the types of changes that have been identified as the highest concerns by resource agencies and the general public for the SNWW project. Specifically, these are potential changes in salinity, stress and death of marsh vegetation, and further loss or degradation of already stressed coastal marshes. The variables measured by WVA are also recognized scientifically and technically as important in characterizing overall habitat quality. Variables utilized in the WVA were selected from existing, widely accepted Habitat Evaluation Procedures (HEP) models, and the model outputs were combinable across the different habitat types. A final factor is that variables were established such that data were easily estimated or collected from existing data sources. This was especially important because the study area is exceptionally large, and therefore extensive field data collection efforts were not practical. The size and habitat diversity of the study area made application of other ecological models very difficult. Other ecological models, such as the Hydrogeomorphic Approach and HEP models, were considered and rejected because extensive field data collection efforts required by these models were not feasible given time and budget constraints.

USACE regulation ER 1105-2-407 and draft EC 1105-2-14 require that a planning model be approved for use by the appropriate Planning Center of Expertise (PCX). The USACE, Galveston District's (SWG) application of the WVA model (USFWS, 2002a, 2002b, 2002c, 2002e) to the quantification of environmental impacts and mitigation for the proposed SNWW deepening and widening project was approved by a model assessment conducted in 2008 (Louis Berger Group [LBG] and Toxicological and Environmental Associates [TEA], 2008) and approved for use by the PCX for Deep Draft Navigation, in consultation with the PCX for Ecosystem Restoration by memo dated 30 June 2009 (Attachment 1). The

WVA modules that were submitted for the assessment are identical to those that were used in the revised modeling for the SNWW deepening-only project.

2.3 MODEL DESCRIPTION

WVA is a modification of the widely used HEP developed by USFWS (1980). It was developed by the EnvWG of the Planning and Evaluation Subcommittee of Louisiana's CWPPRA Technical Committee (USFWS, 2002a). The EnvWG reviews candidate CWPPRA projects, suggests recommended measures to achieve wetland benefits, and determines the estimated annualized benefits for those projects. USFWS chairs the EnvWG and developed the WVA model in consultation with other EnvWG agencies for the purpose of evaluating the benefits of proposed projects. While HEP models use a species-oriented approach, WVA employs a community approach that assumes that optimal conditions for all fish and wildlife within a specific type of coastal wetland habitat can be characterized by a group of significant variables, and that existing or future conditions can be compared to that optimum, providing an index of habitat quality similar to those developed under HEP.

The WVA community models were developed for the following habitat types: fresh marsh, intermediate marsh, brackish marsh, saline marsh, fresh swamp, barrier islands, and barrier headlands. A WVA Procedural Manual was prepared by the EnvWG to provide guidance in the use of these models (USFWS, 2002b). A separate procedural manual has also been prepared for the four marsh habitat models, collectively called the WVA Emergent Marsh Community Models (USFWS, 2002c). Two other habitat assessment models for bottomland hardwoods (LDNR, 1993) and coastal chenier/ridge habitat were developed outside of the CWPPRA arena and are periodically used by the EnvWG for CWPPRA project evaluation. The SNWW Habitat Workgroup chose to apply the WVA models as formulated by the EnvWG because the habitats and environmental stressors in the SNWW study area are the same as those for which the WVA models were developed.

Each model consists of (1) variables considered important to each habitat type, (2) a Suitability Index (SI) graph for each variable, and (3) a mathematical formula that combines the SIs for each variable into a single value for habitat quality (Habitat Suitability Index or HSI). HSIs are then established for the baseline (existing) condition, for FWOP, FWP conditions, and for the MFWP condition for selected target years (TY) throughout the life of the project. Habitat units are calculated by multiplying these HSIs by the affected acreage at each target year. The habitat units for the FWOP, FWP, and MFWP conditions are annualized over the project life to determine AAHUs. The impacts or benefits of the project are then quantified by comparing AAHUs between FWP and FWOP, and between MFWP and FWOP conditions. This procedure fulfills the USACE requirement that compensation be evaluated using a unit of comparison that measures quality and quantity of habitat values over time.

2.4 MODELING PROCESS

The SNWW ICT established the Habitat Workgroup to apply the ecological model. Any ICT agency interested in participating was invited to attend. Representatives from the following agencies participated in workgroup meetings, making all technical decisions regarding data collection and variable input.

SNWW Habitat Workgroup
- USFWS – Clear Lake (Texas) Ecological Field Office
- USFWS – Louisiana Ecological Field Office
- USFWS – Chenier Plain NWR complex
- USFWS – Sabine NWR
- NMFS – Galveston, Texas
- NMFS – Baton Rouge, Louisiana
- EPA, Region 6
- GLO
- TPWD – Federal Projects Review
- TPWD – J.D. Murphree WMA
- LDNR – Coastal Restoration Division
- LDWF
- SRA – TX
- USACE

Meetings were held at Galveston District headquarters in Galveston, Texas, at the J.D. Murphree WMA in Port Arthur, Texas, and at the USFWS – Lafayette Ecological Services Field Office. The following WVA community models were selected for use based upon baseline habitat mapping of the study area: EMCM (saline, brackish, and intermediate/fresh), the SCM, and BHM. They are individually described in sections 2.6 to 2.8.

Members of the Habitat Workgroup divided sensitive habitats into hydro-units (see Figure 2), provided GIS assistance for habitat mapping, reviewed habitat delineations, conducted field work to collect data, developed historical land loss rates, and determined values for model variables. USACE provided hydrodynamic salinity modeling results, provided GIS assistance for habitat mapping, and provided conceptual plans for FWP and MFWP navigation features and mitigation measures. In addition, USACE provided data input for the WVA worksheets based upon workgroup contributions and provided draft worksheets to workgroup members for review. USFWS-Louisiana provided assistance to ensure that WVA procedures (USFWS, 2002b) were followed properly and that WVA worksheets were being used appropriately. USACE conducted in-house quality assurance of worksheet accuracy and an independent technical review of this appendix.

2.5 PERIOD OF ANALYSIS

The estimated date of project completion is 2019, as the dredging of the Sabine Pass and Sabine Pass Jetty channels (the controlling channels for increased salinity intrusion) are currently scheduled for

completion that year. The year 2004 is TY 0 for the ecological modeling because field observations that support many of the WVA variables were made in that year. Since the typical USACE period of analysis for projects of this type is 50 years long, the period of analysis extends to the year 2069. FWP impacts are evaluated for the period beginning in the year 2019 (TY 15) and ending in year 2069 (TY 65).

2.6 WVA EMERGENT MARSH COMMUNITY MODELS

The emergent marsh models were initially developed in the early 1990s by the EnvWG for use in the Louisiana CWPPRA program. They have undergone several revisions since that time, and the 2002 version was employed in this study (USFWS, 2002c). The EMCM is used to evaluate saline, brackish, intermediate, and fresh marsh habitats in the study area as defined and described in Section 1.6.1 above. Variables included in the models were selected by the EnvWG based upon their importance in characterizing fish and wildlife habitat in coastal marsh ecosystems. As part of the variable selection process, species-specific HSI models for a variety of fish and shellfish, freshwater fish, birds, reptiles and amphibians, and mammals were reviewed by the EnvWG during initial model development (Table 3).

The following six variables represent wetland habitat quality in the model:

V_1 percent of the wetland covered by emergent vegetation
V_2 percent of the open water covered by submerged aquatic vegetation
V_3 marsh edge and interspersion
V_4 percent of the open-water area less than or equal to 1.5 feet deep
V_5 salinity
V_6 aquatic organism access

2.6.1 Modeling Assumptions for Suitability Indices

2.6.1.1 V_1 Percent of the Wetland Covered by Emergent Vegetation

Persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. In this model, an area that is 100 percent shallow water is assumed to have minimal habitat suitability (SI = 0.1). For all marsh types, optimal vegetative coverage is assumed to be 100 percent (SI = 1.0). This assumption diverges from the general biological understanding that optimum cover falls in the 60 to 80 percent range. Selection of 100 percent marsh

Table 3: Species Representative of and Dependent on the Habitats Considered in the WVA

Common name	Scientific Name
Estuarine Fish and Shellfish	
pink shrimp	*Penaeus duorarum*
white shrimp	*Penaeus setiferus*
brown shrimp	*Penaeus aztecus*
spotted seatrout	*Cynoscion nebulosus*
Gulf flounder	*Paralichthys albagutta*
southern flounder	*Paralichthys lethostigma*
Gulf menhaden	*Brevoortia patronus*
juvenile spot	*Leiostomus xanthurus*
red ear sunfish	*Lepomis microlophus*
juvenile Atlantic croaker	*Micropoqonias undulatus*
red drum	*Sciaenops ocellatus*
Reptiles and Amphibians	
bullfrog	*Rana catesbeiana*
red-eared slider	*Pseudemys scripta*
American alligator	*Alligator mississippiensis*
Birds	
great egret	*Ardea alba*
northern pintail	*Anas acuta*
mottled duck	*Anas fulvigula*
American coot	*Fulica americana*
marsh wren	*Cistothorus palustris*
snow goose	*Chen caerulescens*
clapper rail	*Rallus longirostris*
great blue heron	*Ardea herodias*
red-winged blackbird	*Agelaius phoeniceus*
roseate spoonbill	*Ajaia ajaja*
white-fronted goose	*Anser albifrons*
laughing gull	*Larus atricilla*
Mammals	
mink	*Neovison vison*
muskrat	*Ondatra zibethicus*
swamp rabbit	*Sylvilagus aquaticus*

Allen (1984, 1985a, 1985b); Allen and Hoffman (1984); Buckley (1984); Chapman and Howard (1984); Christmas et al. (1982); Diaz and Onuf (1985); Enge and Mulholland (1985); Graves and Anderson (1987); Gutzwiller and Anderson (1987); Kaminski (1986); Kostecki (1984); Leslie and Zwank (1985); Lewis (1983); Lewis and Garrison (1983); Morreale and Gibbons (1986); Mulholland (1984); Newsom et al. (1987); Rorabaugh and Zwank (1983); Short (1985); Short and Cooper (1985); Stickney and Cuenco (1982); Suchy and Anderson (1987); Turner and Brody (1983); Twomey et al. (1984); Zale and Mulholland (1985).

cover as the optimal habitat condition is based upon several factors. Loss of emergent coastal marsh is a serious existing condition in the study area, and it is assumed that this loss will continue due to RSLR (NOAA-USDC, 2006). Salinity was one of the driving subvariables for V_1 because increased salinity is a cause of land loss in coastal Louisiana and Texas (Visser et al., 2004). Increasing salinities even within the optimal range for some species may be outside of the optimal range for other species. Existing and potentially accelerated marsh loss associated with channel deepening has been identified as one of the highest concerns by resource agencies and the general public. Mitigation measures should therefore maximize emergent marsh creation, maintenance, and protection.

V_1 Line Formula

All marsh types

$$SI = (0.009 \times \% V_1) + 0.1$$

2.6.1.2 V_2 Percent of the Open Water Covered by Submerged Aquatic Vegetation

For the purpose of this model, SAV is defined as any of the diverse array of floating-leaved and submerged aquatic plants that are typically found in the SNWW study area. Seagrasses, included in the SAV designation, are flowering plants that grow entirely underwater. SAV coverage is included as an important marsh variable because it provides important food and cover to a wide variety of fish and wildlife (Virnstein, 1987; Thomas et al., 1990; Castellanos and Rozas, 2001; Raz-Guzman and Huidobro, 2002; Wyda et al., 2002; Lazzari and Stone, 2006). SAVs provides a refuge from predation, and because of this protection, densities of many invertebrates (infaunal and epifaunal) and small fishes are greater in SAV than in nearby unvegetated areas. SAV (including seagrasses) provide additional benefits by stabilizing sediments and filtering water. SAV (including seagrasses) tolerate or require a wide range of salinities.

The species composition and primary productivity of SAV communities corresponds to the salinity regime (Haller et al., 1974; Longstreth et al., 1984; Dunton, 1990; Bonis et al., 1993; Bortone, 2002; La Peyre and Rowe, 2003; Singh and Arora, 2003; Paresh and Freedman, 2006). Fresh and intermediate marshes, in particular, often support diverse communities of submerged and floating-leaved vegetation. Open water with no aquatics within a fresh or intermediate marsh is assumed to have low suitability (SI = 0.1). Optimal conditions are assumed when 100 percent of the open water is dominated by aquatic vegetation (SI = 1.0). Brackish marshes can also support aquatic plants that provide food and cover for several species of fish and wildlife. Although amounts are generally less than that which occurs in fresh or intermediate marshes, certain species such as widgeon-grass, coontail, and milfoil, can be abundant under some conditions, and widgeon grass, in particular, is an important food source for waterfowl. The SI graph for brackish marsh is identical to the fresh/intermediate model.

Low-salinity saline marshes may also contain beds of widgeongrass, which is able to tolerate a wide range of salinities. However, open-water areas in saline marshes generally contain sparse aquatic vegetation and are primarily important as nursery areas for marine organisms. In order to reflect the

importance of saline open-water areas to marine organisms, a saline marsh with no aquatic vegetation is assigned an SI = 0.3. Optimal coverage by aquatic plants is assumed to be 100 percent.

V_2 Line Formulas

Fresh/intermediate and brackish marsh

$$SI = (0.009 \times \% V_2) + 0.1$$

Saline marsh

$$SI = (0.007 \times \% V_2) + 0.3$$

2.6.1.3 V_3 Marsh Edge and Interspersion

This variable takes into account the relative amount of marsh to open water, and the degree to which open water is dispersed throughout the marsh. Interspersion is an important characteristic for freshwater and estuarine fish and shellfish nursery and foraging habitat in all marsh types (Rakocinski et al., 1992; Baltz et al., 1993, 1998; Rozas and Reed, 1993; Minello et al., 1994; Peterson and Turner, 1994; Rozas and Zimmerman, 2000; Minello and Rozas, 2002; Whaley and Minello, 2002; Rozas and Minello, 2007). The marsh/open-water edge provides cover for postlarval and juvenile organisms. Smaller, isolated ponds are less turbid and contain more aquatic vegetation, thereby providing more suitable waterfowl habitat. Conversely, a large degree of interspersion is assumed indicative of marsh degradation, as solid marsh converts to ever-larger areas of open water. If the entire area is solid marsh, or marsh with natural stream courses and tidal channels, Class 1 interspersion is assigned (SI = 1.0). If the entire area is open water, Class 5 interspersion is assigned (SI = 0.1).

> The SI for V_3 is not calculated with a line formula. Classes 1 through 5 are assigned by comparing marsh edge and interspersion to photographic examples for each class provided in Appendix A of the EMCM (USFWS, 2002c).

Inclusion of a table or index for V_3 (Marsh Edge and Interspersion) variable is not possible because the classification is made by comparison to photographic examples of each class. Percentage marsh coverages for each class are not provided by model documentation. The FEIS description of the model was not intended to fully replicate the model documentation. The reader is encouraged to refer to the model documentation for a more complete understanding of model application methodology.

2.6.1.4 V_4 Percent of Open-Water Areas Less than or Equal to 1.5 feet deep

Deeper water is assumed to be less biologically productive than shallow water because sunlight, oxygen, and temperature are reduced as depth increases. Shallow water also provides better bottom access for waterfowl, better foraging habitat for wading birds, and more-favorable conditions for the growth of aquatic vegetation. Certain species typically use shallow water for spawning, feeding, and/or shelter during various life stages (e.g., white/brown shrimp, Gulf flounder, red drum, roseate spoonbill, and mottled duck). SIs for shallow water are calculated differently for fresh/intermediate, brackish and saline

marshes. Optimal shallow-water conditions in fresh/intermediate marsh are assumed when 80 to 90 percent of the open water is equal to or less than 1.5 feet deep. It is assumed that brackish marshes generally contain deeper open-water areas because of tidal scouring, and therefore lower percentages of shallow water receive a higher SI than in fresh/intermediate marsh. The SI for saline marsh is similar to that of brackish marsh, with one difference. The SI for 100 percent shallow water is slightly less than that for brackish marsh, reflecting the importance of deeper tidal channels for estuarine organism access into saline marshes.

V_4 Line Formulas

Fresh/intermediate marsh

If $0 \leq \% < 80$, then $SI = (0.01125 \times \% V_4) + 0.1$

If $80 \leq \% \leq 90$, then $SI = 1.0$

If $\% > 90$, then $SI = (-0.04 \times \% V_4) + 4.6$

Brackish marsh

If $0 \leq \% < 70$, then $SI = (0.01286 \times \% V_4) + 0.1$

If $70 \leq \% \leq 80$, then $SI = 1.0$

If $\% > 80$, then $SI = (-0.02 \times \% V_4) + 2.6$

Saline marsh

If $0 \leq \% < 70$, then $SI = (0.01286 \times \% V_4) + 0.1$

If $70 \leq \% \leq 80$, then $SI = 1.0$

If $\% > 80$, then $SI = (-0.025 \times \% V_4) + 3.0$

2.6.1.5 V_5 Salinity

This variable may appear to duplicate or overlap with V_1 (emergent marsh cover) because the functionality and potential land loss of the marsh vegetation are related to salinity. However, this variable was included as a separate variable in order to account for salinity impacts to fish and wildlife as well as to vegetation.

Salinity is one of the most important factors affecting coastal land loss. Salinity projections affect all of the other WVA variables with the exception of aquatic organism access. Small increases in mean salinity can adversely affect aquatic systems by reducing overall biological productivity. A recent extensive literature review (Visser et al., 2004) compiled information on the effect of salinity on the productivity of emergent tidal marsh. Productivity algorithms, based upon measurements of total biomass, stem/leaf elongation, and photosynthesis, were developed that predict changes in primary productivity for every part per thousand change in salinity. Salinity and primary productivity were found to be inversely related, as salinity increases, primary productivity decreases by different amounts dependent upon the salinity tolerance of the vegetation community.

For fresh/intermediate marshes, the mean high salinity (calculated as a roaming mean of the highest 33 percent consecutive salinity readings) during the growing season is used to assess impacts. For

brackish and saline marshes, average annual salinity is used. Optimum salinity ranges assumed by the model for the various habitat types are as follows: swamp and bottomland hardwood (≤1 ppt), fresh marsh (≤2 ppt), intermediate marsh (≤4 ppt), brackish marsh (≤10 ppt), and saline marsh (≥9 and ≤ 1 ppt). For V_5, salinity changes within the optimal salinity ranges of each marsh type are not considered an impact, and are assigned a maximum suitability index score of "1." But even a small salinity change outside of these optimal ranges, as shown in the formulas for the salinity variable, reduce the suitability index scores below "1."

V_5 Line Formulas

Fresh marsh

If $0 \leq ppt \leq 2$, then SI = 1.0

If $2 < ppt \leq 4$, then SI = (–0.4 x ppt) + 1.8

If $4 < ppt \leq 5$, then SI = (–0.1 x ppt) + 0.6

Intermediate marsh

If $0 \leq ppt \leq 4$, then SI = 1.0

If $4 < ppt \leq 8$, then SI = (–0.2 x ppt) + 1.8

Brackish marsh

If $0 \leq ppt \leq 10$, then SI = 1.0

If $ppt > 10$, then SI = (–0.15 x ppt) + 2.5

Saline marsh

If $9 \leq ppt \leq 21$, then SI =1.0

If $ppt > 21$, then SI = (–0.067 x ppt) + 2.4

2.6.1.6 V_6 Aquatic Organism Access

Access by estuarine-dependent fishes and shellfishes, as well as other aquatic organisms, is important in assessing the quality of marsh systems. It is assumed that a high degree of surface hydrologic connectivity with adjacent systems provides high organism access, as well as providing greater nutrient exchange. The SI is calculated by determining an Access Value that is based on an interaction between the wetland area accessible to aquatic organisms during normal tidal fluctuations and the type of man-made structures (if any) blocking access channels (USFWS, 2002c: Appendix B). Access ratings for specific structures, developed by the Louisiana EnvWG, were adopted for the SNWW application. The installation and operation of water control structures has been shown to significantly impact marine fishery access to, use of, and production on wetlands behind those structures (Rogers and Herke, 1985; Herke et al., 1992; Rogers et al., 1992; Sanzone and McElroy, 1998); therefore, optimal conditions are assumed when the entire wetland area is accessible and access points are unobstructed. Brackish and saline marshes are assumed to be more important than fresh/intermediate marshes as habitat for estuarine-dependent fish and shellfish.

V_6 Line Formulas

Fresh marsh

SI= (0.7 x Access Value) + 0.3

Intermediate marsh

SI= (0.8 x Access Value) + 0.2

Brackish and saline marsh

SI= (0.9 x Access Value) + 0.1

The Structure Rating Table for V_6 (Aquatic Organism Access) was not included because the appropriate application of these ratings requires additional considerations that are described in detail in the model documentation. The FEIS description of the model was not intended to fully replicate the model documentation. The reader is encouraged to refer to the model documentation for a more complete understanding of model application methodology.

2.6.2 Habitat Suitability Index Formulas

All of the variable suitability indices (SIV) for a specific marsh type (i.e., fresh/intermediate, brackish, or saline) are combined in a mathematical formula, the HSI, which represents the composite habitat quality of the wetland being evaluated. Within each HSI formula, specific variables can be weighted to increase the relative importance of that variable over others in the formula. The HSI formulae were the same as those used by the CWPPRA EnvWG.

The primary focus of the SNWW application of the WVA model is the preservation of vegetated wetlands, but it is also recognized that some marsh restoration or protection strategies could have an adverse effect on the access of aquatic organisms. Therefore, variables V_1 (Percent Emergent Vegetation), V_2 (Percent SAV), and V_6 (Aquatic Organism Access) are grouped together and weighted greater than the remaining variables. For all marsh models, V_1 receives the greatest weighting; however, the relative weights of V_1, V_2, and V_6 vary by marsh model to reflect different levels of importance between the marsh types.

WVA emergent marsh models employ a split model format to account for the value of both marsh and open-water habitats. Two HSI formulas are calculated for each marsh type—one for emergent marsh habitat and one for open-water habitat. The HSI formula for emergent marsh contains only those variables that are important for evaluating its habitat quality (V_1, V_3, V_5, and V_6). The HSI formula for open-water habitat contains only those variables important to that habitat component (V_2, V_3, V_4, V_5, and V_6).

Fresh/Intermediate Marsh HSI

$$\text{Emergent Marsh HSI} = \frac{(3.5 \times (SIV_1{}^5 \times SIV_6{}^1)^{(1/6)}) + \underline{(SIV_3 + SIV_5)}}{4.5}$$

$$\text{Open Water HSI} = \frac{(3.5 \times (SIV_2{}^3 \times SIV_6{}^1)^{(1/4)}) + \underline{(SIV_3 + SIV_4 + SIV_5)}}{4.5}$$

Brackish Marsh HSI

$$\text{Emergent Marsh HSI} = \frac{(3.5 \times (SIV_1{}^{5} \times SIV_6{}^{1.5})^{(1/6.5)}) + (SIV_3 + SIV_5)}{4.5}$$

$$\text{Open Water HSI} = \frac{(3.5 \times (SIV_2{}^{3} \times SIV_6{}^{2})^{(1/5)}) + (SIV_3 + SIV_4 + SIV_5)}{4.5}$$

Saline Marsh HSI

$$\text{Emergent Marsh HSI} = \frac{(3.5 \times (SIV_1{}^{3} \times SIV_6{}^{1})^{(1/4)}) + (SIV_3 + SIV_5)}{4.5}$$

$$\text{Open Water HSI} = \frac{(3.5 \times (SIV_2{}^{1} \times SIV_6{}^{2.5})^{(1/3.5)}) + \frac{(SIV_3 + SIV_4 + SIV_5)}{3}}{4.5}$$

Since the marsh models are split into emergent marsh and open-water components, an HSI is calculated for both. Net AAHUs, determined for both components, must be combined to determine total net benefits. In the weighted formulas for determining net AAHUs for each marsh type (below), AAHUs for emergent marsh are weighted higher than open-water AAHUs to reflect the ICT emphasis on marsh restoration/protection over open-water habitat.

Fresh/Intermediate Marsh: $\frac{2.1\text{ (Emergent Marsh AAHUs) + Open-water AAHUs}}{3.1}$

Brackish Marsh: $\frac{2.6\text{ (Emergent Marsh AAHUs) + Open-water AAHUs}}{3.6}$

Saline Marsh: $\frac{3.5\text{ (Emergent Marsh AAHUs) + Open-water AAHUs}}{4.5}$

2.7 SWAMP COMMUNITY MODEL (SCM)

In 2001, the EnvWG developed the swamp community model for use in the Louisiana CWPPRA program by modifying a recent LDNR model (USFWS, 2002d). Variables included in the model were selected based upon their ability to evaluate the suitability of swamp habitat in providing resting, foraging, and nesting habitat for a wide variety of wildlife species. In general, the swamp model can be applied if woody canopy cover is at least 33 percent of the surface area, and at least 60 percent of the canopy consists of any combination of bald cypress, tupelo-gum, red maple, buttonbush (*Cephalanthus occidentalis*), and/or planertree (*Planera aquatica*). Variable selection for the original swamp model

developed by LDNR was based upon a review of USFWS HSI models for various bird and small mammal species and a USFWS community model for forest birds. Other variables were added by the EnvWG to reflect different aspects of habitat quality, landscape function, and salinity.

The following four variables represent swamp habitat quality in the model:

V_1 stand structure
V_2 stand maturity
V_3 water regime
V_4 mean high salinity during the growing season

2.7.1 Modeling Assumptions for Suitability Indices

2.7.1.1 V_1 Stand Structure

Wildlife foods in swamp habitats consist predominantly of soft mast, other edible seeds, invertebrates, and vegetation. Since most swamp tree species produce soft mast or edible seeds, the actual tree species composition is not considered a limiting factor. However, a variety of stand structure should be present to provide appropriate habitat for resting, foraging, breeding, nesting, and nursery activities. Three structures are evaluated: (1) overstory closure, (2) scrub-shrub midstory cover, and (3) herbaceous cover. The variable assigns the lowest suitability to sites with a limited amount of all three stand structures, and the highest suitability to sites with significant amounts of all three stand structures.

V_1 SI Classes

The SI for V_1 is not calculated with a line formula. Classes and associated SI are assigned according to the relative percentages of structure classes as shown below.

	Overstory Closure (%)		Shrub/Scrub Midstory Cover (%)		Herbaceous Cover (%)	Suitability Index (SI)
Class 1	<33		n/a		n/a	0.1
Class 2	33 <50	and	<33	and	<33	0.2
Class 3	33 <50	and	>33	or	>33	0.4
Class 4	50–75	and	>33	or	>33	0.6
Class 5	33–<50	and	>33	and	>33	0.8
Class 6	≥50	and	>33	and	>33	1.0
			OR			
	≥75	and	>33	or	>33	1.0

2.7.1.2 V_2 Stand Maturity

Swamps with mature sizable trees are considered to be rare and ecologically important because of the historical loss of swamp habitat from timber harvesting, saltwater intrusion, and a reduced growth rate in the subsiding coastal zone. Two components, stand age and stand density, are combined in the SI for this variable. Stand age is included because older trees provide important wildlife requisites such as snags, nesting cavities, and the medium for invertebrate production. Additionally, as the older, stronger trees establish themselves in the canopy, weaker trees die and form additional snags that would not be present in younger stands. Stand age is determined by average trunk diameter measured at breast height (dbh). The optimal size for canopy-dominant and canopy co-dominant bald cypress is greater than 16 inches, and greater than 12 inches for tupelo-gum and other species. Stand density allows evaluation of mature swamp ecosystems that contain an overstory of a few widely scattered, mature bald cypresses but in which other stand characteristics important for nesting, foraging, and other habitat functions are absent. Basal area is used as a measure of stand density; it measures how much of the forest floor is covered by the area of standing tree trunks. Stand age and density are evaluated separately for cypress and tupelo-gum.

V_2 SI Line Formulas for bald cypress

If dbh = 0 then SI = 0

If 0 < dbh ≤1 then SI = 0.01 x dbh

If 1 < dbh ≤4 then SI = (0.013 x dbh) - 0.002

If 4 < dbh ≤7 then SI = (0.017 x dbh) - 0.019

If 7 < dbh ≤9 then SI = (0.1 x dbh) - 0.6

If 9 < dbh ≤11 then SI = (0.15 x dbh) - 1.05

If 11 < dbh ≤13 then SI = (0.1 x dbh) - 0.5

If 13 < dbh ≤16 then SI= (0.067 x dbh) - 0.071

If dbh >16 then SI = 1.0.

V_2 SI Line Formulas for tupelo-gum et al.

If dbh = 0 then SI = 0

If 0 < dbh ≤1 then SI = 0.01 x dbh

If 1 < dbh ≤2 then SI = (0.04 x dbh) - 0.03

If 2 < dbh ≤4 then SI = 0.025 x dbh

If 4 < dbh ≤6 then SI = (0.1 x dbh) - 0.3

If 6 < dbh ≤8 then SI = (0.15 x dbh) - 0.6

If 8 < dbh ≤12 then SI = (0.1 x dbh) - 0.2

If dbh >12 then SI = 1.0.

V_2 SI Line Formulas for Basal Area (BA)

If open (BA <40 ft^2), then SI = 0.2 x BA

If moderately open (40 $ft^2 \leq$ BA $\leq$80 ft^2), then SI = 0.4 x BA

If moderate (81 $ft^2 \leq$ BA $\leq$120 ft^2), then SI = 0.6 x BA

If moderately dense (121 $ft^2 \leq$ BA $\leq$ 60 ft^2), then SI = 0.8 x BA

If dense (>160 ft^2), then SI = 1.0 x BA

2.7.1.3 V_3 Water Regime

Seasonal flooding with periodic drying cycles increases nutrient cycling, vertical structure complexity, and recruitment of dominant overstory trees. The optimal water regime is assumed to be seasonal flooding with abundant and consistent riverine/tidal input and water flow-through. Optimal flow-through is assumed to be an abundant and consistent input, allowing maximum use as fish and wildlife habitat. Temporary or seasonal flooding is optimal because permanent flooding produces poor water quality during warm weather and reduces fish and invertebrate production.

The SI for V_3 is not calculated with a line formula. Classes and associated SI are assigned according to the various combinations of four flow/exchange and four flooding duration categories as shown below.

V_3 Categories

		Flow/Exchange			
		High	Moderate	Low	None
Flooding Duration	Seasonal	1.00	0.85	0.70	0.50
	Temporary	0.90	0.75	0.65	0.40
	Semipermanent	0.75	0.65	0.45	0.25
	Permanent	0.65	0.45	0.30	0.10

2.7.1.4 V_4 Mean High Salinity During the Growing Season

Many swamp species, especially tupelo-gum and many herbaceous species, are salinity sensitive (Conner et al., 1997; Pezeshki et al., 1989). Swamp systems may be acutely affected by the sudden addition of only a few parts per thousand of salt during an intrusion event (Reid and Wood, 1976). Primary biological productivity is lowered 8.4 percent for each 1 ppt increase in salinity, slowing growth rates for dominant overstory species such as tupelo-gum (and, to a lesser degree, bald cypress since it is more salt tolerant), reducing the overstory coverage, and reducing the percentage cover and variety of fresh, herbaceous understory vegetation. These changes would result in lower wildlife values for forage, cover, and reproduction (Palmisano, 1972).

Bald cypress is able to tolerate higher salinities than the other species. Optimal conditions are assumed to occur at salinities less than 1 ppt, and habitat suitability is assumed to decrease rapidly as mean high

salinities exceed that mark. Mean high salinity during the growing season (March 1 through October 31) is defined as the average of the highest 33 percent consecutive salinity readings.

V_4 SI Line Formulas

If $0 \leq ppt \leq 1.0$, then $SI = 1.0$

If $1.0 < ppt < 3.0$, then $SI = (-0.45 \times ppt) + 1.45$

If $ppt \geq 3.0$, then $SI = 0.1$

2.7.2 Habitat Suitability Index Formula

All of the variable SIV are combined in a mathematical formula, the HSI, which represents the composite habitat quality. Variables V_1 and V_3 (stand structure and water regime) are considered the most important variables in characterizing swamp habitat quality and therefore are weighted heavier than other variables. Variable V_4 (salinity) was considered to be least important.

Swamp HSI

$$HSI = (SI\ V_1^3 \times SI\ V_2^{2.5} \times SI\ V_3^3 \times SI\ V_4^{1.5})^{1/10}$$

2.8 BOTTOMLAND HARDWOOD MODEL

In 1993, the LDNR developed a BHM for use in quantifying impacts and mitigation for permitted activities in the coastal zone (LDNR, 1993). This model was adopted by the Habitat Workgroup for use in conjunction with ecological modeling for the SNWW Feasibility Study. It applies to forested wetlands that support a canopy of woody vegetation of which more than 40 percent of tree species consist of oaks, hickories, American elm, cedar elm (*Ulmus crassifolia*), green ash, sweetgum, sugarberry (*Celtis laevigata*), boxelder (*Acer negundo*), common persimmon (*Diospyros virginiana*), honeylocust (*Gleditsia triacanthos*), red mulberry (*Morus rubra*), eastern cottonwood (*Populus deltoides*), black willow (*Salix nigra*), and American sycamore (*Platanus occidentalis*). Variable selection for the model was based upon a review of various USFWS HSI models for bottomland hardwood wildlife.

The following variables represent bottomland hardwood habitat quality in the model:

V_1 Tree Species Composition
V_2 Stand Maturity
V_3 Midstory/Understory
V_4 Hydrology
V_5 Size of Contiguous Forested Area
V_6 Surrounding Land Uses
V_7 Disturbance

2.8.1 Modeling Assumptions for Suitability Indices

2.8.1.1 V_1 Tree Species Composition

Bottomland hardwood wildlife depends heavily on mast, other edible seeds, and tree buds as primary sources of food. The model assumes that more production of mast and other edible seeds is better than less, and that hard mast is more critical than soft mast because it is available during late fall and winter and has high energy content. Typical hard mast producers in the SNWW study area are oaks, pecan, and other hickories. Soft mast and other edible seeds are produced by red maple, sugarberry, green ash, boxelder, common persimmon, sweetgum, honeylocust, red mulberry, bald cypress, tupelo-gum, American elm, and cedar elm. Nonmast/inedible seed producers are eastern cottonwood, black willow, and American sycamore. The model defines five classes based upon the percentage of the overstory that contains mast-producing trees, and the percentage of hard mast producers in the canopy.

The SI for V_1 is not calculated with a line formula. Classes and associated SI are assigned according to the various classes as shown below.

V_1 Classes of Tree Species Composition

	Description	SI
Class 1	<25% mast or other edible-seed-producing trees in overstory	0.2
Class 2	25% to 50% mast or other edible-seed-producing trees in overstory; hard mast producers <10 percent of canopy	0.4
Class 3	25% to 50% mast or other edible-seed-producing trees in overstory; hard mast producers >10 percent of canopy	0.6
Class 4	>50% mast or other edible-seed-producing trees in overstory; hard mast producers <20 percent of canopy	0.8
Class 5	>50% mast or other edible-seed-producing trees in overstory; hard mast producers >20 percent of canopy	1.0

2.8.1.2 V_2 Stand Maturity

Mature stands of bottomland hardwood are rare in the study area and ecologically important. Historical and ongoing timber harvesting has reduced the number of mature stands and increased the ecological importance of those that remain. These stands provide more hard and soft mast, other edible seeds, and buds than younger stands. They provide important wildlife requisites such as snags, nesting cavities, and medium for invertebrate production. Older, stronger trees in the canopy outcompete understory trees and stimulate the production of additional snags and downed treetops as younger trees die.

V_2 SI Line Formulas

If dbh = 0 then SI = 0

If 0 < dbh ≤5 then SI = 0.01 x dbh

If 5 < dbh ≤8 then SI = (0.017 x dbh) - 0.03

If 8 < dbh ≤11 then SI = (0.067 x dbh) - 0.43

If 11 < dbh ≤14 then SI = (0.1 x dbh) - 0.8

If 14 < dbh ≤20 then SI = (0.067 x dbh) - 0.33

If dbh >20 then SI = 1.0.

2.8.1.3 V_3 Midstory/Understory

Midstory and understory plants also provide important food sources for bottomland hardwood wildlife. Understory and midstory SIs are calculated separately and averaged for the variable SI. The model assumes that the value of understory coverages increases as the percent of understory coverage increases between 0 and 30 percent. Optimal understory coverage is assumed to be between 30 and 60 percent. The SI decreases slowly when understory coverage exceeds 60 percent, based upon the assumptions that denser understory inhibits access and is less preferable for breeding, nesting, and feeding activities.

V_3 Understory Percent SI Line Formulas

If understory % = 0 then SI = 0.01

If 0 < understory % ≤30 then SI = (0.03 x understory %) + 0.1

If 30 < understory % <60 then SI = 1.0

If understory % >60 then SI = (–0.01 x understory %) + 1.6

The value of midstory coverage increases as the percent coverage increases between 0 and 20 percent. Optimal midstory coverage is assumed to be between 20 and 50 percent. The SI decreases slowly when midstory coverage exceeds 50 percent, based upon the assumptions that denser midstory inhibits understory growth and provides less preferable habitat for breeding, nesting, and feeding activities.

V_3 Midstory Percent SI Line Formulas

If midstory % = 0, then SI = 0.01

If 0 < midstory % ≤20 then SI = (0.045 x midstory %) + 0.1

If 20 < midstory % ≤50 then SI = 1.0

If midstory % >50 then SI = (–0.01 * midstory %) + 1.5

2.8.1.4 V_4 Hydrology

The model assumes that the optimum hydrology for stands of bottomland hardwood is one that is essentially unaltered from natural conditions, allowing natural wetting and drying cycles that are beneficial to vegetation and associated fish and wildlife species. In addition to this unaltered class, three other classes of altered water regimes are commonly found in the study area. For areas with efficient forced drainage, the vegetation provides some habitat value, but water-dependent wildlife are excluded

and there is no fisheries production. For areas with a moderately lowered water table, the vegetation provides excellent habitat for many wildlife species and temporary habitat for water-dependent wildlife, but fisheries production is still excluded. Areas with a raised water table provide habitat for fish and water-dependent wildlife that is equivalent to an unaltered system, but vegetation and associated wildlife are adversely affected.

The SI for V_4 is not calculated with a line formula. Classes and associated SI are assigned according to the various classes as shown below.

V_4 Hydrology Classes

	Description	SI
Class 1	Forced drainage system – efficiently removes water from the surface year-round	0.1
Class 2	Water table lowered relative to ground level so as to significantly reduce period of inundation OR Water table raised so as to cause extended inundation or impoundment	0.5
Class 3	Hydrology essentially unaltered (with exception of small levees and/or ditches that do not significantly affect water regime)	1.0

2.8.1.5 V_5 Size of Contiguous Forested Area

The model assumes that larger forested tracts are less common and offer higher-quality habitat than smaller tracts, and that species in greatest need of conservation are specialists in habitat use requiring large forested tracts. It is recognized that forest edge and diversity are important, but the model assumes that species that thrive in edge habitat are highly mobile and occur in substantial numbers because of the increase in forest fragmentation. Species found in "edge" habitat are generalists in habitat use but are capable of existing in larger tracts. For this model, tracts greater than 500 acres in size are considered optimal.

The SI for V_5 is not calculated with a line formula. Classes and associated SI are assigned according to the various classes as shown below.

V_5 SI for Classes of Contiguous Forested Area

	Description	SI
Class 1	0 to 5 acres	0.2
Class 2	5.1 to 20 acres	0.4
Class 3	20.1 to 100 acres	0.6
Class 4	100.1 to 500 acres	0.8
Class 5	>500 acres	1.0

2.8.1.6 V_6 Surrounding Land Uses

The model assumes that surrounding land uses affect the wildlife value of specific bottomland hardwood tracts. Many wildlife species commonly use adjacent areas as temporary escape or resting cover, as seasonal or diurnal food sources, or as connecting corridors to other desirable habitats. Surrounding areas that meet these needs can make a specific bottomland hardwood area more valuable. Furthermore, some types of surrounding land use are more valuable than others in providing food sources or encouraging wildlife movement. The model defines five types of surrounding land use that are typically found in the study area, and assigns weighting factors that reflect their estimated potential in meeting specific needs. The effect of surrounding land use is measured within a 0.5-mile perimeter of the bottomland hardwood tract. The percent of this area occupied by each of the land use types is calculated and summed. If 100 percent of the Surrounding Habitat is considered nonhabitat, SI equals 0.01.

The SI for V_6 is not calculated with a line formula. The SI is calculated using the various classes and weighting factors shown below.

V_6 SI for Surrounding Land Use

Land Use	Weighting Factor		Percent of 0.5-mile Circle		Weighted Percent
Bottomland hardwood, other forested areas, marsh habitat, etc.	1.0	x		=	
Abandoned agriculture, overgrown fields, dense cover, etc.	0.6	x		=	
Pasture, hayfields, etc.	0.4	x		=	
Active agriculture	0.2	x		=	
Nonhabitat: linear, residential, commercial, industrial development, etc.	0.0	x		=	
					Total/100 = SI

2.8.1.7 V_7 Disturbance

It is assumed that human-induced disturbance can displace individuals, modify home ranges, interfere with reproduction, cause stress, and force animals to use important energy reserves. The model measures the effect of disturbance using two components: (1) type of disturbance, and (2) distance from disturbance. The magnitude of the effect of each type of disturbance is a factor of the distance to that disturbance.

Separate suitability indices were developed for each of the type and distance factors as shown below.

Distance Classes		SI	Type Classes		SI
Class 1	0 to 50 feet	1	Class 1	Constant/Major (Major highways, industrial, commercial, major navigation)	1
Class 2	50.1 to 500 feet	2	Class 2	Frequent/Moderate (Residential development, moderately used roads, waterways commonly used by small to mid-sized boats)	2
Class 3	>500 feet	3	Class 3	Seasonal/Intermittent (Agriculture, aquaculture)	3
			Class 4	Insignificant (Lightly used roads and waterways, individual homes, levees, rights of way)	4

The SI for V_7 is not calculated with a line formula. A combined SI for disturbance is assigned in accordance with various combinations of these factors as shown below.

V_7 SI Disturbance

		Type Class			
		1	2	3	4
Distance Class	1	0.01	0.26	0.41	1.0
	2	0.26	0.50	0.65	1.0
	3	1.0	1.0	1.0	1.0

2.8.2 Habitat Suitability Index Formula

The model incorporates site-specific habitat quality features (tree species composition, forest stand structure, stand maturity, and hydrology) and landscape parameters (forest size, surrounding land use, and disturbance). Because the primary application of this model is to quantify the loss of ecological values due to changes in the site-specific conditions, variables that are likely to be affected by these changes (V_1, V_2, V_3, and V_4) are considered more important than the landscape variables. Of the site-specific variables, V_1 (Tree Species Composition) and V_2 (Stand Maturity) are considered equal and of greater importance than the other variables; they are weighted to the power of four. Variables V_3 (Understory/Midstory) and V_4 (Hydrology) are weighted to the power of two. The "landscape" variables (V_5, V_6, V_7) are not weighted.

Additionally, the following factors influence the HSI formulas. The suitability index for V_1 (Tree Species Composition) and V_3 (Understory/Midstory) are a function of hard and soft mast production. Until the trees reach hard mast–bearing age (approximately 7 years of age), V_1 and V_3 do not affect the value of the site. Therefore, V_1 and V_3 are not incorporated into HSI formulas until the trees reach approximately 7 years of age (dbh ≥5 inches). V_5 (Forest Size) assigns a greater value to larger contiguous forested tracts than to edge and diversity. In keeping with that approach, seedlings and saplings present at a forest regeneration site are not yet part of the contiguous forested area. Therefore, V_5 is not incorporated into HSI formulas until dbh ≥5 inches.

HSI formula for bottomland hardwood

If dbh <5 inch, then $HSI = (SI_{V2}^{4} \times SI_{V4}^{2} \times SI_{V6} \times SI_{V7})^{1/8}$

If dbh $\geq$5 inch, then $HSI = (SI_{V1}^{4} \times SI_{V2}^{4} \times SI_{V3}^{2} \times SI_{V4}^{2} \times SI_{V5} \times SI_{V6} \times SI_{V7})^{1/15}$

3.0 HS MODELING

Application of the WVA EMCM and SCM relied upon a 3-dimensional (3-D) numerical HS model to provide values for salinity variables in both models. Information about the HS model, its development, and application in the SNWW WVA modeling are described below.

3.1 SNWW MODELING WORKGROUP

At the beginning of the study, the ICT established a Modeling Workgroup to advise and assist in development of the HS model for the SNWW study.

SNWW Modeling Workgroup
- USFWS – Clear Lake (Texas) Ecological Field Office
- USFWS – Louisiana Ecological Field Office
- NMFS – Galveston, Texas
- EPA, Region 6
- GLO
- TPWD – Federal Projects Review
- TWDB
- LDNR – Coastal Restoration Division
- LDWF
- USACE-Galveston District
- Engineer Research and Design Center (ERDC)-Coastal Hydraulics Laboratory (CHL)

Most of the agencies on the ICT were represented and several (TPWD, TWDB, and ERDC-CHL) provided individuals with experience and expertise in HS modeling. The Modeling Workgroup assisted and advised ERDC in the development of the original HS model, which was described in Brown et al. (2006). Due to changes in the recommended plan of navigation improvements and technical review recommendations, the HS model was revised in 2009 to incorporate the effects of RSLR and forecasts of future freshwater inflows into the FWOP and FWP conditions (Brown and Stokes, 2009). Due to schedule constraints, the Modeling Workgroup was not consulted during model development but the revised modeling was presented for ICT review. The model described below is the revised HS model developed in 2009.

3.2 DESCRIPTION OF THE HS MODEL

ERDC-CHL applied an established 3-D estuarine model (ERDC modified TABS MDS) to compute hydrodynamics and salinity transport for the SNWW study. It includes forcing due to tides, freshwater inflows, wind, Coriolis, and density gradients due to salinity variation, and accounts for precipitation and evaporation. The code uses a finite-element formulation, which gives it great flexibility in matching complex geometry. Over the last decade, the code has been extensively used for a variety of USACE field

projects, including the Houston-Galveston Navigation Channels project; New York Harbor; St. Johns River, Florida; and Atchafalaya Bay in Louisiana. Two of the special features of the code, wetting/drying and "marsh porosity," enable successful modeling of wetlands. A description of the model and its output is summarized in a draft report by ERDC-CHL (Brown and Stokes, 2009). The reader is referred to this report for a full technical explanation of the model. A description of assumptions and methods of HS model application is provided here to facilitate interpretation of salinity values applied in the WVA worksheets.

3.3 APPLICATION OF THE HS MODEL

The HS model was calibrated and verified using field observations collected by ERDC during a long-term data collection effort at 16 locations (stations) in the study area from May 16, 2001, through January 10, 2002 (Fagerburg, 2003). The long-term data collection effort was intended to provide adequate coverage to determine tidal velocity, magnitude, and direction, ranges of water level elevations, and changes in salinity concentration. In addition to the long-term effort, additional velocity and salinity data were collected during a short-term, intensive data collection effort at 10 transects over a 25-hour period during a spring tide event.

The model salinities were verified against salinity data from June through December 2001. An index with the location of all sampling locations and model nodes is provided in Table 4. For the baseline condition, model outputs were provided for all original sampling locations. Model nodes, or specific locations in the model mesh, were added later to obtain additional output for the FWP condition.

Future projections of freshwater inflow and accelerated rates of RSLR are likely to cause significant changes in the FWOP condition for the SNWW study's period of analysis (NRC, 1987; IPCC, 2007; Milliken et al., 2008a). It is, therefore, important that the implications of FWOP RSLR and freshwater inflows be explored relative to FWP salinity changes and related impacts to plant and animal communities in the study area. A summary of the wide range of possible future scenarios and rapidly changing scientific opinions on these issues is presented below, along with an explanation of assumptions that were used to revise the HS model runs.

3.3.1 RSLR Considerations

Incorporation of RSLR into HS modeling for the SNWW study was initiated in the fall of 2008 in consultation with Headquarters, USACE (HQUSACE). At that time, it was determined that the SNWW HS modeling would use Curve II from NRC (1987) to determine project impacts as it appeared to be the "most likely" eustatic sea level rise over the next 50 years. In the 1987 report, the NRC believed that the three NRC scenarios of sea level rise (i.e., 0.5, 1.0, and 1.5 meters over 100 years) would provide a useful range of possible future sea level changes for design calculations. The confidence that these scenarios will encompass actual future sea levels decreases over time, and significant deviations outside the range of these scenarios are possible, including an amelioration in the rate of rise. The NRC committee recommended that these projections be updated approximately every decade to incorporate additional data

and to provide an improved basis for planning and response to the rise. Since that time, new HQUSACE guidance on incorporating considerations of RSLR into USACE programs (EC 1165-2-211) was issued on July 1, 2009, to be effective immediately.

Table 4: SNWW HS Modeling Stations and Nodes

H/S Sampling Station No.*	Name	Location
1A	Upper Beaumont	Pine Island Bayou
2	Beaumont	Neches River opposite Rose City
3	Rainbow Bridge	Neches River downstream of lower Bessie Heights
4	Lower Sabine River	Mouth of Sabine River on GIWW
5	Orange	Sabine River at Interstate 10
6	Port Arthur	Upstream of MLK bridge next to Pleasure Island
7	Sabine Pass	Texas Point
8	Sabine Offshore	Never deployed due to offshore conditions
9	Upper Sabine Lake	Mouth of East Pass/Black Bayou
10	Lower Sabine Lake	Blue Buck Point
11	Blacks Bayou	East of intersection with East Pass
12	GIWW East	Black Bayou at GIWW East
13	GIWW West	Star Lake at GIWW West
14	Johnson's Bayou	Inside mouth of Johnson's Bayou, southeast Sabine Lake shore
15	Keith Lake	West of Hwy 87 in Keith Lake Fish Pass
16	Willow Bayou	Inside mouth of Willow Bayou, east Sabine Lake shore
H/S Model Nodes**		
1B	Neches River Saltwater Barrier	New node just below saltwater barrier substituted for 1A
17	GIWW - Taylors Bayou	In GIWW near mouth of Taylor's Bayou diversion channel
18	Neches River near Beaumont	In meander south of Rose City Oil Field
19	Neches River at Port Neches	In mouth of Bessie Heights Canal
20	Upper Neches River	In mouth of Lake Bayou
21	Sabine River and Old River Confluence	Confluence of Sabine and Old River
22	Black Bayou at GIWW	At mouth of Black Bayou in GIWW East
23	Cow Bayou at Sabine River	In mouth of Cow Bayou
24	Adams Bayou at Sabine River	In mouth of Adams Bayou
25	Black Bayou at Sabine Lake	At mouth of Black Bayou at its intersection with East Pass
26	Between Black Bayou and Pines Ridge	In marsh
27	Black Bayou mid-point	In midpoint of Black Bayou
28	North of Black Bayou	In marsh between Black Bayou and GIWW East
29	Right Prong South of Black Bayou	In channel leading to NW corner of Pool 3
30	Greens Lake	In Greens Lake west of Pool 3
31	South of Pines Ridge	In marsh west of Greens Lake
32	Willow, Starks Central, Burton Sutton Cana	At SW corner of Pool 3
33	Willow Bayou at Deep Bayou Canal	On canal midway between Pool 3 and Sabine Lake
34	Willow Bayou near Sabine Lake	In mouth of Willow Bayou on east shore of Sabine Lake
35	Johnson's Bayou at Sabine Lake	In mouth of Johnson's Bayou on east shore of Sabine Lake
36	Johnson's Bayou Landing	In Johnson's Bayou in marsh inland from SE corner of Sabine Lake
37	Deep Bayou Canal at Starks South Canal	In marsh east of node 35
38	Starks South Canal at Burton Sutton Canal	In marsh south of SW corner of Pool 3
* Stations are data location locations and model nodes.		
** Nodes are specific locations in the model mesh for which model output was derived.		

This guidance requires that potential RSL change be considered in every USACE coastal activity. Planning studies should evaluate alternatives using three specific rates of potential future sea level change for both the FWOP and FWP conditions. The base, or low, level of potential RSL change should be the long-term historic rate of RSL change at the closest tide gage station. The intermediate and high rates of local sea level change should be evaluated using a modified NRC Curve I and Curve III, respectively. The intermediate rate falls within the range of IPCC's least and most extreme sea level rise scenarios. The high rate exceeds the upper bounds of the 2007 IPCC estimates, accommodating the potential rapid loss of ice from Antarctica and Greenland. Faster melting of these ice sheets would increase their contributions to twenty-first-century sea level rise and raise levels above those currently projected. Indeed, some recent studies of geologic terrestrial and marine records support the plausibility of higher projections of sea level rise, on the order of 1.0 ± 0.5 meters by A.D. 2100 (Rahmstorf, 2007; Rohling et al., 2007; Carlson, et al., 2008). A sensitivity analysis has been prepared to determine how sensitive the SNWW alternatives would be to the three levels of change. This analysis is presented in Section 9 of this report.

Table 5 gives the various computed future rates of RSLR in the SNWW study area that were prepared per the most recent guidance (EC 1165-2-211, July 2009). According to this guidance, the subsidence rate should be chosen based on the tidal record analysis. However, the regional scientific debate concerning the validity of these tidal records with respect to projection of future subsidence rates indicate that the basal peat rates should also be considered. The existing rate of eustatic sea level rise in the SNWW study area, and various projections as delineated in the NRC (1987) and IPCC (2007, AR4 Working Group 1:820) reports. Among all of the emission scenarios, the IPCC's A1B scenario provides the central estimate of the rate of sea level rise during the period 2090 to 2099 at 3.8 mm per year. The range provided in Table 5 for the IPCC scenarios gives the low, middle, and high ranges of the potential rise in sea level between 1980 to 1999 and 2090 to 2099 as taken from Scenarios B1, A1B, and A1F1, respectively.

Table 5: Predicted RSLR Rates for the SNWW Study Area

Predicted Rates of Future RSLR	Observed Tide Gage Values (rapid subsidence)	Observed Basal Peat Values (moderate subsidence)
Low Rate (Historic)	1.1 feet/year	0.3 foot/year
Intermediate Rate (Modified NRC Curve I)	1.5 feet/year	0.7 foot/year
High rate (Modified NRC Curve III)	2.8 feet/year	2.2 feet/year

In Coastal Louisiana, the local subsidence component of RSLR is at a minimum on the same order of magnitude as the eustatic component. To date, there is no scientific consensus on what this rate should be, and the estimates vary by orders of magnitude. However, it should be noted that subsidence in the Chenier Plain in western Louisiana and eastern Texas is much lower than rates found to the east. The

Chenier Plain lies beyond the limits of downloading by the deep Holocene Mississippi Delta sediments (Simms et al., 2007). Rather than hundreds of feet of silty sediment, the Pleistocene surface lies beneath 49 feet of sediment in the Chenier Plain (Penland and Ramsey, 1990). Table 6 gives several estimates of this local subsidence component.

Table 6: Estimates of Local Subsidence

Researchers	Primary Source of Data	Subsidence Rate	Total Subsidence (50 years)
Shinkle and Dokka (2004)	National Geological Survey (NGS) survey releveling/benchmark data	10–15 mm/year	500–750 mm
Morton et al. (2006) and others	Tide data	2–5 mm/year	100–250 mm
Törnqvist et al. (2006)	Sedimentary record	0.4–0.6 mm/year	20–30 mm

The highest estimates of local subsidence are attributed to the research of Shinkle and Dokka (2004). They conducted an analysis of the settling rates of established benchmarks and Global Positioning System (GPS) observations, and verified these against rates obtained from water level data from the National Ocean Service. They concluded that local subsidence at the Sabine-Neches estuary is on the order to 10 to 15 mm/year. These results are based on data representative of approximately 75 years. The authors note that the rates of subsidence vary greatly both spatially and temporally, and any attempts to project these rates forward in time should be done with this in mind.

Several other researchers have obtained values of subsidence that are much lower than those given by Shinkle and Dokka (2004). For example, Morton et al. (2006) used data from tide gages and found a rate of subsidence of 2 to 5 mm year. Törnqvist et al. (2006) conducted an analysis of basal peat layers in the Mississippi Delta area to generate a proxy record of RSLR over approximately 10,000 years. The results indicate a relative local subsidence rate of only 0.4 to 0.6 mm/year. This subsidence rate was confirmed for the Sabine estuary by a recent field study of basal peat layers, in which it was determined that, during the Holocene, sea level rose more or less continuously at rates less than 5.2 mm/year (Milliken et al., 2008a).

Currently, there is no established consensus as to which rates are most appropriate for use in generating projected rates of subsidence. Morton et al. (2006) assert that the higher rates observed by Shinkle and Dokka (2004) are likely attributable to large-scale fluid extraction from the subsurface. Milliken et al. (2008b) and Gonzalez and Törnqvist (2006) assert that these higher rates do not appear to correlate well with trends observed in the basal peat data, and therefore are likely due to some temporary or anthropogenically induced cause. However, Berman (2005) notes that the methods used by Shinkle and Dokka (2004) are sound and follow accepted guidelines, and that the results should not therefore be dismissed merely because they are anomalous. Although the Shinkle and Dokka (2004) data may indicate that local subsidence is proceeding much more rapidly than previously thought, the SNWW deepening study relied on the results of the basal peat analysis. These represent long-term trends in the subsidence

rate and seem to be the closest approximation of consensus concerning the local subsidence rate currently available.

HS modeling and environmental analyses were updated to include the effects of RSLR on the project impacts. These impacts were included by analyzing both the with- and without-project conditions for a single "most likely" future sea level rise condition that was based on NRC Curve II. Adding subsidence rates estimated using the basal peat analysis to the NRC II projections for eustatic sea level rise, the value for the RSLR in the SNWW study area over 50 years would be 245 to 255 mm (4.9 to 5.1 mm/year). The average of this range (250 mm/year) has been used for modeling purposes. Hence, the "most likely" value of RSLR to be used for the SNWW deepening study's 50-year period of analysis is 250 mm or 0.82 feet. Adjusting this to account for the period of analysis beginning in 2019 and ending in 2069, the "most likely" amount of RSLR by the year 2069 is 1.1 feet. The new guidance was released subsequent to the completion of this reanalysis. The modeled "most likely" rate is between the intermediate and high rates for the moderate subsidence case, and close to the low rate for the high subsidence case. Hence, the "most likely" rate is within the range of the rates recommended for consideration in the most recent guidance.

Inclusion of RSLR in the WVA modeling required the development of new estimates of FWOP shoreline recession rates and adjustment of FWOP land loss rates for interior marsh areas. The forecasted 1.1 feet of RSLR was used to identify shoreline areas expected to be submerged during the revised period of analysis (2019 to 2069). Project effects of RSLR to interior marsh areas are expected to be limited to an increase in salinity, and are modeled with the WVA. Assumptions and methodologies used to estimate shoreline recession and land loss rates over the period of analysis are presented below.

3.3.1.1 RSLR-related Shoreline Recession

The forecasted rate of RSLR would result in the recession of Gulf and Sabine Lake shorelines in the SNWW study area. Potential problems associated with sea level change can be categorized into two classes: those of the open coast and large waterbodies where both water level and wave action are concerns, and those of inland tidal waters where wave action is usually much less severe (NRC, 1987). The NRC report discusses different approaches that can be used to model the change in shoreline configuration associated with RSLR. Two of those techniques were applied to project shoreline recession in the SNWW study area over the period of analysis (2019 thru 2069).

The first technique is recommended for areas of active wave attack and erosion and was applied to the Texas Gulf of Mexico shoreline and the eastern shoreline of Sabine Lake. It is a historical trend analysis that includes an adjustment for higher future rates of RSLR. The second method was applied to the shorelines of interior lakes and inland waterways where the wave climate is subdued, and the stable or accreting Louisiana Gulf shoreline (as described below). This method involves applying the projected change in sea level over the period of analysis to preexisting topography.

Two major factors influencing erosion and eventual shoreline profiles are fetch and exposure to predominant directions of wave approach (Wilson and Allison, 2008). In the SNWW study area,

prevailing winds and wave approach are from the southeast but northers frequently occur during winter months (Anderson, 2007). The portions of the study area most affected by these prevailing wind patterns are the Gulf shoreline and the eastern shore of Sabine Lake. In Sabine Lake, fetch and wave attack associated with prevailing southeasterly winds primarily affect the western shore; an area that is protected from erosion by riprapped levees around PAs 8 and 11. These levees are quite large and sufficiently high such that the rates of RSLR predicted here would have little to no effect. Winter northers, however, do affect the unprotected eastern shore of Sabine Lake (Greco and Clark, 2005; Parchure et al., 2005).

For the Gulf and east Sabine Lake shorelines, the historical trend analysis, modified by the projected RSLR over the period of analysis, was used to project shoreline recession (NRC, 1987:51). Historical rates of change incorporate the inherent variability of the shoreline response based upon local coastal processes, local subsidence rates, coastline exposure, the local sedimentary environment, and eustatic sea level changes. This method assumes that the amount of recession during the historical record is directly correlated with the rate of sea level rise. Therefore, an accelerated rate of RSLR is assumed to result in a commensurate accelerated increase in shoreline recession. For example, a projected fourfold rise in the rate of RSLR in the study area would result in a fourfold increase in the recession rate. For the SNWW study area, the future rate of eustatic sea level was forecast to be roughly 3.8 times the existing rate (existing 1.2 mm/year compared to the forecasted 4.5 mm/year in year 2069). With the addition of the local subsidence rate (0.4 to 0.6 mm/yr), RSLR in 2069 was forecast to be roughly 4.2 times the existing rate.

Rates of existing historical Gulf shoreline change were obtained from several recent studies (Barras et al., 2004; USACE, 2004; BEG, 2009). Most of the Texas shoreline in the study area experienced very high rates of shoreline retreat from the 1950s through 2002, ranging from –5 to –51 feet/year. However, small reaches near the SNWW west jetty and near Sea Rim State Park are stable or accreting. The BEG (2009) has developed a projected shoreline for the upper Texas coast for the year 2056, based upon historical Gulf shoreline changes. The historical rate of change includes historic rates of RSLR but not the accelerated rates expected in the future. The projected shoreline retreat was adjusted to account for the accelerated rate of future RSLR by multiplying the width of the BEG shoreline retreat by 4.2 (the projected increase in the rate of RSLR) and mapping a revised shoreline. Acreage that would be lost with the revised shoreline was then calculated with GIS.

A similar method was followed for Sabine Lake; however, in this case an existing rate of feet lost per year was calculated with a GIS analysis of aerial photographs taken between 1978 and 2004 (Greco and Clark, 2005). This analysis estimated an average shoreline retreat rate of 4.5 feet/year for the Sabine Lake shoreline between the Sabine River and Willow Bayou. For the purposes of this analysis, the 4.5 feet/year rate was applied to the entire east Sabine Lake shoreline as shoreline retreat is also a problem along the Sabine Lake shoreline between Willow Bayou and Blue Buck Point (LCWCR/WCRA, 1998). The 4.5 feet/year rate was increased by a factor of 4.2 to account for the accelerated rate of RSLR, resulting in an estimated 1,230 feet of shoreline retreat by the year 2069. The current shoreline was recessed by this

width, except where other controlling features such as levees or roadways would block retreat, and the lost acreage was calculated by GIS.

For the Louisiana Gulf shoreline in the study area, no change is projected through the year 2050 (Barras et al., 2004). The history of shoreline change for this area, developed in conjunction with the Louisiana Coastal Areas Ecosystem Restoration Report (USACE, 2004), documented that the segment of the Chenier Plain shoreline between Sabine Pass and Ocean View Beach (located 6 miles beyond the 10-mile SNWW study boundary) prograded seaward at an average rate of +12.9 feet/year between 1883 and 1994. Between 1985 and 1995, the average rate of progradation slowed to +1.2 feet/year. The shoreline in the study area is dominated primarily by the effect of the Sabine Pass jetties, which intercept the westward-moving littoral drift and tend to trap sediment, creating a more stable shoreline than that nearer to Ocean View Beach. This study assumed a stable shoreline through the period of analysis and applied the projected RSLR at the Gulf shoreline (1.1 feet in year 2069) to the preexisting topography using the GIS method described below.

For the Louisiana Gulf shoreline and the shorelines of all other major waterways and waterbodies in the study area, the second method was applied. Preexisting topography along shorelines was assumed to be fixed; current shoreline elevations were combined with the projected increase in sea level to project a new shoreline. The increase in sea level at the end of the period of analysis (year 2069) was projected by HS model to be +1.1 feet throughout the study area. Slope is a major controlling variable in the determination of shoreline changes using this method. Steep slopes would experience little shoreline displacement, while gentle slopes would show a much larger lateral change. It is assumed that man-made features such as jetties, roads and highways, dikes and levees, and bulkheads and fill would continue to be maintained at a sufficient elevation that they would block shoreline retreat, and that current beneficial use projects that use dredged material to isolate interior wetlands from large waterways would be continued.

In the WVA EMCM, hydrologic unit acreages were adjusted to remove acres lost to RSLR-related shoreline recession for the FWOP land loss projection in the WVA model. This adjustment was made in the WVA land loss tables. The rate of acreage lost due to shoreline recession was assumed to be linear. The acres lost per year were subtracted from the base acreage before the revised land loss rate for the interior marsh was applied. This adjustment results in the removal of an equivalent amount of acres (lost due to RSLR only) from both the FWOP and FWP conditions. FWOP and FWP interior land loss rates were then applied to the remaining acreage, as described below, to determine the effect of salinity changes over the period of analysis in both the FWOP and FWP conditions.

3.3.1.2 RSLR-related Interior Land Loss

Land loss rates for interior marsh areas were adjusted to account for increasing salinity due to RSLR over the period of analysis using the land loss methodology of the WVA. FWOP and FWP land loss rates over the period of analysis were projected using a productivity-based land loss projection methodology that is described later in this document. Year 2069 FWOP and FWP interior land loss rates were calculated by

incorporating FWOP and FWP RSLR salinities into the respective land loss projection. Salinity increases were projected by the HS model and a linear rate of change was assumed over the period of analysis.

The deepening project would result in a minimal increase in water elevation over the majority of the project area (averaging less than half an inch). Thus, no FWP impacts due to water elevation increases are anticipated. It is, however, assumed that all tidally influenced habitats would see a gradual increase in water elevation associated with an RSLR of 13.2 inches by 2069.

The effects of the projected rate of RSLR on coastal marshes are very difficult to predict. Biomass accumulation would be expected to offset much if not all of the RSLR change in water surface elevation. However, many different climatic, physical, and biological processes could affect the rate of accumulation. Recent experimental evidence suggests that increasing atmospheric carbon dioxide concentrations could stimulate biogenic mechanisms of elevation gain in a brackish marsh, and further, that this effect could be enhanced under salinity and flooding conditions expected with future RSLR (Langley et al., 2009). Although it is recognized that changes in precipitation and temperature could also affect vegetation growth rates, there is as yet no consensus on the amount, timing, and distribution of future precipitation. Changes in climate would affect the timing and quantity of freshwater delivery to the coastal estuaries, and this would affect sediment delivery to the coastal marshes. Uncertainties related to all of these processes could result in very different predictions of future marsh conditions.

"Primary productivity of salt marsh vegetation is regulated by changes in sea level, and the vegetation, in turn, constantly modifies the elevation of its habitat toward an equilibrium with sea level" (Morris et al., 2002:2876). A rise in RSL brings an increase in production and biomass density that enhances sediment deposition by increasing the efficiency of sediment trapping. This can lead to an absolute increase in the elevation of the marsh platform and result in a landward migration of the marsh (Gardner et al., 1992; Gardner and Porter, 2001). This may change total wetland area, depending upon local geomorphology and anthropogenic barriers to migration, such as bulkheads, canals, etc.

This response is further complicated by variations in sediment supply from river discharges and variations in primary production due to changes in nutrient loading, precipitation, temperature, and other factors (Morris et al., 2002). Gulf shoreline erosion associated with accelerated rates of RSLR may increase the amount of nearshore sediment. Wilson and Allison (2008) have shown that material released by Gulf shoreline erosion remains nearshore rather than being dispersed into offshore waters, therefore remaining available for redeposition by tidal flooding or storm surge overwash. In addition to RSLR, future changes in climate would influence the quantity and timing of freshwater delivery to the coastal estuaries. At this time there is no consensus in the direction or amount of changes in precipitation in the study area (Nielsen-Gammon, 2009). Whatever the net effect of climate change on basin runoff, most climate change projections agree that more-frequent high-intensity rainfall events are likely. In most drainages, this type of event would most likely produce increased sediment runoff, and thus periodically increase sediment delivery to the coastal marshes.

Existing coastal marshes appear to have adapted to historical ranges of mean sea level and gradual changes in RSLR. FWOP projections of coastal land loss in the Louisiana portion of the SNWW study area forecast relatively stable landforms and shorelines through 2050 (Barras et al., 2004), not accounting for the effects of tropical storms and hurricanes. In general, the interior marshes in the Louisiana portion of the SNWW study area appear to have stabilized and are not undergoing rapid conversion of large areas to open-water like areas to the east in Louisiana (LCWCR/WCRA, 1998; USACE, 2004). Recent Louisiana LIDAR data show that existing marsh is higher than the projected RSLR for the period of analysis and thus should be able to withstand the gradual rise in elevation (Louisiana State University [LSU], 2009). Similar large-scale FWOP land loss projections are not available for the Texas portion of the study area. However, this study assumed that the Texas portion would also remain relatively stable with respect to the effects of RSLR because the same chenier landforms, marshes, and sediments are present throughout the study area. A GIS study of aerial photographs of the Salt Bayou/Keith Lake system confirmed that the open-water trend has slowed and possibly reversed itself in that area in recent years (TPWD, 2003). Texas interior marshes most at risk to the effects of RSLR are located just outside and to the west of the SNWW study area in the McFaddin NWR.

It must be recognized that large areas of interior marsh could quickly convert to open water under certain extraordinary events. If RSLR accelerates to the extent that the coastal plant community cannot sustain an elevation within its range of tolerance, rates of primary production would decrease, resulting in an unstable and rapidly deteriorating marsh community (Morris et al., 2002). In addition, if shoreline recession cuts existing fore dune formations, large areas of interior marsh could quickly be exposed to higher-salinity Gulf waters and wave attack. In this case, large marsh areas could quickly be lost to the Gulf.

3.3.2 Freshwater Inflows

Freshwater inflows for the SNWW HS model's future conditions were developed using model outputs from Run 8 of the TCEQ Water Availability Models (WAMs) for the lower Sabine and Neches rivers. For existing conditions, "Run 8 uses modified diversion amounts (maximum use for the last 10 years), year 2000 area-capacity parameters for major reservoirs, and assumed return flows. It also includes term water rights and provides the most realistic assessment of current streamflow conditions" (TWDB, 2007:363). The TWDB has projected flows for the year 2060 by modifying Run 8 "to include projected increased demand from existing water rights, expected change to return flows, projected new strategies to come online before 2060, and estimated year 2060 storage capacities for major reservoirs" (TWDB, 2007:363). For the Neches River, the flow appears to increase over existing conditions as a result of projected releases from new reservoirs to diversion points downstream during periods of dry weather.

The 2060 WAMs run was selected for use in the SNWW HS modeling because it was developed by the State's lead water planning agency, and it includes future water supply strategies approved by the 2007 Texas State Water Plan (TWDB, 2007). The SNWW study area is included in Regional Plan I for the East Texas Region. The Region I water plan takes into consideration existing flows that are dedicated to the

State of Louisiana as prescribed by the Sabine River Compact. All existing and proposed future strategies for meeting Texas's demand must be met by the Texas firm-yield share (750,000 acre-feet) of the total Sabine River flow, as appropriated under the use provision of Certificate of Adjudication No. 05-4658 (March 5, 1958). The WAMs 2060 model does not attempt to predict future demand in the Louisiana portion of the Sabine basin. This should not significantly affect future projections because the majority of the Sabine River watershed in the study area is located in Texas, and large increases in water use are not expected, given the large amount of undeveloped, coastal wetlands in the Louisiana portion of the watershed.

By 2060, the Region I population is projected to grow 36 percent, and water demands are projected to increase by 41 percent. The greatest increase (48 percent) is expected in the demand for manufacturing water. Municipal demand is expected to grow 24 percent. The existing water supply is projected to decrease slightly by 2060, due primarily to reservoir sedimentation and a small decline in groundwater supply. Although the region as a whole appears to have enough supply to meet demands through 2060, the total water supply is not readily available to all users.

The regional plan recommends the following strategies to provide the additional water supply projected to be needed by 2060: (1) the construction of the Lake Columbia reservoir in the Neches River watershed; (2) cooperation with Region C, which includes the Dallas-Fort Worth metropolitan area, in the use of surface water from Toledo Bend Reservoir and proposed Lake Fastrill; (3) expanded groundwater use by smaller communities; and (4) municipal conservation throughout the region.

The WAMs Run 8 for the year 2060 was developed using current patterns of precipitation and evaporation. USACE did not modify the WAMs model to use future projections of precipitation or evaporation for SNWW future conditions because the Texas State Climatologist has recently concluded that it is impossible to predict with confidence what precipitation trends will be in Texas over the next half century (Nielsen-Gammon, 2009). Unlike precipitation, there is more consensus for a predicted temperature increase in Texas of close to 4°F by 2060. No attempt was made to change future temperatures in the 2060 WAMs model because resulting changes in evapotranspiration would be so small as to result in a negligible change in the modeling results.

4.0 APPLICATION OF THE EMERGENT MARSH COMMUNITY MODELS

4.1 V_1 PERCENT EMERGENT VEGETATION

4.1.1 Preparation of Baseline Data Set

Since salinity and inundation are major forces in the distribution of habitats across the coastal landscape (Mitsch and Gosselink, 2000), units used to evaluate impacts were defined to the greatest extent possible on hydrologic characteristics. USGS orthophoto quadrangle maps (1995, 2000, 2005) were reviewed by the Habitat Workgroup, and all sensitive habitats hydrologically connected to waterways influenced by the proposed channel improvements were divided into hydro-units. Hydro-unit boundaries were based upon small watershed divides, or on the basis of other topographic features that serve as hydrologic separators. Uplands and developed areas were excluded from the analysis. These upland and developed areas possess no sensitive resources or habitats that could be impacted by the proposed project and are not addressed further. Care was taken to ensure that the hydro-units were scaled so that all significant environmental effects of the proposed project would be captured.

Habitat classification definitions were derived from Cowardin et al. (1979). National Wetlands Inventory (NWI) classifications and USFWS habitat maps of coastal Louisiana were collapsed into 15 land cover classifications in accordance with a protocol developed by the USGS National Wetlands Research Center and LDNR, Coastal Management Division (USGS-NWRC and LDNR, 2004) and used by the CWPPRA EnvWG in Louisiana. Cover classes were aggregated because this study did not require the level of detail inherent in the NWI classifications. Baseline habitat types within each hydro-unit were classified as marsh (fresh, intermediate, brackish, or saline), cypress-tupelo swamp, or bottomland hardwood. Habitat acreages for each habitat type were measured from satellite imagery using GIS software, and field truthed by the Habitat Workgroup during field visits on August 24 and 25 and October 13 and 21, 2004.

Acreages for baseline habitats in the Texas hydro-units were classified and mapped with the assistance of the Habitat Workgroup. TPWD provided habitat mapping for the Keith Lake/Salt Bayou hydro-unit (USFWS, 2001a; TPWD, 2004), the Lower Neches WMA (TPWD, 1992), and Cow Bayou (TPWD, 2002). USFWS (2001a, 2001b) provided habitat maps of the McFaddin and Texas Point NWRs, and also mapped habitat types on the Neches River using the NWI data (USFWS and GLO, 1992; USFWS, 2004), supplemented and revised as necessary on the basis of expert knowledge and field visits. All other Texas hydro-units were mapped by PBS&J specifically for this study, using collapsed NWI (USFWS and GLO, 1992) data, and revised as necessary by the Habitat Workgroup. Water acreages were taken from a GIS data layer provided by TxDOT (2002).

Hydro-units and habitat types for Louisiana marsh habitats were drawn directly from mapping units developed for the Louisiana CWPPRA program (Chabreck and Linscombe, 1978; Linscombe, 2001; USGS, 2002; USGS-NWRC, 2004). Nonmarsh habitats on the Sabine River were mapped by PBS&J for this study using NWI data (USFWS and GLO, 1992), reviewed and revised by the Habitat Workgroup. Water acreages were taken from a GIS data layer provided by USGS (2002).

Because habitat acreages were initially calculated using images from different years, acreages were adjusted, as described below, to reflect a common base year of 2004. All acreages that were originally measured from images predating 2004 were adjusted by applying the base land loss rate to the acreage and subtracting acres of emergent marsh lost for each year between the imagery date and 2004. An index map of all HUs is provided on Figure 2, and overview habitat maps are provided as figures 4 through 9. Tables 7 and 8 provide a breakdown of habitat acreages within each hydro-unit for Texas and Louisiana, respectively. The acreages presented in these tables present acreages that have been adjusted, as necessary, to the 2004 base year.

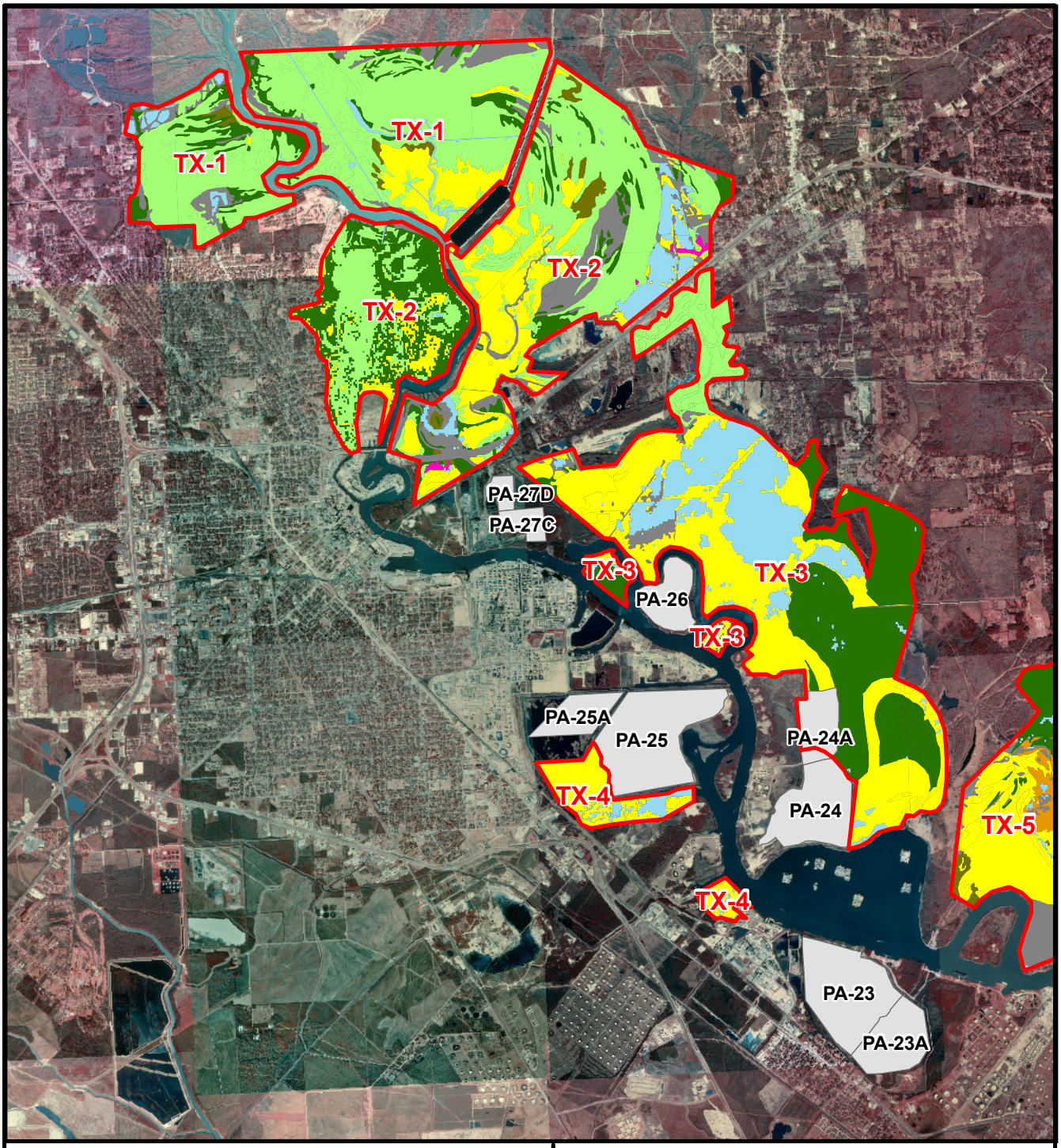
4.1.2 Land Change Projection Methodology

Variable V_1 (Percent Emergent Marsh) of the WVA Emergent Marsh models requires a projection of FWOP and FWP acres of emergent marsh. To make this projection, a methodology that has been applied in numerous Louisiana CWPPRA projects was utilized in this study, with some modifications, as described below.

A number of factors currently contribute to existing land loss in the study area, and the Habitat Workgroup assumed that the same trends will continue in the FWOP condition. FWOP projections of land loss were developed as a baseline against which project-induced changes could be measured. The Habitat Workgroup employed historical data to assess recent trends in land loss or land gain, and then used these historical rates to project changes into the future. Base land loss rates were determined by measuring changes of emergent marsh and open-water areas using GIS software between images from 2 or more years. The time between images generally spanned the most recent 15- to 20-year time period for which reliable data were available. This time period generally fell between the years 1978 and 2001.

The time span over which base land loss rates were calculated postdates the mid-twentieth-century decades in which the greatest volumes of oil and gas were extracted in this region. These base rates thus exclude subsidence related to the most extensive period of oil and gas extraction, which has waned significantly in recent decades. The base land loss rates do include chronic, regional effects of subsidence, altered sediment delivery, sea level rise, and tropical storms or hurricanes that occurred during the period of observation.

The Habitat Workgroup applied the most recent reliable data available for each hydro-unit. For Louisiana marshes, the Habitat Workgroup generally applied land loss rates between 1983 and 1990 (Dunbar et al., 1992; Britsch and Dunbar, 1993) and 1978–1990 (USGS-LDNR, 1993). In Texas, a land loss rate developed for 1987 to 2001 (TPWD, 2004) was applied to all marshes adjacent to the GIWW and south through Texas Point. On the Neches River, a land loss rate for the period from 1978 to 1994, measured for a BEG study, was applied to the Old River Cove marshes (White et al., 1996). For Bessie Heights marsh, the most recent data available were from a period between 1956 and 1978 (White et al., 1987).



Hydrologic Unit
Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Placement Areas
Upland/Impoundment/Other
Shrub/Scrub
Swamp
Water

0 0.5 1 2
Miles

Figure 4

Habitats in Hydrologic Units TX-1 through TX-4

Prepared for: USACE	
Job No.: 100007609	Scale: 1:102,000
Prepared by:EM/AChristiansen	Date: 09/02/2009

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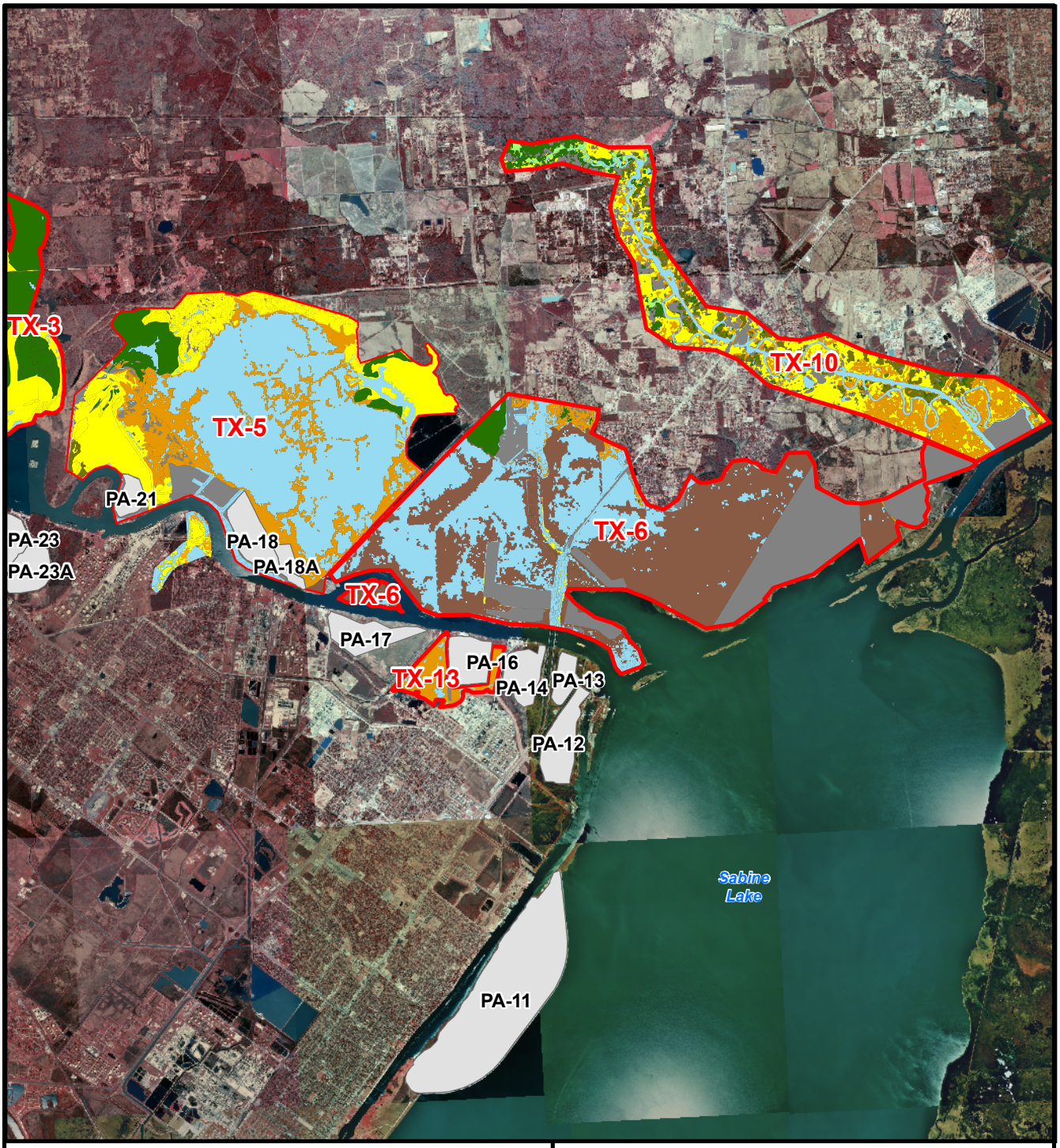

Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water

Hydrologic Unit
Placement Areas

0 0.75 1.5 3 Miles

Figure 5

Habitats in Hydrologic Units TX-5, TX-6, TX-10, and TX-13

Prepared for: USACE	
Job No.: 100007609	Scale: 1:148,000
Prepared by:EM/AChristiansen	Date: 09/10/2009

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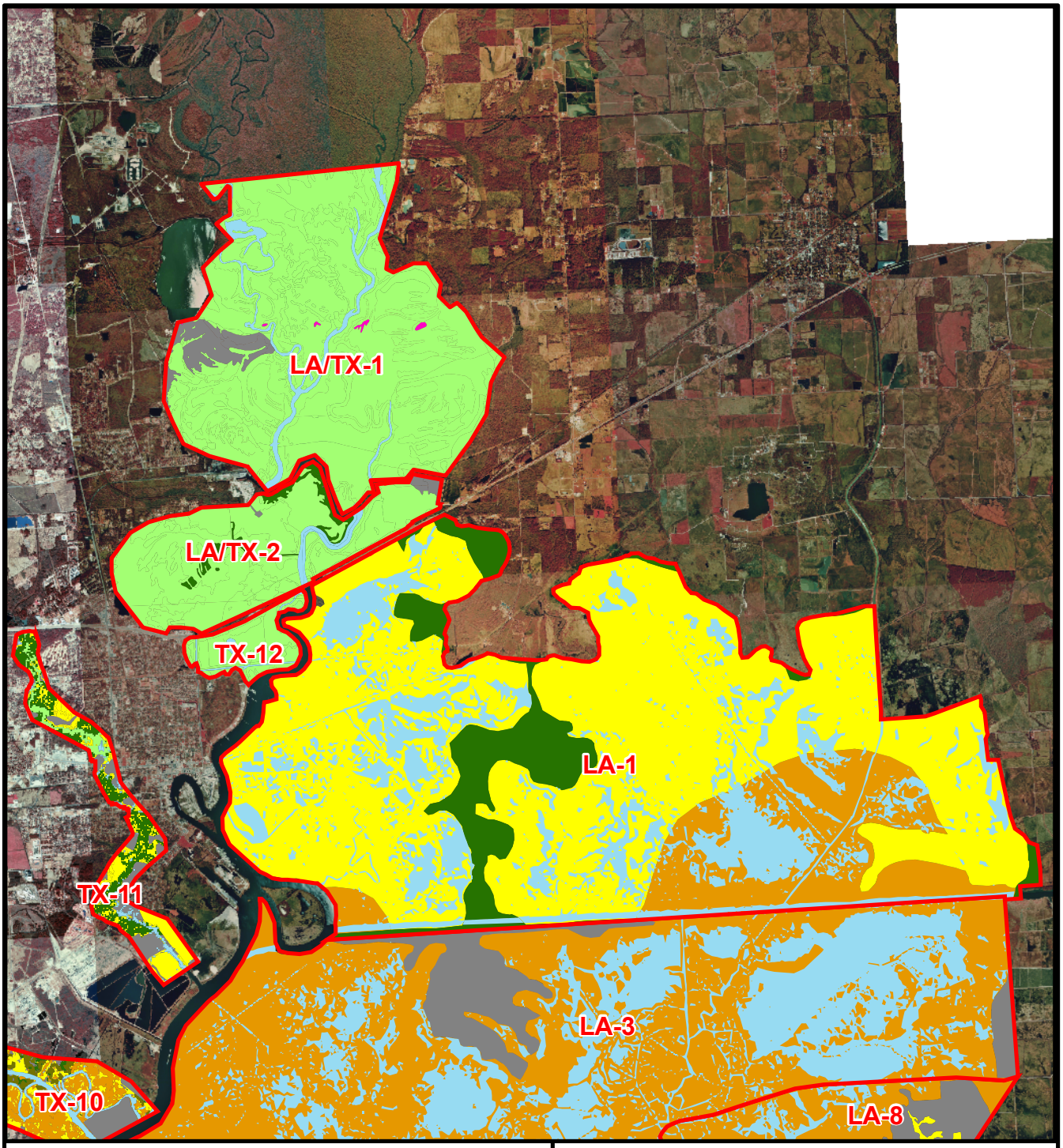

Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water

Hydrologic Unit

0 0.5 1 2 Miles

PBSJ
6504 Bridge Point Pkwy, Ste. 200
Austin, Texas 78730
Phone: (512) 329-8342 Fax: (512) 327-2453

Figure 6

Habitats in Hydrologic Units TX-11, TX-12, LA/TX-1, LA/TX-2, and LA-1

Prepared for: USACE	
Job No.: 100007609	Scale: 1:133,000
Prepared by:EM/ Christiansen	Date: 09/02/2009

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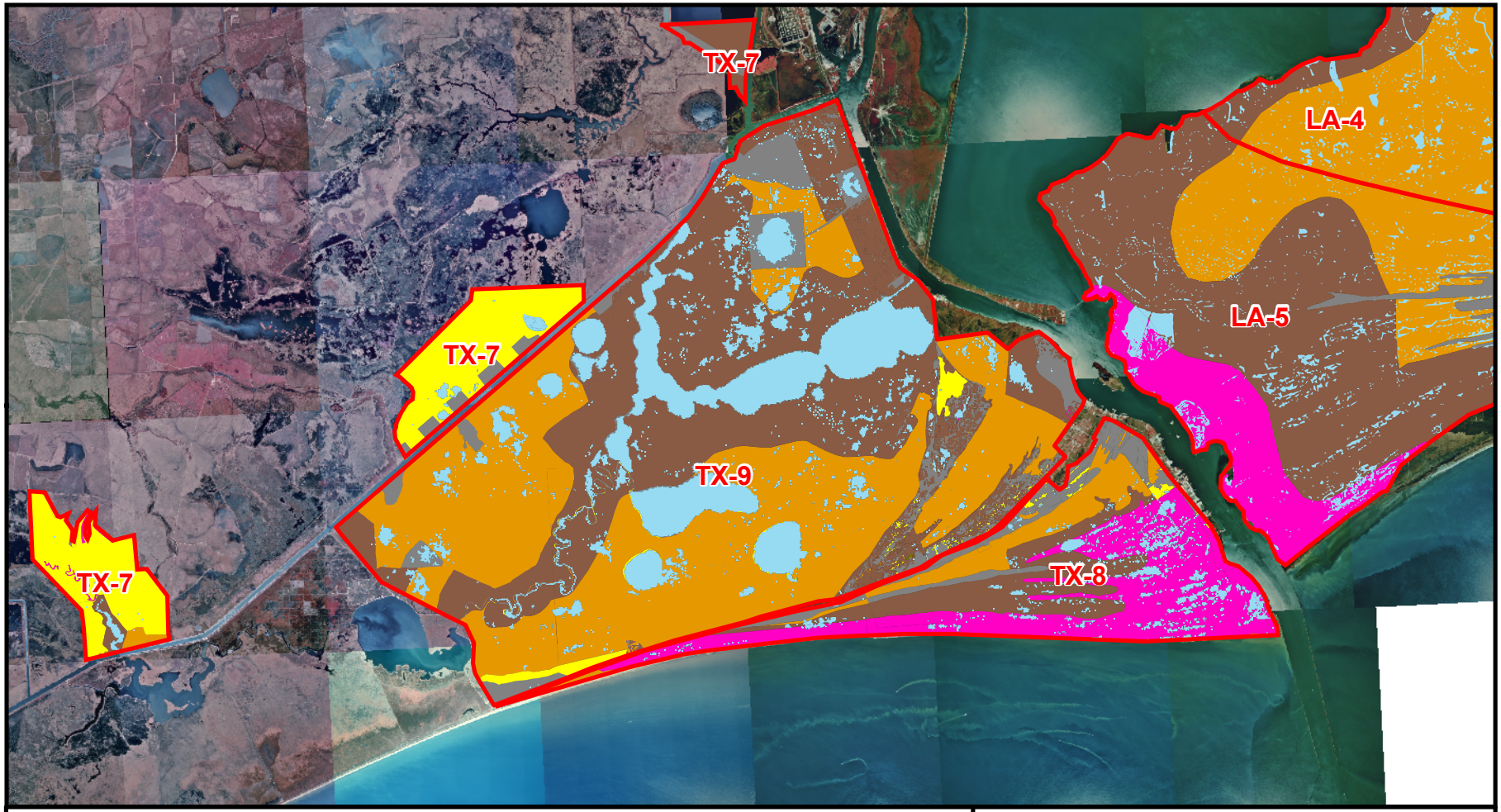


Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water

Hydrologic Unit

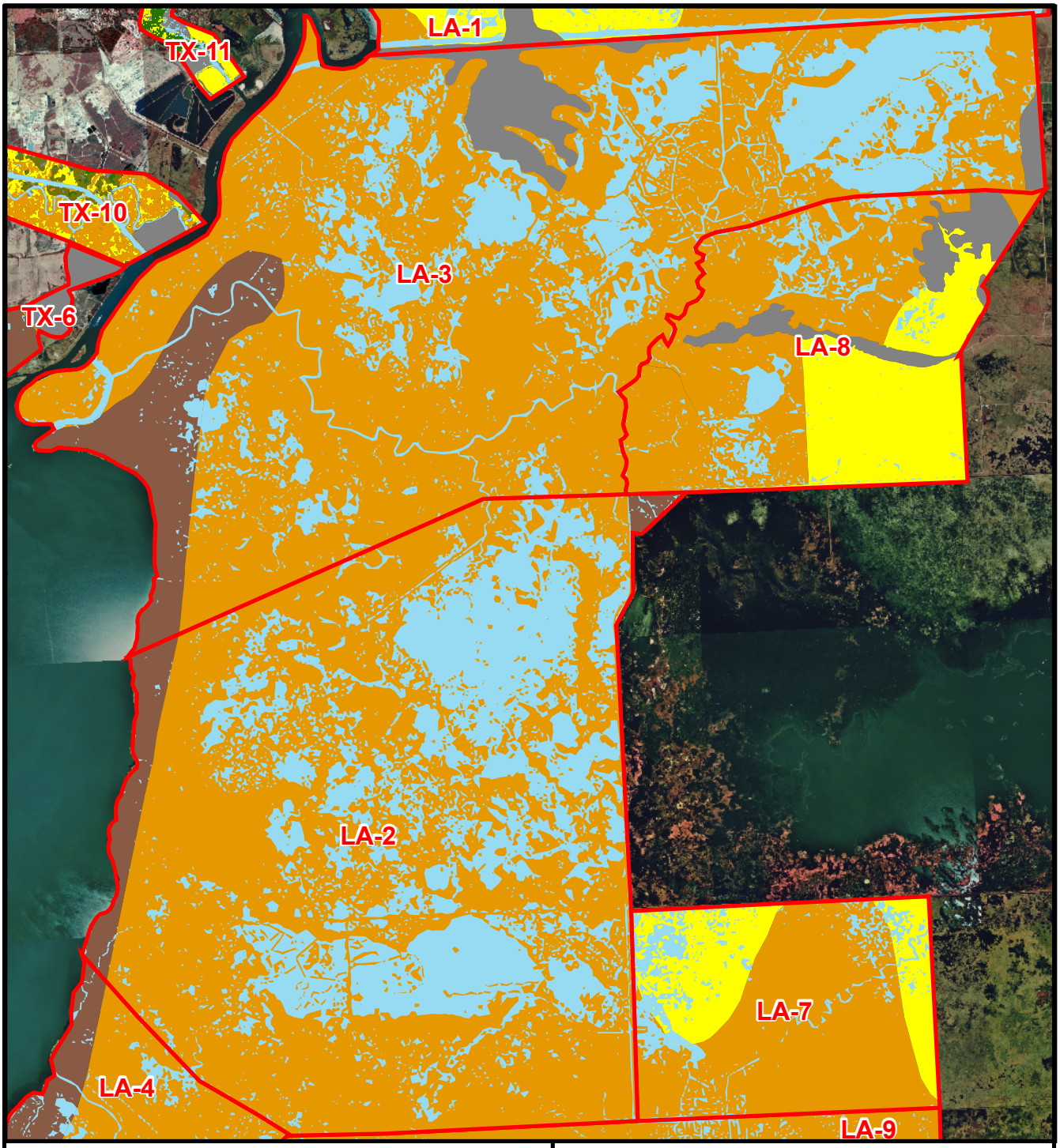
2 1 0 2 Miles

Figure 7

Habitats in Hydrologic Units TX-7 through TX-9

Prepared for: USACE	
Job No.: 100007609	Scale: 1:180,000
Prepared by: AC/GC	Date: 12/10/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/TXLA_PAs7_Hbtat_vr3.mxd



Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water
Hydrologic Unit

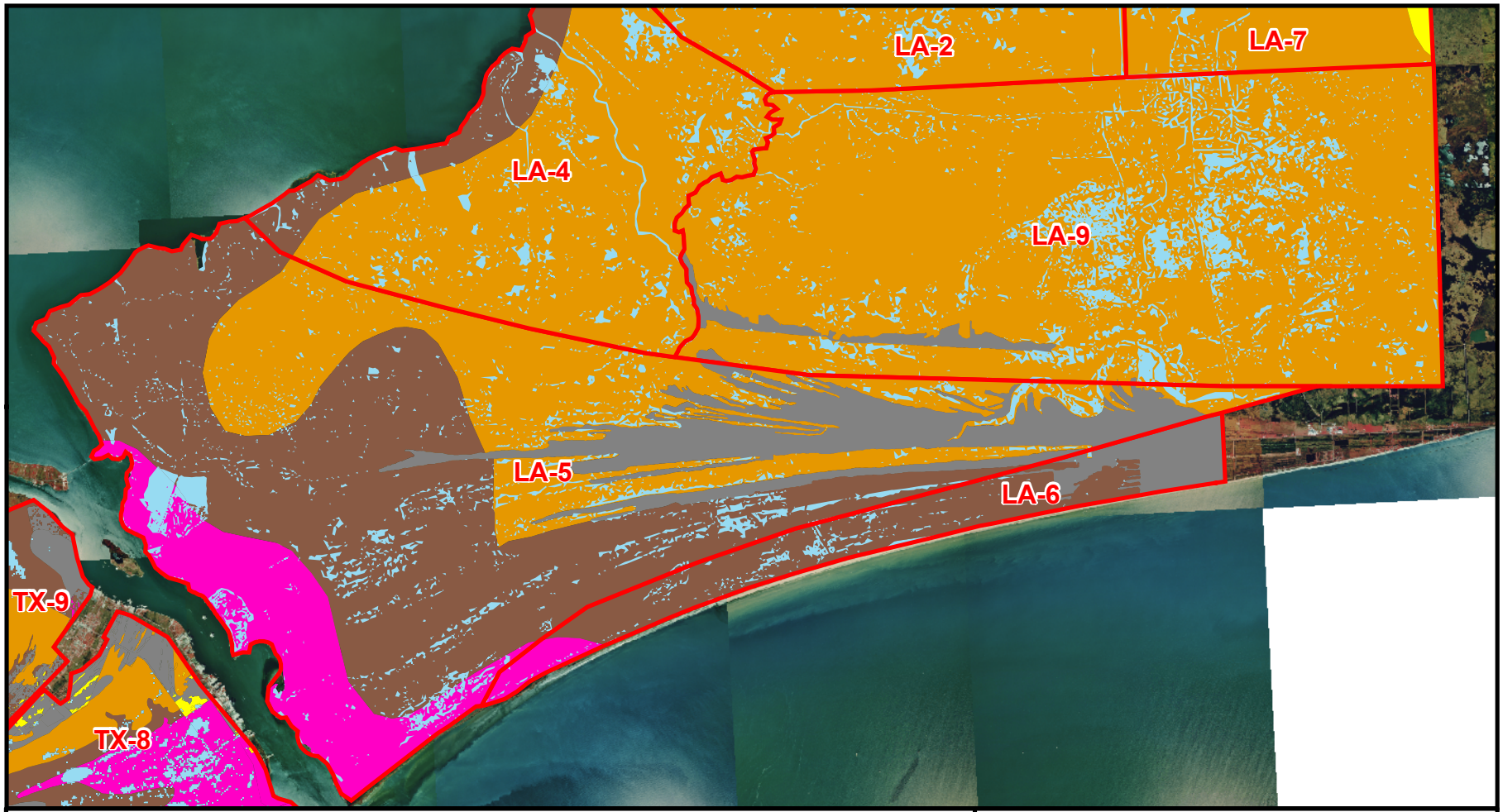
0 0.75 1.5 3 Miles

Figure 8

Habitats in Hydrologic Units LA-2, LA-3, LA-7, and LA-8

Prepared for: USACE	
Job No.: 100007609	Scale: 1:136,000
Prepared by:EM/ Christiansen	Date: 09/03/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/TXLA_PAs8_Hbtat_vr3.mxd



Saline Marsh
Brackish Marsh
Forest (Bottomland Hardwood)
Freshwater Marsh
Intermediate Marsh
Swamp
Shrub/Scrub
Upland/Impoundment/Other
Water

Hydrologic Unit

2 1 0 2 Miles

Figure 9

Habitats in Hydrologic Units LA-4, LA-5, LA-6, and LA-9

Prepared for: USACE	
Job No.: 441206.00	Scale: 1:140,000
Prepared by: EM/RC/GC	Date: 12/10/2009

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Table 7: Texas Hydrologic Unit Habitat Acreage (2004)

	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Placement Areas	Other	Total Hydro Unit Acreage
TX 1 - North Neches River												
Acreage	2,760	384	0	0	53	0	412	384	3,609	0	407	4,016
Water	n/a	52	0	0	0	0	n/a	52	52	0	75	127
Totals	2,760	436	0	0	53	0	412	436	3,661	0	482	4,143
TX 2 - Neches River/Lake Bayou												
Acreage	2,277	1,270	0	0	108	0	1,040	1,270	4,695	0	684	5,379
Water	n/a	266	0	0	0	0	n/a	266	266	0	63	329
Totals	2,277	1,535	0	0	108	0	1,040	1,535	4,960	0	747	5,707
TX 3 - Rose City												
Acreage	464	2,323	0	0	0	0	1,775	2,323	4,562	0	152	4,714
Water	n/a	1,004	0	0	0	0	n/a	1,004	1,004	0	87	1,091
Totals	464	3,327	0	0	0	0	1,775	3,327	5,566	0	239	5,805
TX 4 - West of Rose City												
Acreage	0	395	0	0	0	0	0	395	395	0	1	396
Water	n/a	97	0	0	0	0	n/a	97	97	0	0	97
Totals	0	492	0	0	0	0	0	492	492	0	1	493
TX 5 - Bessie Heights												
Acreage	0	2,018	1,932	20	40	0	293	3,970	4,303	769	743	5,815
Water	n/a	129	4,981	0	77	0	n/a	5,110	5,187	0	361	5,548
Totals	0	2,147	6,913	20	117	0	293	9,080	9,490	769	1,104	11,363
TX 6 - Old River Cove												
Acreage	0	31	199	5,240	0	0	197	5,470	5,667	399	2,165	8,231
Water	n/a	0	0	3,290	0	0	n/a	3,290	3,290	0	330	3,620
Totals	0	31	199	8,530	0	0	197	8,760	8,957	399	2,495	11,851
TX 7 - GIWW North												
Acreage	0	4,541	129	588	0	0	0	5,258	5,258	0	454	5,712
Water	n/a	136	0	59	0	0	n/a	195	195	0	0	195
Totals	0	4,677	129	647	0	0	0	5,453	5,453	0	454	5,907

Table 7 (Cont'd)

	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Placement Areas	Other	Total Hydro Unit Acreage
TX 8 - Texas Point												
Acreage	0	100	1,605	2,398	0	4,898	0	9,001	9,001	0	1,413	10,414
Water	n/a	11	26	148	0	810	n/a	995	995	0	13	1,008
Totals	0	111	1,631	2,546	0	5,708	0	9,996	9,996	0	1,426	11,422
TX 9 - Salt Bayou												
Acreage	0	567	24,942	15,801	0	0	0	41,310	41,310	0	4,392	45,702
Water	n/a	0	4,181	4,757	0	0	n/a	8,938	8,938	0	404	9,342
Totals	0	567	29,123	20,558	0	0	0	50,248	50,248	0	4,796	55,044
TX 10 - Cow Bayou												
Acreage	110	1,436	1,144	0	0	0	388	2,580	3,078	173	1,060	4,311
Water	n/a	339	0	0	0	0	n/a	339	339	0	340	679
Totals	110	1,775	1,144	0	0	0	388	2,919	3,417	173	1,400	4,990
TX 11 - Adams Bayou												
Acreage	115	516	0	0	0	0	640	516	1,271	6	316	1,593
Water	n/a	83	0	0	0	0	n/a	83	83	0	3	86
Totals	115	599	0	0	0	0	640	599	1,354	6	319	1,679
TX 12 - South of Blue Elbow												
Acreage	689	0	0	0	0	0	0	0	689	0	0	689
Water	n/a	0	0	0	0	0	0	0	0	0	0	0
Totals	689	0	0	0	0	0	0	0	689	0	0	689
TX 13 - Groves												
Acreage	0	0	385	0	0	0	0	385	385	0	0	385
Water	0	0	52	0	0	0	0	52	52	0	0	52
Totals			437					437	437	0	0	437
LA-TX 1 - SABINE ISLAND (TEXAS PORTION)												
Acreage	1,194	0	0	0	0	0	524	0	1,718	0	559	2,277
Water	n/a	0	0	0	0	0	0	0	0	0	0	0
Totals	1,194	0	0	0	0	0	524	0	1,718	0	559	2,277
LA-TX 2 - BLUE ELBOW (TEXAS PORTION)												
Acreage	2,548	0	0	0	0	0	189	0	2,737	0	0	2,737
Water	n/a	0	0	0	0	0	0	0	0	0	0	0
Totals	2,548	0	0	0	0	0	189	0	2,737	0	0	2,737
Acreage	10,157	13,580	30,336	24,047	201	4,898	5,458	73,062	88,677	1,347	12,346	102,370
Water	0	2,117	9,240	8,254	77	810	0	20,498	20,498	0	1,676	22,174
TOTAL	10,157	15,697	39,576	32,301	278	5,708	5,458	93,560	109,175	1,347	14,022	124,544

Table 8: Louisiana Hydrologic Unit Habitat Acreage (2004)

	LA 1 - PERRY RIDGE											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	14,810	3,074	0	0	0	2,158	17,884	20,042	0	2,373	22,415
Water	n/a	4,049	1,630	0	0	0	n/a	5,679	5,679	0	0	5,679
Totals	0	18,859	4,704	0	0	0	2,158	23,563	25,721	0	2,373	28,094
	LA 2 - WILLOW BAYOU											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	0	22,470	1,133	0	0	0	23,603	23,603	0	0	23,603
Water	n/a	0	12,639	49	0	0	n/a	12,688	12,688	0	0	12,688
Totals	0	0	35,109	1,182	0	0	0	36,291	36,291	0	0	36,291
	LA 3 - BLACK BAYOU											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	0	24,633	2,964	0	0	0	27,597	27,597	0	1,717	29,314
Water	n/a	0	10,308	231	0	0	n/a	10,539	10,539	0	0	10,539
Totals	0	0	34,941	3,195	0	0	0	38,136	38,136	0	1,717	39,853
	LA 4 - WEST JOHNSON'S BAYOU											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	0	10,031	1,837	0	0	0	11,868	11,868	0	2	11,870
Water	n/a	0	1,079	241	0	0	n/a	1,320	1,320	0	0	1,320
Totals	0	0	11,110	2,078	0	0	0	13,188	13,188	0	2	13,190
	LA 5 - SABINE LAKE RIDGES											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	0	8,232	14,673	0	3,198	0	26,103	26,103	0	4,473	30,576
Water	n/a	0	1,038	1,289	0	569	n/a	2,896	2,896	0	0	2,896
Totals	0	0	9,270	15,962	0	3,767	0	28,999	28,999	0	4,473	33,472
	LA 6 - JOHNSON'S BAYOU RIDGES											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	0	0	2,505	0	353	0	2,858	2,858	0	975	3,833
Water	n/a	0	0	239	0	17	n/a	256	256	0	0	256
Totals	0	0	0	2,744	0	370	0	3,114	3,114	0	975	4,089
	LA 7 - SOUTHEAST SABINE											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	2,023	4,925	0	0	0	0	6,948	6,948	0	0	6,948
Water	n/a	611	475	0	0	0	n/a	1,086	1,086	0	0	1,086
Totals	0	2,634	5,400	0	0	0	0	8,034	8,034	0	0	8,034

Table 8 (Cont'd)

	LA 8 - SOUTHWEST GUM COVE											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	3,503	5,346	0	0	0	0	8,849	8,849	0	1,166	10,015
Water	n/a	112	1,259	0	0	0	n/a	1,371	1,371	0	0	1,371
Totals	0	3,615	6,605	0	0	0	0	10,220	10,220	0	1,166	11,386
	LA 9 - EAST JOHNSON'S BAYOU											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other Upland	Total Hydro Unit Acreage
Acreage	0	0	22,694	0	0	0	0	22,694	22,694	0	581	23,275
Water	n/a	0	3,444	0	0	0	n/a	3,444	3,444	0	0	3,444
Totals	0	0	26,138	0	0	0	0	26,138	26,138	0	581	26,719
	LA-TX 1 - SABINE ISLAND (LOUISIANA PORTION)											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other	Total Hydro Unit Acreage
Acreage	5,998	0	0	0	0	0	1,041	0	7,039	0	21	7,060
Water	n/a	0	0	0	0	0	0	0	0	0	0	0
Totals	5,998	0	0	0	0	0	1,041	0	7,039	0	21	7,060
	LA-TX 2 - BLUE ELBOW (LOUISIANA PORTION)											
	Swamp	Fresh	Intermediate	Brackish	Shrub/ Scrub	Saline	Bottomland hardwood	Total Marsh	Total Wetlands	Place-ment areas	Other	Total Hydro Unit Acreage
Acreage	643	0	0	0	0	0	7	0	650	0	0	650
Water	n/a	0	0	0	0	0	0	0	0	0	0	0
Totals	643	0	0	0	0	0	7	0	650	0	0	650
Acreage	6,641	20,336	101,405	23,112	0	3,551	3,206	148,404	158,251	0	11,308	169,559
Water	0	4,772	31,872	2,049	0	586	0	39,279	39,279	0	0	39,279
TOTAL	6,641	25,108	133,277	25,161	0	4,137	3,206	187,683	197,530	0	11,308	208,838

The Habitat Workgroup believed this rate was preferable since it reflects a higher rate of change than has occurred in recent years, and it is difficult to measure land loss in an area in which most marsh has already been lost. The Habitat Workgroup applied land loss rates from adjacent areas to the marshes in the Rose City and Lake Bayou areas on the Neches River, adjusting them for local conditions. The loss rate from the adjacent Black Bayou marsh was applied to marshes along Cow and Adams bayous.

After changes in acreages were calculated, the amount of emergent marsh that converted to open water was expressed as a percentage loss per year. Adjustments to FWOP land loss projections were made to account for shoreline recession, constructed or funded CWPPRA projects in the east Sabine Lake marshes (Clark et al., 2000; USFWS and NRCS, 2003), at Black Bayou (LDNR, 1993), and at Perry Ridge (USGS-NWRC, 2002a, 2002b) and RSLR. FWP projections added projected increases to coastal shore erosion (Gravens and King, 2003) and interior marsh loss. A spreadsheet that calculates land loss annually was used for all projections. It was assumed that TY 0 was 2004 (the WVA planning year), that TY 1 was 2019 (the year project construction would be completed), and TY 51 was 2069 (the end of the period of analysis).

4.1.2.1 Productivity-based Land Loss Projection

In order to provide a systematic evaluation of future land loss changes for the SNWW WVA application, the Habitat Workgroup developed a productivity-based method of land loss projection based upon a salinity-productivity relationship developed for the Habitat Switching Module in the Louisiana Coastal Areas Ecosystem Restoration Study (Visser et al., 2004). For V_1, any change in salinity is reflected in the projected land loss rate through the productivity-based method described below. Even small changes within the optimal salinity range of a marsh type result in a small change to the land loss rate, either positive or negative. This is intended to capture effects to fish and wildlife species that are sensitive to even small changes in salinity.

In the Louisiana Coastal Area study, productivity algorithms were developed for all herbaceous and forested wetlands based on available published and unpublished data. Supporting references for salinity-related productivity changes in vegetation include:

- **Swamp** – co-dominant species bald cypress (*Taxodium distichum*) (Conner et al., 1997; Megonigal et al., 1997; Mitsch et al., 1991; Pezeshki et al., 1987a, 1990)

- **Fresh marsh** – co-dominant species maidencane (*Panicum hemitomon)* and bulltongue (*Sagittaria lancifolia)* (Greiner LaPeyre et al., 2001; Hester et al., 2001; Howard and Mendelssohn, 1999; McKee and Mendelssohn, 1989; Pezeshki et al., 1987b, 1987c; Willis and Hester, 2004; Spalding and Hester, 2007)

- **Intermediate marsh** – co-dominant species bulltongue and marshhay cordgrass (*Spartina patens)* (Baldwin and Mendelssohn, 1998; Greiner La Peyre et al., 2001; Howard and Mendelssohn, 1999, 2000; Pezeshki et al., 1987b; Spalding and Hester, 2007; Webb and Mendelssohn, 1996)

- **Brackish marsh** – co-dominant species marshhay cordgrass and seashore saltgrass (*Distichlis spicata*) (Bertness et al., 1992; Broome et al., 1995; Ewing et al., 1995; Greiner LaPeyre et al., 2001; Hester et al., 2001; Kemp and Cunningham, 1981; Parrondo et al., 1978; Warren and Brockelman, 1989)

- **Saline marsh** – Smooth cordgrass (*Spartina alterniflora)* and blackrush (*Juncus romerianus*) (Bradley and Morris, 1992; Eleuterius, 1989; Gosselink, 1970; Linthurst and Seneca, 1981; Parrondo et al., 1978; Pezeshki and DeLaune, 1995)

These studies used various measurements of productivity including total biomass, stem/leaf elongation, and photosynthesis, which were gathered using greenhouse experiments on saturated soils. To better illustrate the relationship of salinity and productivity, linear regression equations were fitted to these data. The equations can be used to predict percentage changes in habitat productivity per 1 ppt salinity for each major coastal habitat type, regardless of inundation. Table 9 relates the predicted changes in primary productivity for every 1 ppt increase in salinity (Visser et al., 2004) to land loss rate changes applied in the current study.

Table 9: Productivity-based Land Loss Projection

Habitat Type	Percent Productivity Lowered and Land Loss Rates Increased per ppt Increase in Salinity
Swamp	8.4
Fresh marsh	11.1
Intermediate marsh	11.4 (*Sagittaria*) 2.3 (*Spartina patens*) mean = 6.8
Brackish marsh	2.6
Saline marsh	2.1

Relating changes in salinity to specific amounts of land loss is problematic. While extensive literature relates increases in salinity to decreased productivity, vegetation stress, and eventual wetland loss (see list above), USACE and the ICT are not aware of any studies that have documented specifically how much land loss is associated with specific increases in salinity. Similarly, no data are currently available that relate salinity reduction with a reduction in land loss (Visser et al., 2004). Therefore, the Habitat Workgroup assumed a direct linear correlation between decreased primary productivity due to salinity increases and increased land loss rates due to the project. The Habitat Workgroup considered increasing land loss rates for salinities that changed from optimal to suboptimal conditions and, conversely, also considered decreasing land loss rates in target years 20 to 50. The latter consideration is based upon historical observations that land loss rates generally stabilize and lessen a few decades after channel-deepening projects are completed. Since the effects of these considerations would generally offset one another, the Habitat Workgroup opted for the simpler 1:1 relationship.

The relationship between productivity decreases and land loss rate increases is assumed to be linear, thus a 1 percent decrease in productivity translates to a 1 percent increase in the land loss rate. For example, in Table 9, the productivity of fresh marsh decreases by 11.1 percent with every salinity increase of 1 ppt for fresh marshes. This translates to an 11.1 percent increase in the land loss rate for every 1 ppt increase in salinity. The following standard formula was applied to calculate FWP rates used in the land loss spreadsheets.

FWP land loss rate = (((FWP salinity ppt – FWOP salinity ppt) x % productivity decrease per habitat type) + 1) x baseline land loss rate)

4.1.2.2 FWOP Land Loss

4.1.2.2.1 Consideration of RSLR in Interior Marsh Loss

To make the interior land loss projection for the FWOP conditions, the baseline land loss rates adopted by the ICT were applied as the baseline rate (TY 0). The baseline rates include chronic, regional effects of

subsidence, altered sediment delivery, historical rates of sea level rise, and tropical storms or hurricanes that occurred during the period of observation. FWOP effects of RSLR to interior marsh areas are expected to be limited to an increase in salinity. It is assumed that interior marshes throughout the tidally influenced portions of the study area would see a gradual increase in water elevation associated with an RSLR of 1.1 feet by 2069 and that biomass accumulation would offset much, if not all, of this RSLR effect. The SNWW HS model predicts that RSLR would result in higher salinity levels throughout the tidally influenced areas by 2069. Gradually rising salinities resulted in gradually increasing land loss rates, as rates were adjusted for the higher with-RSLR salinity using the productivity-based land loss projection methodology. Resulting changes in the biological productivity were forecast with the WVA worksheets.

4.1.2.2.2 Shoreline Recession Due to RSLR

The predicted FWOP acres lost to RSLR-related shoreline recession in each affected hydro-unit through TY 65 are presented in Table 10. The total acres of marsh lost for each marsh type was divided by 65 years, and the acres lost per year were subtracted from the FWOP marsh (acres) columns in the Land Loss Spreadsheets of the affected hydro-units for TYs 1 to 65.

4.1.2.2.3 Adjustments for CWPPRA Restoration Projects

FWOP adjustments to acreages for constructed CWPPRA projects in the east Sabine Lake marshes (Clark et al., 2000; USFWS and NRCS, 2003), at Black Bayou (LDNR and NRCS, 1993), and at Perry Ridge (USGS-NWRC, 2002a, 2002b) were applied in the WVA Land Loss Spreadsheets. Acres of restored marsh were added in the FWOP marsh (acres) column in the target year in which they were completed.

4.1.2.3 FWP Land Change Projection

FWP projections address the changes that would be expected to occur as a result of channel deepening. Although the SNWW channel is located primarily in Texas, large indirect impacts may occur in both Texas and Louisiana due to small increases in salinity levels causing an increase in wetland loss rates and a decrease in biological productivity in aquatic habitats of the study area. Only a negligible increase in water surface elevation is expected, but a small increase in coastal shore erosion is forecast for up to 4 miles from each jetty. Beneficial use features and mitigation measures would reduce FWP land loss by restoring marshes on the Neches River and in the marshes east of Sabine Lake, respectively, and with periodic Gulf shoreline nourishment.

Table 10: Projected Acres Lost to Shoreline Recession

HU #	HU name	Marsh Type	Marsh	Water	Total
Louisiana					
LA 2	Willow Bayou	Brackish	627.4	20.2	647.6
LA 3	Black Bayou	Brackish	621.4	8.7	630.1
LA 4	West Johnsons Bayou	Brackish	956.5	130	1086.5
LA 5	Sabine Lake Ridges	Brackish	685.1	48.8	733.9
		Saline	105.7	32.5	138.2
	LA Subtotal		2996.1	240.2	3236.3
Texas					
TX 7	GIWW North	Fresh	7.9	0	7.9
		Intermediate	3.6	0	3.6
TX 8	Texas Point	Fresh	0.6	0	0.6
		Intermediate	67.8	1.9	69.7
		Brackish	812.5	39.8	852.3
		Saline	2043.1	150.6	2193.7
TX 9	Salt Bayou	Fresh	0.1	0	0.1
		Brackish	26.6	3.4	30
	TX Subtotal		2962.2	195.7	3157.9

FWP land changes are applied to the net FWOP acreage after all FWOP land loss adjustments have been made. The same productivity-based land loss formula applied for the FWOP land loss projection is used for the FWP land change projection. HS Model salinity outputs are used in the land loss formula to forecast FWP land loss rates.

4.1.2.3.1 Productivity-based Interior Marsh Loss

An increase in interior marsh loss would likely result when increased FWP salinities interact with FWOP submergence, causing a marginally higher land loss rate. Associating higher land loss rates in marsh interiors with salinity increases is based upon documented biological responses of inundated vegetation to salinity. Salinity predominantly drives the change among marsh habitats, and extreme salinities may lead to the conversion of marsh to open water, but small changes in salinity can also affect the primary productivity of marsh grasses, and this stress is worsened with inundation stress (Baldwin and Mendelssohn, 1998; Broome et al., 1995; Ewing et al., 1995; Flynn et al., 1995; Hester et al., 2001; Howard and Mendelssohn, 1999, 2000; Kemp and Cunningham, 1981; McKee and Mendelssohn, 1989; Pezeshki and DeLaune, 1995; Pezeshki et al., 1987a, 1987b; Spalding and Hester, 2007; Willis and Hester, 2004).

RSLR would increase tidal flows, water surface elevations, and salinities in all areas affected by tidal influence. Decreased plant productivity has been demonstrated to result from the interaction of excessive

submergence and salinity. This interaction leads to a decrease in organic matter accumulation, which, in turn, results in greater submergence because the rate of increase in marsh elevation cannot keep up with the rate of submergence due to RSLR (Mendelssohn and McKee, 1988; Day and Templet, 1989; Koch and Mendelssohn, 1989; Koch et al., 1990; Nyman et al., 1993; DeLaune et al., 1994; Day et al., 1995; Webb et al., 1995; Spalding and Hester, 2007). The death of wetland vegetation often results, followed by peat collapse, erosion, and wetland loss (Salinas et al., 1986; DeLaune et al., 1994; Webb and Mendelssohn, 1996; Gough and Grace, 1999; Visser et al., 1999).

Impacts to primary productivity resulting from this process have been well documented for maidencane and marshhay cordgrass, two widespread species in the study area (Pezeshki et al., 1987c; Ewing et al., 1995; Hester et al., 1996, 2001, 2002; Baldwin and Mendelssohn, 1998; Willis and Hester, 2004). Marshhay cordgrass is the most prevalent marsh grass throughout the large intermediate marshes around Sabine Lake, and it is also common in brackish and fresh marsh communities. Maindencane is a co-dominant marsh plant in the area's freshwater marshes. Freshwater marshes are much more sensitive to sudden changes in hydrology like those predicted in the with-project condition than are saline marshes, which have no negative response to occasional freshets and are not sensitive to salinities in the predicted range. Fresh systems are less able to respond to sudden and permanent increases in salinity and/or water depth (i.e., subsidence/RSLR), especially if those changes cross a critical threshold. Saltwater intrusion and related sulfide formation kill fresh and intermediate vegetation, and exposes bare soils to increased erosion. Substrate elevation is reduced to the point that open-water areas form before the succession to salt-tolerant vegetation can take place. In some cases, fresh and intermediate grasses are replaced by more-salt-tolerant brackish vegetation, but this can only occur in areas with the firm substrate required by these grasses and where hydrologic forces are not eroding those substrates. This is the same process that was documented by the Louisiana Coastal Areas Ecosystem study for coastal habitats, which includes the Sabine-Neches estuarine system (USACE, 2004).

4.1.2.3.2 SNWW Channel Extension Effects to Gulf Shoreline

FWP Gulf shoreline erosion impacts that could be caused by the proposed offshore channel extension were included in the FWP land loss calculations as follows. The Gravens and King study (2003) predicted a loss of 0.42 feet/year in the first 4 miles of shoreline from each jetty. This loss was converted to acres for each affected marsh type, the total acres were divided by 51 years (years of FWP impacts), and the acres lost-per-year were subtracted from the FWP Marsh (acres) column in the land loss spreadsheets of the affected hydro-units for TYs 15–65

4.1.2.3.3 Land Change Projections for BU Features

The SNWW LPP includes the Neches River and Gulf Shoreline BU Features. The benefits of these BU features were calculated in land loss spreadsheets and WVA worksheets following conventions described for other land change processes, with the exception that acres of restored marsh or shore nourishment were added in the FWP Marsh columns.

4.1.2.3.4 Land Change Projections for Mitigation Measures

WVA modeling was conducted only for mitigation measures that were advanced for final screening: marsh restoration in the Willow and Black Bayou areas, and Gulf shoreline nourishment at Texas and Louisiana Points. In the Willow and Black Bayou areas, mitigation measures would add new mineral soils to degraded areas of former marsh. The land loss rate for the WVA modeling of the restored marsh areas was reduced by 50 percent when dedicated dredging would be used to add denser, mineral soils and the increase in marsh elevation would create a more stable landform. Marsh restoration measures employing in situ marsh terracing and shoreline nourishment measures were modeled using a land loss rate equivalent to the FWP rate. Acreages in the land loss spreadsheets of each mitigation measure were adjusted to add acres of restored, emergent marsh, or acres were adjusted to account for effect of shoreline nourishment, which stopped or slowed existing shoreline retreat. For measures constructed with maintenance material, dredging cycles were estimated using historical information available in the Galveston District dredging database.

It was assumed that mitigation measures would be constructed and vegetated by TY 14, and therefore credit for marsh acreage was taken in TY 15. Recent experience with CWPPRA and other marsh restoration projects in the lower Sabine and Neches watersheds has shown that marsh plantings and natural vegetation rebound quickly and robustly to create a stable marsh landscape. It is recognized that the created marsh does not become functionally equivalent to natural marsh systems in such a short time (Minello and Webb, 1993, 1997; Minello, 2000) but the constructed marshes would begin providing cover and possibly food for some species soon after marsh vegetation is established (Minello and Zimmerman, 1992).

4.1.3 Limitations and Uncertainties

Several limitations and uncertainties are associated with this approach to land loss projections.

- Since the historical land loss rates reflect observed changes over specific time periods, they include effects of actual hurricanes, tropical storms, and droughts that occurred during the period of observation, rather than the average probability of these events.
- Uncertainties associated with future rates of RSLR are large. Future estimates of eustatic sea level rise and regional subsidence have a large range of potential outcomes. Impact evaluations have been made with best estimates of the “most likely” future scenario, while the range of possible impacts has been evaluated with a sensitivity analysis.
- Changes in land loss rates predicted for CWPPRA projects are assumed to be 100 percent effective, since all are too early in their project lives to assess actual performance.
- All of the rates are based on time periods after heaviest oil/gas extraction and after canal/levee construction. They capture the lingering effects of these activities, but not the localized high subsidence rates that occurred earlier.
- The direct, linear relationship between productivity decreases and land loss rate increases is based upon relationships between salinity and primary productivity that have been reported by a large

number of peer-reviewed studies. Most of these studies were conducted in controlled environments (i.e., greenhouse experiments) and thus can be considered only an approximation of field relationships. The salinity/productivity relationship is the underlying basis for projections of land loss impacts of this project. It is assumed that abrupt and continuing salinity increases would stress existing marsh vegetation, which would in turn cause the death of a small percentage of that vegetation, the subsequent erosion of marsh soils, and the creation of large areas of open water within formerly healthy marsh communities.

4.2 V_2 PERCENT SUBMERGED AQUATIC VEGETATION

Baseline values for this variable were based largely upon previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate, and data collected for existing CWPPRA or other restoration projects in or near the areas under evaluation. SAV species that have been reported in the SNWW hydro-units and their salinity tolerance ranges are presented in Table 11. Information on SAV species presented here is limited to presence/absence and does not include information on relative abundance. SAV species present in each hydro-unit are listed in the notes of each WVA worksheet. In hydro-units where observational data were not available, SAV species were assumed to be similar to those reported in nearby vegetation communities of the same type.

SAV species diversity is highest in the swamps and fresh-intermediate marshes of the study area. All of the SAV species reported in the SNWW study area occur in these areas (*Alternanthera philoxoides, Ceratophyllum demersum, Chara* spp., *Eichhornia crassipes, Lemna* sp., *Myrophyllum spicatum, Najas guadalupensis, Nymphaea odorata, Nymphaea mexicana, Ottelia alismoides, Pistia stratiotes, Potamogeton pectinatus, Potamogeton pusillus, Ruppia maritima, Salvinia minima, Utricularia* sp. unspecified, and *Vallisneria americana*). This list includes several noxious, invasive plants. Species reported in the fresh and intermediate marshes range in salinity tolerance from 0 to 0.5 ppt to 2 to 16 ppt. In brackish and saline marshes, far fewer SAV species occur, and cover is generally dominated by *Ruppia maritima*, a species that tolerates salinities from 2.0 to 25+ ppt.

SAV cover and species can change rapidly in response to a complex interaction of environmental conditions. Future conditions that could affect SAV growth include changes in salinity, freshwater introduction, nutrient input, turbidity, water depth, and fetch (Longstreth et al., 1984; Dunton, 1990; Livingston et al., 1998; Koch, 2001; Singh and Arora, 2003; Frazer et al., 2006; Paresh and Freedman, 2006). However, the FWP effects on SAV are limited to changes in salinity, and so comparisons of the FWOP and FWP conditions were limited to predicted salinity changes for this impact evaluation. Potential changes in the percentage of SAV cover in both the FWOP and FWP conditions were evaluated by comparing the salinity tolerance range of SAV species observed or expected in each hydro-unit to predicted TY 65 salinities.

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

Scientific Name	Common Name	Salinity Range*	Salinity Tolerance	SNWW Occurrence	Vegetation Community	Observations	References
Alternanthera philoxoides	alligatorweed	fresh to mesohaline (0 to 8 ppt)	low	North Neches & Lake Bayou	Cypress-Tupelo Swamp	Observed during SNWW Habitat Workgroup field investigation (2004)	Emergent or floating-rooted invasive and noxious weed that forms thick mats that displaces native vegetation, retards water flow, lowers dissolved oxygen levels, and increases sedimentation; tolerates salinity of up to 10% by volume (Texas Invasive Org [TIO], 2009). Salinity tolerance is low (USDA, 2009). Common in slightly brackish and tidal fresh waters (Tiner, 1993). Chabreck (1972) reports it comprising 2.5% of intermediate and 5.3% of fresh Louisiana coastal marshes, with salinity range of 2 to 7.7 ppt. Stutzenbaker (1999) limits the salinity range to ~0 ppt. Provides excellent, good, and poor food value for crawfish, furbearers, and geese and ducks, respectively (Chabreck, 1972).
				Sabine Island & Blue Elbow	Cypress-Tupelo Swamp	Observed during SNWW Habitat Workgroup field investigation (2004)	
				Salt Bayou and Texas Point	Fresh Marsh	Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b)	
Ceratophyllum demersum	coontail, common hornwort	fresh and oligohaline (0 to 5.0 ppt)	low	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Brittle, rootless, and entirely submerged aquatic plant (Wildflower Center [WC], 2009). Finely divided leaves arranged in whorled pattern around stem; similar to chara but bushier and softer (Center for Aquatic and Invasive Plants [CAIP], 2009). Fresh to slightly brackish waters (Flora of North America Editorial Committee [FNAEC], 1993+). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Fair food value for ducks and crawfish (Chabreck, 1972).
				Rose City	Fresh Marsh	Project Goal Summary, CEPRA Cycle 2 (GLO, 2000a)	
				Willow Bayou	Intermediate Marsh	Observed during SAV and terrace study in Sabine NWR terraces (Caldwell, 2003). Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a).	
Chara spp.	chara, stonewort, muskgrass	fresh and oligohaline (0 to 4.0 ppt)	low	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Branched multicellular algae that is entirely submerged and has a grainy texture; prefers hard or alkaline waters (Texas A&M University [TAMU], 2009). Chabreck (1972) gives salinity tolerance for *Chara vulgaris* as 0.15 to 3.9 ppt. Fair and poor food value for ducks and geese, respectively (Chabreck, 1972; TAMU, 2009).
				Black Bayou	Intermediate Marsh	Observed in postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007)	
				Willow Bayou	Intermediate Marsh	SAV and terrace study in Sabine NWR terraces (Caldwell, 2003)	
Eichhornia crassipes	water hyacinth	fresh and oligohaline (0 to 0.5 ppt)	low	Bessie Heights	Fresh and Intermediate Marsh	Observed during SNWW Habitat Workgroup field investigation (2004).	Floating aquatic plant with thick leaves and conspicuous flowers extending above water surface; nonnative, invasive plant that alters native vegetation and fish communities by lowering light penetration and dissolved oxygen levels; grows in a wide variety of aquatic habitat and tolerates drastic fluctuations in water level, flow, acidity, and nutrients (TIO, 2009). Dominant in tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range is 0 to 0.5 ppt. Chabreck (1972) reports it comprising 1.4% of fresh Louisiana coastal marshes, with salinity range of 0.3 to 0.5 ppt; provides poor food value for crawfish.
				Rose City	Fresh marsh	Observed during SNWW Habitat Workgroup field investigation (2004)	
				Salt Bayou and Texas Point	Fresh and Intermediate Marsh	Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b)	

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

Scientific Name	Common Name	Salinity Range*	Salinity Tolerance	SNWW Occurrence	Vegetation Community	Observations	References
Lemna L.	common duck weed	fresh and oligohaline (0 to 2.0 ppt)	low	North Neches River	Cypress-Tupelo Swamp	Observed during SNWW Habitat Workgroup field investigation (2004)	Perennial floating plant with tiny leaves that forms a carpet-like cover on water surface (WC, 2009). Salinity tolerance is low (USDA, 2009). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Chabreck (1972) reports it comprising 0.2% of brackish, 0.16% of intermediate and 3.3% of fresh Louisiana coastal marshes, with salinity range of 0.4 to 1.9 ppt. Stutzenbaker (1999) salinity range is 0 to 0.5 ppt. Provides good and fair food value for ducks and crawfish, respectively (Chabreck, 1972; WC, 2009).
				Salt Bayou and Texas Point	Fresh Marsh	Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b)	
Myriophyllum spicatum L.	Eurasian watermilfoil	fresh to mesohaline (0 to 16 ppt)	medium	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Submerged perennial plant with finely dissected featherlike leaves; nonnative, invasive that can form large, floating mats that prevent light penetration for native aquatic plants; thrives in areas subjected to natural and man-made disturbances; tolerates salinities up to 15 ppt (TIO, 2009). Invasive, noxious weed (USDA, 2009). Salinity range is 0 to 10 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). A brackish aquatic bed plant (Tiner, 1993). Stutzenbaker (1999) salinity range is 0 to 20 ppt. Chabreck (1972) reports it comprising 0.15% of brackish, 0.44% of intermediate and 1.56% of fresh Louisiana coastal marshes, and provides good and fair food value for ducks and crawfish, respectively.
				Black Bayou	Intermediate Marsh	Observed in pre- and postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007)	
				Willow Bayou	Intermediate Marsh	Observed in pre- and postconstruction monitoring of Willow Bayou reference area for Black Bayou Project CS-27 (Castellanos and Juneau, 2007). Observed during SAV and terraces study (Caldwell, 2003). Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a).	
				Rose City	Fresh Marsh	Project Goal Summary, CEPRA Cycle 2 (GLO, 2000)	
Najas guadalupensis	Southern waternymph, Southern naiad	fresh to mesohaline (0 to 15 ppt)	medium	Perry Ridge	Fresh and Intermediate Marsh	Observed in postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Annual, submerged aquatic plant with very long branches and short, narrow leaves (CAIP, 2009). Salinity range is 0 to 15 ppt (Urbatsch, 2009); medium salinity tolerance is reported by USDA (2009). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 ppt and 6.0 ppt. Found in fresh and sometimes brackish water (Correll and Correll, 1972). A brackish aquatic bed plant (Tiner, 1993). Stutzenbaker (1999) salinity range is 0–0.5 ppt. Chabreck (1972) reports it comprising 1.03% of intermediate and 1.07% of fresh Louisiana coastal marshes, with salinity range of 0.23 to 1.1 ppt, and provides excellent, good, and fair food value for ducks, geese, and crawfish, respectively.
				Black Bayou	Intermediate Marsh	Observed in pre- and postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007)	
				Willow Bayou	Intermediate Marsh	Observed in pre- and postconstruction monitoring of Willow Bayou reference area for Black Bayou Project CS-27 (Castellanos and Juneau, 2007). Observed during SAV and terraces study (Caldwell, 2003). Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a).	
				Rose City	Fresh Marsh	Project Goal Summary, CEPRA Cycle 2 (GLO, 2000)	
				Salt Bayou and Texas Point	Fresh and Intermediate Marsh	Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b)	

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

Scientific Name	Common Name	Salinity Range*	Salinity Tolerance	SNWW Occurrence	Vegetation Community	Observations	References
Nymphaea odorata	American white water lily	fresh (0 to 0.5 ppt)	low	Blue Elbow & Rose City	Fresh Marsh	Project Goal Summary, CEPRA Cycle 2 (GLO, 2000)	Native, perennial floating aquatic plant with large, fragrant, white or pink flowers and flat, round, floating leaves; waterfowl and mammals eat the buoyant seeds and other parts of the plant (WC, 2009). Stutzenbaker (1999) salinity range 0–0.5 ppt. Good food value for ducks (Chabreck, 1972).
Nymphaea mexicana	yellow water lily, sun lotus, banana water lily	fresh to oligohaline (0 to 3.5 ppt)	low	Rose City	Fresh Marsh	Rose City Project Goal Summary, CEPRA Cycle 2 (GLO, 2000)	A nonnative, perennial, floating aquatic plant with bright yellow flowers and floating leaves (WC, 2009). Salinity tolerance is low (USDA, 2009). Found in alkaline lakes, ponds, pools in marshes, sloughs, etc. (FNAEC, 1993+). Dominant in fresh tidal waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Excellent food value for ducks (Chabreck, 1972).
Ottelia alismoides	duck lettuce	fresh and oligohaline (0 to 5.0 ppt)	low	Perry Ridge	Fresh and Intermediate Marsh	Observed in preconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Invasive, annual, submerged aquatic plant native to the rice fields of southeast Asia that has naturalized in Louisiana (CAIP, 2009). Nonnative invasive (FNAEC, 1993+).
				Black Bayou	Intermediate Marsh	Observed in postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007)	
				Willow Bayou	Intermediate Marsh	Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a)	
Pistia stratiotes	water lettuce	fresh to oligohaline (0 to 5.0 ppt)	low	Salt Bayou and Texas Point	Fresh Marsh	Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b)	Floating perennial aquatic plant that resembles an open head of lettuce (CAIP, 2009). Native and invasive with heavy worldwide distribution (TIO, 2009). Aggressive plant that rapidly covers vast expanses of open waters in southern wetlands, especially cypress swamps (WC, 2009).
Potamogeton pectinatus	sago or fennelleaf pondweed	fresh to mesohaline (0 to 16 ppt)	medium	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Perennial submerged aquatic with long, flattened, branching stems; tolerates wide range of soil types and ph; prefers brackish water (USDA, 2009); alkaline waters for flowering (FNAEC, 1993+). Salinity range is 0 to 9 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). Grows in alkaline, brackish, or saline water of ponds, marshes, and ocean shores (Correll and Correll, 1972). Occurs in brackish, slightly brackish, and tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Excellent and fair food value for ducks and crawfish, respectively (Chabreck, 1972).
				Salt Bayou and Texas Point	Fresh, Intermediate and Brackish Marsh	Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008b)	
Potamogeton pusillus	lesser or baby pondweed	fresh to mesohaline (0 to 16 ppt)	medium	Willow Bayou	Intermediate Marsh	Observed during SAV and terraces study (Caldwell, 2003)	Chabreck (1972) reports it comprising 0.24% of intermediate and 0.62% of fresh Louisiana coastal marshes. Good and fair food value for ducks and crawfish, respectively (Chabreck, 1972).

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

Scientific Name	Common Name	Salinity Range*	Salinity Tolerance	SNWW Occurrence	Vegetation Community	Observations	References
Ruppia maritima	widgeongrass	oligohaline thru polyhaline (2.0 to 25.0+ ppt)	high	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 but frequency of occurrence dropped dramatically post-monitoring (Mouledous and Guidry, 2007a)	Stalkless seagrass with leaves arising directly from rhizome; tolerant of wide range of salinities; generally found in waters of 25.0 ppt or less (Dineen, 2001). Salinity range is 2 to 70 ppt (Urbatsch, 2009). Adapted to brackish marsh community (Penfound and Hathaway, 1938; FNAEC, 1993+); present at 0 thru 16 ppt (USGS, 1997). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 ppt and 6.0 ppt. Stutzenbaker (1999) salinity range 0 to 10 ppt. Chabreck (1972) reported it comprised 3.84% of brackish and 0.64% of intermediate Louisiana coastal marshes, with salinity range of 2.6 to 15.3 ppt; excellent and good food value for ducks and geese, respectively .
				Black Bayou	Intermediate Marsh	Observed in pre- and postconstruction monitoring of Black Bayou Project CS-27 (Castellanos and Juneau, 2007)	
				Willow Bayou	Intermediate and Brackish Marsh	Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a). Observed during SAV and terraces study (Caldwell, 2003)	
				Old River Cove	Intermediate and Brackish Marsh	Observed during SNWW Habitat Workgroup field investigation (2004)	
				Salt Bayou and Texas Point	Intermediate, Brackish and Saline marsh	100% rupia most years (Personal communication - Pat Walthers, USFWS, Texas Point NWR, 4/9/09). Reported by Chenier Plain NWR Comprehensive Conservation Plan (USFWS, 2008a)	
Salvinia minima	salvinia minor	fresh (0 to 2 ppt)	low	Bessie Heights	Fresh and Intermediate Marsh	Observed during SNWW Habitat Workgroup field investigation (2004)	Rootless aquatic fern, long considered native but likely introduced in 1920s; invasive, noxious plant, forms dense mats that can shade out native aquatic species and reduce dissolved oxygen levels; low tolerance to salinity (TIO, 2009). Stutzenbaker (1999) salinity range 0 to 0.5 ppt.
				Rose City	Fresh marsh	Observed during SNWW Habitat Workgroup field investigation (2004)	
Utricularia sp. unspecified	common bladderwort	fresh to oligohaline (0 to 3.0 ppt)	low	Perry Ridge	Fresh and Intermediate Marsh	Observed in postconstruction monitoring for CS-30, Perry Ridge West Bank Stabilization (Mouledous and Guidry, 2007a)	Native, rootless, submerged aquatic plants with lacy, complex leaves and tiny carnivorous bladders and erect flower stalks that extend above the water (CAIP, 2009). Possible species include *Utricularia gibba* and *Utricularia* sp. *macrorhiza* . Normally found in quiet, shallow, acidic waters (TAMU, 2009). Observed in fresh/intermediate habitats (1 to 3 ppt) in southeast Louisiana (Penfound and Hathaway, 1938). Stutzenbaker (1999) limits the salinity range to 0–0.5 ppt. Dominant in fresh tidal waters (Tiner, 1993). Chabreck (1972) provided a salinity range of 0.0 to 1.3 ppt for horned bladderwort *(Utricularia cornuta*); fair and poor food value for crawfish and ducks, respectively.
				Willow Bayou	Intermediate Marsh	Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a)	
Vallisneria americana	freshwater American eelgrass; wild celery	fresh thru mesohaline (0 to 16 ppt)	medium	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Submerged plant that forms tall underwater meadows and is commonly found growing in lakes and streams; leaves arise in clusters from their roots and can be several feet long (CAIP, 2009). Salinity range is 0 to 9 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). Grows in fresh to brackish waters (FNAEC, 1993+). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 ppt and 6.0 ppt, respectively (Zimmerman et al., 1990). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Chabreck (1972) reports that it provides excellent food value for ducks.

Table 11: Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range

Scientific Name	Common Name	Salinity Range*	Salinity Tolerance	SNWW Occurrence	Vegetation Community	Observations	References
Utricularia sp. unspecified	common bladderwort	fresh to oligohaline (0 to 3.0 ppt)	low	Perry Ridge	Fresh and Intermediate Marsh	Observed in postconstruction monitoring for CS-30, Perry Ridge West Bank Stabilization (Mouledous and Guidry, 2007a)	Native, rootless, submerged aquatic plants with lacy, complex leaves and tiny carnivorous bladders and erect flower stalks that extend above the water (CAIP, 2009). Possible species include *Utricularia gibba* and *Utricularia* sp. *macrorhiza.* Normally found in quiet shallow, acidic waters (TAMU, 2009). Observed in fresh/ intermediate habitats (1 to 3 ppt) in southeast Louisiana (Penfound & Hathaway, 1937). Stutzenbaker (1999) limits the salinity range to 0 to 0.5 ppt. Dominant in fresh tidal waters (Tiner, 1993). Chabreck (1972) provided a salinity range of 0.0 to 1.3 ppt for horned bladderwort (*Utricularia cornuta*); fair and poor food value for crawfish and ducks, respectively.
				Willow Bayou	Intermediate Marsh	Reported by Sabine NWR Comprehensive Conservation Plan (USFWS, 2008a)	
Vallisneria americana	freshwater American eelgrass; wild celery	fresh thru mesohaline (0 to 16 ppt)	medium	Perry Ridge	Fresh and Intermediate Marsh	Observed in pre- and postconstruction monitoring of Perry Ridge CS-30 (Mouledous and Guidry, 2007a)	Submerged plant that forms tall underwater meadows and is commonly found growing in lakes and streams; leaves arise in clusters from their roots and can be several feet long (CAIP, 2009). Salinity range is 0 to 9 ppt (Urbatsch, 2009). Present at 0 thru 16 ppt (USGS, 1997). Grows in fresh to brackish waters (FNAEC, 1993+). Reported at mouth of Trinity Bay in areas where monthly mean salinities ranged from 3.0 to 18.9 ppt and 1.7 to 14.4 ppt, with overall means of 9.2 and 6.0 ppt, respectively (Zimmerman et al., 1990). Occurs in slightly brackish to tidal fresh waters (Tiner, 1993). Stutzenbaker (1999) salinity range 0 to 3.5 ppt. Chabreck (1972) reports that it provides excellent food value for ducks.

* After Cowardin et al. (1979): polyhaline 18 to 30 ppt; mesohaline 5 to 18 ppt; and oligohaline 0.5 to 5 ppt. Salinity ranges based on areas of occurrence, and refined when more-specific salinity range data were available (see reference column).

4.2.1 FWOP and FWP Changes in SAV Coverage

In the majority of cases, the FWOP and FWP salinity changes to the percentage of SAV cover were similar. Table 12 presents a graphical summary of SAV salinity impacts in both future conditions. In 7 out of 11 fresh marsh communities, predicted FWOP and FWP salinity changes by TY 65 would not exceed the salinity tolerance range of SAV species reported in the units. At TX 7 (GIWW North), salinity tolerances would be exceeded for two (*Lemna* sp. and *Eichhornia crassipes*) of six species in both the FWOP and FWP conditions. At TX 10 (Cow Bayou) and TX 11 (Adams Bayou), the salinity tolerance of one (*Chara* spp.) of five SAV species would be exceeded in the FWP condition. At TX 3 (Rose City), the salinity tolerances of one (*Nymphaea odorata*) of eight species would be exceeded in the FWP condition.

The highest impacts would occur in the intermediate marsh communities. In only 4 of 12 hydro-units, predicted FWOP and FWP salinity changes did not exceed the SAV salinity tolerance ranges. However, once again, the FWOP and FWP salinity changes would be similar for the majority of hydro-units. FWOP and FWP salinities in LA 3 (Black Bayou), LA 4 (Johnson's Bayou), and TX 5 (Bessie Heights), and TX 13 (Groves) would exceed the tolerance range of one or two of five species in each hydro-unit. The species affected were *Chara* spp., *Ottelia alismoides*, and *Salvinia minima*. FWOP and FWP salinities in LA 2 (Willow Bayou) would exceed the tolerance range of three of six species in each hydro-unit. SAV species affected in these units were *Utricularia* sp. unspecified, *Ceratophyllum demersum*, *Ottelia alismoides*, *Salvinia minima*, and *Eichhornia crassipes*. At LA 1 (Perry Ridge), LA 9, (East Johnson's Bayou), and TX 10 (Cow Bayou), SAV salinity tolerances would only be exceeded in the FWP condition. In LA 1, two (*Ceratophyllum demersum* and *Ottelia alismoides*) of nine SAV species would be impacted. In LA 9 and TX 10, one (*Chara* spp.) of five SAV species would be impacted.

In the brackish and saline marsh communities, the vast majority of hydro-units were dominated by *Ruppia maritima*; the large salinity tolerance range of this species would not be exceeded by salinity changes in either the FWOP or FWP condition. At LA 4 (Johnson's Bayou), the salinity tolerance range of two (*Chara* spp. and *Ottelia alismoides*) of five species would be exceeded in both the FWOP and FWP conditions. In LA 3 (Black Bayou), the salinity tolerance of one (*Ottelia alismoides*) of four SAVs would be exceeded in the FWP condition.

4.2.2 FWOP and FWP SAV Impacts

In the WVA worksheets, the FWOP and FWP salinity impacts to specific SAV species were identified. In no case was all SAV species in a specific marsh community predicted to be adversely affected by the projected salinity increase; the greatest impacts would occur in the LA 2 (Willow Bayou) intermediate marsh community where the salinity tolerances of three of six species would be exceeded in both the FWOP and FWP conditions. SAV salinity impacts would be limited to the FWP condition in seven hydro-units; three in fresh marsh (TX 3, Rose City; TX 10, Cow Bayou; and TX 11 Adam Bayou), three in intermediate marsh (LA 1, Perry Ridge; LA 9, East Johnson's Bayou; and TX 10, Cow Bayou), and one in the brackish marsh community (LA 3, Black Bayou).

Table 12: SNWW 48-ft Project SAV Wildlife Impacts

Hydro-Unit (HU) #	HU Name	Future Salinity Range in HU (ppt)[1]	Alligator Weed[2] 0 to 8 ppt[3] g, F, C[4]	Bladderwort 0 to 3.0 ppt d, c	Chara 0 to 4.0 ppt d, g	Coontail 0 to 5.0 ppt d, c	Duck Lettuce 0 to 5.0 ppt	Duck Weed 0 to 2.0 ppt D, c	Eurasian Watermilfoil 0 to 16 ppt D, c	Freshwater Eelgrass 0 to 16 ppt D	Pickerelweed 0 to 3 ppt d, f	Pondweed 0 to 16 ppt D, c	*Salvinia minor* 0 to 2.0 ppt	Southern Naiad 0 to 15 ppt D, G, c	Water Hyacinth 0 to 0.5 ppt c	Water Lettuce 0 to 5.0 ppt	White Water Lily 0 to 0.5 ppt D	Widgeon Grass 2 to 25 ppt D, G	Yellow Water Lily 0 to 3.5 ppt D
Fresh Marsh																			
LA 1	Perry Ridge																		
	FWOP	1.3–1.7	NI[5]	NI	NA	NI	NI	NA	NI	NI	NA	NI	NA	NI	NA	NA	NA	NI	NA
	FWP	1.3–2.3	NI	NI	NA	NI	NI	NA	NI	NI	NA	NI	NA	NI	NA	NA	NA	NI	NA
LA 7	SE Sabine																		
	FWOP	1.7–2.1	NA	NI	NA	NI	NA	NI	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	1.7–2.4	NA	NI	NA	NI	NA	NI	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 8	SW Gum Cove																		
	FWOP	1.2–1.4	NA	NI	NA	NI	NI	NA	NI	NI	NA	NI	NA	NI	NA	NA	NA	NI	NA
	FWP	1.2–2.0	NA	NI	NA	NI	NI	NA	NI	NI	NA	NI	NA	NI	NA	NA	NA	NI	NA
TX 1	North Neches River																		
	FWOP	0.0–0.0	NI	NA	NA	NA	NA	NI	NA	NA	NI	NA	NA	NA	NA	NA	NA	NA	NA
	FWP	0.0–0.0	NI	NA	NA	NA	NA	NI	NA	NA	NI	NA	NA	NA	NA	NA	NA	NA	NA
TX 2	Neches - Lake Bayou																		
	FWOP	0.0–0.0	NI	NA	NA	NA	NA	NI	NA	NA	NI	NA	NA	NA	NA	NA	NA	NA	NA
	FWP	0.0–0.1	NI	NA	NA	NA	NA	NI	NA	NA	NI	NA	NA	NA	NA	NA	NA	NA	NA
TX 3	Rose City																		
	FWOP	0.1–0.3	NA	NA	NA	NI	NA	NA	NI	NA	NI	NA	NI	NI	NI	NA	NI	NA	NI
	FWP	0.1–0.6	NA	NA	NA	NI	NA	NA	NI	NA	NI	NA	NI	NI	NI	NA	I	NA	NI
TX 4	West of Rose City																		
	FWOP	0.1–0.3	NA	NA	NA	NI	NA	NA	NI	NA	NI	NA	NI	NI	NI	NA	NA	NA	NA
	FWP	0.1–0.6	NA	NA	NA	NI	NA	NA	NI	NA	NI	NA	NI	NI	NI	NA	NA	NA	NA
TX 5	Bessie Heights																		
	FWOP	1.0–1.5	NA	NA	NA	NI	NA	NA	NI	NA	NI	NA	NI	NI	NI	NA	NA	NA	NA
	FWP	1.5–2.0	NA	NA	NA	NI	NA	NA	NI	NA	NI	NA	NI	NI	NI	NA	NA	NA	NA
TX 7	GIWW North																		
	FWOP	0.7–2.5	NI	NA	NA	NA	NA	I	NA	NA	NA	NI	NA	NI	I	NI	NA	NI	NA
	FWP	0.7–4.1	NI	NA	NA	NA	NA	I	NA	NA	NA	NI	NA	NI	I	NI	NA	NI	NA
TX 10	Cow Bayou																		
	FWOP	3.5–4.0	NA	NA	NI	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	3.5–5.0	NA	NA	I	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
TX 11	Adams Bayou																		
	FWOP	2.5–3.5	NA	NA	NI	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	2.5–5.0	NA	NA	I	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
Intermediate Marsh																			
LA 1	Perry Ridge																		
	FWOP	3.8–4.5	NI	I	NA	NI	NI	NA	NI	NI	NA	NI	NA	NI	NA	NA	NA	NI	NA
	FWP	3.8–5.6	NI	I	NA	I	I	NA	NI	NI	NA	NI	NA	NI	NA	NA	NA	NI	NA
LA 2	Willow Bayou																		
	FWOP	6.3–6.8	NA	I	NA	I	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	6.3–7.7	NA	I	NA	I	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 3	Black Bayou																		
	FWOP	4.7–5.1	NA	NA	I	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	4.7–6.5	NA	NA	I	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 4	Johnson's Bayou																		
	FWOP	4.4–5.5	NA	NA	I	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	4.4–7.3	NA	NA	I	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 5	Sabine Lake Ridges																		
	FWOP	4.5–5.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	4.5–7.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA

Table 12: SNWW 48-ft Project SAV Wildlife Impacts

Hydro-Unit (HU) #	HU Name	Future Salinity Range in HU (ppt)[1]	Alligator Weed[2] 0 to 8 ppt[3] g, F, C[4]	Bladderwort 0 to 3.0 ppt d, c	Chara 0 to 4.0 ppt d, g	Coontail 0 to 5.0 ppt d, c	Duck Lettuce 0 to 5.0 ppt	Duck Weed 0 to 2.0 ppt D, c	Eurasian Watermilfoil 0 to 16 ppt D, c	Freshwater Eelgrass 0 to 16 ppt D	Pickerelweed 0 to 3 ppt d, f	Pondweed 0 to 16 ppt D, c	*Salvinia minor* 0 to 2.0 ppt	Southern Naiad 0 to 15 ppt D, G, c	Water Hyacinth 0 to 0.5 ppt c	Water Lettuce 0 to 5.0 ppt	White Water Lily 0 to 0.5 ppt D	Widgeon Grass 2 to 25 ppt D, G	Yellow Water Lily 0 to 3.5 ppt D
LA 7	SE Sabine																		
	FWOP	1.7–2.1	NA	NI	NA	NI	NA	NI	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	1.7–2.4	NA	NI	NA	NI	NA	NI	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 8	SW Gum Cove																		
	FWOP	2.4–2.8	NA	NA	NI	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	2.4–3.9	NA	NA	NI	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 9	East Johnson's Bayou																		
	FWOP	3.3–3.8	NA	NA	NI	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	3.3–4.8	NA	NA	I	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
TX 5	Bessie Heights																		
	FWOP	4.2–4.4	NA	NA	NA	NI	NA	NA	NI	NA	I	NA	I	NI	NA	NA	NA	NA	NA
	FWP	4.2–4.7	NA	NA	NA	NI	NA	NA	NI	NA	I	NA	I	NI	NA	NA	NA	NA	NA
TX 8	Texas Point																		
	FWOP	5.8–7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	5.8–7.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
TX 10	Cow Bayou																		
	FWOP	3.5–4.0	NA	NA	NI	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	3.5–5.0	NA	NA	I	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
TX 13	Groves																		
	FWOP	3.0–4.0	NA	NA	NA	NI	NA	NA	NI	NA	I	NA	I	NI	I	NA	NA	NA	NA
	FWP	3.0–5.0	NA	NA	NA	NI	NA	NA	NI	NA	I	NA	I	NI	I	NA	NA	NA	NA
Brackish Marsh																			
LA 2	Willow Bayou																		
	FWOP	6.3–7.2	NA	NA	NA	NA	NA	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	6.3–7.7	NA	NA	NA	NA	NA	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 3	Black Bayou																		
	FWOP	3.8–4.2	NA	NA	NA	NA	NI	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	3.8–5.3	NA	NA	NA	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 4	Johnson's Bayou																		
	FWOP	4.4–5.3	NA	NA	I	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
	FWP	4.4–7.0	NA	NA	I	NA	I	NA	NI	NA	NA	NA	NA	NI	NA	NA	NA	NI	NA
LA 5	Sabine Lake Ridges																		
	FWOP	6.2–7.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	6.2–8.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
LA 6	Johnson's Bayou Ridge																		
	FWOP	4.4–5.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	4.4–7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
TX 6	Old River Cove																		
	FWOP	10.0–11.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	10.0–13.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
TX 7	GIWW North																		
	FWOP	9.0–10.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	9.0–12.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
TX 8	Texas Point																		
	FWOP	8.5–9.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	8.5–10.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
Saline Marsh																			
LA 5	Sabine Lake Ridges																		
	FWOP	15.8–16.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	15.8–17.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA

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Hydro-Unit (HU) #	HU Name	Future Salinity Range in HU (ppt)[1]	Alligator Weed[2] 0 to 8 ppt[3] g, F, C[4]	Bladderwort 0 to 3.0 ppt d, c	Chara 0 to 4.0 ppt d, g	Coontail 0 to 5.0 ppt d, c	Duck Lettuce 0 to 5.0 ppt	Duck Weed 0 to 2.0 ppt D, c	Eurasian Watermilfoil 0 to 16 ppt D, c	Freshwater Eelgrass 0 to 16 ppt D	Pickerelweed 0 to 3 ppt d, f	Pondweed 0 to 16 ppt D, c	*Salvinia minor* 0 to 2.0 ppt	Southern Naiad 0 to 15 ppt D, G, c	Water Hyacinth 0 to 0.5 ppt c	Water Lettuce 0 to 5.0 ppt	White Water Lily 0 to 0.5 ppt D	Widgeon Grass 2 to 25 ppt D, G	Yellow Water Lily 0 to 3.5 ppt D
LA 6	Johnson's Bayou Ridge																		
	FWOP	15.8–16.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	15.8–17.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
TX 8	Texas Point																		
	FWOP	12.5–13.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA
	FWP	12.5–14.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NI	NA

[1] Predicted by ERDC Hydrodynamic-salinity model (Brown and Stokes, 2009)

[2] Italicized - noxious and invasive aquatic plants

[3] See table "Submerged Aquatic Vegetation in the SNWW Study Area - Species and Salinity Range"

[4] SAVs food value for wildlife, after Chabreck (1972): D (excellent or good for ducks), d (fair or poor for ducks); G (excellent or good for geese), g (fair or poor for geese); F (excellent or good for furbearers); f (fair or poor for furbearers); C (excellent or good for crawfish); c (fair or poor for crawfish)

[5] NI - No Salinity Impact (salinity remains within tolerance range); I - Impact (salinity extends beyond tolerance range); NA - Not Applicable (not known or observed in HU)

The salinity change occurring with RSLR in the FWOP condition through TY 65 would be very gradual; the SAV community structure in the majority of intermediate marshes would likely change to include more salinity-tolerant species, such as *Ruppia maritima*, *Potamogeton pectinatus, Myrophyllum spicatum* and *Vallisneria americana* (USGS, 1997). It is expected that any SAV cover lost as a result of this change would be replaced by the salinity-tolerant SAVs continuing to grow within their tolerance range. As a result, no change in percent SAV cover was predicted for the FWOP condition through TY 65.

In the FWP condition, the project-related change in salinity would occur in TY 15 with dredging of the Sabine Pass and Sabine Pass Jetty channels. The HS model projects that the incremental salinity increase (e.g., the difference between the FWOP with RSLR salinity and the FWP with RSLR salinity) would average 1.3 ppt near the mouths of Sabine and Keith lakes, 0.8 ppt in the east Sabine Lake marshes, 0.7 ppt on the lower Neches and Sabine rivers, and less than 0.15 ppt on the upper Neches and Sabine rivers. Since salinity change is a function of the total dredging template, the time required to reach a new FWP equilibrium would likely be considerable, ranging from a conservative minimum of several months to even a year, because each wetland would be responding to salinity inputs from multiple sources (Gary Brown personal communication, 2009). The most-rapid change (on the order of 2 to 3 months) would likely occur in marshes immediately adjacent and open to tidal exchange with the navigation channel that has just been dredged. Because of the salinity effect of the existing navigation channel, wetlands adjacent to the channel are likely to contain SAVs with greater salinity tolerances, and thus would be able to adapt to the FWP change more easily. Similar to expected changes in the FWOP condition, the SAV community structure in the majority of intermediate marshes would likely change to include more salinity-tolerant species, such as *Ruppia maritima*, *Potamogeton pectinatus, Myrophyllum spicatum,* and *Vallisneria americana* (USGS, 1997). It is expected that any SAV cover lost as a result of this gradual change would be replaced by the salinity-tolerant SAVs continuing to grow within their tolerance range. As a result, no change in percent SAV cover was predicted for the FWP condition through TY 65.

4.2.3 SAV Impacts from BU Features and Mitigation Measures

Marsh restoration BU features and the mitigation measures would likely cause SAV impacts because of temporary but greatly increased turbidity associated with the hydraulic placement of dredged material for marsh restoration. It was assumed that construction would result in the die-off of SAVs in the vicinity of placement activities during the year of construction, followed by quick rebounds associated with increased nutrient input, and the creation of shallow, protected ponds within the restored marsh. Rebounds in the percentage of SAV cover were applied in the year following construction. Increases in SAV cover were predicted based upon the collective professional judgment of the Habitat Workgroup and experience with similar restoration projects in the study area.

4.3 V_3 MARSH EDGE AND INTERSPERSION

The Habitat Workgroup carefully examined enlarged orthophoto quadrangle maps for each hydro-unit and assigned interspersion classes by comparing them to the photographic examples in Appendix 1 of the emergent marsh model methodology. In most cases, the hydro-units contain more than one interspersion

class and are therefore divided into more than one class by percentage of acreage covered by each type. FWP projections were made on the basis of collective professional judgment and were generally associated with salinity changes. Significant increases in salinity, especially if salinities were passing from an optimal to suboptimal range, were assumed to stress existing marsh vegetation and lead to increasing amounts of open water or greater interspersion.

4.3.1 FWOP and FWP Projections

Salinity changes occurring in both the FWOP and FWP conditions would result in increases to the land loss rate for both conditions. The majority of land loss over the period of analysis would occur in the FWOP condition as a result of the baseline land loss rate, increased as described above to account for the salinity effects of RSLR. As a general rule, no change in interspersion class was predicted for minor FWOP changes in interior land loss amounting to less than 3 or 4 percent. For FWOP interior land loss totaling 5 percent or higher, at least half of the percentage loss was assumed to convert from the highest class to the next highest class.

No change in interspersion would be expected to result from water elevation increases associated with RSLR; it was assumed that biomass accumulation would offset much if not all of the RSLR change in water surface elevation (Morris et al., 2002). However, significant changes in interspersion class would occur in conjunction with shoreline recession due to RSLR. In shoreline marsh communities so affected, the percentage of marsh and water lost due to shoreline recession would convert to Class 4 in both the FWOP and FWP conditions. The incremental FWP interior land loss would be less than 1.5 percent in all cases. Because of this insignificant change between the FWOP and FWP conditions, no change in interspersion class through TY 65 would be expected for the FWP condition.

4.3.2 Effects of BU Features and Mitigation Measures

The restoration or protection of marshes resulting from the construction of the BU features and mitigation measures would improve the interspersion class based upon the increase in marsh edge and stable marsh elevation that would result from the construction of these measures.

4.4 V_4 PERCENT OPEN WATER ≤1.5 FEET DEEP

Baseline values for this variable were based largely upon previous observations by Habitat Workgroup members during average summer tidal conditions in the hydro-units that they manage or regulate. Values were also obtained from previous CWPPRA or other restoration projects in or near the areas under evaluation. Projections of the FWP condition considered trends in marsh loss and changes in interspersion predicted for V_1 and V_3, both of which were related to changes in salinity. It was assumed that shoreline retreat would convert an area equivalent to the land lost to water deeper than 1.5 feet. Other factors that could affect water depths, such as changes in water surface elevations, sedimentation rates, or RSLR, were not considered since they would not be affected by construction of the SNWW LPP.

4.4.1 FWOP and FWP Projections

No conversions of shallow water to deep water in the interior marsh would be expected from FWOP water surface elevation increases associated with RSLR; it was assumed that biomass accumulation would offset much if not all of the RSLR change in water surface elevation (Morris et al., 2002). However, shallow water would be lost in conjunction with FWOP shoreline recession due to RSLR. In Gulf and Sabine Lake shoreline marsh communities affected by shoreline recession, a narrow nearshore zone (estimated at 50 feet wide) would remain shallow thru TY 65, and the remainder of new water created from the loss of marsh would convert to deep water in both the FWOP and FWP conditions.

FWP trends in marsh loss and changes in interspersion predicted for V_1 and V_3, both of which are related to changes in salinity, would also affect the FWP percent of shallow water. However, since incremental FWP interior land loss would be generally less than 1.5 percent, no FWP changes in shallow water were assumed through TY 65.

4.4.2 Effects of BU Features and Mitigation Measures

FWP mitigation measures and BU features would slow shoreline retreat or restore marsh and associated shallow-water habitat. Projected increases in the percent of shallow water reflect assumptions that marsh restoration in mitigation and BU areas would convert some deep water to shallow water with the settling of fine sediment in remaining open-water areas. For in situ terracing mitigation measures, shallow-water acreage was decreased commensurate with the size of borrow areas needed for terrace construction. In situ terraces are constructed in open-water areas of degraded marshes, using in situ inundated sediments. Emergent, linear berms are constructed with these in situ sediments, but borrow trenches located parallel to the emergent berms result from the removal of in situ soils.

4.5 V_5 SALINITY

4.5.1 FWOP Salinity Projections

Baseline salinity values for V_5 in the WVA worksheets were based upon HS model output or empirical data provided by resource agencies, if available. Model values were obtained from the nearest station or averaged over a group of stations, and salinity values were adjusted by the Habitat Workgroup for the observed salinity gradient in interior marshes. The HS model incorporates the most likely effects of RSLR and future freshwater inflows for the period of analysis. On average, FWOP salinities with RSLR would be about 1.0 to 1.5 ppt higher in the southern part of Sabine Lake and the Port Arthur/Sabine-Neches canals; about 0.3 to 0.5 ppt higher around the northern edge of Sabine Lake and the Sabine and Neches rivers south of IH 10, and only negligibly higher (0.0 to 0.1 ppt) north of IH 10 on both rivers.

4.5.2 FWP Salinity Projections

The HS model median-flow run was used to evaluate the effects of FWP salinity changes for all vegetative communities. In accordance with the 2002 WVA procedural manuals (USFWS, 2002c, 2002d),

mean salinities were applied in saline and brackish marsh communities, and the mean high 33 percent continuous salinity was utilized for fresh and intermediate marsh communities and cypress-tupelo swamps. On average, FWP salinities with RSLR would be about 1.5 ppt higher in the southern part of Sabine Lake and the Port Arthur-Sabine-Neches canals; about 0.5 to 1.0 ppt higher around the northern edge of Sabine Lake and the Sabine and Neches rivers south of IH 10, and only negligibly higher (0.02 to 0.03 ppt) north of IH 10 on both rivers.

To facilitate evaluation of salinity impacts, the Habitat Workgroup requested that model output be obtained for numerous additional model nodes (specific locations in the model mesh). Values from the original modeling station or node nearest to specific hydro-units were employed. Values were often averaged from two or more nodes that surrounded the hydro-unit in order to obtain a salinity representative of the entire unit. If no nodes were located near a hydro-unit, isohaline maps of average salinity differences were employed to estimate salinity changes in that area.

HS modeling also provided a low-flow run to be used in a sensitivity analysis (presented in Chapter 8) that evaluates potential FWP impacts of occasional extreme drought events on the sensitive swamps and bottomland hardwood forests in the study area. The low-flow run is a hypothetical flow that was defined as the 10th percentile of historical monthly flows for 57 years of inflow data for the Neches and Sabine rivers. It actually represents an event that would have much less than a 10 percent chance of occurrence, because it simulates the effect flows remaining at 10 percent of historical levels for several months in a row.

4.5.3 Salinity Projections for BU and Mitigation Measures

For the preliminary screening of BU and mitigation measures, a previous version of the HS model was used to evaluate measures that could have large-scale effects on the system, and desktop models were used to evaluate effects of water control structures that would have only localized effects (Brown et al., 2006). Some measures were excluded from the modeling effort since they had no hydrologic effect or they completely blocked salinity intrusion. Measures with potential to affect the entire system included combinations of BU features on the Neches River, various designs of a submerged hard sill at the mouth of Sabine Lake, and combinations of salinity control structures. The effects of individual salinity control structures were evaluated with desktop models that used tidal amplitude from the HS model, rainfall estimates, and reductions in tidal cross sections to predict salinity and velocity changes resulting from specific control structures.

No salinity benefits were predicted for BU or mitigation measures retained for final screening. When selecting salinity values for the WVA worksheets, USACE followed the same process and assumptions that were used by the Habitat Workgroup in the initial WVA; however, in all cases mitigation and BU measure salinities were assumed to be the same as the FWP.

4.6 V_6 AQUATIC ORGANISM ACCESS

4.6.1 FWOP and FWP Projections

Baseline values for this variable were based largely upon previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate, and an inventory of constructed or funded CWPPRA or other restoration projects in the areas under evaluation.

The Habitat Workgroup compared specific structures affecting aquatic organism access routes in each hydro-unit to the list of structures and associated structure ratings in Appendix B of the WVA emergent marsh model manual (USFWS, 2002c). The structure ratings were multiplied by the acreage affected by them to calculate the Access Value that was entered into the WVA worksheets. FWP values were generally the same as FWOP values because most construction features of the LPP did not include structures that would inhibit aquatic organism access.

4.6.2 Effects of BU Features and Mitigation Measures

During the preliminary screening of water control structures, the same process described for the FWP condition was followed to calculate access values for those structures. No water control structures provided sufficient benefits to overcome aquatic organism access impacts, and thus none advanced into the final screening of mitigation measures. Containment levees constructed in conjunction with BU marsh restoration projects were rated as solid plugs for the year of construction and then rated as an open system the following year when they were breached to reestablish circulation and access.

5.0 APPLICATION OF THE SCM

5.1 V_1 STAND STRUCTURE

5.1.1 FWOP Projections

Baseline values for this variable were based upon field investigations and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. A field investigation, conducted by the Habitat Workgroup on August 24 and 25 and October 21, 2004, collected baseline data required by the WVA in each hydro-unit that contained swamp habitat. FWOP changes in stand structure were projected based upon changes in stand maturity, which in turn were associated with RSLR-related changes in salinity (V_4) or changes in tidal flooding duration and depth (V_3). Steady maturation was projected for all hydro-units; the increase in overstory coverage was generally associated with a decrease in midstory trees and shrubs and herbaceous vegetation.

5.1.2 FWP Projections

FWP effects to stand structure would be expected in swamp communities near the GIWW East, where a FWP increase in salinity is projected. The magnitude of projected structure changes was based upon the magnitude of the salinity increase and the amount of change in relation to the optimal range. In the Adams Bayou and Blue Elbow South swamps, a projected increase in salinity could slow the growth of all structure components, with tupelo-gum and herbaceous understory considered the most sensitive to increased salinities. Growth rates for cypress and tupelo, expressed as dbh, could be slightly lower than FWOP conditions, averaging 0.03 inch less per year. The Neches River BU Feature would restore the marsh buffer and protect an existing swamp community on the fringe of Rose City; mitigation measures would have no effect on swamp communities in the study area.

5.2 V_2 STAND MATURITY

5.2.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above, and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. The dbh measurements were taken from randomly selected canopy dominant and co-dominant trees in the hydro-unit sample sites, and averages were calculated for the cypress and tupelo-gum et al. subgroups. Basal area was estimated using the density ranges provided in category descriptions. FWOP rates of tree growth were based on data for relevant species from the USDA Silvics of North America (USDA, 1990), and other forest research literature (USDA, 1983; Brown and Montz, 1986) that generally reflect optimum growth conditions on managed lands. Growth rates were adjusted for the effects of gradually rising salinity due to RSLR, and were distributed evenly across the project life.

5.2.2 FWP Projections

FWP effects would be related solely to incremental changes in salinity that could occur as a result of the deepened channel. Effects of the salinity increases were related to their magnitude and changes in relation to the optimal range. In the Adams Bayou and Blue Elbow South swamps, higher salinity would be expected to slow the growth of both tupelo-gum and bald cypress, with greater effects on tupelo-gum because of its greater salinity sensitivity. The magnitude of projected structure changes was based upon the magnitude of the salinity increase and the amount of change in relation to the optimal range.

5.3 V_3 WATER REGIME

5.3.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above, and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. Knowledge of conditions outside of the specific area was also considered in this determination. For example, hydrology may have been altered by nearby navigation channels and highway roadbeds or placement area levees that block through-flow.

The FWOP values consider the effects of gradual RSLR on water surface elevation and tidal circulation. The increase in water surface elevation was forecast by the HS model, which in addition to RSLR, also incorporated forecasted changes in freshwater inflow. The effects of higher FWOP water surface elevations on hydrologic conditions were estimated by comparing FWOP water surface elevations over the period of analysis to existing land elevations within the swamp and bottomland hardwood areas. The range of existing water surface elevations in the Sabine and Neches rivers adjacent to these communities was determined by field sampling in 2001 (Fagerburg, 2003). Water surface elevations associated with diurnal tides and extremes associated with normal seasonal wind variations were measured at that time. The 1.1-foot increase in water surface elevation predicted by the HS model was added to existing average and extreme water surface elevations, and then compared to the land surface elevations taken from recent LIDAR survey data (CADGIS, 2009; NOAA Coastal Service Center, 2009). While some of the lower-lying areas could see a marginal increase in the depth and duration of tidal flooding by the end of the period of analysis, the gradual change in water surface elevation due to RSLR would not permanently inundate swamp substrate throughout the year. Ultimately, FWOP increases in the duration and depth of tidal flooding associated with RSLR would adversely affect these communities, but this is most likely to occur after the period of analysis of this study.

5.3.2 FWP Projections

FWP effects to the water regime would be related to projected changes in velocity and water surface elevations that could be associated with a larger tidal inflow through the deeper channel. The HS model determined that both would be slightly higher under FWP conditions, but these minor increases would not be sufficient to cause changes in flooding duration or water exchange (Brown and Stokes, 2009). No

landscape or structural changes are planned for the project that would affect flow/exchange or flooding duration in the swamps or their general vicinity.

5.4 V_4 MEAN HIGH SALINITY DURING THE GROWING SEASON

5.4.1 FWOP Projections

Baseline salinity values were based upon HS model output or empirical data provided by resource agencies, if available. Model values were obtained from the nearest station or averaged over a group of stations, and salinity values were adjusted by the Habitat Workgroup for the observed salinity gradient in interior marshes. The HS model incorporates the most likely effects of RSLR and future freshwater inflows for the period of analysis. On average, FWOP salinities with RSLR would be only negligibly higher (0.0 to 0.1 ppt) north of IH 10 on both rivers, where the majority of the swamp communities are located. However, FWOP salinities would be expected to increase an average of 0.5 ppt in the swamp communities near the GIWW East.

5.4.2 FWP Projections

The HS model median-flow run was used to evaluate the effects of FWP salinity changes for all vegetative communities. In accordance with the 2002 WVA procedural manuals (USFWS, 2002c, 2002d), the mean high of 33 percent continuous salinity was utilized for fresh and intermediate marsh communities and cypress-tupelo swamps. On average, FWP salinities with RSLR would be only negligibly higher (0.02 to 0.03 ppt) north of IH 10 on both rivers, but about 1.0 to 1.4 ppt higher in the swamp communities near the GIWW East. The Neches River BU Feature would restore the marsh buffer and help protect an existing swamp community on the fringe of Rose City from FWP increases in salinity; mitigation measures would have no effect on swamp communities in the study area.

A sensitivity analysis is presented in Chapter 8 that evaluates potential FWP impacts of occasional extreme drought events on swamp communities in the study area. The analysis considers potential impacts associated with a rare low-flow event that simulates the effect flows remaining at 10 percent of historical levels for several months in a row.

6.0 APPLICATION OF THE BHM

6.1 V_1 TREE SPECIES COMPOSITION

6.1.1 FWOP Projections

Baseline values for this variable were based upon field investigations and previous observations by Workgroup members in the hydro-units that they manage or regulate. A field investigation, conducted by the Habitat Workgroup on August 24 and 25 and October 21, 2004, collected baseline data required by the WVA in each of the hydro-units that contained bottomland hardwood habitat. Changes in tree species composition were projected based upon changes in stand maturity, which in turn were associated with RSLR-related changes in hydrology (V_4). With steady maturation, an increase in mast producers in the overstory was generally associated with a decrease in midstory trees and shrubs and a decrease in understory vegetation.

6.1.2 FWP Projections

FWP effects to tree species composition would be related solely to projected changes in salinity. However, the bottomland hardwood communities are located on upland terrace margins or higher ridges in the floodplain, and are protected from salinity increases by their elevation or buffering marsh. Therefore, no changes to tree species class association would be expected to occur. The Neches River BU Feature would restore marsh buffers for existing bottomland hardwood communities on the upland margins; mitigation measures would have no effect on bottomland hardwood communities in the study area.

6.2 V_2 STAND MATURITY

6.2.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. The dbh measurements were taken from randomly selected canopy trees in the hydro-unit sample sites, and averages were calculated for the variable. FWOP rates of tree growth were based on data for relevant species from the USDA's *Silvics of North America* (1990), and other forest research literature (USDA, 1983; Brown and Montz, 1986) that generally reflect optimum growth conditions on managed lands. Growth rates were adjusted for the effects of gradually rising salinity due to RSLR and were distributed evenly across the project life.

6.2.2 FWP Projections

FWP effects would be related solely to incremental changes in salinity that could occur as a result of the deepened channel. Effects of the salinity increases were related to their magnitude and changes in relation to the optimal range. In the Adams Bayou community, salinity increasing further into the sub optimal range would be expected to slow the growth of all tree species. The magnitude of projected structure

changes was based upon the magnitude of the salinity increase and the amount of change in relation to the optimal range.

6.3 V_3 UNDERSTORY/MIDSTORY

6.3.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above, and previous observations by Habitat Workgroup members in the hydro-units that they manage or regulate. Percentage coverage of understory and midstory was estimated by visual observation. FWOP changes were associated with projected growth and maturation of the overstory canopy, taking into account the effects of gradual RSLR. No conditions were forecast to interfere with steady growth, and therefore the projected increase in overstory coverage was generally associated with a decrease in midstory trees and shrubs and a decrease in herbaceous understory.

6.3.2 FWP Projections

FWP effects would be related solely to projected increases in salinity. However, projected reductions in understory/midstory growth were small to nonexistent because the magnitude of the salinity increase was small.

6.4 V_4 HYDROLOGY

6.4.1 FWOP Projections

Baseline values for this variable were based upon the same field investigations reported above. Conditions outside of the specific hydro-unit were also considered, especially highway roadbeds or placement area levees that block through-flow and result in an elevated water table. Potential effects related to changes in the duration or depth of tidal flooding resulting from RSLR were considered as is described for the SCM.

6.4.2 FWP Projections

FWP effects to hydrology would be related to projected changes in water surface elevations, but the minor increase predicted by the HS model was not sufficient to cause changes in the water table or drainage efficiency (Brown and Stokes, 2009). No landscape or structural changes are planned in conjunction with navigation improvements or mitigation that would affect drainage or water table elevations in the hydro-units or their general vicinities.

6.5 V_5 SIZE OF CONTIGUOUS FORESTED AREA

Baseline values for this variable were taken from GIS measurements. The size of bottomland hardwood stands and other contiguous forests was used to determine which class of forest size was applicable. Navigation improvements do not require the removal of any bottomland hardwoods, and salinity changes

would not be expected to affect the size of these forested wetlands. Therefore, there are no FWP impacts, and no mitigation measures were designed to increase bottomland forest acreage.

6.6 V_6 SURROUNDING LAND USES

A GIS analysis of USGS orthophoto quadrangle maps was used to determine baseline acreages of surrounding land use classes. A 0.5-mile-wide buffer zone was established around each hydro-unit, the different land use types were classified within this buffer zone, and the percent occupied by each of the land use types was calculated. FWOP changes were predicted for the nonhabitat class (residential, commercial, and industrial development) and the relative percentage of adjacent classes most likely to be lost to development was reduced proportionately. FWOP increases in the nonhabitat classes were estimated based upon the 2000 U.S. Census projected population growth rate of the surrounding county. No FWP changes in this variable would be expected.

6.7 V_7 DISTURBANCE

GIS measurements and observations from USGS orthophoto quadrangle maps were used to measure distances and determine appropriate disturbance classes for this variable. Distance to disturbance was measured from the perimeter of major stands of bottomland hardwood, and the shortest distance to disturbance was applied. No FWOP change in disturbance class was projected based upon assumption that most upland perimeters amenable to development are already developed. No FWP changes in this variable would be expected.

7.0 HYDRO-UNITS SUMMARY

7.1 TEXAS HYDRO-UNITS

Table 13 summarizes the results of the WVA modeling of the comparison of the FWOP and FWP condition for Texas. In Texas, negative impacts occur over approximately 39,000 acres with a projected total loss of 412 AAHUs. The majority of these impacts (380 AAHUs) are indirect impacts occurring to approximately 33,500 acres of intertidal marsh and swamp due to small increases in salinity from the proposed channel deepening. Direct impacts (32 AAHUs) are associated with the conversion of 86 acres of fresh marsh to upland PA 24A. After benefits of proposed DMMP BU features are taken into account, the net change in Texas is an increase in 656 AAHUs. A brief verbal summary of baseline, FWOP and FWP conditions is presented below for each hydro-unit. Salinity levels referenced in the hydro-unit descriptions were taken from the HS modeling report (Brown and Stokes, 2009).

7.1.1 TX 1 – North Neches River

This 4,143-acre hydro-unit contains 67 percent (2,760 acres) cypress-tupelo swamp, 9 percent (384 acres) fresh marsh, 10 percent (412 acres) bottomland hardwood forest, 1 percent (53 acres) shrub/scrub, and 10 percent (407 acres) other upland habitat. Open water covers only 3 percent (127 acres) of the unit. Although dominated by cypress-tupelo swamp, the swamp is interspersed with a series of relict meander riverbanks that are dry except during floods and that support bottomland hardwood forest. In addition to bald cypress and tupelo-gum, the swamp supports a diverse assortment of aquatic vegetation, including pickerelweed, alligator weed, duckweed, spider lilies, crinum, and several species of fern along the water's edge. Most of the open water in the wetland forests consists of deeper streams and bayous; SAVs cover less than half of open-water area. The relict riverbank ridges support a relatively mature growth of bottomland hardwoods composed of several species of oaks, hickory, hackberry, sweet gum, maple, and willow, with greater than 50 percent of the overstory canopy consisting of hard mast or other edible seed-producing trees. Because of the thick canopy cover, understory coverage of palmetto, yaupon, lizard's tail, smartweed, and invading tallow trees is generally 50 percent or less. The relatively scarce (on a regional and national scale) swamp and bottomland hardwood habitats have medium to high wildlife values. Mammals adapted to the area's wetland habitats include opossum, armadillo, raccoon, swamp and cottontail rabbit, gray and red fox, coyote, bobcat, and white-tailed deer. Reptiles and amphibians, including the American alligator, are abundant. A prolific and wide array of resident and migratory birds utilizes the area because of the quality and diversity of habitat and its location in the Central Flyway. The influence of the salinity wedge in the navigation channel extends into the adjacent reach of the Neches River, raising salinities during times of low freshwater inflow. However, there is relatively little mixing, and salinity stratification within the river remains strong in this reach, resulting in predominantly fresh water in the upper layer and backwater areas (Academy of Natural Sciences, 1998).

Table 13: Texas SNWW CIP - Net Impacts and Benefits
by Acres and AAHUs

HU #	Hydrologic Unit (HU) Name	Offset Impacts by Acres and Habitat Type (acres)			Total Impacts/Benefits by Habitat Type (AAHUs)		
		No Effect	Impacts Offset by BU Plan	Acres Impacted	Total Loss	Offsetting Benefits of BU Plan	Net FWP Benefit
Bottomland Hardwood							
Neches River Watershed							
TX 1	North Neches River	412			0		0
TX 2	Neches-Lake Bayou	1,040			0		0
TX 3	Rose City	1,775			0		0
TX 5	Bessie Heights	293			0		0
TX 6	Old River Cove	197			0		0
Subtotal - Neches River		**3,717**	**0**	**0**	**0**	**0**	**0**
Sabine River Watershed							
TX 10	Cow Bayou	388			0		0
TX 11	Adams Bayou	640			0		0
LA/TX 1	Sabine Island	524			0		0
Subtotal - Sabine River		**1,552**	**0**	**0**	**0**	**0**	**0**
Total Bottomland Hardwood		**5,269**	**0**	**0**	**0**	**0**	**0**
Cypress/Tupelo Swamp							
Neches River Watershed							
TX 1	North Neches River	2,760			0		0
TX 2	Neches-Lake Bayou	2,277			0		0
TX 3	Rose City	464			0		0
Subtotal - Neches River		**5,501**	**0**	**0**	**0**	**0**	**0**
Sabine River Watershed							
TX 10	Cow Bayou	110			0		0
TX 11	Adams Bayou			115	-4		-4
TX 12	Blue Elbow South			689	-18		-18
LA/TX 1	Sabine Island	1,194			0		0
LA/TX 2	Blue Elbow	2,737			0		0
Subtotal - Sabine River		**4,041**	**0**	**804**	**-22**	**0**	**-22**
Total Cypress/Tupelo Swamp		**9,542**	**0**	**804**	**-22**	**0**	**-22**
Fresh Marsh							
Neches River Watershed							
TX 1	North Neches River	436			0		0
TX 2	Neches-Lake Bayou	1,535			0		0
TX 3	*Rose City PA24A**			86	-32		-32
TX 3	Rose City			3,241	-1	178	177
TX 4	West of Rose City	492			0		0
TX 5	Bessie Heights	2,147			0		0
TX 7	GIWW North			4,806	-140		-140
Subtotal - Neches River		**4,610**	**0**	**8,133**	**-173**	**178**	**5**

Table 13 (Cont'd)

HU #	Hydrologic Unit (HU) Name	Offset Impacts by Acres and Habitat			Total Impacts/Benefits by Habitat Type		
		No Effect	Impacts Offset by BU Plan	Acres Impacted	Total Loss	Offsetting Benefits of BU Plan	Net FWP Benefit
Fresh Marsh (Cont'd)							
Sabine River Watershed							
TX 10	Cow Bayou			1,775	-18		-18
TX 11	Adams Bayou			599	-15		-15
Subtotal - Sabine River		**0**	**0**	**2,374**	**-33**	**0**	**-33**
Total Fresh Marsh		**4,610**	**0**	**10,507**	**-206**	**178**	**-28**
Intermediate Marsh							
Neches River Watershed							
TX 5	Bessie Heights			6,933	-14	433	419
TX 8	Texas Point			1,742	-19		-19
TX 13	Groves			437	-3		-3
Subtotal - Neches River		**0**	**0**	**9,112**	**-36**	**433**	**397**
Sabine River Watershed							
TX 10	Cow Bayou			1,144	-12		-12
Subtotal - Sabine River		**0**	**0**	**1,144**	**-12**	**0**	**-12**
Total Intermediate Marsh		**0**	**0**	**10,256**	**-48**	**433**	**385**
Brackish Marsh							
Neches River Watershed							
TX 6	Old River Cove			8,760	-116	235	119
TX 8	Texas Point			2,546	-7		-7
TX 7	GIWW North			647	-8		-8
Subtotal - Neches River		**0**	**0**	**11,953**	**-131**	**235**	**104**
Total Brackish Marsh		**0**	**0**	**11,953**	**-131**	**235**	**104**
Saline Marsh							
Neches River Watershed							
TX 8	Texas Point		5,708		-5	222	217
Subtotal - Neches River		0	5,708	0	-5	222	217
Total Saline Marsh		**0**	**5,708**	**0**	**-5**	**222**	**217**
Total Neches River Impacts		13,828	5,708	29,198	-345	1,068	723
Total Sabine River Impacts		5,593	0	4,322	-67	0	-67
Total - All Habitats		**19,421**	**5,708**	**33,520**	**-412**	**1,068**	**656**

* Direct impact associated with conversion of wetland to upland PA 24A.

The fresh marsh, restricted primarily to an area in the southeast corner of the hydro-unit, is in good condition. Extensive wetland floodplain forests on both sides of the Neches River are generally buffered from encroaching development by their low elevation. Development is, however, beginning to encroach upon the area from the City of Beaumont to the southwest, and commercial sandpits are located in the floodplain.

Minimal FWOP changes over the 65-year period of analysis would be expected. FWOP RSLR would gradually increase tidal flooding duration, but the gradual change in the depth of tidal flooding is not expected to permanently inundate swamp substrate throughout each year. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. A small change in salinity is expected accompanied by a loss of 24 acres of fresh marsh. A new, permanent saltwater barrier has been constructed on the Neches River at Pine Island Bayou, at the upstream limit of the SNWW study area. A loss of only 8 acres of fresh marsh would be expected. The Habitat Workgroup estimated that a small percentage (5.0 percent) of the surrounding land would convert from pasture to development due to population growth and the hydro-unit's proximity to uplands along its southwestern margin. No changes in the acreages of the bottomland hardwood and swamp areas would be expected, and it is assumed that all wetland forests would continue to mature with no disturbance.

The HS model indicates that FWP salinities under the most likely flow conditions would remain predominantly fresh. Abundant riverine through-flows and seasonal flooding would continue in the FWP condition, and only a negligible increase in water surface elevation would be expected. No FWP salinity impacts and no loss of marsh, bottomland hardwood, or swamp acreage would be expected. No FWP AAHU losses are predicted for the hydro-unit.

7.1.2 TX 2 – Neches Lake Bayou

Located immediately downstream of TX 1, this 5,707-acre hydro-unit contains 40 percent (2,277 acres) cypress-tupelo swamp, 22 percent (1,270 acres) fresh marsh, 18 percent (1,040 acres) bottomland hardwood forest, 2 percent (108 acres) shrub/scrub and 12 percent (684 acres) other upland habitat. Approximately 6 percent (329 acres) of the unit is open water. Swamp and bottomland hardwood forests are present on both sides of the Neches River, and fresh marsh is restricted primarily to a central corridor along the river. Interspersed among the cypress-tupelo swamp is a series of relict meander riverbanks that are dry except during floods. Species of bottomland hardwoods, understory, SAVs, fish, and wildlife are similar to those present in TX 1. However, tupelo-gum is more abundant than bald cypress in this hydro-unit, and the percentage of hard mast or other edible seed-producing trees is somewhat lower, between 25 and 50 percent. Like TX 1, the relatively scarce (on a regional and national scale) swamp and bottomland hardwood habitats have medium to high wildlife values. The influence of the salinity wedge extending up the navigation channel is greater here than upstream. The hydrology of the area is essentially unaltered, with abundant riverine through-flows. Semipermanent flooding is associated with IH 10, which forms the

southern border of the hydro-unit and serves to block overland flow to the south. The fresh marsh, located primarily on the east bank of the Neches River, is in good condition and is experiencing a low rate of land loss.

Minimal FWOP changes over the 65-year period of analysis would be expected. FWOP RSLR would gradually increase tidal flooding duration, but the gradual change in the depth of tidal flooding is not expected to permanently inundate swamp substrate throughout each year. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. Essentially no change in salinity and no marsh loss would be expected. The Habitat Workgroup estimated that 10 percent of the bottomland forest would be lost to development over the project life due to population growth and the area's proximity to existing development. A part of the City of Beaumont lies along the western boundary, and development is also encroaching from the east. No changes in swamp acreage were forecast because of its location in the lower, flood-prone floodplain. Swamp species would continue to mature with no disturbance.

The HS model indicates that FWP salinities under the most likely flow conditions would remain fresh. Abundant riverine through-flows and seasonal flooding would continue in the FWP condition, and only a negligible increase in water surface elevation would be expected. No FWP salinity impacts and no loss of marsh, bottomland hardwood, or swamp acreage would be expected. No FWP AAHU losses are predicted for the hydro-unit.

7.1.3 TX 3 – Rose City

Located on the east bank of the Neches River downstream of IH 10, this 5,805-acre hydro-unit contains 40 percent (2,323 acres) fresh marsh, 31 percent (1,775 acres) bottomland hardwood forest, 8 percent (464 acres) cypress-tupelo swamp, and 2 percent (152 acres) other upland habitat. The unit is 19 percent (1,091 acres) open water. A centrally located expanse of tidally influenced mud flats is the site of eroded wetlands that were formerly fresh marsh and cypress/tupelo swamp (GLO, 2000a). This change is associated with a combination of factors, including subsidence linked to subsurface fluid extraction, timber cutting, reduced sediment supply, and exposure to higher salinities introduced through the adjacent ship channel and internal oil field canals. The hydro-unit contains the Rose City Oil and Gas Field, which ceased production in 2003. Cypress-tupelo swamp is largely confined to the Tiger Creek watershed, which drains a rapidly developing upland area into the northern portion of the hydro-unit. Vestiges of swamp vegetation are also present along the Neches River perimeter and along levees bordering canals. Bottomland hardwoods, largely confined to the southern half of the hydro-unit, grade into developed uplands along the eastern margin. The bottomland hardwoods, comprised primarily of various oaks, maple, honey locust, pecan, and tallow, occupy relict meander ridges, interspersed with fingers of fresh marsh. A 1,000-acre area in the center of the hydro-unit that was formerly marsh and wetland forest has subsided and eroded into a tidally influenced, clay-pan dotted with cypress stumps (Figure 10). Remaining fresh marsh around the rim of the eroded area is gradually being lost. Natural streams and areas that are partially confined by oil field roads and levees are covered with water averaging 2 to 3 feet

in depth. These areas support a lush growth of aquatic vegetation including coontail, southern naiad, Eurasian milfoil, common salvinia, water hyacinth, smartweed, cattails, bulrush, and pickerelweed. Baseline salinities are essentially predominantly fresh, but the hydrology of the area has been altered by oil field canals and levees, subsidence, with run-off from developed uplands to the northeast. Parts of the area are completely open to tidal flow, while other areas are restricted by levees and roads to the extent that water is permanently impounded. Access for marine organisms is unrestricted for most of the area; however, access to a 200-acre impounded area is maintained only through culverts.

Figure 10: Existing condition of Rose City East

It is expected that FWOP changes would be limited to the fresh marsh with the loss of 93 acres (4.2 percent) of fresh marsh over the period of analysis. The FWOP salinity would remain fresh, and no impacts would be expected for the swamp and bottomland hardwood communities. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. The Habitat Workgroup estimated that 10 percent of pasturelands currently buffering the hydro-unit would be lost to development due to population growth in Vidor and the area's proximity to existing development.

FWP project impacts would be limited to those associated with about a 0.5 ppt increase in salinity. The productivity-based land loss projection indicates that this increase would result in the loss of 3 additional acres of fresh marsh (–1 AAHUs), but no losses in bottomland hardwood or swamp acreage. The small increase in salinity will cause no reduction in the general health and productivity of the cypress-tupelo swamp and bottomland hardwood habitats. The SNWW DMMP proposes the expansion of existing

PA 24, which is located at the southern tip of the unit. New PA 24A would convert 85 acres of fresh marsh and 1 acre of open water to a confined, upland placement area, resulting in a loss of –32 AAHUs. The footprint of the acreage converted to PA 24A was coordinated with the Habitat Workgroup to minimize impacts to adjacent bottomland hardwood forest and higher quality fresh marsh. One component of the Neches River BU Feature (Rose City East) would be constructed in this hydro-unit, resulting in a net increase of 249 acres of fresh marsh and a net benefit of 177 AAHUs.

7.1.4 TX 4 – West of Rose City

This 493-acre hydro-unit consists of two separate areas, totaling 80 percent (395 acres) fresh marsh and 20 percent (97 acres) associated open-water areas on the west bank of the Neches River, opposite the Rose City marsh area. The marshes are remnants interspersed among industrial facilities and USACE PAs. The largest remnant marsh lies along the southern and southwestern edge of PA 25. It lies on both sides of a natural drainage and an industrial canal that extends from the Neches River to developed uplands in the City of Beaumont. The southern area is bordered by a large docking slip on the north and the Neches River on the east and is surrounded by industrial facilities. Salinity in the Neches River adjacent to these sites is predominantly fresh.

FWOP land loss of 24 acres (6.4 percent) would be expected over the 65-year period of analysis. FWP project impacts would be associated with a minimal change in salinity (approximately 0.5 ppt) and the loss of 1 acre of fresh marsh (0 AAHUs). It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level.

7.1.5 TX 5 – Bessie Heights

The 11,363-acre Bessie Heights hydro-unit is the site of the most extensive, contiguous coastal marsh loss in Texas (GLO, 2000b). Located on the east bank of the Neches River downstream from the Rose City marsh, this unit contains 18 percent (2,018 acres) fresh marsh, 17 percent (1,932 acres) intermediate marsh, 2 percent (293 acres) bottomland hardwood, less than 1 percent combined (60 acres) brackish marsh and shrub/scrub, and 13 percent (1,512 acres) PAs and other upland habitat. It is dominated by 5,548 acres (49 percent) of open water that was historically a large, mostly emergent, intermediate marsh. Existing fresh marsh rims the edge of the large submerged wetland area, grading into developed uplands to the north and east. Pockets of bottomland hardwood are present in the fresh marsh and at the upland edge. The submerged wetland, now a vast open-water area averaging 2 to 3 feet in depth, is the site of the large Port Neches oil and gas field. This field is still active; however, production levels have been low and steady over the last 25 years. The oil field is connected to the Neches River by the Bessie Heights canal, and a grid of low levees protects active and closed well locations (Figure 11). Wetland loss in this area began during the 1930s, and the most significant losses occurred between 1956 and 1978 (White et al, 1996). The rate of marsh loss dropped during the last 25 years, averaging 0.03 percent per year. This slowing in the land loss rate appears to be due in part to changes in oil production rates and practices. Factors believed to contribute to this marsh loss include subsidence related to the removal of

groundwater, oil, and gas reserves, salt water intrusion, petroleum production brine disposal, altered hydrology, and altered sediment deposition patterns. PAs for the SNWW navigation channel line the Neches River and form the western boundary of the marsh system. They serve as artificial levees that prevent overbank flows and sediment deposition. The Nelda Stark Unit of the Lower Neches WMA is located in the northeast quadrant of the hydro-unit. TPWD data indicate that salinity in the Nelda Stark Unit intermediate marsh averages 4.2 ppt during the growing season. The HS model indicates a predominant baseline salinity of about 1.0 ppt in the fresh marsh.

Figure 11: Bessie Heights Oil Field

A FWOP land loss in the fresh marsh of 40 acres (2.0 percent) and 31 acres (1.6 percent) of intermediate marsh would be expected over the period of analysis. No change in bottomland forest acreage is forecast. The salinity increase associated with RSLR would be about 0.25 to 0.5 ppt. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level.

FWP project impacts would be associated with a small increase in salinity of about 0.5 ppt and the loss of about 2 additional acres of fresh marsh (0 AAHUs), and about 1 acre of intermediate marsh (−14 AAHUs). The small increase in salinity would cause no reduction in the general health and productivity of the bottomland hardwood habitats. One component of the Neches River BU feature (Bessie Heights East) would be constructed in this hydro-unit, resulting in a net increase of 1,189 acres of intermediate marsh and 679 acres of brackish marsh, and a net benefit of 419 AAHUs.

7.1.6 TX 6 – Old River Cove

The 11,851-acre Old River Cove hydro-unit is located on the east bank of the Neches River where its mouth opens onto Sabine Lake. It contains 44 percent (5,240 acres) brackish marsh with minor pockets of fresh and intermediate marsh (2 percent; 230 acres) on its periphery. One 197-acre (2 percent) area of bottomland hardwood is preserved in the northwest corner of the unit. Approximately 30 percent (3,620 acres) of the unit is open water. The submerged brackish wetland is primarily located in the western half, west of Highway 87. Much of this area is managed by TPWD as the Old River Unit of the Neches River WMA. The hydro-unit also contains 2,564 acres (22 percent) that were excluded from the analysis because they are the location of three small PAs and a 2,500-acre area of controlled, isolated wetlands that is owned and managed by a hunt club as intermediate marsh. The intake and outfall canals for a large power plant draw higher-saline waters from Old River Cove and discharge them into the Neches River just upstream of the Rainbow Bridge. Salinities west of the outfall canal tend to be lower because this area is buffered by the bank of the canal and receives lower-salinity overland flow from the Bessie Heights area. TPWD sampling indicates baseline salinities average 10.0 ppt. The Old River Cove area has lost a large amount of marsh due to subsidence, faulting (White et al., 1996), and saltwater intrusion. The most significant losses occurred between 1956 and 1978 when the rate of marsh loss averaged 27.5 acres/year. The rate of marsh loss dropped during the last 25 years, when it averaged 4.8 acres/year. Widgeon grass is abundant in shallow waters west of Highway 87, but SAVs are not common east of the highway. Access for marine organisms is fully open through roadside ditches and the utility canals. Wildlife diversity is high, and it is a key nesting and brooding area for several species of ducks. It is also an important stopover and staging area for waterfowl in the Central Flyway, and it provides high-quality winter waterfowl habitat.

A FWOP land loss of 1,518 acres (28 percent) of brackish marsh would be expected given the high background land loss rate documented in the area (White et al., 1996). Salinity would increase from about 10.0 ppt to about 11.0 ppt over the period of analysis, moving further into the suboptimal range. Gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. It was estimated that 10 percent of the bottomland hardwoods will be lost to development over the project life due to population growth in Bridge City and the area's proximity to existing development.

FWP project impacts would be associated with an increase in salinity to about 13.0 ppt and the loss of 46 acres (1 percent) of brackish marsh (–116 AAHUs). The bottomland hardwood community is buffered from salinity increases by marsh and development; no impacts would be expected. One component of the Neches River BU Feature (Old River Cove) would be constructed in this hydro-unit, resulting in a net increase of 593 acres of brackish marsh, and a net benefit of 119 AAHUs.

7.1.7 TX 7 – GIWW North

The 5,907-acre GIWW North hydro-unit comprises three separate areas on the north side of the GIWW. All are located within the largest remaining coastal freshwater marsh in Texas (USFWS, 2005a). The unit

consists of 77 percent (4,541 acres) fresh marsh, 10 percent (588 acres) brackish marsh, 2 percent (129 acres) intermediate marsh, and 8 percent (454 acres) of PAs and upland areas. Approximately 3 percent (195 acres) of the unit is open water. Most of this area is not hydrologically connected to the waterways that form its southern and eastern boundary, the GIWW and the Taylor Bayou Diversion Channel, respectively. TPWD data indicate that baseline salinities in the fresh and brackish marshes average 0.7 and 9.0 ppt, respectively, during the growing season. PAs along the GIWW and levees, created when the waterways were originally dredged, serve as barriers along the banks of the waterways that protect the marshes from bank overwash. Areas selected for inclusion in the hydro-unit are likely to be affected by salinity increases associated with SNWW channel improvements. They are influenced by breaks in the levees and PAs, or through natural bayous that allow higher-salinity waters to enter the marsh system. The easternmost area is 647 acres of brackish marsh on the west bank of the Taylor Bayou Diversion Channel. The central area is 2,533 acres of fresh marsh located within the McFaddin NWR's North Unit and bordered on the south by the GIWW. The westernmost area is 2,273 acres of fresh and intermediate marsh centered on the drowned valley of Salt Bayou where it is cut by the GIWW. Wildlife diversity is high, and the general locale serves as a key nesting and brooding area for several species of ducks. It is also an important stopover and staging area for waterfowl in the Central Flyway and it provides high-quality winter waterfowl habitat. SAVs are abundant in the small, shallow, open-water ponds in the unit. Fisheries access is restricted by box culverts and fixed-crest weirs in the eastern and central areas, but unrestricted through Salt Bayou in the westernmost area.

FWOP land loss of 539 acres (11.6 percent) of fresh marsh and 62 acres (10.6 percent) of brackish marsh would be expected over the 65-year period of analysis. Included in this land loss are estimated losses due to RSLR-related shoreline recession along the GIWW (about 8 acres of fresh and 3.5 acres of intermediate marsh). It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. Salinities would be expected to increase to about 2.5 ppt in the fresh marsh and about 11 ppt in the brackish marsh. In both marsh communities, the FWOP salinity would rise into the suboptimal range. No other changes in land use or hydrology would be expected.

FWP project impacts would be associated with an increase in salinity to about 4.0 ppt and 12.5 ppt in the fresh and brackish marshes, respectively, and land loss of 63 acres (1.5 percent) of fresh and 2 acres (0.4 percent) of brackish marsh for a total loss of 148 AAHUs. In both cases, salinity would be moving further into the suboptimal range. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.1.8 TX 8 – Texas Point

This 11,422-acre hydro-unit is located adjacent to the SNWW waterway at Sabine Pass; its southern boundary extends for 13.5 miles along the Gulf of Mexico. The unit encompasses the entire 8,950-acre Texas Point NWR (USFWS, 2005a). Located within the Chenier Plain Complex of southwestern Louisiana and southeast Texas, the unit contains 4,898 acres (43 percent) of saline marsh, 2,398 acres

(21 percent) brackish marsh, 1,605 acres (14 percent) intermediate marsh, 100 acres (1 percent) fresh marsh, and 1,413 acres (12 percent) of other upland areas. Approximately 9 percent (1,008 acres) of the unit is open water. Chenier ridges along the northern margin of the hydro-unit were omitted from the analysis because they will not be affected by hydrologic changes associated with the LPP. Marshes in the hydro-unit are hydrologically connected to the SNWW through Texas Bayou and a large, adjoining man-made canal. Saltwater averaging 24 ppt also accesses the area by overwashing a subsided portion of the west jetty near the Gulf shoreline. The hydro-unit is crisscrossed with numerous small bayous that feed waters from the SNWW waterway into the interior, following long finger swales between ridges. The majority of the area is covered by saline marsh (5,708 acres), which front the SNWW waterway and the Gulf of Mexico. Saline marsh grades to brackish marsh (2,654 acres) toward the west, and this in turn grades into intermediate marsh and small pockets of fresh marsh (totalling 1,742 acres). USFWS sampling indicates that baseline salinities average 5.75 ppt, 8.5 ppt, and 12.5 ppt in the intermediate, brackish, and saline marshes, respectively. Salinities regularly exceed the optimal ranges for fresh and intermediate marsh. The marsh buffers inland habitats and the city of Sabine Pass from tropical storm–generated tidal surges and is biologically diverse and extremely productive (TPWD, 2005d). Systematic surveys of fish, wildlife, and plant resources have documented over 250 avian species and over 400 plant species in the NWR. The hydro-unit provides an important wintering and migration stopover for migratory birds including Central Flyway waterfowl, shorebirds, wading birds, marsh birds, and neotropical/neoarctic and temperate landbirds, in addition to providing year-round habitat for the mottled duck. The coastal marsh serves as a nursery area for many important commercial and recreational fish and shellfish species, including white and brown shrimp, blue crab, red drum, flounder, and speckled sea trout. SAVs cover half to three-quarters of open-water areas within the brackish and fresh/intermediate marshes, but are sparse in the saline marsh. Fisheries access is restricted in the intermediate and brackish marshes by low rock weirs on several channels; unrestricted access to the saline marsh is provided through Texas Bayou.

FWOP land loss of 245 acres (14.4 percent), 252 acres (10.6 percent), and 2,446 acres (50.2 percent) would be expected in the intermediate, brackish, and saline marshes. These losses include estimated losses due to RSLR-related shoreline recession of the Gulf shoreline of about 70 acres of fresh/intermediate, 852 acres of brackish, and 2,194 acres of saline marsh over the 65-year period of analysis. Land loss effects are also reflected in change in interspersion; areas converted to open Gulf waters were expected to convert to Class 4. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. Salinities would be expected to increase to about 7.0 ppt, 13.0 ppt, and 13.8 ppt in the intermediate, brackish, and saline marshes, respectively, over the period of analysis. Intermediate and brackish marshes would be impacted by salinities reaching further into the suboptimal range. No other changes in land use or hydrology would be expected.

FWP project impacts would be associated with salinity, interior land loss, and shoreline retreat increases totaling 31 AAHUs. Salinities would be expected to increase to about 7.8 ppt, 10.6 ppt, and 14.6 ppt in the intermediate, brackish, and saline marshes, respectively. Salinity in the intermediate marshes would

be expected to approach the upper limit for this community, increasing the potential for the conversion of large areas to brackish marsh. FWP land loss of 6 acres (0.4 percent), 5 acres (0.2 percent), and 17 acres (0.3 percent) of intermediate, brackish, and saline marshes, respectively, would be expected. FWP land loss trends include additional Gulf shoreline retreat of 0.42 foot/year between 0.5 and 3.5 miles from the jetty. The shoreline erosion results from increased wave heights and decreased sediment transport caused by deepening of the entrance channel (Gravens and King, 2003). No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.1.9 TX 9 – Salt Bayou

This 55,044-acre hydro-unit is located adjacent to the SNWW waterway between TX 8 and the GIWW. The western boundary is the Perkins Levee, which forms a barrier for hydrologic influences from the SNWW. The majority of the unit is located within the J.D. Murphree WMA and the McFaddin NWR. The hydrology of this Chenier Plain wetland is dominated by the Salt Bayou watershed and a chain of lakes along this bayou, which include Shell Lake, Johnson Lake, Keith Lake, and Salt Lake. Saltwater intrusion from the GIWW is controlled by water control structures at Perkins Levee and the opening of Salt Bayou to the GIWW (USACE, 1992), but the marshes remain open to the salinity influence of the SNWW through the Keith Lake Fish Pass. The unit contains 15,801 acres (29 percent) brackish marsh, 24,942 acres (45 percent) intermediate marsh, 567 acres (1 percent) fresh marsh, and 4,392 acres (8 percent) of uplands and ponded compartments that are leveed and hydrologically isolated. Approximately 17 percent (9,342 acres) of the unit is open water. The brackish marsh is located in areas most affected by salinity influence from the SNWW, along Salt Bayou, Johnson and Keith lakes, and the SNWW channel. According to TPWD salinity data, baseline salinities in the intermediate marsh average 4.7 ppt in the growing season and 6.9 ppt in the brackish marsh. The area supports a diversity of wildlife, including over 20 mammal, 80 bird, at least 11 reptile and amphibian species, and over 80 species of fishes and shellfishes (TPWD-GLO, 2001). Lying within the Central Flyway, the Salt Bayou marsh is a major component of the coastal wetland habitat utilized year-round by the mottled duck, and it provides an important wintering and migration stopover for other migratory waterfowl, shorebirds, wading birds, marsh birds, and neotropical/neoarctic and temperate landbirds. Fisheries access is unrestricted through the Keith Lake Fish Pass, but access to approximately 15 percent of the intermediate marsh is restricted by a flap-gate salinity control structure.

The Salt Bayou unit has been extensively impacted by human activities including oil exploration, cattle grazing, the construction of levees and ditches to facilitate waterfowl hunting and commercial fur trapping, and changes in hydrology caused by construction of the SNWW, the GIWW, and the Keith Lake Fish Pass. These have led to increases in the extent of open water at the expense of emergent marsh, with the most likely causative factors being saltwater intrusion, sulfide toxicity, and increased soil erosion associated with submergence associated with subsidence related to oil/gas withdrawal (Morton et al, 2001) and the loss of marsh vegetation (TPWD-USFWS, 1990). TPWD conducted a GIS study of historic patterns of the distribution of emergent marsh communities and changes in open-water areas (TPWD,

2003, 2004). This study documented a 6.15 percent decline in emergent marsh between 1967 and 2001. The rate of decline appears to have slowed between 1987 and 2001, with a loss of 2.36 percent.

FWOP changes for the 65-year period of analysis would be associated with RSLR-related land loss and salinity increases. The FWOP land loss rate assumed that the land loss trend measured between 1987 and 2001 would continue; 2,765 acres (10.8 percent) of existing fresh and intermediate marsh, and 1,697 acres (10.7 percent) of brackish marsh in the Salt Bayou hydro-unit would be lost. Land loss projections are also reflected in a change in interspersion, with 5 percent of Class 1 and 2 converting to Class 4. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. In the brackish marsh, FWOP salinity would be expected to increase from 6.9 ppt to 8.2 ppt, within the optimum range for the brackish marsh community. However, within the intermediate marsh, baseline salinity already exceeds the optimal range, averaging 4.7 ppt in the growing season. RSLR would be expected to raise salinity to 6 ppt by the end of the period of analysis, extending salinity levels further into the suboptimal range. No other changes in land use, hydrology, or salinity are expected.

FWP project impacts, totaling 658 AAHUs, would be associated with salinity and land loss increases primarily within the intermediate marsh system. Within the brackish marsh, salinity would increase from 6.9 ppt to 9.6 ppt, still within the optimum range for that community. For the intermediate marsh, however, salinity would be expected to increase to about 7.4 ppt, pushing near the upper limit of salinity tolerance for this vegetation community. Land loss of 49 acres (0.3 percent) of brackish marsh and 202 acres (0.8 percent) of intermediate marsh would be expected by 2069. Potential changes in water velocity due to a 48-foot deepening alternative were investigated with the 2009 HS model (Brown and Stokes, 2009). In the Keith Lake Fish Pass, the mean peak velocity would be slightly less than FWOP and there would be no change in mean velocity. Velocities in the Salt Bayou/Keith Lake marshes were not determined. However, a significant decrease in velocity would result when moving from the confined fish pass to the adjacent open marsh system. Little change in velocity is expected in the marsh system with the LPP. The deepening-only alternative does not include widening, but FWP velocities would be expected to be similar to the deepening and widening alternative.

It is important to note that the impacts presented here do not include all impacts of the Preferred Alternative in Texas as FWP impacts in Texas's Salt Bayou (TX 9) hydro-unit are not included. Jefferson County, Texas, and USACE, with support from the TPWD, GLO, and TWDB, have been studying ways to reduce the amount of saltwater intrusion, decrease high-energy inflows, and minimize impacts to larval fish access in an ongoing Section 1135 Continuing Authorities Project (CAP) study for the Salt Bayou hydrologic unit. When the Keith Lake Section 1135 CAP study was begun in 2003, it seemed likely that the CAP study and construction would be completed before the SNWW CIP could be authorized and constructed. The Keith Lake Section 1135 study was therefore considered separable from the SNWW CIP and for planning purposes, it was assumed that a water control structure at the Fish Pass would be part of the future without-project condition for the SNWW CIP. Incremental impacts of the SNWW CIP will be calculated for the Salt Bayou unit of the SNWW study area when WVA modeling is completed for the

Keith Lake Section 1135 study. It is possible that the excess DMMP benefits (316 AAHUs) of the SNWW CIP will cover all incremental project impacts. However, if it is determined that additional mitigation is needed, then USACE and the non-Federal sponsor of the SNWW CIP will initiate consultation with resource agencies, identify and incrementally justify additional compensatory mitigation for the Salt Bayou unit, and prepare a supplemental environmental impact statement.

7.1.10 TX 10 – Cow Bayou

The mouth of Cow Bayou flows into the Sabine River approximately 3 miles north of its confluence with Sabine Lake. The 4,990-acre hydro-unit comprises a narrow riparian corridor ranging from 1 mile wide at its mouth to 0.3 mile wide at its upstream extent that extends approximately 10 miles from the Sabine River. The riparian corridor is confined along most of its length by development in Bridge City, Texas. In 1946, the formerly shallow, meandering bayou was channelized and deepened to 13 x 100 feet by the USACE to provide shallow-draft access to the Orange Oil Field (Rivers and Harbors Act of July 24, 1946a). Dredged material from original construction was side cast into low mounds along the length of the channelized bayou. Two large, upland confined PAs (1,233 acres; 25 percent of the total hydro-unit acreage) are located on both sides of the bayou mouth at the Sabine River. These are used for maintenance dredging of the Channel to Orange, a segment of the SNWW waterway that is not part of this study of navigation improvements. Upstream of the PAs lie 1,436 acres (29 percent) of fresh marsh and 144 acres (23 percent) of intermediate marsh. Cypress-tupelo swamp (110 acres; 2 percent) is largely confined to the upper 3 miles. The marsh and swamp are interspersed with small pockets of bottomland hardwood (388 acres; 8 percent), which become larger along the upper bayou. Baseline salinities range from fresh in the uppermost reaches to about 3.5 ppt near the mouth. The hydrology of the hydro-unit has been altered by adjacent development. Roads and subdivisions have artificially lowered the water table in some areas and impounded water in others. TCEQ has identified water quality problems in Cow Bayou, citing impairments due to low dissolved oxygen and high fecal coliform (TCEQ, 2004a).

FWOP land losses of 75 acres (5.2 percent) and 59 acres (5.2 percent) of fresh and intermediate marsh, respectively, would be expected over the period of analysis. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. Salinities would remain fresh in the upper reaches and rise to 4.0 ppt near the mouth of the bayou. RSLR would result in an increase in both the depth and duration of tidal flooding. However, the swamp substrate would be exposed during average low tides and for longer durations seasonally. No other changes in land use or hydrology would be expected.

FWP project impacts would be expected due to an increase in salinities to about 1 ppt in the swamps and fresh marshes in the upper reaches, and 5.0 ppt in the fresh and intermediate marshes in the lower reach, moving into the suboptimal range in marshes closest to the Sabine River. Land losses of 6 acres (0.4 percent) and 3 acres (0.3 percent) in fresh and intermediate marsh, respectively, would be expected. Impacts would total 30 AAHUs. No loss of swamp or bottomland hardwood acreage is predicted. No

other changes in marsh edge, SAV coverage, land use, hydrology, or marine organism access are attributable to the project.

7.1.11 TX 11 – Adams Bayou

The mouth of Adams Bayou flows into the Sabine River approximately 5 miles north of Sabine Lake. The 1,679-acre hydro-unit comprises a narrow riparian corridor ranging from 0.5 mile wide at its mouth to 0.25 mile wide at its upstream extent, approximately 6 miles from the Sabine River. The riparian corridor is confined along most of its length by development in Orange, Texas. In 1946, the formerly shallow, meandering bayou was channelized and deepened to 12 x 100 feet by the USACE to provide shallow-draft access to the interior of Orange County (Rivers and Harbors Act of July 24, 1946b). Dredged material from original construction was side cast into low mounds along the length of the channelized bayou. One large, upland confined PA (322 acres; 19 percent of total hydro-unit acreage) is located on the west side of the bayou, near its mouth at the Sabine River. It is used for maintenance dredging of the Channel to Orange portion of the SNWW. Fresh marsh (516 acres; 31 percent) is interspersed with bottomland hardwood (640 acres; 38 percent) throughout the hydro-unit. Cypress-tupelo swamp (115 acres; 7 percent) is confined to the upper 2 miles. Open water composes 5 percent (86 acres) of the unit. Baseline salinity averages about 2.5 ppt, already edging into the suboptimal range. The hydrology of the hydro-unit has been altered by adjacent development. Roads and subdivisions have artificially lowered the water table in some areas and impounded water in others. TCEQ has identified water quality problems in Adams Bayou, citing impairments due to low dissolved oxygen and high fecal coliform (TCEQ, 2004b). The Adams Bayou Unit of the Lower Neches WMA is located in the lower 3 miles of the hydro-unit.

FWOP land loss of 28 acres (5.3 percent) of fresh marsh would be expected in conjunction with an increase in salinity to about 3.0 to 3.5 ppt, extending further into the suboptimal range for both fresh marsh and swamp communities. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. No changes in swamp or bottomland hardwood acreage are predicted. RSLR would result in an increase in both the depth and duration of tidal flooding. However, the swamp substrate would be exposed during average low tides and for longer durations seasonally. No other changes in land use or hydrology would be expected.

FWP project impacts associated with increases in salinity and land loss would total 19 AAHUs for the hydro-unit as a whole. Salinity would be expected to increase to about 3.9 ppt in the swamp community and to about 5.0 ppt in the fresh marshes, pushing at the upper limit of salinity tolerance for cypress-tupelo swamps and further into the suboptimal range for fresh marsh. The loss of 4 AAHUs in the swamp system is a conservatively high estimate of impacts since baseline growth rates were conservatively estimated assuming maximum growth in optimum conditions. Bottomland hardwoods would be buffered from the effects of most of this salinity increase by their elevation. Land loss of 3 acres (0.6 percent) of fresh marsh would be expected. No loss of swamp or bottomland hardwood acreage would be expected,

but the increased salinity would affect the general health and productivity of the cypress-tupelo swamp by slowing the rates of herbaceous coverage and tree trunk diameter growth by an average of 0.03 inch per year. This small reduction in the growth rate is a conservatively high estimate that assumes maximum growth under optimum conditions, and thus can be considered a negligible impact. Similar reductions in tree growth rates and mid/understory coverage would be expected for bottomland hardwood, but no overall reduction in habitat productivity was reflected in AAHUs. No other changes in marsh edge, SAV coverage, land use, hydrology, or marine organism access were attributable to the project.

7.1.12 TX 12 – South of Blue Elbow

This 689-acre hydro-unit is located on the west bank of the Sabine River, south of IH 10. The City of Orange occupies the uplands to the west. A long east-to-west canal, dug in conjunction with power line construction, passes through the hydro-unit from the upland to the Sabine River. The remnants of a radial star canal system remain from past logging operations in the northeast quadrant of the area. The hydro-unit is composed entirely of cypress-tupelo swamp in good condition. Baseline salinity in the river averages about 0.7 ppt. Overland flow and exchange with the Sabine River is high, and flooding in the area is semipermanent.

FWOP changes would be associated with the continued maturation of existing overstory and rising salinity due to RSLR. The Habitat Workgroup projected that overstory coverage would increase from 50 to 70 percent, and that understory would decrease from 70 to 50 percent due to decreased sunlight on the forest floor. Salinity would be expected to increase to about 1.1 ppt by the end of the period of analysis. RSLR would also result in an increase in both the depth and duration of tidal flooding. However, the swamp substrate would be exposed during average low tides and for longer durations seasonally. None of the area would be expected to be lost to development.

FWP project impacts, totaling 18 AAHUs, would be expected with an increase in salinity to 1.7 ppt, moving further into the suboptimal salinity range for cypress-tupelo swamp. Although no loss in swamp acreage would be expected, the increased salinity would cause a reduction in the general health and productivity of the cypress-tupelo swamp by reducing overstory coverage and slowing the rate of trunk diameter growth by an average of 0.05 inch per year. This small reduction in the growth rate is a conservatively high estimate that assumes maximum growth under optimum conditions, and thus can be considered a negligible impact.

7.1.13 TX 13 – Groves

This 437-acre hydro-unit is located west of the Neches River between PA 16 and the Star Lake Canal. The City of Groves and industrial development occupy the terrace margin just south of this unit. It comprises 88 percent (385 acres) intermediate marsh and 12 percent (52 acres) open water. Shallow, meandering streams cross the marsh and drain into the Star Lake Canal and Neches River. Baseline salinities are approximately 3.0 ppt.

FWOP impacts would result in land loss of 68 acres (18.3 percent) and an increase in salinity to 4.0 ppt over the period of analysis. It is assumed that the gradual rate of RSLR would result in an increase in primary production, biomass density, and sediment deposition such that marsh elevation will remain in equilibrium with sea level. No changes in aquatic organism access would be expected.

FWP project impacts would be associated with an increase in land loss and salinity, resulting in a total loss of 3 AAHUs. It is expected that 3 acres (0.8 percent) of intermediate marsh would be lost and that salinity would increase to about 5.0 ppt, moving into the suboptimal range. No other changes in land use, hydrology, or marine organism access would be attributable to the project.

7.2 LOUISIANA HYDRO-UNITS

Table 14 summarizes the results of the WVA modeling of the comparison of the FWOP and FWP condition for Louisiana. In Louisiana, negative indirect impacts occur to approximately 182,000 acres of intertidal marsh due to small increases in salinities from the proposed channel deepening. The resulting total loss is 1,709 AAHUs. After benefits of a proposed DMMP BU feature are taken into account, the net Louisiana loss is 1,499 AAHUs. A brief verbal summary of baseline, FWOP, and FWP conditions is presented below for each hydro-unit. Salinity levels referenced in the hydro-unit descriptions were taken from the hydro-dynamic salinity modeling report (Brown and Stokes, 2009).

7.2.1 LA 1 – Perry Ridge

The 28,094-acre Perry Ridge hydro-unit is bordered on the east by the Sabine River and on the south by the GIWW. Its north and east borders are uplands that form the Coastal Zone Boundary. It contains 53 percent (14,810 acres) fresh marsh with 11 percent (3,074 acres) intermediate marsh in smaller areas affected by the Vinton and Gray drainage ditches and the Sabine River. The north-south-trending Perry Ridge that bisects the hydro-unit is covered by 2,158 acres (8 percent) bottomland hardwood forest and 2,373 acre (8 percent) of other upland habitat. Approximately 19 percent (5,679 acres) of the unit is covered by open water.

Marsh losses in the area have been caused by water level fluctuations, saltwater intrusion, and tidal scour from the GIWW as a result of breaches in the northern bank. CWPPRA Project No. CS-24, Perry Ridge Shore Protection, completed in 1999, and Project No. CS-30, completed in 2001, are intended to prevent further erosion of the GIWW shore along a 4.3-mile reach of the north bank near the Vinton drainage ditch, a 1.8-mile reach of the GIWW from Perry Ridge to the Sabine River, and a 0.4-mile reach of the Sabine River north from its intersection with the GIWW, and reduce the salinity intrusion from the GIWW (USGS-NWRC, 2002a, 2002b). The GIWW is the dominant hydrologic influence in the area, connecting the Sabine and Calcasieu estuaries and allowing salt water to encroach into traditionally freshwater areas. The goal is to prevent impacts to fragile marsh habitats in the interior of the area. HS modeling indicates that baseline salinities during the growing season average about 1.3 ppt in the fresh

Table 14: Louisiana SNWW CIP - Net Impacts
by Acres and AAHUs

HU #	Hydrologic Unit (HU) Name	Offset Impacts by Acres and Habitat Type (acres)			Total Impacts/Benefits by Habitat Type (AAHUs)		
		No Impact	Impacts Offset by BU Plan	Acres Impacted	Total Loss	Offsetting Benefits of BU Plan	Net FWP Impact
All HUs in Sabine River Watershed							
Bottomland Hardwood							
LA 1	Perry Ridge	2,158	0	0	0	0	0
LA/TX 1	Sabine Island	1,041	0	0	0	0	0
	Subtotal	3,199	0	0	0	0	0
Cypress/Tupelo Swamp							
LA/TX 1	Sabine Island	5,998	0	0	0	0	0
LA/TX 2	Blue Elbow	650	0	0	0	0	0
	Subtotal	6,648	0	0	0	0	0
Fresh Marsh							
LA 1	Perry Ridge	0	0	18,859	-65	0	-65
LA 7	Southeast Sabine	0	0	2,634	-11	0	-11
LA 8	Southwest Gum Cove	0	0	3,615	-2	0	-2
	Subtotal	0	0	25,108	-78	0	-78
Intermediate Marsh							
LA 1	Perry Ridge	0	0	4,704	-53	0	-53
LA 2	Willow Bayou	0	0	35,109	-328	0	-328
LA 3	Black Bayou	0	0	34,941	-509	0	-509
LA 4	West Johnson's Bayou	0	0	11,110	-269	0	-269
LA 5	Sabine Lake Ridges	0	0	9,270	-218	0	-218
LA 7	Southeast Sabine	5,400	0		0	0	0
LA 8	Southwest Gum Cove	0	0	6,605	-4	0	-4
LA 9	East Johnson's Bayou	0	0	26,138	-190	0	-190
	Subtotal	5,400	0	127,877	-1,571	0	-1,571
Brackish Marsh							
LA 2	Willow Bayou	0	0	1,182	-1	0	-1
LA 3	Black Bayou	0	0	3,195	-1	0	-1
LA 4	West Johnson's Bayou	0	0	2,078	-1	0	-1
LA 5	Sabine Lake Ridges	0	0	15,962	-14	0	-14
LA 6	Johnson's Bayou Ridge	0	0	2,744	-6	0	-6
	Subtotal	0	0	25,161	-23	0	-23
Saline Marsh							
LA 5	Sabine Lake Ridges	0	3,767	0	-35	210	173
LA 6	Johnson's Bayou Ridge	0	370	0	-2		
	Subtotal		4,137	0	-37	210	173
Louisiana Impacts Total		15,247	4,137	178,146	-1,709	210	-1,499

marsh and 3.8 ppt in the intermediate marsh (Brown and Stokes, 2009). SAVs are abundant in the shallow open-water areas, and access for marine organisms is fully open along the Sabine River and through the Vinton Drainage Ditch.

FWOP RSLR would be expected to increase salinities in the fresh and intermediate marshes to 1.7 ppt and 4.5 ppt, respectively, by the end of the 65-year period of analysis. FWOP changes would push salinity in the intermediate marsh into the suboptimal range. Interior land loss of 921 acres (6.2 percent) in the fresh marsh and 191 acres (6.3 percent) in the intermediate marsh would be expected as a result of the higher salinities. However, RSLR would not be expected to result in marsh submergence or shoreline recession. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. CWPPRA Projects CS-24 and CS-30 would be expected to prevent the shoreline erosion and recession associated with RSLR (Mouledous and Guidry, 2005a, 2005b, 2007a, 2007b). FWOP RSLR would gradually increase tidal flooding depth and duration, but the higher water surface elevations would not be expected to inundate the majority of Perry Ridge. Lower areas of the ridge, however, could be inundated during occasional, extreme high-tide events. The brief insults of salinities between 1.0 and 2.0 ppt would not be expected to significantly impact the bottomland hardwood community that grows on the ridge. It was predicted that population growth in the upland margins would result in the conversion of 5 percent of existing bottomland hardwood to development by 2069.

FWP project losses, totaling 188 AAHUs, would be expected with an increase in interior marsh loss and salinity. Salinity would be expected to increase to 2.3 ppt in the fresh marsh and 5.6 ppt in the intermediate marsh by the end of the period of analysis. These salinities would edge into the suboptimal range in the fresh marsh, but push further into the suboptimal range for the intermediate. Interior marsh loss of 50 acres (0.3 percent) of fresh marsh (–131 AAHUs) and 12 acres (0.4 percent) of intermediate marsh would be expected. The bottomland hardwoods would be protected by the ridge's elevation and buffered from salinity increases by the surrounding marsh. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.2 LA 2 – Willow Bayou

The 36,291-acre Willow Bayou hydro-unit is bordered on the west by Sabine Lake, on the north by the Sabine NWR boundary, on the east by the Burton-Sutton Canal, and on the south by Starks South Canal, which forms the Sabine NWR boundary. Gray's Ditch parallels a raised cattle walkway that runs along most of the Sabine Lake shoreline south of Pines Ridge Bayou. Access to Sabine Lake is provided by Willow Bayou Canal, Three Bayou, and Johnson's Bayou. Black Bayou influences the eastern half of the area through connections via Greens Bayou and the Right Prong of Black Bayou. The majority of the hydro-unit is located within the western half of the Sabine NWR. Except for a narrow margin of 3 percent (49 acres) brackish marsh along the lakeshore, the unit is composed primarily of 62 percent (22,470 acres) intermediate marsh. Large interior areas, especially in the vicinity of Greens Lake and the intersection of the Deep Bayou and Willow Bayou canals, are converting to shallow open water due to elevated salinity

and subsidence. In total, approximately 34 percent (12,688 acres) of the unit is open water. Marsh loss caused by wave action is also occurring along the shoreline at an average rate of 4.7 feet/year (Greco and Clark, 2005). Baseline salinities, based on data provided by the USFWS during ICT meetings, average about 6.3 ppt in the hydro-unit. Access for marine organisms is fully open through Willow, Three, and Black bayous.

The East Sabine Lake Hydrologic Restoration Project (CWPPRA Project No. CS-32) has been constructed with the intent of countering this deterioration (USGS-NWRC, 2005). Project goals include the reduction of salinities within interior marshes, encouragement of SAV development, hydrologic restoration of historic flows, reduction of turbidity in open-water areas, and the restoration and protection of marsh through earthen vegetative terraces. Construction Unit 1, completed in 2006, includes a rock weir at Pines Ridge Bayou, two flap-gate culverts at Bridge Bayou, a rock weir at Double Island Gully, a 3,000-foot-long foreshore rock dike along the Sabine Lake shore north of Willow Bayou, and approximately 45 miles of vegetated earthen terraces in large, shallow, open-water areas south of Greens Lake and south of Willow Bayou Canal (USFWS-LDNR, 2008a). Hydrodynamic modeling of proposed Construction Unit II water control structures (fixed-crest weirs with boat bays) at Right Prong, Greens, Three, and Willow bayous was completed in 2004 (USFWS-LDNR, 2008b). The modeling predicted that the proposed structures would have very little effect on reducing project area salinities, and therefore Construction Unit 2 components were deleted from the restoration plan in 2006. The Pines Bayou weir was rehabilitated in 2007 due to heavy damage from Hurricane Rita. Four 50-foot-wide gaps were also installed in 2007 in the breakwater near Willow Bayou.

The FWOP condition includes all elements of Construction Unit 1 of CWPPRA Project CS-32. Marsh acreage in both the brackish and intermediate marshes has been adjusted to add marsh protected or restored by that project. FWOP salinities would be expected to increase to 6.8 ppt and 7.2 ppt in the intermediate and brackish marshes, respectively. Higher salinity would be expected to result in the loss of 2,116 acres of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 695 acres would be expected in the brackish marsh, which includes 627 acres expected to be lost with recession of the East Sabine Lake shoreline due to RSLR. However, RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 329 AAHUs would be expected with increases in salinity and interior marsh loss, with nearly all of this loss occurring in the intermediate marsh. Salinities would be expected to increase to 7.7 ppt and 8.6 ppt in the intermediate and brackish marshes, respectively, increasing the potential for the conversion of large areas to brackish marsh. Interior marsh loss of 102 acres (0.5 percent) in intermediate marsh and 2 acres (0.2 percent) in brackish marsh would be expected. Open-water areas would be expected to enlarge slightly as salinity nears the maximum tolerance of the intermediate community. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.3 LA 3 – Black Bayou

The 39,853-acre Black Bayou hydro-unit is bordered on the west by Sabine Lake and the Sabine River, on the north by the GIWW, on the east by Gum Cove Ridge, and on the south by the Willow Bayou hydro-unit. Black Bayou meanders through the unit, entering at the intersection of the GIWW and the Black Bayou Cut-off Canal and eventually flowing into the Sabine River near its mouth. A small triangular area on the western margin of the unit is part of the Sabine NWR. The unit is composed primarily of intermediate marsh, with brackish marsh along the Sabine Lake shore and shrub-scrub forest on the southern end of Perry Ridge. Large interior areas, especially in the Black Bayou Cut-off Canal area, are converting to shallow open water due to elevated salinity and subsidence. Intermediate marsh composes 62 percent (24,633 acres), brackish marsh 8 percent (2,964 acres), and other upland 4 percent (1,717 acres). In total, 28 percent (10,539 acres) of the unit is open water. Baseline salinity averages between 3.8 and 4.7 ppt throughout the hydro-unit. Access for marine organisms is fully open through the Black Bayou Cut-off Canal and Black Bayou at the Sabine River and Sabine Lake.

The Black Bayou Hydrologic Restoration Project (CWPPRA Project No. CS-27) was constructed in December 2001 for the purpose of restoring coastal marsh habitat and slowing the conversion of wetlands to shallow open water. The project limits the amount of saltwater intrusion into the surrounding marsh and canals from Black Bayou and the GIWW and reduces erosion caused by wave action from nearby boats and tides (USGS-NWRC, 2002c). These elements are (1) approximately 4.3 miles of rock foreshore dike along the south shore of the GIWW; (2) the Black Bayou Cut-off Canal rock weir with boat bay; (3) the Burton Canal weir with boat bay; (4) the Block's Creek rock weir with boat bay; and (5) a self-regulating tide gate for the NO-13 unit wetlands. Terracing and vegetative plantings are also planned as part of the CWPPRA project.

The FWOP condition assumes that all elements of CWPPRA Project CS-27 are in place and fully functioning. The land loss rate of 0.08 percent/year, predicted as the FWP condition for the CS-27 project, was adopted through TY 16. Beginning in TY 16, it was assumed that 50 percent of the CWPPRA project structures would not be functioning, raising the land loss rate by 50 percent to 0.12 percent/year through TY 65. FWOP salinities would be expected to increase to about 4.2 to 5.1 ppt throughout the unit, resulting in the loss of 1,713 acres (7.0 percent) of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 803 acres (27.3 percent) would be expected in the brackish marsh, which includes 621 acres expected to be lost with recession of the East Sabine Lake shoreline due to RSLR. However, RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 510 AAHUs would be expected with increases in salinity and interior marsh loss, with nearly all of this loss occurring in the intermediate marsh. Salinities would be expected to increase to between 5.3 and 6.5 ppt, pushing further into the suboptimal range for intermediate marsh. Interior marsh loss of 130 acres (0.5 percent) in intermediate marsh and 4 acres (0.1 percent) in brackish marsh would be

expected. Open-water areas would be expected to enlarge slightly as salinity rises further into the suboptimal range. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.4 LA 4 – West Johnson's Bayou

The 13,190-acre West Johnson's Bayou hydro-unit is bordered on the west by Sabine Lake, on the north by the Sabine NWR and Willow Bayou hydro-unit, on the east by Deep Bayou, and on the south by Buck Ridge. Johnson's Bayou flows from the southeast to the northwest through the unit, eventually flowing into Sabine Lake. The unit is composed of 76 percent intermediate marsh (10,031 acres), with 14 percent brackish marsh (1,837 acres) along the Sabine Lake shore. Located just north of the Johnson's Bayou Chenier Plain, the interior of the unit is fairly stable but the shoreline is affected by wave erosion. In total, 10 percent (1,320 acres) of the unit is open water. Access for marine organisms is fully open through Johnson's Bayou. Baseline salinity averages about 4.5 ppt throughout the hydro-unit. No CWPPRA projects have been constructed in this area.

FWOP salinities would be expected to increase to between 5.3 and 5.5 ppt throughout the unit, resulting in the loss of 1,703 acres (17.1 percent) of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 1,189 acres (65.4 percent) would be expected in the brackish marsh, which includes about 957 acres expected to be lost with recession of the East Sabine Lake shoreline due to RSLR. However, RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 270 AAHUs would be expected with increases in salinity and interior marsh loss, with nearly all of this loss occurring in the intermediate marsh. Salinities would be expected to increase to 7.0 to 7.3 ppt, pushing further into the suboptimal range for intermediate marsh and increasing the possibility for conversion to brackish marsh. Interior marsh loss of 142 acres (1.4 percent) in intermediate marsh and 6 acres (0.3 percent) in brackish marsh would be expected. Open-water areas would be expected to enlarge slightly as salinity rises further into the suboptimal range. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.5 LA 5 – Sabine Lake Ridges

The triangular, 33,472-acre, Sabine Lake Ridges hydro-unit is bordered on the west by Sabine Lake and Sabine Pass, on the north by Buck Ridge, and on the south by the Gulf of Mexico and Hackberry Ridge. Greens Bayou drains the northern part of the unit, emptying into Sabine Lake. The lower reach of Lighthouse Bayou parallels the beach and empties into Sabine Pass. Several chenier ridges run parallel to the Gulf Coast, the most prominent of which are Buck Ridge, Blue Buck Ridge, and Hackberry Ridge. The unit comprises 44 percent brackish marsh (14,673 acres), 24 percent (8,232 acres) intermediate marsh, 10 percent (3,198 acres) saline marsh, and 13 percent (4,473 acres) of upland ridges. Located within the Chenier Plain, the interior of the unit is fairly stable but the shoreline is affected by wave

erosion along Sabine Pass. In total, 9 percent (2,896 acres) of the unit is open water. Average baseline salinities range between 4.5 and 6.2 ppt in the intermediate and brackish marshes, and about 15.8 ppt in the saline marshes near the coast. The Gulf of Mexico shoreline is stable and appears to be accreting at a rate of 1.2 feet/year (USACE, 2004:Appendix D). Access for marine organisms is fully open through Greens and Lighthouse bayous.

FWOP salinities would be expected to increase to between 5.5 and 7.1 ppt in the intermediate and brackish marshes, resulting in the loss of 1,103 acres (13.5 percent) of intermediate marsh as new open-water areas develop within healthy marsh. Marsh loss of 2,567 acres (17.6 percent) would be expected in the brackish marsh, which includes about 685 acres expected to be lost with recession of the East Sabine Lake and Sabine Pass shorelines due to RSLR. FWOP salinity in the saline marsh would increase to 16.6 ppt, resulting in a net loss of 398 acres (12.6 percent). This also reflects the addition of about 22 acres by 2069 due to shoreline accretion; no shoreline recession would be expected because of the relatively high and stable Gulf shoreline in this area. RSLR would not be expected to result in the submergence of interior marsh. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. No CWPPRA projects have been constructed or were assumed as a FWOP condition for this hydro-unit.

FWP losses totaling 267 AAHUs would be expected with increases in salinity and interior marsh loss, with about 82 percent of this loss occurring in the intermediate marsh. Salinities would be expected to increase to between 7.0 to 7.3 ppt in the intermediate and brackish marshes, pushing further into the suboptimal range for intermediate marsh and increasing the possibility for conversion to brackish marsh. Interior marsh loss of 142 acres (1.4 percent) in intermediate marsh and 6 acres (0.3 percent) in brackish marsh would be expected. Open-water areas in the intermediate marsh would be expected to enlarge slightly as salinity rises further into the suboptimal range. In the saline marsh, salinity would increase to about 17.3 ppt and about 10 acres of marsh would be lost. FWP saline marsh loss includes about 6.0 acres resulting from erosion of 0.42 foot/year along the 2.3-mile Gulf shoreline that would be caused by the offshore channel extension (Gravens and King, 2003). No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.6 LA 6 – Johnson's Bayou Ridge

The wedge-shaped, 4,089-acre, Johnson's Bayou Ridge hydro-unit is bordered on the north by Hackberry Ridge, on the south by the Gulf of Mexico, and on the east by Johnson's Bayou. Lighthouse Bayou parallels Hackberry Ridge through much of the unit. The unit is composed of 61 percent brackish marsh (2,505 acres), 9 percent (353 acres) saline marsh, and 24 percent (975 acres) uplands located at Johnson's Bayou on the eastern edge. Only 6 percent (251 acres) of the unit is open water. The Gulf of Mexico shoreline is stable and appears to be accreting at a rate of 1.2 feet/year (USACE, 2004:Appendix D). The Coast 2050 report noted that 25 percent of the chenier ridge has eroded to marsh elevations since 1968

(LCWCR/WCRA, 1998). The baseline salinity within the brackish marsh averages 4.4 ppt and in the saline marsh is 15.8 ppt. Access for marine organisms is fully open through Lighthouse Bayou.

FWOP salinities would be expected to increase to 5.3 ppt in the brackish marsh and 16.6 ppt in the saline marshes, resulting in the loss of 707 acres (28.9 percent) of brackish marsh and 93 acres (27 percent) of saline marsh. The change in saline marsh acreage reflects the addition of about 18 acres by 2069 due to shoreline accretion; no shoreline recession would be expected because of the relatively high and stable Gulf shoreline in this area. RSLR would not be expected to result in the submergence of interior marsh. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level. No CWPPRA projects have been constructed or were assumed as a FWOP condition for this hydro-unit.

FWP losses totaling 8 AAHUs would be expected with increases in salinity and interior marsh loss. The majority of this loss would occur in the brackish marsh, which is linked directly to the SNWW through Lighthouse Bayou. Salinities would be expected to increase to 7.0 ppt and 17.3 ppt in the brackish marshes and salinity marshes, respectively, remaining within the optimal range for both. Interior marsh loss of 22 acres (0.9 percent) in brackish marsh and 5 acres (1.4 percent) in saline marsh would be expected. Nearly all of the saline marsh loss (about 4.9 acres) is due to predicted erosion of 0.42 foot/year along the 1.9-mile Gulf shoreline that would be caused by the offshore channel extension (Gravens and King, 2003). No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.7 LA 7 – Southeast Sabine (West)

The 8,034-acre Southeast Sabine (West) hydro-unit is located in the East Sabine Lake marshes, bordered on the west by the Burton-Sutton Canal, on the north by the Starks-Central Canal, on the south by the Starks South Canal, and on the east by a line extending north from the Starks Canal. This eastern boundary arbitrarily divides the CWPPRA Southeast Sabine mapping unit roughly in half. The Habitat Workgroup concluded that only the western section was influenced by the SNWW project. Old North Bayou flows from the northeast to the southwest through the unit, but the primary hydrologic connections to Sabine Lake are through the extensive canal system. The unit is composed of 61 percent intermediate marsh (4,925 acres) and 25 percent fresh marsh (2,023 acres). In total, 14 percent (1,086 acres) of the unit is open water. Marsh loss in this unit has stabilized and there is now a low rate of land loss. Access for marine organisms is fully open through the canal system. The Sabine Structures Replacement project (CWPPRA Project CS-23) has replaced salinity control structures on Hog Island Gully, West Cove, and Headquarters canals. These structures are controlling salinity intrusion to the eastern section of the original CWPPRA unit, while the west segment remains open to the influence of the SNWW through the South, Starks-Central, and Burton-Sutton canals. Baseline salinities in the fresh and intermediate marshes average 1.7 ppt in the growing season.

FWOP salinities would be expected to increase to about 2.1 throughout the unit, edging slightly into the suboptimal range for fresh marsh. Interior land loss of 40 acres (2.0 percent) of fresh and 96 acres of intermediate marsh (2.0 percent) would be expected. The unit has no Sabine Lake shoreline, and therefore none of the land loss is attributable to shoreline recession. RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 11 AAHUs would be expected due to small increases in salinity and interior marsh loss, with all of this loss occurring in the fresh marsh. Salinities would be expected to increase to about 2.4 ppt, edging further into the suboptimal range for fresh marsh. Interior marsh loss of about 1 acre would be expected. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.8 LA 8 – Southwest Gum Cove

The 11,386-acre Southwest Gum Cove (West) hydro-unit is a revised version of the CWPPRA mapping unit. A 3,865-acre area of marsh south of Gum Cove Ridge was not included in the SNWW hydro-unit because it extends into the Calcasieu watershed. Southwest Gum Cove is an interior marshland unit bordered on the north by the Bankcroft Canal, on the south by the Starks North Canal, on the west by Black Bayou and the Right Prong of Black Bayou, and on the east by Gum Cove Ridge and the watershed divide. The unit is composed of 47 percent (5,346 acres) intermediate marsh, 31 percent (3,503 acres) fresh marsh, 10 percent (1,166 acres) upland, and 12 percent (1,371 acres) open water. The majority of marsh loss in this area occurred between 1956 and 1974, and the rate of loss has been much lower in recent years (LCWCR/WCRA, 1998). Baseline salinities average 1.2 ppt and 2.4 ppt during the growing season in the fresh and intermediate marshes, respectively. Hydrology has been altered by numerous oil field canals and levees. Access for marine organisms into fresh marsh in the southeast corner of the unit is partially blocked by levees that border oil field canals; culverts provide approximately 50 percent of normal access to this area. Access to intermediate marsh in the remainder of the area is unrestricted through Black Bayou. No CWPPRA projects have been constructed within this unit.

The FWOP land loss rate was based upon the trend observed between 1983 and 1990, which is much lower than that observed earlier in this century. FWOP salinities would be expected to increase to about 1.4 ppt in the fresh marsh and 2.8 ppt in the intermediate marsh, remaining in the optimal range for both marsh types. Interior land loss of 152 acres (4.4 percent) of fresh and 233 acres (4.4 percent) of intermediate marsh would be expected. The unit has no Sabine Lake shoreline, and therefore none of the land loss is attributable to shoreline recession. RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 6 AAHUs would be expected due to small increases in salinity and interior marsh loss, with the majority of this loss occurring in the fresh marsh. Salinities would be expected to increase to about 2.0 ppt and 3.9 ppt in the fresh and intermediate marshes, respectively, reaching the high end of the optimal range for each marsh type. Low interior marsh loss of about 8 acres (0.2 percent) of fresh marsh and 15 acres (2.8 percent) of intermediate marsh would be expected, with no large areas of open water developing. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.2.9 LA 9 – East Johnson's Bayou

The 26,719-acre East Johnson's Bayou hydro-unit is bordered on the west by Deep Bayou, on the north by the Sabine NWR and the South Line Canal, on the east by Second Bayou, and on the south by Buck Ridge. The interior unit is 85 percent intermediate marsh (22,694 acres), 2 percent (581 acres) upland, and 13 percent open water. Baseline salinity averages 3.3 ppt during the growing season. Access for marine organisms is partially blocked by levees and roads that border oil field canals. The Habitat Workgroup estimated that culverts provide approximately 50 percent of normal marine organism access. Natural bayous have been channelized to provide oil field access. No CWPPRA projects have been constructed or were assumed as a FWOP condition for this hydro-unit.

The FWOP land loss rate was based upon the trend observed between 1983 and 1990, which is much lower than that observed earlier in this century. FWOP salinities would be expected to increase to about 3.8 ppt in the intermediate marsh, remaining within the optimal range. Interior land loss of 895 acres (3.9 percent) would be expected. The unit has no Sabine Lake shoreline and therefore none of the land loss is attributable to shoreline recession. RSLR would not be expected to result in marsh submergence. It is assumed that gradual RSLR would result in an increase in primary production, biomass density, and sediment deposition such that interior marsh elevation would remain in equilibrium with sea level.

FWP losses totaling 190 AAHUs would be expected due to increases in salinity and interior marsh loss. Salinity would be expected to increase to about 4.8 ppt, extending into the suboptimal range for intermediate marsh. Interior marsh loss of about 46 acres (0.2 percent) would be expected with expansion of existing areas of open water. No other changes in land use, hydrology, or marine organism access are attributable to the project.

7.3 LOUISIANA/TEXAS HYDRO-UNITS

7.3.1 LA/TX 1 – Sabine Island

This 8,756-acre hydro-unit straddles the border between Louisiana and Texas. The Sabine River and Old River flow from north to south through the unit and intersect in the southern third, placing approximately 76 percent of the acreage in Louisiana, where the southern half of Louisiana's Sabine Island WMA is located. The unit is bordered on the south by the Blue Elbow bend in the Sabine River, and on the east and west by the upland terrace margins. The northern extent of the unit coincides with the terminus of

tidal influence on the Sabine (Morgan Bluff) and Old (Nibletts Bluff) rivers. It comprises 82 percent (7,192 acres) cypress-tupelo swamp and 18 percent (1,564 acres) bottomland hardwood forest. Although dominated by cypress-tupelo swamp, the unit is interspersed with a series of relict meander riverbank ridges that are dry except during floods and that support the bottomland hardwood forest. These ridges support a relatively mature growth of bottomland hardwoods composed of several species of oaks, hickory, hackberry, sweet gum, maple, and willow, with greater than 20 percent of the overstory canopy consisting of hard mast or other edible seed-producing trees. Canopy cover is approximately 55 percent, and midstory/understory coverage of palmetto, yaupon, lizard's tail, smartweed, greenbriar, blackberries, and invading tallow trees averages 50 to 65 percent. The relatively scarce (on a regional and national scale) swamp and bottomland hardwood habitats have medium to high wildlife values. Extensive wetland floodplain forests on both sides of the Sabine River are generally buffered from encroaching development by their low elevation. Development is, however, beginning to encroach upon the area from the city of Orange to the southwest. The hydrology of this fresh wetland system is essentially unaltered, with abundant riverine through-flows and seasonal flooding providing full access to aquatic organisms.

FWOP changes would be associated with the continued maturation of existing overstory and rising salinity and tidal flooding due to RSLR. A negligible increase in salinity would be expected (about 0.1 ppt) by the year 2069. Both the duration and depth of tidal flooding would be expected to increase, but the swamp substrate would continue to be exposed at average low tides and for longer periods seasonally. The Habitat Workgroup estimated that a small percentage (5.0 percent) of the bottomland forest would be converted to development due to population growth and the hydro-unit's proximity to uplands along its southwestern margin. No changes in the acreages of the bottomland hardwood and swamp areas would be expected, and wetland forests would continue to mature with no disturbance.

No FWP project impacts would be expected. The area would be beyond the influence of the LPP; no changes in salinity or tidal flows would be expected.

7.3.2 LA/TX 2 – Blue Elbow

This 3,387-acre hydro-unit straddles the border between Louisiana and Texas. The Sabine River bisects the unit, placing approximately 81 percent of the acreage in Texas. The unit is bordered on the north by the Blue Elbow bend in the Sabine River, on the east and west by the upland terrace margins, and on the south by IH 10. TxDOT's Blue Elbow Mitigation Bank (2,606 acres) and the Tony Houseman WMA, a viewing site along the Great Texas Coastal Birding Trail, are located within the unit. Cypress-tupelo swamp makes up the majority of the hydro-unit (82 percent; 7,192 acres), with bottomland hardwood forest composing the remainder (18 percent; 1,564 acres). The hardwoods are restricted to a gallery along the bank of the Sabine River and a northeast-southwest-trending ridge in the center of the Texas swamp. The Habitat Workgroup chose to lump the hardwoods with the swamp for the WVA analysis. Canopy cover within the swamp is approximately 20 percent, with a dense midstory/understory coverage of palmetto, yaupon, lizard's tail, smartweed, greenbriar, blackberries, and invading tallow trees averaging 60 to 70 percent. The relatively scarce (on a regional and national scale) swamp and bottomland

hardwood habitats have medium to high wildlife values. The area is utilized by the same suite of fish and wildlife described for the Sabine Island unit. Baseline salinity averages 0.3 ppt during the growing season. This fresh wetland forest system experiences high annual flows with abundant riverine through-flows; semipermanent flooding occurs upstream of the IH 10 embankment.

FWOP changes would be associated with the continued maturation of existing overstory and rising salinity and tidal flooding due to RSLR. A small increase in salinity would be expected (to about 0.6 ppt) by the year 2069. Both the duration and depth of tidal flooding would be expected to increase, but the swamp substrate would continue to be exposed at average low tides and for longer periods seasonally. TxDOT and TPWD management of a majority of the area would be expected to provide protection from most disturbances, ensure no development, and encourage the continued maturation of the forested wetland habitat. No changes in the acreages of the bottomland hardwood and swamp areas would be expected, and wetland forests would continue to mature with no disturbance.

A small FWP increase in salinity (to 0.9 ppt) within the optimal range for the swamp community would be expected. No bottomland hardwood or swamp acreage would be expected to convert to fresh marsh with this salinity change, and no FWP changes in tidal flow would be expected. Growth of the wetland forests would be expected without disturbance and no AAHU loss is projected.

8.0 MODELING OF BENEFICIAL USE AND MITIGATION MEASURES

8.1 ECOLOGICAL MITIGATION PLAN

The FWP scenario, without consideration of BU feature benefits, would negatively impact approximately 39,000 acres in Texas and 182,000 acres in Louisiana primarily by causing a decrease in biological productivity in tidally influenced areas. This reduction in productivity would be due to a small increase in salinity causing an increase in wetland loss in aquatic habitats of the study area. The ecological value of the lost productivity is represented by 2,121 AAHUs. Of those AAHUs, the majority of the productivity losses occur in the intermediate (76 percent) and fresh (13.9 percent) marsh communities. The remaining 10 percent would occur in the brackish (7 percent) and saline (2 percent) marshes and the cypress-tupelo swamp (1 percent).

8.2 PRELIMINARY SCREENING OF AVOIDANCE, BENEFICIAL USE, AND MITIGATION MEASURES

Planning for the avoidance, minimization, or mitigation of channel improvement impacts began with the identification and screening of a wide array of potential measures that could reduce, avoid, or minimize salinity or land loss impacts and provide compensation for unavoidable impacts. Early in the study scoping process, the SNWW ICT created the Restoration Workgroup to develop ideas for restoration or mitigation and opportunities for the beneficial use of dredged material throughout the study area. A series of public workshops was held with environmental organizations and commercial and recreational groups in Texas and Louisiana with the goal of obtaining extensive public input and identifying a wide array of ideas that could be used in the SNWW Feasibility Study planning process. A complete list of these ideas can be found in the report that summarizes this effort (Gulf Engineers and Consultants, Inc. [GEC], 2002). The SNWW Habitat Restoration Workgroup relied heavily upon this effort in developing a preliminary list of measures. Hydrologic measures that were considered ranged from large-scale measures with the potential to affect salinities throughout the estuary to small-scale measures that would have principally localized effects. Emphasis was also placed on identifying measures that could make beneficial use of dredged new work and maintenance material. Potential BU or mitigation measures that were evaluated by the SNWW ICT and eliminated during preliminary screening are summarized in Table 15.

8.3 DREDGED MATERIAL MANAGEMENT PLAN FEATURES

DMMP features described below use dredged material beneficially to significantly offset predicted LPP impacts and are least-cost alternatives for dredged material placement. They are included in the base plan for navigation improvements. The benefits of each of the DMMP features were evaluated and quantified using the WVA model, and these benefits were used to offset project impacts. Table 16 provides descriptions of all DMMP features that were adopted for the project. Cost estimates, developed by USACE based upon conceptual designs described below, established that these features were more cost effective than traditional upland confined placement areas. Incremental analysis was not required because

Table 15: BU and Mitigation Measures Eliminated During Preliminary Screening

Measure Description	Reason for Elimination
Hydrologic Restoration	
Lock and dam at Sabine Pass	Reduced or eliminated navigation benefits Caused backwater flooding High flows and velocities through Sabine Pass increase engineering design risks Excessive cost
Purchasing water from Sabine River Authority and Neches River Authority during times of low flow	Fresh water availability likely restricted during low flows when needed most Excessive cost
Marsh islands isolating Sabine-Neches Canal B from Sabine Lake	Increased salinities in Black Bayou and the Sabine River
Marshes constricting flow at mouth of Sabine Lake (north and south of bridge on Highway 82)	Ineffective at reducing salinities Increases velocities through mouth of Sabine Lake
Marshes constricting flow along the Port Arthur Canal	Ineffective at reducing salinities
Construction of channel islands blocking flow from bayous emptying Neches River marshes at Rose City and Bessie Heights	Caused backwater flooding Obstructed water access for private landowners Safety concerns – too close to navigation channel
Habitat Restoration	
Swamp replacement on Neches River	Excessive cost FWP salinities on Neches River would slow growth and lessen biological productivity Long maturation period – delayed benefits
Marsh restoration using new work material from Neches River Channel to restore marsh in Rose City West	Area is being developed as a mitigation bank; no longer available for restoration
Marsh restoration using new work material from Neches River Channel to restore marsh in Bessie Heights West	Would be feasible but cost exceeds Traditional Placement Plan; preliminary estimate of incremental cost – $581K; sponsor has not been identified
Marshes restoration along the east shores of PAs 8 and 11 at Pleasure Island	Unacceptable location Interferes with levee maintenance
Creation of confined saline marsh along Gulf shoreline at Texas Point	Excessive cost compared to benefits

Table 16: DMMP Restoration and Nourishment Features

Beneficial Use Features	No.	Description	Size of Influence Area
Rose City East (component of Neches River BU Measure)	TX 3-1 East	Restores 345 acres of fresh marsh, 72 acres of shallow water, and nourishing 151 acres of existing marsh in two construction events. New work material from Neches River Channel would be used to restore 225-acre marsh, construct hydraulic containment levees and higher-elevation features. Maintenance material from the first maintenance cycle would be used to restore an additional 120 acres of marsh.	Influence area – 568 acres
Bessie Heights East (component of Neches River BU Measure)	TX 5-2	Restores 679 acres of brackish and 1,190 acres of intermediate marsh and 660 acres of shallow-water habitat, and nourishes 651 acres of existing marsh. Marsh would be constructed with maintenance material from Neches River Channel for 28 years. New work material would be used to build hydraulic containment levees.	Influence area – 3,180 acres
Old River Cove (component of Neches River BU Measure)	TX 6-1	Restores 639 acres of brackish marsh and 139 acres of shallow-water habitat, and nourishes 432 acres of existing marsh with new work material from Neches River Channel. New work material would be used to construct hydraulic containment levees.	Influence area – 1,210 acres
Gulf Shore BU Feature (Texas and Louisiana Points)	TX 8-11 LA 5-2/ 6-2	Nourishes 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from east and west jetties, using maintenance material from Sabine Pass Channel. Unconfined placement of maintenance material along shoreline every 3 years for 50-year period of analysis (8 placement episodes). Assumes 50:50 split of material between Texas and Louisiana accomplished by alternating placement in Texas and Louisiana.	Affected shoreline 6.0 miles total

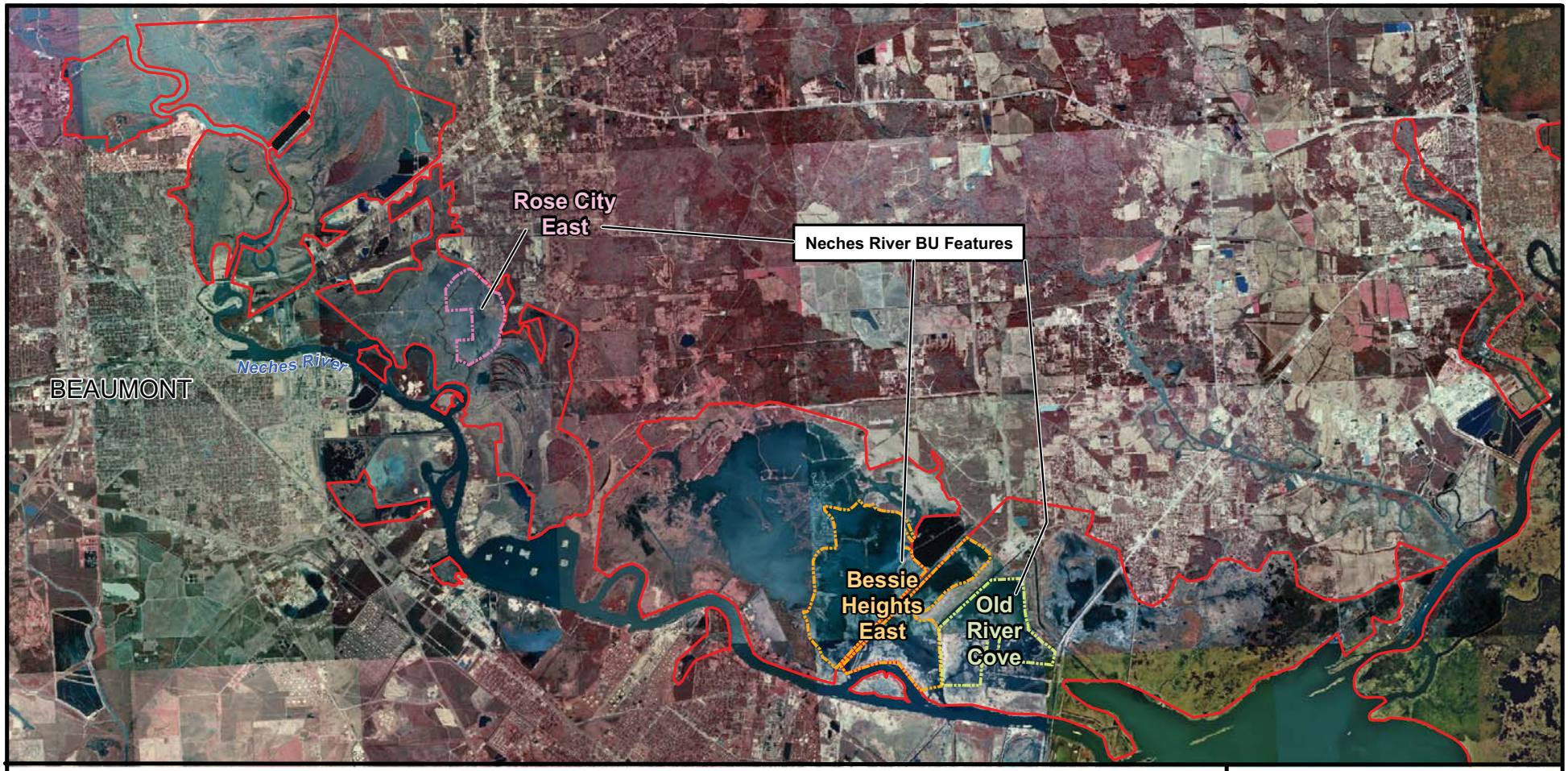
they were determined to be the least-cost plans. Maps of the DMMP features are provided on figures 12 through 14.

8.3.1 DMMP Features in Texas

BU features included in the DMMP provide benefits that offset and minimize all indirect and direct impacts (–412 AAHUs) of the Preferred Alternative in Texas and partially offset impacts in Louisiana (Table 17). An evaluation of placement alternatives presented in the FEIS includes all of the features listed in Table 16 as part of the DMMP. They have been determined to be the least-cost alternatives for dredged material placement and are part of the SNWW LPP. In Texas, construction of the Neches River BU Feature and the Texas portion of the Gulf Shore BU Feature will produce benefits totaling 1,068 AAHUs. There would be a net gain of 656 AAHUs in Texas, which would more than offsets all negative impacts that could occur in that state. Impacts that would be offset include the direct loss of 32 AAHUs for the conversion of fresh marsh to upland PA 24A. The majority of the offset Texas impacts are in the Neches River watershed, but approximately 16 percent are losses that could occur to cypress-tupelo swamp (–22 AAHUs) and fresh and intermediate marsh (–45 AAHUs) in the Sabine River watershed. In Louisiana, the Gulf Shore BU Feature provides benefits totaling 210 AAHUs. Given total Louisiana impacts of 1,709 AAHUs, there is a net loss of 1,499 AAHUs remaining in Louisiana after offsetting benefits of the Louisiana portion of the Gulf Shore BU Feature are applied.

Table 17: AAHU Summary of DMMP BU Feature Benefits

	Swamp	Bottomland Hardwood	Fresh Marsh	Intermediate Marsh	Brackish Marsh	Saline Marsh	Totals
Texas Impacts	–22	0	–206	–48	–131	–5	–412
TX 3 Rose City East			178				
TX 5-2 Bessie Heights East				305	128		
TX 6-1 Old River Cove					235		
TX 8-11 Texas Point Shoreline Nourishment						222	
Louisiana Impacts	0	0	–78	–1,571	–23	–37	–1,709
LA5-2/6-2 Louisiana Point Shoreline Nourishment						210	
Total DMMP BU Benefits							1,278
Net Benefits of DMMP Features	–22	0	–106	–1,314	209	390	–843



Rose City East
Bessie Heights East
Old River Cove
Hydrologic Unit

0 8,750 17,500
Feet

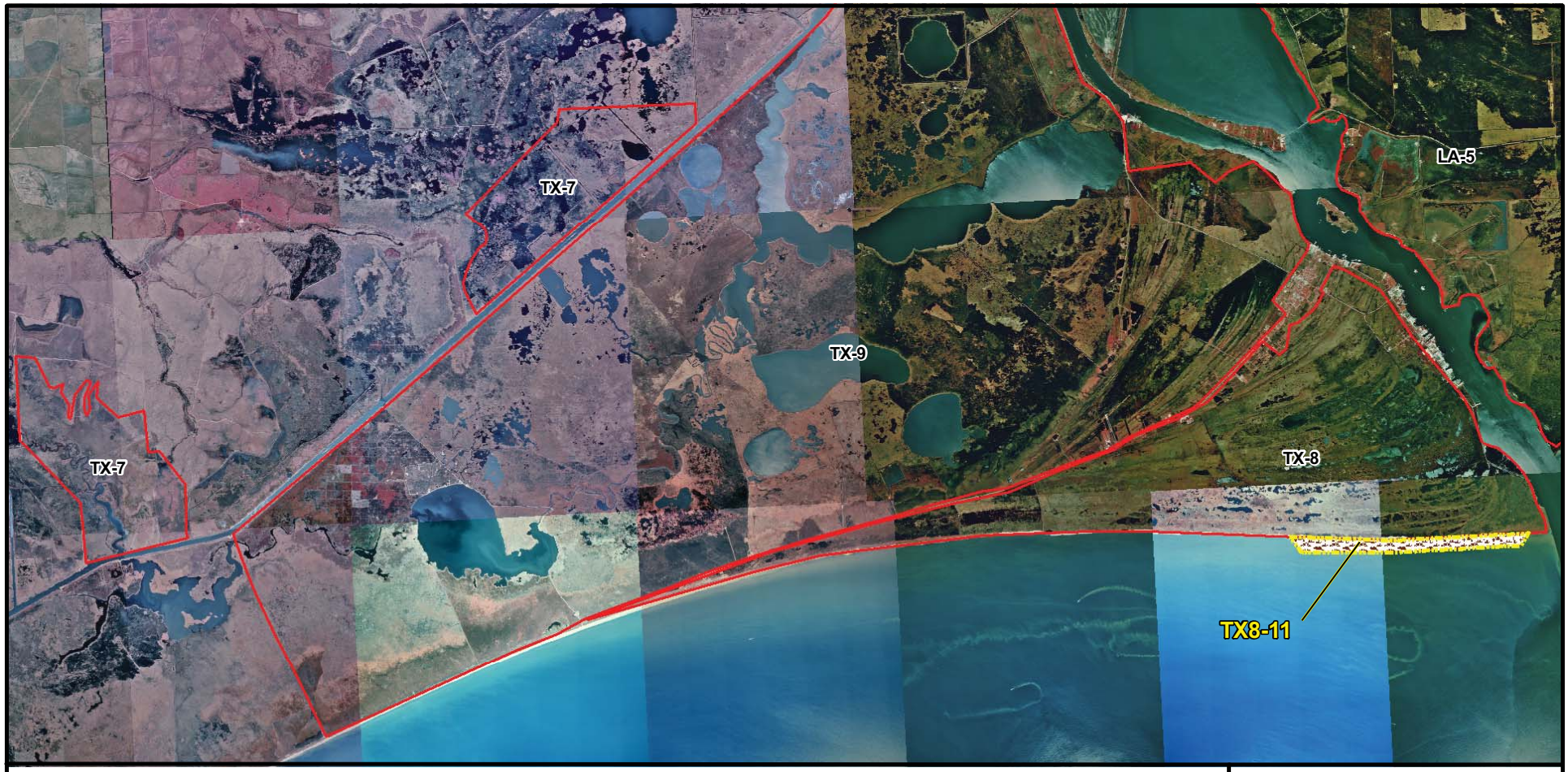
N
W E
S

Figure 12

Neches River BU Feature

Prepared for: USACE	
Job No.: 100007609	Scale: 1 inch equals 8,750 feet
Prepared by: 18827	Date: 08/10/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/Figures/Fig_12.mxd



TX8-11 Selected Feature

Shoreline Nourishment

Hydrologic Unit

2 1 0 2

Miles

N W E S

Figure 13

Gulf Shoreline BU Feature - Texas

Prepared for: USACE	
Job No.: 044198800	Scale: 1:93,500
Prepared by: A. Christiansen	Date: 04/30/2008

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/044198000/figures/WVA/Figure_16.mxd

LA 5-1/6-1 Selected Mitigation Feature

LA 5-3 Non- Selected Mitigation Measures

Shoreline Nourishment

Hydrologic Unit

2 1 0 2

Miles

N W E S

Figure 14

Gulf Shoreline
BU Feature - Louisiana

Prepared for: USACE	
Job No.: 100007609	Scale: 1inch equals 6,600 feet
Prepared by: A. Christiansen	Date: 09/10/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/Gulf_BU_Feature_LA.mxd

8.3.1.1 Neches River BU Feature

Three former marsh areas on the Neches River have been combined into one large management feature, called the Neches River BU Feature, to provide flexibility in the use of new work and maintenance material from the several construction reaches of the Neches River Channel. The primary objective of this combination feature would be to beneficially utilize dredged material to restore emergent marsh in an area that has suffered dramatic, widespread loss of marsh. The BU feature would utilize new work and maintenance material that would otherwise be removed from the sediment system and stored in upland, confined placement areas.

The Neches River BU Feature would offset all indirect salinity impacts to Texas wetland habitats on the Neches and Sabine rivers (TX 3 through TX 8, and TX 10 through TX 13) by restoring 2,853 acres of emergent marsh; improving 871 acres of shallow water by creating shallower ponds and interconnecting channels; and nourishing 1,234 acres of existing fringing marsh by winnowing fine-grained material from unconfined flows of dredged material effluent (Table 18). The BU feature thus provides benefits to a total of 4,958 acres of degraded marsh on the lower Neches River, or 53 percent of the restoration target set by the Coastal Erosion Planning and Response Act (CEPRA) 2004 plan update for the lower Neches River (GLO, 2005). The BU feature also offsets the direct impact of converting 86 acres of freshwater wetland to a confined placement area (PA 24A). The size of the Neches River BU Feature components and the magnitude of their ecological benefits are made possible by the large amounts of dredged material that will be generated by the proposed project and extensive opportunities for beneficial use in the project area.

Table 18: Acreage Restored by Each Component of Neches River BU Feature

Components of the Neches River BU Feature	Restored Emergent Marsh	Improved Shallow-water Habitat	Nourished Existing Marsh	Total Influence Area
Rose City East	345	72	151	568
Bessie Heights East	1,869	660	651	3,180
Old River Cove	639	139	432	1,210
Total	2,853	871	1,234	4,958

8.3.1.1.1 TX 3-1 Rose City East

Benefits of the Neches River DMMP features in the Rose City (TX 3) hydro-unit are associated with marsh restoration measures within the footprint of this unit. A total of 225 acres of emergent fresh marsh would be constructed with new work by TY 15, and 120 more acres would be added with maintenance material from the first maintenance dredging cycle following construction. Benefits earned with this restoration total 178 AAHUs. The hydraulic placement of dredged material would restore 18 inches of topsoil over eroded mudflats and open water, creating 345 acres of emergent fresh marsh, improve 72

acres of shallow-water habitat by reducing water depths, fetch, and turbidity, and renourish 151 acres of existing fringe marsh by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved significantly, with 80 percent projected as Class 1. Conditions for SAV are expected to improve dramatically with an increase in shallow water and the creation of still-water conditions, which favor their growth. Although planned ridges of various elevations within the reconstructed marsh could, in the long run, support bottomland hardwood forest and cypress-tupelo swamp, no benefits for these habitats are being claimed because long-term management required to ensure their growth is not included in the plan.

8.3.1.1.2 TX 5-2 Bessie Heights East

Benefits of the Neches River DMMP features in the Bessie Heights East (TX 5-2) hydro-unit would accrue from marsh restoration of a total of 1,190 acres of emergent intermediate and 679 acres of emergent brackish marsh. New work material would be used to build a containment levee along the southern end of the BU area, and the marsh would be constructed incrementally over seven maintenance cycles. Benefits earned with this marsh restoration total 433 AAHUs. The hydraulic placement of dredged material would restore a total of 1,869 acres of emergent marsh, improve 660 acres of shallow-water habitat by reducing water depths, fetch, and turbidity, and renourish 651 acres of existing fringe marsh by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved significantly from primarily Class 3 and Class 4 to 100 percent Class 1. Channels would be constructed to allow inner marshes to drain through reconstructed stream channels into the Neches River, providing flushing to maintain moderate soil salinities, access to more of the marsh for fishery organisms, and facilitating the escape of organisms from the marsh. Conditions for SAV are expected to improve throughout the marsh restoration area, with the restoration of shallow water and the creation of still-water conditions, which favor SAV growth. Fisheries access would be fully restricted in the first construction year while containment and training levees are constructed, but access would be incrementally restored with each marsh creation episode by the placement of breaches or culverts in training and containment levees.

8.3.1.1.3 TX 6 Old River Cove

Benefits of the Neches River DMMP features in the Old River Cove West (TX 6-1) hydro-unit would result from marsh restoration of a total of 639 acres of emergent brackish marsh with new work material. A containment levee would be constructed along the power plant outfall canal on the western boundary of the unit. Benefits earned with this restoration total 235 AAHUs. The hydraulic placement of dredged material would restore 639 acres of emergent marsh, improve 139 acres of shallow-water habitat, and renourish 432 acres existing fringe marsh by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved significantly from 85 percent Class 2 and Class 3 to 75 percent Class 1. Channels would be constructed within the marsh to allow full circulation with the outfall canal, providing flushing to maintain moderate soil salinities and ameliorate salinities in the canal, access to more of the marsh for fishery organisms, and facilitating the escape of organisms from the

marsh. Conditions for SAV are expected to improve throughout the marsh restoration area with an increase in shallow water and the creation of still-water conditions, which favor SAV growth. Full access for marine organisms would be maintained by breaches in the containment levee. No benefits to the fringing bottomland hardwoods are projected with the hydrologic and marsh restoration plan.

8.3.1.2 Gulf Shore BU Feature

The use of dredged material was also evaluated for Gulf shoreline nourishment at Texas and Louisiana Points (see figures 13 and 14). The most cost effective plan would hydraulically pump maintenance material from Section 5 of the adjacent Sabine Pass Channel onto a total of 6 miles of shoreline on both sides of Sabine Pass. Some material would be expected to flow over existing marsh, while the remainder would flow into nearshore waters. Material placement during each 3-year Sabine Pass Channel dredging cycle would alternate between Texas and Louisiana, so that material would be placed on each state's shoreline every 6 years. This recurring action would nourish eroding marsh, minimize projected FWP shoreline impacts, and potentially create new marsh.

Texas Point is undergoing severe beach erosion, with shoreline retreat of up to 1,150 feet between 1974 and 2000 (Morang, 2006; King, 2007). This is a Texas CEPRA "critical erosion area," having the highest rate of shoreline loss on the upper Texas coast and (GLO, 2005). In Louisiana, persistent erosion along the shoreline between Ocean View and Holly Beach, on the order of –4.3 feet/year between 1985 and 1998, was recorded here prior to Hurricane Rita (USACE, 1971, 2004). Nearer to Louisiana Point, significant accretion over the last 100 years has slowed to +1.2 feet/year, and the behavior of this shoreline has become erratic, with some areas eroding and some aggrading (USACE, 2004).

Historic dredging records indicate that the maintenance material from Sabine Pass would average 51 percent silt, 31 percent clay, and 18 percent fine sand (USACE dredging database). This mix of materials does not contain typical beach-quality sand, but the material types and composition are similar to what is present on the shorelines today. Narrow beachfronts of silt or clay lie seaward of eroding overwash marsh terraces (PBS&J, 2006). Given the unusual characteristics of this sand-starved system, returning the material to the littoral system is likely to have a net beneficial effect, regardless of material type. The longshore transport in this system contains primarily fine-grained sediments, but these sediments have been shown to accumulate in the nearshore zone and result in shoreline accretion by as yet poorly understood processes (Morang, 2006; King, 2007).

The Gulf Shore BU Feature would provide a regular source of predominantly fine-grained sediment that should contribute to mudflat accretion and periodically move onshore to become shore-attached through a process described by Pacific International Engineering (PIE, 2003). On the western Louisiana and east Texas coasts, sediments accumulate as mudflats and underwater mudshoals (or "fluid mud") in the nearshore region. Nearshore, fluid mud can be trapped against the shoreline by prevailing south and southwesterly winds, and storms carry the trapped muddy ooze onto the chenier shoreline. The northwest Gulf is a microtidal, storm-dominated environment. In a typical year there are about 20 to 30 frontal

passages generating waves, surges, and wind-driven currents, with most-frequent waves from the southeast about 3 to 4.5 feet in height.

The presence of additional fine-grained sediments in the littoral system that would be regularly provided by the BU Feature should reduce the current erosion rate and minimize the small increase in shore erosion predicted with the project (Gravens and King, 2003). In systems that have an abundant supply of fine-grained sediments, the nearshore seabed can be blanketed with fluid mud. The presence of additional muddy sediment in the near shore environment may attenuate waves and lessen wave-induced erosion (Tubman and Suhayda, 1976; Hsiao and Shemdin, 1980; Wells and Kemp, 1986). There are also anecdotal reports of Gulf areas off Louisiana and Texas Points being safe havens for vessels during storms due to the near-total attenuation of waves (Block, 1984; Wells and Kemp, 1986; King, 2007).

The BU dredged material is expected to be composed largely of unconsolidated muds. These fine-grained sediments would be expected to be highly mobile initially, and some portion of the material will be rapidly lost from the vicinity of the shoreline. As demonstrated by another BU project at Texas Point (USACE, 2000), a significant percentage would also flow onshore and nourish existing marsh along the eroding beachfront. Because of the prevailing wave climate, the mobile material within the surfzone should generally migrate to the west at both Texas and Louisiana Points (Wamsley, 2008). Transport processes identified by the Sabine Pass sediment budget (Morang, 2006) indicate that the material would move toward the eroding shoreline at Texas Point. There, the additional fine-grained sediments could lower erosion rates through the mudflat accretion and wave attenuation processes described above. A small quantity of material may migrate to the east and contribute to the Sabine Fillet at the west jetty (Morang, 2006; King, 2007).

In Louisiana, the sand bar formed by BU sediments from the Cheniere LNG project may shelter the shoreline from wave energy sufficiently to allow fine-grained sediments to form a mudflat behind the sandbar (Nairn and Willis, 2002). While a significant percentage would be rapidly carried offshore, some is likely to move downcoast with the littoral current, enlarging the sand and mudflat already present at the east jetty. Potential impacts of elevated levels of total suspended solids would be expected to be similar to those that resulted from the Cheniere LNG BU project (PBS&J, 2004). A temporary increase in suspended silt/clay was expected during the first 8 to 9 months following placement. After the termination of placement activities, total suspended solids decreased gradually for about 18 months when concentrations reached background levels. Modeling conducted for the Cheniere project indicated that it would take 9 years before the silt and clay component of Cheniere BU material becomes totally suspended and is removed from the littoral zone. Since the Gulf Shore BU Feature proposes a placement episode every 6 years, all the fine-grained sediments would not have been removed before new material is added. This should result in the retention of some portion of the fine-grained sediment, and thus facilitate mudflat accretion through the processes described above. During and after each placement episode, most of the resuspended silt and clay is expected to enter the Sabine Pass Jetty Channel through the shallow boat cut, but deposition in the channel is not expected. It should remain in suspension and be transported back into the Gulf.

Although the BU sediments would be largely fine grained, approximately 18 percent of maintenance material is expected to be sand. Sands that are deposited onshore will nourish and stabilize eroding marshes; sand deposited in the nearshore zone should stay in the nearshore environment, moving back and forth across the shore face (Wamsley, 2008). Sand placed at Louisiana Point should remain on the shore face where it was deposited; no significant amounts of sand are expected to enter the Jetty Channel. On erosive mud shorelines like those in the BU area, the sand percentage should increase and form sandy lenses or a veneer over the mud shoreline substrate. As the sand lenses thicken, the sands help protect the underlying mud from further erosion (Nairn, 1992). However, in smaller quantities, sand can also accelerate erosion of a mud beach. If the consolidated mud is not covered by a sand veneer, any sand that is mobilized by wave action could act as a scouring agent (King, 2007).

The behavior of the BU sediments within this complex littoral system cannot be predicted with certainty over the period of analysis, especially given the potential for strong storms to affect the coastal environment. However, there is sufficient knowledge of general processes and baseline conditions to support evaluation of potential impacts and benefits. Furthermore, the engineering feasibility and potential environmental benefits have been demonstrated by successful recent BU projects at Texas and Louisiana Points (USACE, 2000; PBS&J, 2004). All of this information was used to establish explicit assumptions about the expected behavior of the BU material in the quantification of project impacts and benefits using the WVA model. The WVA model analysis assumed that 60 percent of the pumped quantity would remain in the existing marsh and on the shallow nearshore slope in front of the existing shorefront immediately after material placement. Since the material is unconsolidated and prone to erosion, only 50 percent of that material was assumed to remain by the end of each 6-year cycle. It was further assumed that the regular addition of material every 6 years would slow the resuspension of fine-grained sediments and result in the accumulation of some new marsh by the end of the period of analysis. No attempt was made to account for the effect of large storm systems. No long-term impacts to vegetation or benthic sediments were assumed to result from nourishment episodes. NWR personnel reported that the marsh vegetation at Texas Point rebounded quickly and with renewed vigor after being covered with up to 1 foot of material by the Texas Point BU project (Walther, 2005). Potential impacts to Critical Habitat for the wintering piping plover are expected to be beneficial in the long term, with short-term displacement during disposal activities. Benthic invertebrate fauna residing in the intertidal and tidal impact zones would be smothered, but studies have shown the impact to be similar to that resulting from natural events such as storms and hurricanes (Saloman and Naughton, 1977; Simon and Dauer, 1977). Following the burial, the resident species should recover quickly because of their short life cycle, high reproductive potential, and the rapid recruitment of larvae and motile macrofauna from nearby unaffected areas (Nelson and Pullen, 1988).

Benefits earned from the Gulf Shore BU Feature at Texas and Louisiana Points are shown in Table 18. With adoption of the DMMP, all FWP impacts in Texas would be avoided or offset and no compensating mitigation is proposed in conjunction with construction of the LPP. Included in the offset are negligible impacts (–22 AAHUs) to 804 acres of cypress-tupelo swamp, where small increases in salinity may affect the general health and productivity of the cypress-tupelo swamp system by slowing the trunk diameter

growth rate by an average of 0.03 inch per year. No impacts from the LPP were identified for the majority of cypress-tupelo swamps and all bottomland hardwoods in the study area.

Impacts in Louisiana are minimized to the greatest extent possible by the DMMP, but the unavoidable loss of 1,499 AAHUs remains. When looking at the project as a whole (Texas and Louisiana combined), the LPP would result in the loss of 843 AAHUs. However, because the ecological benefits of the DMMP BU features are primarily in Texas, additional compensatory mitigation beyond the total project loss of 843 AAHUs is proposed so that impacts in Louisiana will be compensated in Louisiana, with the exception of impacts that occur on Federal lands in Louisiana, specifically the Sabine NWR. Impacts on Federal lands in Louisiana would be offset by the excess Texas BU feature benefits as shown in Table 19. A mitigation plan, described in Section 8.6, has been developed to compensate for unavoidable impacts of the LPP.

8.4 FEASIBILITY SCREENING OF MITIGATION MEASURES

Unavoidable impacts of the LPP in Louisiana would remain after all benefits of the DMMP BU features have been applied. These impacts are related primarily to a decrease in the overall biological productivity of approximately 182,000 acres (284 square miles) of intertidal marsh in Louisiana. The important ecological functions of the wetlands in the affected area would decline as increases in salinity levels affect emergent marsh communities and the fish and wildlife that depend upon this habitat. Indirect adverse affects of increased salinity on marsh health and productivity could lead to the resultant loss of 691 acres of marsh, associated SAV, and shallow-water habitat, as stressed emergent marsh converts to open water.

8.4.1. Compensatory Mitigation Target for Louisiana

Since the Coastal Zone Management Act (CZMA) does not apply to Federal lands, then the need to provide one-to-one mitigation for all AAHU losses in Louisiana (over and above full compensation calculated for the project as a whole) can be reduced by the total number of AAHU losses to Federal lands in Louisiana. The only Federal lands in Louisiana that would be affected by this exclusion are located in the Sabine NWR. While the Texas Point and McFaddin NWRs in Texas would also be affected by salinity increases associated with the project, two DMMP BU features (the Neches River and the Gulf Shore BU features) provide benefits that offset all project impacts in Texas (including impacts to both NWRs) and provide excess benefits of 656 AAHUs. The DMMP BU features fulfill Texas's Coastal Zone Management Plan (CZMP) requirements to avoid and minimize impacts to the coastal zone, such that no compensatory mitigation for Texas state resources is needed.

Total SNWW project impacts to the Sabine NWR in Louisiana would be 340 AAHUs. When these are removed from the net project impacts in Louisiana (–1,499 AAHUs), the mitigation target proposed for compliance with Louisiana's CZMP is –1,159 AAHUs. Table 19 illustrates this calculation. Since all mitigation measures for the SNWW would be located in Louisiana, the new mitigation target would compensate for total project losses of 843 AAHUs.

8.4.2. Preliminary Screening of Mitigation Measures

The Habitat Restoration Workgroup met or convened by teleconference four times between December 2004 and January 2006 to develop, model, and recommend potential BU and mitigation measures for the SNWW LPP. The Habitat Workgroup and USACE developed concepts for hydrologic and marsh restoration, shoreline protection, and Gulf shoreline nourishment measures, and applied the WVA model to compute mitigation outputs. Conceptual designs and costs for these measures were completed by the USACE, Galveston District. ERDC conducted HS modeling and developed a desk-top off-channel wetlands salinity mitigation model (DOWSMM) to test the effectiveness of salinity control structures proposed within the Willow and Black Bayou watersheds in Louisiana, and the Texas Bayou watershed in Texas (Brown et al., 2006:Appendix B). These are the hydrologic restoration measures listed in Table 20.

Table 19: Compensatory Mitigation Target for Louisiana

Units (AAHUs)	Texas	Louisiana	Project
Net FWP Benefits/Impacts			
Total Impacts (negative)	–412	–1,709	–2,121
Total BU Benefits (positive)	1,068	210	1,278
Net FWP Benefits (positive) or Impacts (negative)	656	–1,499	–843
Excess Texas Benefits Applied to Federal Lands			
Excess Texas Benefits	656		
Sabine NWR Impacts	–340		
Net Excess Texas Benefits	316		
Compensatory Mitigation Target			
Net Impacts by State and Project		–1,499	–843
Federal Impacts Compensated with Texas Excess Benefits		340	
FWP Compensatory Mitigation Target		–1,159	–843

Developing sufficient acceptable and effective mitigation measures to compensate for predicted impacts proved to be quite a challenge. Measures developed specifically for salinity impacts in Louisiana marshes and in the Texas Point NWR proved unsuccessful. All measures designed to directly address salinity impacts in the Texas Point, Willow Bayou, and Black Bayou hydro-units were eliminated during preliminary or feasibility level screenings. Reductions in salinity proved too small to overcome reduced marine organism access in the WVA model.

Numerous measures explored by the Habitat Workgroup were eventually found not to be feasible or cost effective. Table 20 summarizes measures that were not included in the final CE/ICA. Although not discussed in detail in this report, WVA benefits were calculated for the majority of these measures.

Table 20: Eliminated Mitigation Measures

	Measure Description	Reason for Elimination
	Hydrologic Restoration Measures	
TX 8-1	Plug in old logging canal just west of Texas Bayou at Sabine Pass with new work material from Sabine Pass Channel	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) Negligible marsh restoration benefits
TX 8-1-A	Restriction of Texas Bayou cross section with sheet pile wall at State Highway 82 bridge; armor channel sides and bridge supports and provide sloping bottom to transition between deeper Sabine Pass and existing –6-foot bottom of Texas Bayou	Ineffective at reducing salinities per HS model (Brown et al., 2006) Increases velocities through mouth of Sabine Lake
TX 8-1-B	Combination of rock weir in Texas Bayou and plug in old logging canal; channel filling restores 13 acres of marsh	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006) Increases velocities through mouth of Sabine Lake Negligible marsh restoration benefits Not cost effective
TX 8-2	Constructing dredged material berm inside west jetty south of the Pilot House, and fill behind the berm to construct 32 acres of marsh; assume that subsided portion of west jetty has been repaired and raised by O&M prior to construction of mitigation measure	Negligible marsh restoration benefits Not cost effective Dependent upon operation and maintenance (O&M) action
TX 12-1	Earthen plug in mouth of old logging access canal on Sabine River; fill material mined from adjacent Sabine River channel	Negligible AAHU benefits
LA 2-7	Large adjustable salinity control structures at Willow Bayou and Three Bayou with slide/flap gates and boat bays (20 feet wide and 4 feet deep). Assume managed by USFWS to maintain salinity of 10 ppt	Impacts from severe restriction of marine organism access did not offset salinity reduction
LA 2-8	Large adjustable salinity control structures at Greens Bayou and Right Prong of Black Bayou with slide/flap gates and boat bays (20 feet wide and 4 feet deep); assume managed by USFWS to maintain salinity of 5 ppt	Impacts from severe restriction of marine organism access did not offset salinity reduction
LA 2-14	Two rock weirs with boat bays (20 feet wide and 4 feet deep) at mouth of Willow Bayou at Sabine Lake and at mouth of Three Bayou at Sabine Lake	Reduction in aquatic organism access not offset by small salinity reduction
LA 2-15	Rock weirs with boat bays (20 feet wide and 4 feet deep) at Greens Bayou at Sabine NWR boundary and on Right Prong of Black Bayou near refuge boundary	Reduction in aquatic organism access not offset by small salinity reduction
LA 3-1	Large, adjustable salinity control structure at mouth of Black Bayou with slide/flap gates and boat bay (20 feet wide and 4 feet deep); assumed managed for specific salinity	Severe restriction of marine organism access; does not offset salinity reduction

Table 20 (Cont'd)

	Measure Description	Reason for Elimination
	Hydrologic Restoration Measures	
LA 3-2-A	(1) Rock weir with boat bay at east end of Raleigh's ditch; (2) rock weir with boat bay at small tributary opening on west Black Bayou; and (3) a plug in Raleigh's Ditch upstream of small tributary on west Black Bayou	Reduction in aquatic organism access not offset by small salinity reduction
LA 3-3	Rock liner at mouth of small stream leading south from Black Bayou	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)
LA 3-4	Rock weir with boat bay on small stream leading south from Black Bayou into Sterling Pond	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)
LA 3-5	Rock weir at mouth of stream leading north from Black Bayou	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)
LA 3-6	Water control structures (two 36-inch sluice gates) under cattlewalk between Perry Ridge and Isaacs Ridge on the north side of Black Bayou	Reduction in aquatic organism access not offset by small salinity reduction
LA 3-7	Rock liners at 4 large streams leading north from Black Bayou	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)
LA 3-8	Rock weir at oil field canal opening on west side of Black Bayou Cutoff Canal	Ineffective at reducing salinities per DOWSMM (Brown et al., 2006)
LA/TX 1-1	Plugs in openings of pipeline ditches on Sabine River and Big Bayou in Sabine Island WMA	Ineffective at reducing salinities
LA/TX 2-1	Plug of large logging canal leading into Blue Elbow Swamp just upstream of IH 10	Canal is sole recreational access
LA/TX 3-1	Underwater sill at mouth of Sabine Lake	Ineffective at reducing salinities; maximum average reduction of 0.5 ppt in southern half of Sabine Lake (Brown et al., 2006) Creates unacceptably high velocities Creates higher water elevations during floods upstream of sill
	Marsh Restoration Measures	
TX 6-1 East	Unconfined placement new work material; frequent movement of pipe to create mound field; restores 267 acres of brackish marsh by TY 1; new work material comes from Neches River Channel, sections 11 and 12	Not cost effective
TX 8-3	Filling logging canal at Texas Bayou with new work material	Negligible marsh restoration benefits Not cost effective
TX 8-4	Unconfined flow of maintenance material into open-water areas west of TX 8-2, via pipeline dredge	Use of pipeline dredge instead of hopper dredge determined to be infeasible because of safety and risk
LA 2-9	Duck-wing earthen terraces in south part of Greens Lake with in situ material using amphibious excavator; 5.9 miles total terrace length	Ineffective measure due to small size of influence area and restored marsh

Table 20 (Cont'd)

	Measure Description	Reason for Elimination
	Marsh Restoration Measures	
LA 2-10	Duck-wing earthen terraces in north part of Greens Lake with in situ material using amphibious excavator; 2.1 miles total terrace length	Ineffective measure due to small size of influence area and restored marsh
LA 2-11	Marsh restoration in Willow Bayou Unit 7 with maintenance material from Sabine-Neches Canal Section B or from the SNWW channel	Ineffective measure due to high pumping cost and small size of influence area and restored marsh
LA 2-12	Marsh restoration in Willow Bayou Unit 7 with new work material from SNWW channel construction	Ineffective measure due to high pumping cost and small size of influence area and restored marsh
LA 2-13	Marsh restoration in Willow Bayou Unit 7 with material from dedicated dredging of Sabine Lake; dredging of access canal may be required since nearshore water depths are shallow; area designated as oyster seed harvesting ground	Ineffective measure due to high pumping cost and small size of influence area and restored marsh
LA 3-9R	Marsh restoration into area north of Black Bayou using maintenance material from another navigation project (Channel to Orange in Sabine River)	Benefits earned between TY 50 and TY 65 and longer pumping distance make it not cost effective in average annual benefits
LA 3-11	Marsh restoration in area northwest of Rusty Vincent Lake using maintenance material from the Channel to Orange	Combined with LA 3-10
LA 3-16 A and B	Marsh restoration in small area east of Black Bayou Cutoff Canal and south of GIWW using dedicated dredging of adjacent GIWW	Ineffective measure due to small size of influence area and restored marsh
LA 3-17	Marsh restoration in very large area east of LA 3-16 and south of GIWW using dedicated dredging of adjacent GIWW	Area approved for marsh terracing project under CWPPRA CS-27
	Shoreline Protection Measures	
TX 7-1/ 7-2	Rock shoreline protection (Section 1) protects 2.4 miles of GIWW north shore between existing PAs, reducing salinity intrusion in 2,534 acres. Section 2 protects 1.5 miles shoreline on west edge of TX 7 with rock breakwater	Measure is not cost effective for amount of AAHUs earned
LA 2-1R	Rock foreshore dike located parallel to and 150 feet offshore of east Sabine Lake shoreline; 3-mile segment from Willow Bayou to Three Bayou; 35 acres created behind dike	Measure is not cost effective for amount of AAHUs earned; potential fisheries impacts from armored shoreline
LA 2-2R	Rock foreshore dike located parallel to and 150 feet offshore of east Sabine Lake shoreline; 1.4-mile segment from Three Bayou to Pine Ridge Canal; 16 acres created behind dike	Measure is not cost effective for amount of AAHUs earned; potential fisheries impacts from armored shoreline
LA 3-12R	Rock foreshore dike located parallel to and 150 feet offshore of east Sabine Lake shoreline; 4.2-mile segment from Pine Ridge Canal to Black Bayou; 48 acres created behind dike	Measure is not cost effective for amount of AAHUs earned; potential fisheries impacts from armored shoreline

Table 20 (Cont'd)

	Measure Description	Reason for Elimination
	Shoreline Protection Measures	
LA 2-3	Earthen foreshore dike, east shore of Sabine Lake, 3 miles north from Willow Bayou	Less durable for 50-year project life than rock structures; cost is equivalent to or slightly higher than rock structures
LA 2-4	Earthen foreshore dike, east shore of Sabine Lake, 1.4 miles north from LA 2-3	Less durable for 50-year project life than rock structures; cost is equivalent to or slightly higher than rock structures
LA 2-5	Dedicated dredging to fill behind LA 2-1 or LA 2-3 and create marsh	Dedicated dredging not needed to fill 100 feet behind breakwater; access canal dredging provided sufficient material
LA 2-6	Dedicated dredging to fill behind LA 2-2 or LA 2-4	Dedicated dredging not needed to fill 100 feet behind breakwater; access canal dredging provided sufficient material
LA 2-20	Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks between segments, located parallel to and 250 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh	Not cost effective
LA 2-21	Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks, located parallel to and 500 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh	Not cost effective
LA 2-22	Rock foreshore breakwater, 1.4 miles north from LA 2-20 in 1,000-foot segments, with 50-foot breaks, located parallel to and 250 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh	Not cost effective
LA 2-23	Rock foreshore breakwater 1.4 miles north from LA 2-21 in 1,000-foot segments, with 50-foot breaks, located parallel to and 500 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh	Not cost effective
LA 2-24	Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks between segments, located parallel to and 250 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh	Not cost effective
LA 2-25	Rock foreshore breakwater 3 miles north from Willow Bayou, 1,000-foot segments, 50-foot breaks between segments, located parallel to and 500 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh	Not cost effective

Table 20 (Cont'd)

	Measure Description	Reason for Elimination
	Shoreline Protection Measures	
LA 2-26	Rock foreshore breakwater 1.4 miles north from LA 2-24 in 1,000-foot segments, with 50-foot breaks, located parallel to and 250 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh	Not cost effective
LA 2-27	Rock foreshore breakwater 1.4 miles north from LA 2-25 in 1,000-foot segments, with 50-foot breaks, located parallel to and 500 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh	Not cost effective
LA3-13	Earthen foreshore dike, east shore of Sabine Lake, continuation of LA 2-3	Less durable for 50-year project life than rock structures; cost is equivalent to or slightly higher than rock structures
LA 3-14	Dedicated dredging to fill behind LA 3-12 or LA 3-13; assume marsh creation to shore behind all levees	Dedicated dredging not needed to fill 100 feet behind breakwater; access canal dredging provided sufficient material
LA 3-19	Rock foreshore breakwater, 4.2 miles north from LA 2-20, in 1,000-foot segments, with 50-foot breaks between segments located parallel to and 250 feet offshore; dedicated dredging of Sabine Lake used to fill behind breakwater and create marsh	Not cost effective
LA 3-20	Rock foreshore breakwater 4.2 miles north from LA 2-21, in 1,000-foot segments, with 50-foot breaks between segments located parallel to and 500 feet offshore; dedicated dredging of Sabine Lake to fill behind breakwater and create marsh	Not cost effective
LA 3-21	Rock foreshore breakwater 4.2 miles north from LA 2-25, in 1,000-foot segments, with 50-foot breaks between segments located parallel to and 500 feet offshore; new work material from SNWW Section 10 used to fill behind breakwater and create marsh	Not cost effective and not supported by LDWF
	Gulf Shoreline Nourishment	
TX 8-5	Confined cell on Gulf shoreline – new work and maintenance material – 0.5 to 3.5 miles from west jetty, no booster; levees built with new work material, 1,750 feet offshore, with maintenance material fill between the levee and the shore with 0 foot mean lower low water (MLLW) elevation	Measure is not cost effective for amount of AAHUs earned
TX 8-6	Shoreline nourishment – unconfined new work from Section 5; hydraulic pipeline placement of new work material, 0.5 to 3.5 miles from west jetty; assume 50:50 split of material between Texas and Louisiana	Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11

Table 20 (Cont'd)

	Measure Description	Reason for Elimination
	Gulf Shoreline Nourishment	
TX 8-7	Shoreline nourishment – 0.5 to 3.5 miles from west jetty – unconfined maintenance material from sections 5 and 6; hydraulic pipeline placement of maintenance material every 6 years for project life (8 placement episodes); assume 50:50 split of material between Texas and Louisiana	Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11
TX 8-8	Shoreline nourishment – unconfined placement of new work material from Section 5 from 0.5 mile to 1 mile from west jetty; nourish 27 acres of shoreline in accretion zone	Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11
TX 8-9	Shoreline nourishment – 0.5 to 2.5 miles from west jetty – one-time hydraulic pipeline placement of all maintenance material from one dredging cycle from Section 5	Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11
TX 8-10	Shoreline nourishment – 0.5 to 3.5 miles from west jetty – new work material from sections 5 and 6; placement using pipeline dredge; assume 50:50 split of material between Texas and Louisiana	Superseded by least-cost alternative – optimized Gulf nourishment measure TX 8-11
LA 5-2 and 6-2	Shoreline nourishment – 0.5 to 3.5 miles from east jetty – maintenance material from sections 5 and 6; unconfined hydraulic pipeline placement every 6 years for project life (8 placement episodes); assume 50:50 split of material between Texas and Louisiana	Superseded by least-cost alternative – optimized Gulf nourishment measure LA 5-6
LA 5-4	Shoreline nourishment – 0.5 to 2.5 miles from east jetty – one time placement of all maintenance material from one dredging cycle from Section 5; unconfined hydraulic pipeline placement	Superseded by least-cost alternative – optimized Gulf nourishment measure LA 5-1/6-1 that uses material only from Section 5

8.5 FINAL COST EFFECTIVENESS/INCREMENTAL COST ANALYSIS SCREENING OF MITIGATION MEASURES

Table 21 lists mitigation measures included in the final CE/ICA screening of the SNWW LPP; the measures ultimately selected are shown in bold. These mitigation measures are required to compensate for impacts that would remain after measures designed to avoid or minimize impacts have been applied. A concerted effort was made to use new work and maintenance material beneficially in both minimizing and mitigating environmental impacts. Mitigation measures in the Louisiana marshes would be located in the Willow Bayou and Black Bayou hydro-units because they had the highest projected FWP losses in terms of acreage and AAHUs. East and West Johnson's Bayou hydro-units had the next highest projected losses in both acreage and AAHUs, but measures were not located in these areas because no large, open-water areas existed or were expected to develop. Maps of all mitigation measures considered in the final screening are provided on figures 15 and 16.

In 2009, changes in the proposed project and HS modeling necessitated that the WVA modeling of mitigation measures retained for final screening be revised. Due to schedule constraints, USACE performed the modeling without ICT involvement, basing it as closely as possible on methods and assumptions used by the ICT in the original modeling. The results of this remodeling were coordinated with the ICT. A quality check was also performed for the revised worksheets.

8.5.1 Description of Evaluated Mitigation Measures

LPP impacts in Louisiana are primarily indirect impacts related to a salinity increase associated with a deeper SNWW navigation channel. As demonstrated above, extensive efforts were made to identify feasible measures that could minimize or eliminate salinity increases in the estuary as a whole, or in localized areas within the affected marsh. Since no feasible measures were identified that could minimize salinity effects, the Habitat Workgroup evaluated an array of compensation measures that utilized marsh restoration, shoreline protection, and Gulf shoreline nourishment measures. Marsh restoration measures included in situ terracing and marsh restoration using several different sources of dredged material (SNWW new work material, dedicated dredging, Channel to Orange maintenance material, and accumulated material in the Lake Charles Deepwater Channel (GIWW-East). All of the measures described below were evaluated using the CE/ICA in the USACE certified version of IWR-PLAN to identify those measures that provide the most environmental benefits for the least incremental cost. The reader is referred to FEIS Section 5.4.3 for a detailed description of the CE/ICA process.

8.5.1.1 Marsh Restoration

Five areas within the Willow Bayou hydro-unit were identified as high priority areas for marsh restoration by USFWS. Different marsh restoration solutions are proposed within the same footprint of these units. Figure 15 shows all measures that were evaluated within each specific area, with the labels for the measures ultimately included in the recommended mitigation plan shown in bold.

Table 21: Mitigation Measures, Final Screening

Marsh Restoration – In Situ Terracing			
Description of Alternative			
Duck-wing-shaped earthen terraces built with in situ material using amphibious excavator. Each terrace is 1,000 feet long; 100-foot gap between terraces; approximately 500 feet between each row of terraces. Terraces should have 15-foot-wide tops at +2.0' NAVD88 and 4:1 side slopes.			
Hydro-Unit	No.	Size of Influence Area	Emergent Marsh Created
Willow Bayou	LA 2-16(A)	Influence area – 1,831 acres in north part of Greens Lake; located within the same footprint as LA 2-16(B) and LA 2-16(C).	38 acres
	LA 2-17(A)	Influence area – 2,297 acres in southern part of Greens Lake; located within the same footprint as LA 2-17(B) and LA 2-17(C).	45 acres
	LA 2-18(A)	Influence area – 680 acres in area north of Willow Bayou canal; located within the same footprint as LA 2-18(B) and LA 2-18(C).	11 acres
	LA 2-19(A)	Influence area – 1,809 acres; in area west of Deep Bayou; located within the same footprint as LA 2-19(B) and LA 2-19(C).	28 acres
Marsh Restoration – Sabine Lake Dedicated Dredging			
Description of Alternative			
Hydraulically dredged material from Sabine Lake (dedicated dredging) to restore marsh and shallow-water habitat in open-water areas of marsh. Borrow trench located 500 feet from shore, excavated approximately 7.5 feet deep; width and length vary for each scale. Assume unconfined flow of maintenance material, frequent movement of pipe, and few training or containment structures.			
Hydro-Unit	No.	Size of Influence Area	Emergent Marsh Created
Willow Bayou	LA 2-16(B)	Influence area – 1,831 acres in north part of Greens Lake; borrow trench approximately 1,000 feet wide and 2 miles long	822 acres
	LA 2-17(B)	Influence area – 2,297 acres in southern part of Greens Lake area; borrow trench approximately 1,250 feet wide and 2 miles long	1,035 acres
	LA 2-18(B)	**Influence area – 680 acres in area north of Willow Bayou Canal; borrow trench approximately 700 feet wide and 0.8 mile long**	**251 acres**
	LA 2-19(B)	Influence area – 1,809 acres in area west of Deep Bayou; borrow trench approximately 1,200 feet wide and 1.8 miles long	719 acres
	LA 2-ADD B	**Influence area – 1,285 acres in area north of Willow Bayou Canal; borrow trench approximately 1,000 feet wide and 1.25 miles long**	**436 acres**

Table 21 (Cont'd)

Marsh Restoration -SNWW New Work Material			
Description of Alternative			
Use new work material from SNWW Section 10 to restore emergent marsh and shallow-water habitat in open water in north part of Greens Lake area. Assume unconfined flow of new work material; frequent movement of pipe; few training or containment structures.			
Hydro-Unit	No.	Size of Influence Area	Emergent Marsh Created
Willow Bayou	LA 2-16(C)	Influence area – 1,831 acres in north part of Greens Lake area; located within the same footprint as LA 2-16(A) and LA 2-16(B)	822 acres
	LA 2-17(C)	Influence area – 2,297 acres in southern part of Greens Lake area; located within the same footprint as LA 2-17(A) and LA 2-17(B)	1,035 acres
	LA 2-18(C)	Influence area – 680 acres in area north of Willow Bayou Canal; located within the same footprint as LA 2-18(A) and LA 2-18(B)	251 acres
	LA 2-19(C)	Influence area – 1,809 acres in area west of Deep Bayou; located within the same footprint as LA 2-19(A) and LA 2-19(B)	719 acres
	LA 2-ADD C	Influence area – 1,285 acres in area north of Willow Bayou Canal; located within the same footprint as LA 2-ADD B	436 acres
Marsh Restoration –Channel to Orange Maintenance Material			
Description of Alternative			
Hydraulically pump maintenance material from the Channel to Orange (Sabine River) between East Pass and the GIWW into areas north of Black Bayou to restore emergent marsh in degraded marsh and open-water areas. Assume unconfined flow of maintenance material, frequent movement of pipe, and few training or containment structures. Material would come from maintenance dredging of the Sabine River Channel.			
Hydro-Unit	No.	Size of Influence Area	Emergent Marsh Created
Black Bayou	**LA 3-10R**	**Influence area – 2,465 acres; restoring 132 acres every 5 years, TY 5 thru TY 30 (total of 6 cycles, ending TY 30)**	**792 acres**

Table 21 (Cont'd)

Marsh Restoration – GIWW Dedicated Dredging			
Description of Alternative			
Dedicated dredging of adjacent GIWW to restore emergent marsh and shallow0water habitat; percent of open water restored to emergent marsh is different in A and B scales. Assume unconfined flow of hydraulically pumped material that has accumulated in GIWW (formerly the 30-foot Deepwater Channel to Lake Charles), frequent movement of pipe, and few training or containment structures.			
Hydro-Unit	No.	Size of Influence Area	Emergent Marsh Created
Black Bayou	LA 3-15(A)	Influence area – 1,788 acres in area west of Black Bayou Cutoff Canal; assume 60 percent of open water restored to emergent marsh	546 acres
	LA 3-18(A)	Influence area – 1,877 acres in large area of open water south of LA 3-15; assume 60 percent of open water restored to emergent marsh	497 acres
	LA 3-15(B)	**Influence area – 1,788 acres area west of Black Bayou Cutoff Canal; assume 75 percent of open water restored to emergent marsh**	**683 acres**
	LA 3-18(B)	**Influence area – 1,877 acres in large area of open water south of LA 3-15; assume 75 percent of open water restored to emergent marsh**	**621 acres**
Gulf Shoreline Nourishment			
Description of Alternative			
Nourish Gulf shoreline at Louisiana Point; length of nourished shore and number of placement cycles vary. Material pumped along shoreline using hydraulic pipeline dredge. Assume 50:50 split of material between Texas and Louisiana. Assume 60 percent retention of material after initial placement; 50 percent of newly added acres remain at end of 8 years.			
Hydro-Unit	No.	Size of Influence Area	Length of Shoreline
Sabine Lake Ridges	LA 5-3	Nourish 0.5 to 1.0 mile from east jetty; assume one-time unconfined placement of new work material from SNWW Section 5; all added acres eroded away by TY 51	0.5 mile
	LAs 5-1 and 6-1	Nourish 0.5 to 3.5 miles from east jetty; assume one-time unconfined placement of new work material from SNWW Section 5; all added acres eroded away by TY 51	3.0 miles
	LA 5-5	Nourish 0.5 to 3.5 miles from east jetty; assume one-time unconfined placement of new work material from SNWW sections 5 and 6; all added acres eroded away by TY 51	3.0 miles

LA2-17B Selected Component
LA2-19B Non-Selected Component
Mitigation Area
Non-Selected Component
Hydrologic Unit

N
W E
S

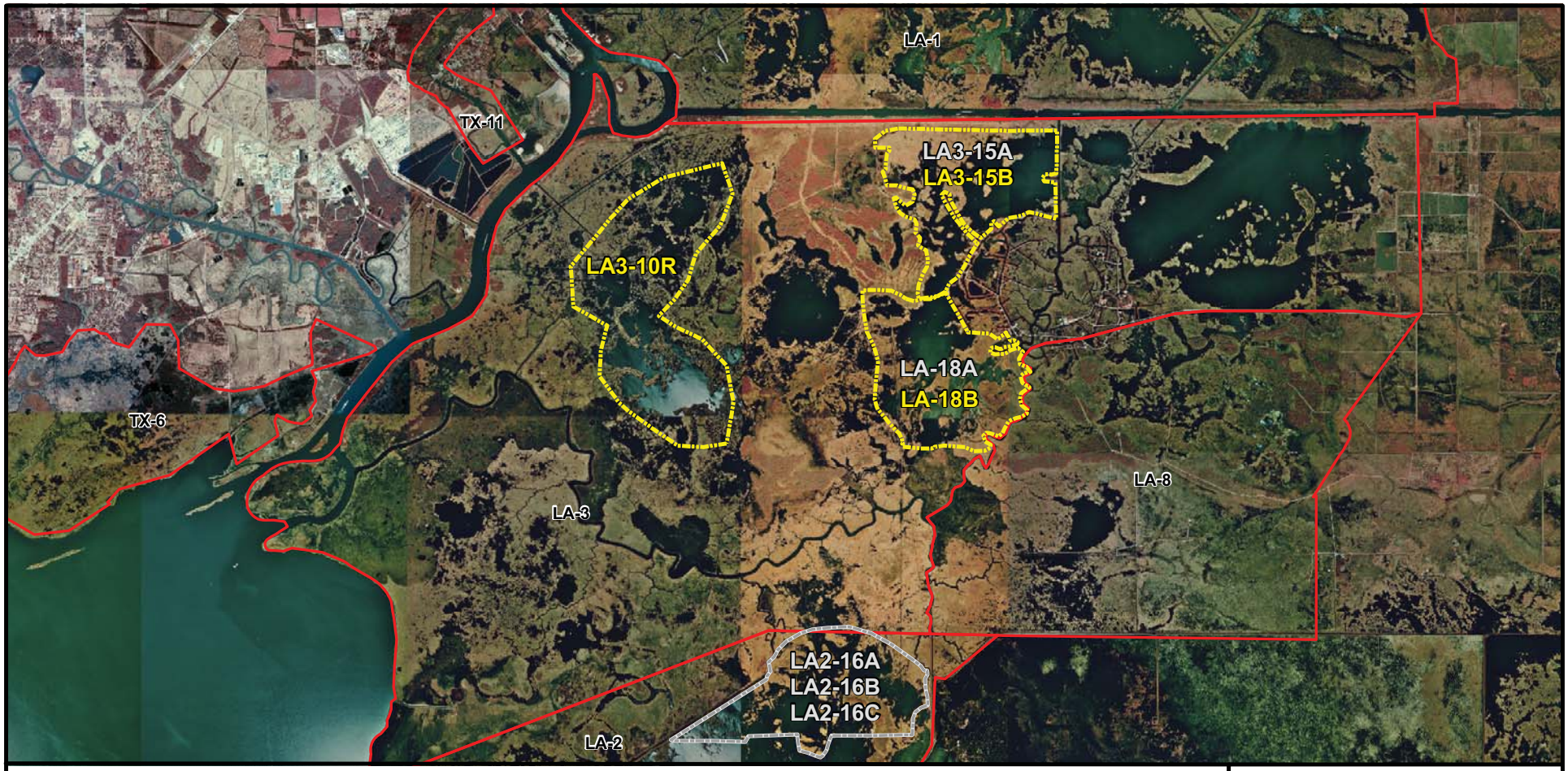
0 1 2 Miles

Figure 15

LA 2 Mitigation Potential and Selected Mitigation Measures

Prepared for: USACE	
Job No.: 044198800	Scale: 1:65,000
Prepared by: A.Christiansen	Date: 5/01/2008

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/044198000/figures/WVA/Figure_18.mxd



LA2-17B Selected Component
LA2-19B Non-Selected Component
Mitigation Area
Non-Selected Component
Hydrologic Unit

2 1 0 2
Miles

N
W E
S

Figure 16

LA 3 Mitigation Potential and Selected Mitigation Measures

Prepared for: USACE	
Job No.: 100007609	Scale: 1:80,000
Prepared by: A.Christiansen	Date: 09/10/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100007609/geo/figs/Figure_19_vr4.mxd

8.5.1.1.1 Willow Bayou In Situ Terracing

Marsh terracing in the Willow Bayou hydro-unit has been identified as a mitigation measure. Four areas in Sabine NWR units 5 and 7 are combined as one incrementally scaled measure in the CE/ICA. For example, terracing would first be conducted in LA 2-16A, followed step-by-step by LA 2-17A, LA 2-19A, and LA 2-18A, forming four scales of potential terracing (Table 22). Targeted areas encompass areas of disintegrating, or breaking, marsh that would benefit from a marsh restoration effort. Areas affected by terracing projects south of Greens Lake and south of the Willow Bayou Canal (CWPPRA Project No. CS-32, East Sabine Lake Hydrologic Restoration Project) are not included in the footprint of this measure.

Table 22: Summary of Benefits, Willow Bayou Marsh Terracing Measure

Mitigation Measure	AAHU	Influence Area (acres)	Existing Marsh (acres)	Open Water (acres)	Restored Emergent Marsh (acres)
LA 2-16A	17	1,831	803	1,028	38
LA 2-17A	20	2,297	1,003	1,294	45
LA 2-19A	12	1,809	910	899	28
LA 2-18A	4	681	367	314	11

Construction of the earthen terraces would follow specifications established by USFWS for nearby terraces, with a height modification to accommodate predicted RSLR. Earthen terraces would be built using an amphibious excavator in “duck-wing” shapes with in situ material from open-water areas of the marsh. Each terrace would be 1,000 feet long, with 100-foot gaps between terraces and approximately 500 feet between each row of terraces. Marsh grass would be planted on the crowns and side slopes. Acreage of restored emergent marsh was determined by estimating the total terrace length in each unit and assuming a 22-foot-wide vegetated crown. The acreage restored by this measure is low compared to other restoration methods.

Marsh restoration benefits are associated with the additional marsh acreage and the terracing’s effect on hydrology and wind fetch. Terracing would be expected to reduce wind fetch and promote more still-water conditions favorable for SAV growth. In addition, land loss rates would be expected to be lower due to the reduction in fetch. Impacts associated with construction are limited to the excavation of shallow open-water areas within the marsh. It is anticipated that these borrow areas would eventually fill with degraded organic material from the vegetated terraces. Salinities are expected to remain the same as FWP projections.

8.5.1.1.2 Willow Bayou Marsh Restoration – Dedicated Dredging or SNWW New Work Material

Marsh restoration using material from dedicated dredging of Sabine Lake (B) or SNWW new work material (C) was also proposed within the Willow Bayou hydro-unit. In addition to LA 2-16 through LA

2-19, a fifth area (LA 2-ADD) in Sabine NWR Unit 5 was added for the dedicated dredging solution. All are combined in various incremental combinations in the CE/ICA according to the most cost effective pumping distances and dredges proposed for use. For both solutions, marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation for intermediate marsh. If needed, tidal creek channels could be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

The dedicated dredging alternative (B) would take material from a borrow area in Sabine Lake located at least 1,000 feet from the Sabine NWR shore. The borrow area would average 1,100 feet wide and range from 1.8 to 7.8 miles long, depending upon how many of the unit increments are adopted. The borrow area would be 7.5 feet deep, as measured from the lake bottom; it would be continuous and parallel with the common longshore circulation pattern present in Sabine Lake. This circulation is expected to prevent the development of hypoxic conditions that would be detrimental to aquatic organisms. The borrow area would eventually fill with Sabine River sediments. An access channel would also be needed for the pipeline dredge to reach the proposed borrow area. The borrow area is located within an area designated as an oyster seed harvesting ground by the State of Louisiana. However, commercial oyster species are not present in the area. Oyster reefs are restricted to higher-salinity areas in the southern part of Sabine Lake near Blue Buck Point. LDWF has stated that it would require that an oyster ground survey be conducted prior to its approval for use in conjunction with this mitigation measure.

The SNWW new work material alternative (C) would pump dredged material from the deepening of the navigation channel across Sabine Lake into the Willow Bayou marshes. The pumping distance is approximately 11 miles and would require the use of a several booster dredges. An access canal would be required for boosters to access the lakeshore.

Marsh restoration benefits (Table 23) are associated with the additional marsh acreage, and the restored marshes' affect on hydrology and wind fetch. Restoration of marsh in open-water areas would reduce wind fetch and promote the still-water conditions favorable for SAV growth. In addition, land loss rates would be expected to be lower due to a stable, higher marsh elevation. Salinities would be expected to remain the same as FWP projections.

Table 23: Summary of Benefits, Willow Bayou Marsh Restoration Measures B and C

Mitigation Measure	AAHU	Influence Area (acres)	Existing Marsh (acres)	Open Water (acres)	Restored Emergent Marsh (acres)
LA 2-16B & C	445	1,831	803	1,028	822
LA 2-17B & C	492	2,297	1,003	1,294	1,035
LA 2-19B & C	419	1,809	910	899	719
LA 2-18B & C	152	681	367	314	251
LA 2-ADD B	214	1,285	745	540	436

8.5.1.1.3 Black Bayou Marsh Restoration – Channel to Orange Maintenance Material

Marsh restoration using material from maintenance dredging of the Channel to Orange has been proposed in the vicinity of Rusty Vincent Lake (see Figure 16). The mitigation measure (LA 3-10R) would be located in open-water areas west of Rusty Vincent Lake. Intermediate marsh restoration in LA 3-10R would be accomplished in six cycles between TY 20 and TY 45, adding 132 acres each 5-year cycle for a total of 792 acres.

The marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation for intermediate marsh. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Marsh restoration benefits (Table 24) would be associated with the restoration of marsh acreage, and the restored marshes' affect on hydrology and wind fetch. Approximately 70 percent of the open water would be restored to intermediate marsh, and existing fringe marsh would be nourish by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved from 100 percent Class 3 and 4 to 100 percent Class 1 and 2 in both areas. Restoration of marsh in open-water areas would reduce wind fetch and promote the still water conditions favorable for SAV growth. In addition, land loss rates are expected to be lower due to a more stable, higher marsh elevation. Salinities are expected to remain the same as FWP projections.

Table 24: Summary of Benefits, Black Bayou Marsh Restoration Measures, Channel to Orange Maintenance Material

Mitigation Measure	AAHU	Influence Area (acres)	Existing Marsh (acres)	Open Water (acres)	Restored Emergent Marsh (acres)
LA 3-10R	198	2,465	1,317	1,148	792

8.5.1.1.4 Black Bayou Marsh Restoration – Dedicated dredging of Lake Charles Deep Water Channel/GIWW

Marsh restoration using dedicated dredging of accumulated material in the Lake Charles Deep Water Channel/GIWW has been proposed for three areas in the vicinity of the Black Bayou Cut Off Canal (see Figure 16). The Lake Charles Deep Water Channel coincides along its entire 24.9-mile length with the GIWW between the Sabine River and Lake Charles. Constructed by local interests, the 30-foot channel was authorized as a Federal channel by the River and Harbor Act of 1935 (USACE, 1998). It was approved to provide a deep-water navigation channel to the Port of Lake Charles through the Sabine River, Sabine-Neches Canal, Port Arthur Canal, and Sabine Pass to the Gulf of Mexico. It was last maintained to 30 feet in 1940 because direct access to the Gulf was provided by the Calcasieu River and Pass Project. Communications with the USACE, New Orleans District indicate that a considerable amount of material has accumulated in the 30-foot channel, and it is this material that could be used to restore marshes in the Black Bayou area.

Material would be pumped from a 13-mile stretch of the GIWW in two increments. The first increment (LA 3-15) is located adjacent to the GIWW and has the shortest pumping distance; pumping would move to LA 3-18 after LA 3-15 is complete. In addition, two different percentages are evaluated for marsh restoration. LA 3-15A and LA 13-18A would fill 60 percent of open-water areas, and LA 3-15B and LA 13-18B would fill 75 percent of open-water areas. Marsh would be constructed through unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevation for intermediate marsh. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Marsh restoration benefits (Table 25) are associated with the restoration of marsh acreage, and the restored marshes' affect on hydrology and wind fetch. Between 60 and 75 percent of the open water would be restored to intermediate marsh, and existing fringe marsh would be nourish by winnowing fine-grained suspended solids during placement. Marsh edge and interspersion would be improved from 100 percent Class 3 and Class 4 to at least 90 percent Class 1 in both areas. Restoration of marsh in open-water areas would reduce wind fetch and promote the still-water conditions favorable for SAV growth. Land loss rates are expected to remain the same because the area is projected to have a low land loss rate with construction of CWPPRA Project No. CS-27. Salinities are expected to remain the same as FWP projections. Dedicated dredging would not establish a hydrologic connection to the deeper navigation channels in the Sabine and Calcasieu rivers, and thus would not provide a channel for their salinity wedges to enter the GIWW.

Table 25: Summary of Benefits, Black Bayou Marsh Restoration Measures, GIWW Dedicated Dredging

Mitigation Measure	AAHU (A)	AAHU (B)	Influence Area (acres)	Existing Marsh (acres)	Open Water (acres)	Restored Emergent Marsh (A)	Restored Emergent Marsh (B)
LA 3-15	231	307	1,788	878	910	546	683
LA 3-18	239	310	1,876	1,048	828	497	621

8.5.1.1.5 Gulf Shore Nourishment

Gulf shoreline nourishment using the unconfined placement of new work material with a hydraulic pipeline dredge was proposed as a mitigation measure for the LPP. If one of these measures were selected by the CE/ICA, it would be constructed prior to the Louisiana Point (LA 5/6) DMMP measure, which uses maintenance material. Three different scales of shoreline nourishment using new work material were proposed (Table 26). The first scale (LA 5-3) would nourish 0.5 mile of shoreline and was intended initially to provide minimum compensation for the FWP loss of 7.6 acres due to erosion. The second scale (LA 5-1/6-1) was designed to use half of all material from Section 5, the nearest dredging reach. Only half of the material could be used since it would be shared equally between the states of Texas and Louisiana. The third scale (LA 5-5) was designed to use half of all material from sections 5 and 6, the farthest pumping distance considered feasible. The location of these measures is shown on Figure 16.

Table 26: Summary of Benefits, Gulf Shore Nourishment Measures, Louisiana Point

Mitigation Measure	New Work Quantity (mcy*)	Dredging Reach	AAHU	Nourished Shoreline (miles)
LA 5-3	0.78	Section 5	5	0.5
LA 5-1/6-1	2.5	Section 5	54	3.0
LA 5-5	4.3	Sections 5 and 6	90	3.0

mcy = million cubic yards

Core borings in Sabine Pass Channel (USACE, 1982) indicate new work material would originate from the relict Sabine River channel. There is little stiff clay; core borings show mostly soft, high-plasticity clay and some sand lensing. It would likely not stack but would spread in a mass, acting much like SNWW maintenance material from these reaches. The material would be hydraulically pumped into the nearshore zone, and some material would be expected to flow over existing marsh while the remainder flows into the nearshore waters. Marsh plantings would occur as soon as possible on the inland half of the emergent berm, to assist in stabilization. Recent experience with a similar Section 204 CAP project constructed at Texas Point indicates that the dredged material would dissipate quickly during a placement event, with 60 percent remaining and forming a shelf on the shallow nearshore slope in front of the

existing marsh edge. Since the material is unconsolidated and prone to erosion, it is estimated that 50 percent of the material that remains after each placement episode would erode away by TY 25. It is assumed that all of the new work material would erode by TY 65.

The Habitat Workgroup concluded that unconfined placement on the shoreline would have a net beneficial effect on this environment. It could widen the marsh, create a shallow shelf in the nearshore zone, and/or create sand bars just offshore, providing more storm protection for interior marsh. It would inject additional sediment into the littoral drift and potentially benefit shorelines to the east during those limited periods when the net drift is eastward. The placement event would impact shallow nearshore waters and marsh, but benthic organisms in the nearshore zone would quickly rebound from the short-term impacts, as would marsh areas that would be nourished with additional sediment. The potential for the nourishment activity to affect threatened and endangered species was evaluated. USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (Unit LA 1, in part) as Critical Habitat for the wintering piping plover; however, the shoreline in the proposed nourishment area is eroding marsh shoreline with no, or only a narrow, beach. Therefore, minimal intertidal beaches, dunes, or sand flats used by the plover as its wintering range would be affected by this measure. Should beach nourishment occur when piping plovers are utilizing the proposed nourishment area, they would be temporarily displaced to nearby habitat to the east, but would not be permanently excluded from using the area as nourishment would only occur every 6 years. The piping plover and its Critical Habitat would experience beneficial habitat enhancement (i.e., shoreline nourishment) from the proposed mitigation measure. While it is unlikely that the creation of more beach on Louisiana Point would allow sea turtle nesting, it would have no adverse impacts on potential nesting habitat.

8.6 RECOMMENDED MITIGATION PLAN

Best Buy Plan 6 appears to be an efficient mitigation plan since it reaches the mitigation target of 1,159 AAHUs by providing a total of 1,181 AAHUs. Best Buy Plan 6 consists of emergent marsh restoration in two Willow Bayou areas (totaling 607 acres) and three areas in the Black Bayou area (totaling 2,096 acres). All measures included in the recommended mitigation plan are identified in Table 27. Maps of the recommended measures are provided on figures 15 and 16. The mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan will restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. In total, these measures produce 1,181 AAHUs, providing full compensation for all Louisiana impacts of the CIP. Given the Texas BU benefits net gain of 316 AAHUs, the mitigation plan would result in a net gain of 338 AAHUs for the project as a whole. The FFR and FEIS provide details of the CE/ICA process and a summary of all agency coordination regarding this plan.

Table 27: Recommended Mitigation Measures, SNWW LPP

Recommended Mitigation Plan	AAHUs
Willow Bayou	
LA 2-18B Marsh Restoration (Sabine Lake dredging)	152
LA 2A-DD B Marsh Restoration (Sabine Lake dredging)	214
Black Bayou West	
LA 3-10R Marsh Restoration (Sabine River Channel maintenance material)	198
Black Bayou East	
LA 3-15B Marsh Restoration (GIWW dredging)	307
LA 3-18B Marsh Restoration (GIWW dredging)	310
Total Compensation	1,181
FWP Mitigation Target	–1,159
Net Benefits After Compensation	**22**

8.6.1 Willow Bayou Mitigation Measures

Recommended Willow Bayou mitigation measures (LA 2-18B and LA 2-ADD B) would be located within the boundaries of the Sabine NWR. Material dredged from a borrow area in Sabine Lake would be used to restore 687 acres of emergent marsh within open-water areas, improve 167 acres of shallow-water habitat, and nourish 1,112 acres of existing marsh within the total influence area of 1,966 acres (Table 28). Small ponds and sinuous, interconnected channels would be created to maintain tidal connectivity, increase marsh edge, and create protected areas for SAV. Approximately 1,966 acres of existing marsh in the influence area would also be renourished by winnowing fine-grained suspended solids during placement events. Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would allow for differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would be needed to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Table 28: Recommended Mitigation Measures, Acreage Analysis

Mitigation Measure	AAHUs	Total Influence Area (acres)	Nourished Existing Marsh (acres)	Restored Open Water (acres)	Restored Emergent Marsh (acres)
Willow Bayou					
LA 2-18B	152	681	367	63	251
LA 2-ADD B	214	1,285	745	104	436
Subtotal	366	1,966	1,112	167	687
Black Bayou West					
LA 3-10R	198	2,465	1,317	356	792
Black Bayou East					
LA 3-15B	307	1,788	878	227	683
LA 3-18B	310	1,876	1,048	207	621
Subtotal	617	3,664	1,926	434	1,304
Total Compensation	1,181	8,095	4,355	957	2,783

The dedicated dredging would take approximately 3.1 million cubic yards (mcy) of material from a 1.8-mile-long borrow area in Sabine Lake. The borrow area would be located at least 1,000 feet from the Sabine NWR shore, and would average 1,030 feet wide by 7.5 feet deep. The borrow area would be continuous and parallel the current shoreline and the common longshore circulation pattern in Sabine Lake. The circulation would prevent the development of hypoxic conditions that would be detrimental to aquatic organisms. It is expected that the borrow area would eventually fill with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River, would be needed for the dredge to reach the proposed borrow trench area.

One-time impacts of the borrow area and access channel dredging include an increase in water column turbidity during dredging activities; such effects would be temporary and local to nekton, phytoplankton, and water quality. A hydraulic pipeline dredge would be used to minimize turbidity. No further effects to water quality and related organisms would be expected. Benthic fauna would be removed due to evacuation of sediment during dredging activities; however, benthic organisms can rapidly recolonize, and no long-term effects would be anticipated. A study by T. Baker Smith, Inc. (2006) found no live oyster reefs in this area. SAV cover is not likely to be found in this area due to low salinities and turbidity.

8.6.2 Black Bayou Mitigation Measures

For the Black Bayou West (LA 3-10R) mitigation measure, material from maintenance dredging of the Sabine River Channel between East Pass and the GIWW would be used to restore a large area of marsh north of Black Bayou and west of Rusty Vincent Lake. Maintenance dredging of the Sabine River Channel is routinely conducted for a separate deep-draft navigation project within the SNWW system; the Channel to Orange has a different non-Federal sponsor. It is a FWOP condition for the SNWW CIP, and

therefore only the incremental cost associated with placing the material in the marsh is included in the cost estimate. Material removed during regularly scheduled maintenance dredging of this channel would be hydraulically pumped into a large degraded marsh area west of Rusty Vincent Lake. This area is close to the navigation channel, minimizing pumping distance and cost. Marsh restoration in LA 3-10R would be accomplished in six 5-year dredging cycles beginning within 5 years of the completion of CIP construction. Each dredging cycle would pump approximately 526,000 cubic yards of material and create 132 acres of emergent marsh, creating a total of 792 acres over 30 years. In addition, 356 acres of shallow-water habitat would be improved and 1,317 acres of existing marsh would be nourished within the total 2,465 acres influenced by the unconfined flow of dredged material.

For Black Bayou East (LA 3-15B and LA 3-18B) mitigation measures, marsh restoration would be accomplished in two areas just west of the Black Bayou Cut-Off Canal using dedicated dredging of accumulated material in the Lake Charles Deepwater Channel/GIWW East. Dedicated dredging of the Lake Charles Deepwater Channel for Black Bayou mitigation efforts would remove and kill benthic organisms; however, constant ship traffic in the shallow channel is an ongoing disturbance to benthic organisms. Recovery of benthic organisms would be rapid (Sheridan, 1999). No impacts to salinity are expected because the dredged section would not connect with the Sabine River Channel or the Calcasieu Ship Channel; therefore, there would be no connection with the saltwater wedge in the Calcasieu Ship Channel (there is no Sabine River wedge; Brown and Stokes, 2009). It is expected that sediment will accumulate over time, refilling the channel to its current depth of approximately –12 feet.

Approximately 10.5 mcy of material would be pumped from a 13-mile stretch of the GIWW East into two degraded marsh areas. The first (LA 3-15B) is located adjacent to the GIWW and has the shortest pumping distance; the second is located south of LA 3-15B and pumping would move to it after the first is complete. A total of 1,304 acres of emergent marsh would be restored, 434 acres of shallow-water habitat would be improved, and 1,926 acres of existing marsh would be nourished within the total 3,664 acres influenced by the unconfined flow of dredged material.

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would allow for differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would be needed to return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

9.0 UNCERTAINTIES ASSOCIATED WITH ECOLOGICAL MODELING FOR THE SNWW CIP

9.1 ACTIONS FOR CHANGE DIRECTIVE

An analysis of risk and uncertainty associated with the WVA models' application to the SNWW CIP has been performed in consideration of recommendations contained in the Actions for Change directive (USACE, 2006). This analysis will facilitate risk-informed decision-making regarding the levels of ecological impacts and resulting recommended compensatory mitigation that was established using the models. The analysis will allow decision-makers to evaluate uncertainties associated with impact predictions, and understand how different predictable outcomes would affect the cost of the mitigation plan.

9.2 TYPES OF RISK ASSOCIATED WITH PREDICTIVE ECOLOGICAL MODELING

Risks to human health and safety associated with ecological impacts evaluated by the model are small. The primary impact of the Preferred Alternative is an indirect impact associated with a small increase in salinity and an associated reduction in biological productivity over approximately 182,000 acres (284 square miles) of intertidal marshes and swamps. The loss in productivity includes the loss of some marsh within the area of tidal influence in the Sabine-Neches study area. The most likely loss of marsh acreage is about 691 acres (about 2/5ths of 1 percent of the affected emergent marsh acreage) in the interior of the large estuarine marshes east of Sabine Lake. This amount of additional marsh loss would not affect the overall effectiveness of these coastal wetlands in buffering inland areas from storm surge effects. The proposed compensatory mitigation plan would contribute to the long-term sustainability of areas with the highest FWP impacts by adding stabilizing mineral sediments, increasing marsh elevations, and decreasing the size of open-water areas within the marsh.

The primary risks associated with ecological modeling for the SNWW CIP relate to the accuracy of the impact assessment and the cost of mitigation. Although the incremental impacts of the project as quantified by the WVA models have been determined to be small, when applied to the unusually large size of the affected area, the amount of net impacts as quantified in AAHUs is relatively high (1,511 AAHUs). An extensive evaluation of mitigation measure alternatives and a CE/ICA analysis, described in FEIS Section 5.4, have identified the Best Buy combination of recommended mitigation measures. Most of the measures included in the Best Buy mitigation plan involve the use of dedicated dredging to obtain mineral soils for marsh restoration. Dredged material originating with construction or maintenance of the Preferred Alternative cannot be used because of lengthy pumping distances, and therefore, dredging must be conducted to provide sediment for some mitigation measures (hence the term "dedicated dredging"). The entire cost of two dedicated dredging contracts (contracts 13 and 15) is thus included in the mitigation cost. One of the mitigation measures does take advantage of the only close source of maintenance material, i.e., regular maintenance dredging of the nearby Sabine River Channel (Contract 14). The Sabine River Channel is a separate deep-draft navigation project with a different non-Federal sponsor. In this case, only the incremental cost of using the material to restore marsh elevation is included

in the mitigation cost. The first cost of construction for the entire compensatory mitigation plan is $77,491,000 (contracts 13, 14, and 15; August 2009 cost estimate). An evaluation of the risks and uncertainties involved in application of the ecological model, on which the amount of proposed compensatory mitigation is based, is necessary to support the recommended Federal investment in a mitigation plan of this magnitude.

9.3 UNCERTAINTIES ASSOCIATED WITH PREDICTIVE ECOLOGICAL MODELING

There are two types of uncertainty that have been identified for the predictive ecological modeling conducted in this study—uncertainty associated with model quality and performance, and uncertainty associated with model predictions. Extensive review of both the WVA models and the HS model has been conducted to ensure they are technically sound and defensible. Technical reviews of both models have been completed as reported below. Uncertainty of model predictions is addressed with sensitivity analyses of critical model assumptions and parameter quality.

The HS model is an established engineering model that has been used by ERDC's CHL for computing hydrodynamics, salinity, and sediment transport for numerous studies across the nation for nearly 20 years (Brown and Stokes, 2009). The SNWW application of the model underwent agency technical review (ATR) by the Deep Draft Center for Expertise, and an Independent External Peer Review (IEPR) (Battelle, 2010). These reviews affirmed the technical quality of the model and the computational accuracy of its software and systems, as well as its application to the SNWW study.

Application of the WVA models was also evaluated by both an ATR at the Deep Draft Center of Expertise, and an IEPR (Battelle, 2010). All ATR questions concerning the WVA models have been resolved, and IEPR comments have been addressed with revised HS and WVA modeling that are reported in this document. To further evaluate technical quality, an assessment of the suite of WVA models used in this application has also been performed to determine if the models are technically sound and that they satisfy general USACE guidelines for mitigation and specific mitigation objectives of the SNWW CIP (LBG and TEA, 2008). This satisfies the requirements of EC 1105-2-407, as the WVA models were developed by a Federal agency other than USACE, and are therefore subject to approval for use rather than certification.

The WVA model assessment (LBG and TEA, 2008) determined that the theoretical approaches behind the WVA Emergent Marsh Community Model, the Swamp Community Model, and the Bottomland Hardwoods Model are valid. These community models use scientifically established structural surrogates to evaluate wetland quality. The concept and application of the models are sound for planning efforts. The models' variables, calculated using established protocols, provide a reasonable description of the emergent marsh, swamp, and bottomland hardwood habitats. The models identify habitat structural components, evaluate habitat-related ecological functional processes that may be affected by the project, and assess damages or losses attributable to the project. Model testing and validation was performed by running the model using three test data sets from each community type and comparing the results. The

model assessment confirmed that the assumptions of variables are appropriate and that the basic mathematics and spreadsheet formulas have been appropriately computed.

As part of the WVA model assessment, a sensitivity analysis was employed to verify that the models would behave as intended with incremental changes in input variables (Hamby, 1994; Jackson et al., 2000). The value of each variable was tested at 10, 20, and 30 percent while holding the others constant. Model outputs responded as expected to changes in model input, and in conformance with theoretical assumptions expressed as model equations. Uncertainty in model behavior was found to be low; model output did not react disproportionately to changes in variable values (LBG and TEA, 2008).

9.4 SENSITIVITY ANALYSES OF WVA MODEL PREDICTIONS

Uncertainty associated with WVA model predictions (e.g., how different predictable outcomes could affect ecological impacts and costs) was evaluated with a different type of sensitivity analysis. The WVA models do not include a direct way to measure risk, i.e., the model does not calculate a probability distribution that provides a statistically significant confidence level for the model projections. However, it is possible to conduct a sensitivity analysis of the model results by varying input values for the most significant variables. In this case, a range of possible outcomes associated with variable V_1 (percent of emergent marsh) in the EMCM, and variables V_4 and V_5 (salinity) in the SCM and EMCM, respectively, were evaluated to determine how uncertainties related to variable assumptions and values could affect impact predictions and compensatory mitigation decisions. Since the analysis is being conducted to evaluate uncertainties with the recommended level of compensatory mitigation, the analysis was performed for the Louisiana hydro-units in which unavoidable impacts would occur.

While the WVA modeling was originally performed by the ICT Habitat Workgroup, the sensitivity analyses presented below were performed solely by USACE. For the salinity sensitivity study, changes to salinity variable values were determined by statistical analysis. ERDC-CHL was consulted for advice in calculating some of the statistics used in the analysis. For the percent emergent marsh sensitivity analysis, the USFWS Louisiana Ecological Services Field Office provided a revised equation for the V_1 (percent of emergent marsh) variable. In the salinity sensitivity analysis, changes in the salinity variable induced changes in other variables. In adjusting these other variables, care was taken to ensure that the direction and magnitude of the adjustments were consistent with the original application of the WVA models by the ICT.

9.4.1 Salinity Sensitivity Analysis

9.4.1.1 Methodology

Salinity is the driving force influencing ecological model predictions for the SNWW CIP. The WVA EMCM and SCM were specifically chosen to evaluate impacts of the SNWW CIP because changes in salinity are the primary project impact and these models directly measure the impact of salinity changes on various aspects of habitat quality and quantity. Salinity affects five of the six variables in the EMCM

(V_1, percent of the wetland covered by emergent vegetation; V_2, percent of the open water covered by SAV; V_3, marsh edge and interspersion; V_4, percent of the open-water area less than or equal to 1.5 feet deep; and V_5, salinity). In the SCM, three of the four variables are influenced by salinity (V_1, stand structure, V_2, stand maturity, and V_4, mean high salinity during the growing season). The BHM does not contain a variable that measures salinity directly, but the effects of salinity were captured indirectly by its effect on growth rates, as reflected in three of the model's seven variables (V_1, tree species composition, V_2, stand maturity, and V_3, midstory/understory coverage). Because of uncertainties associated with HS model predictions of salinity impacts, and the wide range of salinity variability in the SNWW estuarine system, a sensitivity analysis was performed to evaluate the full range of potential project effects.

Salinity changes predicted with implementation of the Preferred Alternative were provided by the HS model. HS model output includes a statistical analysis of the salinity differences between existing and FWP conditions at 13 salinity sampling stations used for the calibration and verification of the model. This analysis includes standard deviations of the differences between existing and FWP **mean salinity** values that can be used to calculate the range of potential impacts for brackish and saline marshes. For intermediate and fresh marshes, and swamps and bottomland hardwoods, **mean high salinity** during the growing season was used to evaluate impacts. Standard deviations for mean high salinity values at model nodes were generated from a salinity exceedance analysis produced in conjunction with the HS model. The range of these mean high salinity values was used to calculate the range of potential impacts for these communities. More information on the biological assumptions related to these statistics is provided in Section FEIS 4.6.3.

High- and low-salinity values bracketing the 95 percent confidence level were entered into WVA model land loss spreadsheets and worksheets for all habitats in Louisiana hydro-units. The high and low range of salinities and associated AAHU impacts for all Louisiana hydro-units are presented in Table 29. For comparative purposes, the FWP salinity and AAHU impacts are shown in the middle columns. Table 30 shows the high and low land loss predictions that are associated with the range of salinity values.

9.4.1.2 Analysis

For brackish and saline marshes, a range equal to the mean salinity ± 2 standard deviations provides impact predictions at the 95 percent confidence level. For saline marshes, the sensitivity analysis yielded a maximum salinity range of 15.3 to 19.2 ppt, as compared to the FWP salinity of about 17.3 ppt. For brackish marshes, the sensitivity analysis predicts a maximum range of 3.7 to 10.6 ppt, as compared to the FWP range of 5.3 to 8.6 ppt. With the exception of brackish marsh in the Sabine Lake Ridges hydro-unit, salinity for the full 95 percent confidence range was forecast to remain within the optimal range as defined by the WVA model. For salinities at the high end of the range, brackish marsh would be

Table 29: WVA Salinity Sensitivity Analysis

Hydro-Unit #	Hydro-Unit Name	Habitat Type	95 Percent Confidence Range*					
			Low Range		Most Likely		High Range	
			Low Salinity (ppt)	Lower Limit of Impacts or Benefits (– or + AAHUs)	FWP Salinity (ppt)	FWP Impacts (– AAHUs)	High Salinity (ppt)	Upper Limit of Impacts (– AAHUs)
Bottomland Hardwoods (optimal salinity range ≤1 ppt)								
LA/TX 1	Sabine Island	Bottomland Hardwood	0.0	0–	0.1	0.0	0.2	0.0
LA 1	Perry Ridge	Bottomland Hardwood	1.4	0.0	2.3	0.0	3.1	0.0
Cypress–Tupelo Swamp (optimal salinity range ≤1 ppt)								
LA/TX 1	Sabine Island	Cypress/Tupelo Swamp	0.0	0.0	0.1	0	0.2	0
LA/TX 2	Blue Elbow	Cypress/Tupelo Swamp (BH lumped)	0.3	0.0	0.9	0	1.5	–9
Fresh Marsh (optimal salinity range ≤2 ppt)								
LA 1	Perry Ridge	Fresh Marsh	1.4	–5	2.3	–65	3.1	–412
LA 7	Southeast Sabine	Fresh Marsh	2.2	–3	2.4	–11	2.6	–23
LA 8	Southwest Gum Cove	Fresh Marsh	1.5	0	2.0	–2	2.5	–42
Intermediate Marsh (optimal salinity range ≤4 ppt)								
LA 1	Perry Ridge	Intermediate Marsh	4.5	0	5.6	–53	6.7	–107
LA 2	Willow Bayou	Intermediate Marsh	7.0	–93	7.7	–328	8.0	–317
LA 3	Black Bayou	Intermediate Marsh	5.4	–113	6.5	–509	7.6	–927
LA 4	West Johnson's Bayou	Intermediate Marsh	5.9	–60	7.3	–269	8.0	–275
LA 5	Sabine Lake Ridges	Intermediate Marsh	5.9	–43	7.3	–218	8.0	–269
LA 7	Southeast Sabine	Intermediate (Brackish lumped)	2.2	–1	2.4	0	2.6	–1
LA 8	Southwest Gum Cove	Intermediate (Brackish lumped)	2.9	0	3.9	–4	4.9	–62
LA 9	East Johnson's Bayou	Intermediate Marsh	4.0	–2	4.8	–190	5.6	–449
Brackish Marsh (optimal salinity range ≤10 ppt)								
LA 2	Willow Bayou	Brackish Marsh (shifts from intermediate)	NA	NA	NA	NA	8.9	–29
LA 2	Willow Bayou	Brackish Marsh	6.3	1	8.6	–1	9.3	–1
LA 3	Black Bayou	Brackish Marsh	3.7	0	5.3	–1	6.6	–3
LA 4	West Johnson's Bayou	Brackish Marsh (shifts from intermediate)	NA	NA	NA	NA	7.7	–46
LA 4	West Johnson's Bayou	Brackish Marsh	5.1	0	7.0	–1	7.9	–2
LA 5	Sabine Lake Ridges	Brackish Marsh (shifts from intermediate)	NA	NA	NA	NA	7.7	–26
LA 5	Sabine Lake Ridges	Brackish Marsh	6.0	13	8.3	–14	10.6	–77
LA 6	Johnson's Bayou Ridge	Brackish Marsh	5.5	–2	7.0	–6	7.9	–9
Saline Marsh (optimal salinity range ≥9 ≤21 ppt)								
LA 5	Sabine Lake Ridges	Saline Marsh	15.3	–31	17.3	–35	19.2	–40
LA 6	Johnson's Bayou Ridge	Saline Marsh	15.3	–1	17.3	–2	19.2	–20
Range of AAHUs (95 Percent Confidence Range)				14		0		0

*95 percent confidence range for saline and brackish marshes is equivalent to mean salinity ± 2 standard deviations; for swamps, fresh, and intermediate marshes, it is equivalent to mean high 33 percent continuous salinity ± 1 standard deviation.

Table 30: Land Loss Impacts (95 Percent Confidence Range)

Hydro-Unit #	Hydro-Unit Name	Habitat Type	FWOP Land Loss		FWP Incremental Land Loss - 95 Percentage Confidence Range					
					Low Range Salinity		Most Likely Salinity		High Range Salinity	
			Land loss acres	Hydro-Unit %	Land loss acres	Hydro-Unit %	FWP land loss	Hydro-Unit %	Land loss acres	Hydro-Unit %
Fresh Marsh										
LA 1	Perry Ridge	Fresh Marsh	–921	–6.2	–21	–0.1	–50	–0.3	–106	–0.7
LA 7	Southeast Sabine	Fresh Marsh	–40	–2.0	–1	0.0	0	0.0	–2	–0.1
LA 8	Southwest Gum Cove	Fresh Marsh	–153	–4.4	–1	0.0	–8	–0.2	–15	–0.4
Intermediate Marsh										
LA 1	Perry Ridge	Intermediate Marsh	–191	–6.3	0	0.0	–11	–0.4	–22	–0.7
LA 2	Willow Bayou	Intermediate Marsh	–2,117	–1.9	–1	0.0	–102	–0.5	–4	–0.0
LA 3	Black Bayou	Intermediate Marsh	–1,713	–7.0	–19	–0.1	–131	–0.5	–121	–0.5
LA 4	West Johnson's Bayou	Intermediate Marsh	–1,703	–4.4	–1	0.0	–142	–1.4	–12	–0.1
LA 5	Sabine Lake Ridges	Intermediate Marsh	–1,103	–13.5	–4	–0.3	–93	–1.1	–29	–0.4
LA 7	Southeast Sabine	Intermediate (Brackish lumped)	–96	–2.0	–2	–0.1	–1	0.0	–2	–0.1
LA 8	Southwest Gum Cove	Intermediate (Brackish lumped)	–234	–4.4	–1	0.0	–15	–0.3	–25	–0.5
LA 9	East Johnson's Bayou	Intermediate Marsh	–895	–4.0	–6	0.0	–46	–0.2	–84	–0.4
Brackish Marsh										
LA 2	Willow Bayou	Brackish Marsh (shifts from intermediate)	NA	NA	NA	NA	NA	NA	–87	–0.4
LA 2	Willow Bayou	Brackish Marsh	–695	–61.7	1	0.1	–2	–0.2	–4	–0.3
LA 3	Black Bayou	Brackish Marsh	–803	–27.2	–1	0.0	–5	–0.2	–10	–0.3
LA 4	West Johnson's Bayou	Brackish Marsh (shifts from intermediate)	NA	NA	NA	NA	NA	NA	–113	–1.2
LA 4	West Johnson's Bayou	Brackish Marsh	–1,188	–65.4	0	0.0	–6	–0.4	–10	–0.6
LA 5	Sabine Lake Ridges	Brackish Marsh (shifts from intermediate)	NA	NA	NA	NA	NA	NA	–67	–0.9
LA 5	Sabine Lake Ridges	Brackish Marsh	–2,567	–17.6	40	0.3	–43	–0.3	–124	–0.9
LA 6	Johnson's Bayou Ridge	Brackish Marsh	–707	–28.9	–5	–0.2	–22	–0.9	–36	–1.5
Saline Marsh										
LA 5	Sabine Lake Ridges	Saline Marsh	–399	–12.6	–3	–0.1	–10	–0.3	–22	–0.7
LA 6	Johnson's Bayou Ridge	Saline Marsh	–93	–26.9	–2	–0.6	–5	–1.5	–8	–2.3
Range of Land Loss		Total Acres and Percentage of Total Emergent Acres	–15,618	–10.5	–27	0.0	–692	–0.5	–903	–0.6

expected to expand at the expense of intermediate marsh, as described below. The highest impacts would be seen in the Sabine Lake Ridges brackish marsh where the highest potential salinity is predicted to be 10.6 ppt, only marginally suboptimal as defined by the WVA model.

For saline and brackish marshes combined, AAHU losses could range from 20 to 253 AAHUs, as compared to the FWP loss of 60 AAHUs. Overall, impacts at the highest potential salinity would not threaten the sustainability of any of the brackish and saline marshes in the study area over the period of analysis. Salinities remain within or close to the optimal range for each vegetation community, and incremental land loss is small. Land loss could range from 40 to 481 acres, and the maximum percentage loss in a single hydro-unit could be 2.3 percent in the saline marsh of Johnson's Bayou Ridge. When compared to the total acres of brackish and saline emergent marsh in the Louisiana portion of the study area, the highest potential loss of 481 acres would represent a loss of 1.8 percent. For salinities at the low end of the range, small benefits (positive AAHUs) were predicted by the WVA model.

Salinity impacts to fresh and intermediate marshes, cypress-tupelo swamps, and bottomland hardwoods were evaluated using a different statistic required by the WVA model – the mean high salinity. The HS model generated this statistic in accordance with the definition provided in the WVA Models Procedural Manual (USFWS, 2002b). It measures the mean of the highest continuous 33 percent of salinity values (mean high salinity) during a specific period of record. This statistic captures the effect of periodic pulses of higher salinity associated with reduced freshwater inflow or tidal surge. Standard deviations of mean high salinity values were calculated by the Galveston District with the assistance of ERDC-CHL, using output from an exceedance analysis performed as part of the HS modeling study. For the mean high salinity, a range equal to ± 1 standard deviation provides impact predictions at the 95 percent confidence level. The mean high statistic is generally equivalent to the high range of the 68 percent confidence level, and therefore application of ± 1 standard deviation broadens the range to the 95 percent confidence range (Steel and Torrie, 1976).

The largest range of potential impacts would occur within the intermediate marsh community. These marshes are located east of Sabine Lake and are buffered by a band of brackish marsh along the lakefront. Salinity impact predictions for the fresh and intermediate vegetation communities are associated with periods of higher salinity, which generally occur in late summer and early fall, when lower rainfall reduces freshwater inflow from the Sabine and Neches rivers. These pulses change salinities in upper Sabine Lake from almost fresh to brackish, and can remain at high levels for several weeks to months. Similar conditions can occur in association with high tides and storm surges associated with tropical storms and hurricanes. FWOP pulses of higher salinity for the majority of intermediate marsh habitats are expected to be suboptimal; only hydro-units with no frontage on Sabine Lake would remain within the optimal range.

The sensitivity analysis yielded a maximum salinity range of 1.0 to 8.0 ppt within intermediate marshes that remain intermediate, as compared to the FWP predicted range of 2.4 to 7.7 ppt. However, three large areas of intermediate marsh adjacent to the southern part of Sabine Lake (Willow Bayou, 35,109 acres;

West Johnson's Bayou, 11,110 acres; and Sabine Lake Ridges, 9,270 acres) would be expected to convert to brackish marsh about 20 years after project construction. High-range salinities in all but one of the remaining intermediate marshes would push the marshes further into suboptimal range. Salinity in only one hydro-unit (Southeast Sabine) would remain within the optimal range.

Impacts to intermediate marshes represent 92 percent of total FWP impacts. AAHU losses for the intermediate marshes could range from 312 to 2,407 AAHUs, as compared to the FWP loss of 1,571 AAHUs. Overall, impacts at the highest potential salinity would likely result in the conversion of large areas of intermediate marsh to brackish marsh, especially in the marshes east of Sabine Lake. Land loss could range from 34 to 541 acres, and the maximum percentage loss in a single hydro-unit could be 1.4 percent in West Johnson's Bayou. When compared to the total acres of intermediate emergent marsh in the Louisiana portion of the study area, the highest potential loss of 541 acres would represent a loss of 0.5 percent. While the highest range of potential impacts would not be expected to threaten the long-term sustainability of the overall marsh community, the diversity of habitats and the fish and wildlife species they support would be reduced with the conversion of large areas of formerly intermediate marsh to brackish marsh.

For the fresh marsh communities, the sensitivity analysis yielded a maximum salinity range of 1.4 to 3.1 ppt, as compared to the most likely salinity range of 2.0 to 2.4 ppt. AAHU losses could range from 8 to 477, as compared to the mostly likely loss of 78 AAHUs. Periodic pulses of higher salinities in all of the fresh marsh communities would be suboptimal for most of the salinity range, but not to the extent that conversion to intermediate marsh would likely result. The percentage incremental increase in land loss within fresh marsh is less than predicted for the intermediate marshes, ranging between 0 and 0.7 percent for any individual hydro-unit. The total number of acres predicted to be lost ranges from 23 to 123, or a maximum of 0.6 percent of total emergent fresh marsh in the Louisiana portion of the study area. The highest potential salinity would not threaten the sustainability of the fresh marsh communities, and incremental land loss is small.

For cypress-tupelo swamps, the sensitivity analysis yielded a potential salinity range of 0.0 to 1.5 ppt, compared to the most likely range of 0.0 to 0.9 ppt. In the uppermost reaches of the Sabine River, only a minimal increase in salinity over normal fresh conditions (0.2 ppt) is predicted even at the high end of the range. The Blue Elbow swamp could experience salinities ranging from 0.3 to 1.5 ppt, with the highest potential salinity extending into the suboptimal range. AAHU losses could range from 0.0 to 9.0, with no impact predicted to be most likely. Even at the maximum salinity, salinity levels would not be suboptimal to the extent that sustainability of the swamp forest would be threatened. Studies indicate that mean salinities must exceed 4 ppt before swamp forest converts to marsh habitat (Visser et al., 2004).

No impacts would be expected in the bottomland hardwood habitats at the maximum range of salinity predicted by the sensitivity analysis (3.1 ppt at Perry Ridge). Located on higher ridges or terrace margins and buffered by intervening swamp and marsh, this community would only occasionally be exposed to

the higher salinities present in the surrounding marshes. No loss of bottomland hardwood acreage is predicted.

9.4.1.3 Conclusions

The salinity sensitivity analysis of the WVA models demonstrated that there is a wide range of potential outcomes in AAHU losses attributable to uncertainties in salinity predictions. These outcomes range from a loss of 340 to 3,146 AAHUs within the 95 percent confidence range of salinity, the primary driver in the EMCM and SCM. After adjustments for the Gulf Shore BU Feature benefits (210 AAHUs) and the BU offset of impacts to Federal lands (340 AAHUs), losses could range from zero to 2,596 AAHUs. Based on the cost per AAHU of the recommended mitigation plan ($77.5 million; 1,181 AAHUs), the cost of compensatory mitigation could range from $0 to about $170 million. The total predicted FWP loss of 1,499 AAHUs in Louisiana is based upon forecasts of the most likely salinity levels and takes into account the potential FWOP effects of RSLR and changes in future freshwater inflows. The recommended mitigation plan contains sufficient mitigation to ensure that the selected plan will not have more than negligible impacts on the ecological resources of the project area.

However, in light of the uncertainties in the projection of salinity change due to the project, it is recommended that salinities before, during, and after construction of the SNWW CIP be monitored by USACE for evidence that the salinity levels associated with implementation of the Preferred Alternative are significantly different than predicted. Salinity data, routinely collected throughout the study area by several State and Federal agencies, can be gathered and applied for this purpose.

9.4.2 Percent Emergent Marsh Sensitivity Analysis

9.4.2.1 Methods

One hundred percent of Louisiana impacts predicted by the ecological model were made using the WVA EMCM. The most highly weighted variable in this model is V_1 (percent emergent marsh). This parameter is considered most significant because persistent emergent vegetation provides foraging, resting, and breeding habitat for a variety of coastal fish and wildlife species. Detritus from coastal marshes also provides a source of mineral and organic nourishment for organisms at the base of the food chain. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by these systems disappear. Changes in the value of this parameter were predicted by relating changes in salinity to changes in marsh loss using a process that is described in FEIS Section 4.10. The salinity sensitivity analysis, above, includes an analysis of the effect of different salinities in land loss projections and productivity impacts.

This sensitivity analysis explores the effects of an assumption that underlies the valuation of emergent marsh in this variable. The SNWW application of this model uses the same assumptions adopted by the EnvWG in its application of the model to CWPPRA restoration projects (USFWS, 2002b). In this model, optimal vegetative coverage is assumed to be 100 percent (SI = 1.0) for all marsh types (V_1-Original).

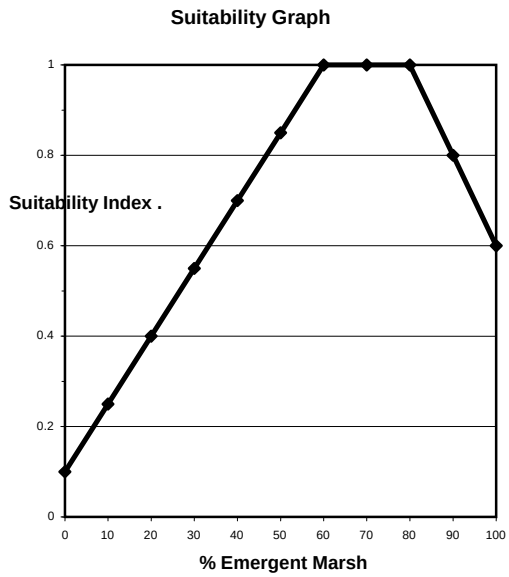
This assumption diverges from the general biological understanding that optimum cover falls in the 60–80 percent range, but it was adopted by the EnvWG to reflect CWPPRA's objective of long-term marsh creation and restoration. Questions have arisen as to whether maximizing the value of marsh coverage is appropriate for the SNWW application in which the primary purpose is the identification of project impacts and compensatory mitigation.

Selection of 100 percent marsh cover as the optimal habitat condition (V_1-Original) for the SNWW application was based upon several factors. Loss of emergent coastal marsh is a serious existing condition in the study area, and it is assumed that this loss would continue and most likely accelerate due to an increased rate of RSLR (NOAA-USDC, 2006; IPCC, 2007). Existing and potentially increased marsh loss associated with channel deepening has been identified as one of the highest concerns by resource agencies and the general public. The V_1-Original model assumption maximizes the value of emergent marsh when measuring impacts or determining compensatory mitigation. Maximizing the value of emergent marsh over associated shallow-water habitat is based upon the important ecological concept of long-term sustainability. With the SNWW project, marshes would continue to degrade over the 65-year period of analysis due to the effects of RSLR. Without the associated marshes, the small open-water areas would lose their value as nursery habitat, becoming open bay or open Gulf habitat. When marshes are restored to levels that will ensure sustainability for a minimum of 50 years postconstruction, small channels and ponds would be created naturally because of the ongoing effects of RSLR and salinity increases. Restoration or mitigation projects generally need to maximize the creation of emergent marsh, so as to ensure the sustainability of the land itself.

To evaluate the effect of this assumption on the SNWW application, the EMCM was rerun using a revised formula for the variable in which optimal vegetative coverage (SI = 1.0) is assumed for a marsh coverage of 60 to 80 percent (V_1-Revised). At the request of USACE, USFWS provided the revised formulas, suitability index graph (Figure 17), and revised worksheets specifically for this sensitivity analysis. The graph illustrates the assumption that underlies V_1-Revised. The value of the percentage of emergent marsh (versus the percentage of open water) is assumed to rise linearly from an SI value of 0.1 at zero percent emergent marsh to an SI of 1.0 for marsh coverage between 60 and 80 percent. The SI value of marsh above 80 percent then drops linearly to an SI of 0.6 at 100 percent marsh coverage. The graph for the V_1-Original (not illustrated) rises linearly from an SI value of 0.1 at zero percent emergent marsh to an SI of 1.0 for marsh coverage of 100 percent.

Using the V_1-Revised assumption, the model was rerun to calculate impacts to marsh communities in all of the Louisiana hydro-units and for the proposed compensatory mitigation measures. No adjustments were necessary to any of the parameter values, as they were not affected by the change in SI formula. In addition, there was no need to rerun the land loss spreadsheets since none of the assumptions that underlie that impact prediction were affected by the SI formula change.

Figure 17: Revised Suitability Index Graph for $V_{1\ \mathbf{Percent}}$ Emergent Marsh



V_1-Revised Line Formula (all marsh types)

If $0 \leq \% < 60$, then SI = (0.015 * %) + 0.1

If $60 \leq \% \leq 80$, then SI = 1.0

If % > 80, then SI = (–0.02 * %) + 2.6

9.4.2.2 Analysis

The results of the percent emergent marsh sensitivity analysis on project impacts are shown in Table 31. Overall, impacts dropped 3 percent when V_1-Revised was used. WVA worksheets were reviewed to determine which hydro-units were affected most by the revised formula. As would be expected, the smallest percentage changes would occur in marshes where the percent emergent marsh remained between 60 and 80 percent for both the FWOP and FWP conditions.

If the V_1-Revised formula were used to calculate the mitigation target for the SNWW CIP, it would be 1,078 AAHUs. A comparison of the V_1-Original and V_1-Revised mitigation targets is presented in Table 32. To calculate the mitigation target, it was necessary to recompute compensation that would be earned by recommended mitigation measures and the Louisiana Gulf Shore BU Feature. WVA EMCM worksheets for these measures were rerun using the V_1-Revised formula shown above. A comparison of the compensation earned using both formulae is shown in Table 33.

Table 31: V_1 Revised Sensitivity Analysis – Comparison of Impact Predictions

HU #	Hydrologic Unit	Habitat Type	FWP Impacts (AAHUs)	V_1 Sensitivity Impacts (AAHUs)
LA 1	Perry Ridge	Bottomland Hardwood	0	NA
LA/TX 1	Sabine Island	Bottomland Hardwood	0	NA
LA/TX 1	Sabine Island	Cypress/Tupelo Swamp	0	NA
LA/TX 2	Blue Elbow	Cypress/Tupelo Swamp (Bottomland Hardwood lumped)	0	NA
LA 1	Perry Ridge	Fresh Marsh	–65	–61
LA 7	Southeast Sabine	Fresh Marsh	–11	–11
LA 8	Southwest Gum Cove	Fresh Marsh	–2	–2
LA 1	Perry Ridge	Intermediate Marsh	–53	–53
LA 2	Willow Bayou	Intermediate (Brackish lumped)	–328	–339
LA 3	Black Bayou	Intermediate Marsh	–509	–502
LA 4	West Johnson's Bayou	Intermediate Marsh	–269	–254
LA 5	Sabine Lake Ridges	Intermediate Marsh	–218	–208
LA 7	Southeast Sabine	Intermediate (Brackish lumped)	0	0
LA 8	Southwest Gum Cove	Intermediate (Brackish lumped)	–4	–3
LA 9	East Johnson's Bayou	Intermediate Marsh	–190	–173
LA 2	Willow Bayou	Brackish Marsh	–1	–1
LA 3	Black Bayou	Brackish Marsh	–1	–1
LA 4	West Johnson's Bayou	Brackish Marsh	–1	–2
LA 5	Sabine Lake Ridges	Brackish Marsh	–14	–9
LA 6	Johnson's Bayou Ridge	Brackish Marsh	–6	–2
LA 5	Sabine Lake Ridges	Saline Marsh	–35	–34
LA 6	Johnson's Bayou Ridge	Saline Marsh	–2	–1
Total			–1,709	–1,656

Table 32: Comparison of Louisiana Impacts with V_1 Sensitivity

Net FWP Impacts for Project (AAHUs)	(444)	
	Original V_1 (AAHUs)	Revised V_1 (AAHUs)
Total FWP Impacts in Louisiana	–1,709	–1,656
Benefits of Gulf Shore BU Feature	210	235
Net FWP Louisiana Impacts	–1,499	–1,421
Reduced by Sabine NWR Impacts	340	343
FWP Mitigation Target for Louisiana (Total State Impacts less Sabine NWR Impacts)	**–1,159**	**–1,078**

Table 33: V_1 Sensitivity Analysis – Comparison of Compensatory Mitigation Computation

Mitigation Measures	Best Buy Plan #6 (AAHUs)	V_1 Sensitivity of Best Buy Plan #6 (AAHUs)	V_1 Sensitivity of Modified Best Buy Plan #6 (AAHUs)
Willow Bayou			
LA 2-18B Marsh Restoration (Sabine Lake Dredging)	152	98	108
LA 2-ADD B Marsh Restoration (Sabine Lake Dredging)	214	168	167
Black Bayou West			
LA 3-10R Marsh Restoration (Sabine River Channel Maintenance Material)	198	177	185
Black Bayou East			
LA 3-15B Marsh Restoration (GIWW Dredging)	307	223	248
LA 3-18B Marsh Restoration (GIWW Dredging)	310	164	203
Total	1,181	830	911
Mitigation Target	1,159	1,078	1,078
Net Excess or Deficit	22	–248	–167

The amount of credit (in AAHUs) earned by the proposed marsh mitigation measures would decrease by about 30 percent with the V_1-Revised formula. This is to be expected since no additional credit is earned by any marsh fill that exceeds 80 percent. The percentage of emergent marsh relative to open water ranges from 81.0 to 86.4 percent in the five recommended mitigation areas. Filling above 80 percent was considered desirable by the Louisiana agencies because of the significant existing rate of RSLR and the uncertainties associated with an unknown increase in the rate of RSLR due to climate change. It was decided that the mitigation features should maximize the creation of emergent marsh, so as to ensure the sustainability of the land itself. In addition to the creation of small channels during construction, it is expected that small channels and ponds would establish themselves naturally with the gradual increase in RSLR. It also appears that filling above 80 percent would be more cost effective because greater benefits are earned over the same area, as costs for longer pumping distances and additional pipe movement that would be needed to fill a lower percentage over a greater area were avoided.

If V_1-Revised were used to compute compensatory mitigation as it is currently designed, mitigation costs would increase by at least 42 percent to meet the V_1-Revised mitigation target. The V_1-Revised mitigation plan would need to provide an additional 248 AAHUs (see Table 33). Based upon the cost per acre of the recommended mitigation plan, the additional cost would at least equal that of the last two added increments of mitigation (LA 2-18B and LA 2-ADD B). Together, these mitigation measures would provide 266 AAHUs at a first cost of construction of $33.5 million (October 2009 price level). Costs would likely be higher, however, as the incremental cost of each AAHU would be more than the measures already selected.

If the same five mitigation measures were redesigned so that marsh fill would never exceed 80 percent (see V_1-Sensitivity Modified Best Buy Plan #6 in Table 33), the amount of restored acres would drop from 2,696 to 2,215 acres. However, compensation as measured with the V_1-Revised formula would increase from 830 to 911 AAHUs, and the number of additional AAHUs needed to meet the V_1-Revised mitigation target would be 167 AAHUs. Based upon the cost of the recommended mitigation plan, it is estimated that the total mitigation cost would be about 3 percent greater than the recommended mitigation plan. More significantly, the modified plan would restore about 18 percent fewer acres and do less to ensure the long-term sustainability of the marsh than the recommended mitigation plan.

9.4.2.3 Conclusions

It is obvious, therefore, that the V_1-Original assumption is most advantageous for the computation of mitigation. The WVA model assessment (LBG and TEA, 2008) confirmed that the original model assumption applied for variable V_1 (e.g., optimal vegetative coverage is assumed to be 100 percent) is appropriate for the SNWW application in computing both impacts and mitigation, as it reflects the importance of emergent vegetation as habitat for this study area.

Given serious existing rates of marsh loss, the predicted increase in marsh loss in the FWP condition, and uncertainties related to salinity and land loss impacts due to the project, it is reasonable and appropriate to

utilize the assumption that maximizes the value of emergent marsh to the sustainability of the marsh system. Without the structure provided by the emergent marsh, the majority of the ecological benefits provided by these systems disappear. In addition, use of the V_1-Original assumption provides a larger margin of protection for the mitigation that is being proposed.

9.5 RECOMMENDATIONS RESULTING FROM THE WVA SENSITIVITY ANALYSES

The recommended compensatory mitigation plan is based upon the most likely range of salinity change as established by the HS model, scientifically based projections of changes in habitat resulting from the predicted salinity change, and the professional judgment and knowledge of the area by the large team of natural resource and engineering professionals who applied the HS and WVA models to the SNWW CIP. The HS model was developed and applied by experts at ERDC-CHL, with oversight from engineers and HS modeling experts from the TWDB, TPWD, and LDNR. The ICT Habitat Workgroup contained professionals with expertise in wetland impact evaluation, marsh restoration, wetland forest management, aquatic habitat evaluation, freshwater and marine fisheries, terrestrial and avian wildlife biology, as well as natural resource management personnel from all of the protected lands in the study area.

In addition, the recommended mitigation plan maximizes the value of emergent marsh when measuring impacts and determining compensatory mitigation for project-related losses to this nationally significant, endangered resource. It uses the V_1-Original assumption (e.g., optimal vegetative coverage is assumed to be 100 percent) to predict project impacts and compute compensatory mitigation. For these reasons, no changes to the recommended mitigation plan are proposed as a result of this sensitivity analysis. It is recommended that Best Buy Plan #6 mitigation plan (described in FEIS Section 5) be selected as it incorporates the level of compensation needed to address the most likely impacts of the SNWW CIP.

10.0 REFERENCES

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Attachment 1

Wetland Value Assessment Model Approved for Use Memorandum

DEPARTMENT OF THE ARMY
SOUTH ATLANTIC DIVISION, CORPS OF ENGINEERS
ROOM 9M15, 60 FORSYTH ST., S.W.
ATLANTA, GEORGIA 30303-8801

REPLY TO
ATTENTION OF
CESAD-PDS-P

30 June 2009

MEMORANDUM FOR

COMMANDER, HQ USACE (CECW-PC/Bruce D. Carlson)
COMMANDER, SOUTHWEST DIVISION (CESWD-PDS-P/JoAnn M. Duman)

SUBJECT: Wetlands Value Assessment Model Assessment Report - Recommendation for Use for the Sabine-Neches Waterway Study, Galveston District

1. References:

a. EC 1105-2-407 Planning Models Improvement Program: Model Certification (CECW-CP, 31 May 2005).

b. Memorandum, CECW-CP, 13 August 2008, Subject: Policy Guidance on Certification of Ecosystem Output Models.

c. Model Assessment Support to Ecosystem Planning Center of Expertise For Wetland Value Assessment Model Application in the Sabine Neches Waterway Channel Improvement Project.

d. Final Wetland Value Assessment Model Application in the Sabine-Neches Waterway (SNWW) Channel Improvement Project Model Assessment Report prepared by The Louis Berger Group, Inc. and Toxicological and Environmental Associates, April 2008.

2. The Deep Draft Navigation Planning Center of Expertise (DDN-PCX) in consultation with the National Ecosystem Planning Center of Expertise (ECOPCX) has evaluated the use of the Wetland Value Assessment (WVA) Model for use in the plan formulation of channel improvements to the SNWW in accordance with references 1.a. and 1.b. above. The assessment followed the scope of work in reference 1.c above. The report, reference (d) concluded that the application of the WVA Marsh, Swamp, and Bottomland Hardwood Community Models to the SNWW Feasibility Study had: (a.) valid theoretical approaches within the context of USACE guidelines; (b.) provided reasonable descriptions of system habitats; (c.) identified habitat structural components and functional processes; (d.) assessed damages that may result from the project using habitat units; (e.) included appropriate variables; and (f.) used appropriate and accurate formulas in a spreadsheet format.

3. Based on these findings we concur that the WVA Marsh, Swamp, and Bottomland Hardwood Community Models are certified for use in the SNWW Feasibility study.

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Appendix D

Dredged Material Management Plan

APPENDIX D

ENVIRONMENTAL IMPACT STATEMENT
SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT, TEXAS
DREDGED MATERIAL MANAGEMENT PLAN

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
GALVESTON DISTRICT
SOUTHWESTERN DIVISION

June 2010

Printed on recycled paper

APPENDIX D
SABINE-NECHES WATERWAY, TEXAS AND LOUISIANA
CHANNEL IMPROVEMENT PROJECT
DREDGED MATERIAL MANAGEMENT PLAN

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ACRONYMS

AO	allowable overdepth
BU	beneficial use
CG	Construction General
CIP	Channel Improvement Project
CPT	cone penetrometer testing
cy	cubic yards
DAMP	Disposal Area Management Plan
DMMP	Dredged Material Management Plan
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Development Center
FEIS	Final Environmental Impact Statement
FFR	Final Feasibility Report
GIWW	Gulf Intracoastal Waterway
HTRW	hazardous, toxic, and radioactive waste
ICT	Interagency Coordination Team
JCND	Jefferson County Navigation District
LPP	Locally Preferred Plan
mcy	million cubic yards
NWP	New Work Plan
O&M	operations and maintenance
ODMDS	Ocean Dredged Material Disposal Sites
PA	placement area
PED	Preconstruction Engineering and Design
psf	per square foot
SH	State Highway
SNND	Sabine Neches Navigation District (SNND
SNWW	Sabine-Neches Waterway
TCB	Turner Collier Braden, Inc.
TPWD	Texas Parks and Wildlife Department
TxDOT	Texas Department of Transportation
URS	URS Corporation
USACE	U.S. Army Corps of Engineers

1.0 PURPOSE

The purpose of the Dredged Material Management Plan (DMMP) is to guide the Federal and non-Federal sponsors in the placement of material to be dredged from the Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) for the 50-year period of analysis. This DMMP would apply to both construction (new work) and maintenance dredging.

The DMMP was developed by the U.S. Army Corps of Engineers (USACE), Galveston District, the Sabine Neches Navigation District (SNND), and the SNWW Interagency Coordination Team (ICT). The DMMP includes the use of construction and maintenance material for marsh restoration and Gulf shore nourishment, and modification of existing practices for the remaining construction and maintenance material.

2.0 DESCRIPTION OF EXISTING AND CIP

2.1 EXISTING SNWW PROJECT

The existing Sabine-Neches Waterway (SNWW) extends from the Gulf of Mexico through a jettied entrance at the mouth of Sabine Pass through Port Arthur, and up the Neches River into Beaumont, Texas (Drawing G-01 in Appendix 1 of the Final Feasibility Report [FFR]). It is 63.8 miles in length and has a 40-foot authorized depth. Channel dimensions for the 40-foot project are shown in Table 2-1.

Table 2-1: Existing 40-Foot Authorized Channel Dimensions

Reach	Station	to	Station	Bottom Width (feet)	Project Depth (feet MLT)	Channel Depth (feet MLT)	Allowable Overdepth (feet)	Side Slope
Sabine Bank Channel	95+734		18+000	800	42	44	2	1V/2H
Sabine Pass Outer Bar	18+000		0+000	800	42	44	2	1V/10H
Sabine Pass Jetty Channel	–214+88		0+00	800–500	40	42	2	1V/2H
Sabine Pass Channel	0+00		296+24	500	40	42	2	1V/2H
Port Arthur Canal	0+00		326+24	500	40	42	1	1V/2H
Sabine-Neches Canal	0+00		593+69	400	40	42	1	1V/2H
Neches River Channel	0+00		978+60	400	40	42	2	1V/2H
Taylor Bayou								
Entrance Channel	0+00		19+05	275–678	40	42	1	1V/2H
East Turning Basin	0+00		17+65	420	40	42	1	1V/2H
West Turning Basin	19+05		31+10	600	40	42	1	1V/2H
Connecting Channel	31+10		61+30	200–250	40	42	1	1V/2H
Taylor Bayou Turning Basin	61+30		96+00	1000	40	42	1	1V/2H

Channel Depth includes Advance Maintenance depth – there is a constant 2 feet for the entire waterway.
Existing stationing applies to this table.
^Entrance Channel and East and West Turning Basins are also called “Port Arthur Turning Basins.”

2.2 PROPOSED SNWW CIP

The SNWW CIP would deepen the navigation channel to 48 feet and extend the channel an additional 13.2 miles into the Gulf of Mexico (Drawing G-02 in Appendix 1 of the FFR), resulting in a total SNWW CIP length of 77 miles (Table 2-2). Proposed project channel reaches are illustrated in drawings C-01 through C-12 in Appendix 1 of the FFR. The Channel to Orange is considered part of the SNWW system but it is not a part of this study.

Table 2-2: Proposed SNWW CIP 48-Foot Project Dimensions

Reach	Station	to	Station	Bottom Width (feet)	Project Depth (feet)	Side Slope
Extension Channel	165+443		95+734	700	50	1V/2H
Sabine Bank Channel	95+734		25+800	700	50	1V/2H
	25+800		23+300	700–800	50	1V/2H
	23+300		18+000	800	50	1V/2H
Sabine Pass Outer Bar	18+000		0+000	800	50	1V/10H
Sabine Pass Jetty Channel	–214+88		0+00	500–800	48	1V/2H
Sabine Pass Channel	0+00		296+25	1355–500	48	1V/2H
Port Arthur Canal	0+00		325+84	1660–500	48	1V/2H
Sabine-Neches Canal	0+00		592+94	1050–400	48	1V/2H
Neches River Channel	0+00		980+00	400–1413	48	1V/2H
Taylor Bayou						
Entrance Channel	0+00		25+27	406–764	48	1V/2H
East Turning Basin	0+00		17+65	532–354	48	1V/2H
West Turning Basin	25+27		41+30	776	48	1V/2H
Connecting Channel	41+30		71+50	470–250	48	1V/2H
Taylor Bayou Turning Basin	71+50		106+25	1000	48	1V/2H

3.0 GEOTECHNICAL INVESTIGATIONS

The level of geotechnical engineering performed for this report is fully sufficient to substantiate the recommended plan. Additional investigations and analyses, briefly outlined in Section 6.0 in accordance with ER 1110-2-1150, Appendix C-4, would be performed during both the Preconstruction Engineering and Design (PED) and Construction General (CG) phases of the project, and documented in a Design Documentation Report before each feature is constructed.

3.1 REGIONAL AND SITE GEOLOGY

3.1.1 Regional Geology

The project site, as shown on Drawing G-01 in Appendix 1 of the FFR, is located in the Coastal Plain physiographic province of Texas. This region contains marine sediments, mainly younger Holocene

deposits overlay older Pleistocene deposits. More-recent riverine overwash deposits overlay the Holocene sediments in floodplains in the Neches and Sabine rivers. The subdivision of the Coastal Plain in which the project lies is called the Coastal Prairie. This area is characterized by low-lying flat land and has evolved to its present conditions by erosion, deposition, compaction, and subsidence, all of which are still active. Gradual faulting continues as Pleistocene and older Gulf basin sediments continue to compact.

3.1.2 Site Geology

The site geology is characterized by modern marine deposits overlaying recent Holocene deposits that in turn overlay the Beaumont and Lissie formations of the Pleistocene Series. The modern deposits are generally normally consolidated clays, silts, and fine sands that were deposited through natural overwash and sedimentation processes or through man-made depositional processes. The recent deposits of the Holocene consist of silts, clays, silty sands, clayey sands, and clayey silts that exhibit the characteristics of normally to lightly overconsolidated materials. These deposits are generally encountered to depths of 30 to 40 feet.

Beaumont Clay is the predominant Pleistocene formation whose eroded surface forms the upper limit of stiff to very stiff clay material. It is red, yellow, and brown calcareous stiff clay that weathers into black or gray soil at the surface. Lenses of fine-grained, poorly graded sand and silt and a few calcareous nodules are sometimes encountered in this formation. The clay fraction is composed of montmorillonite (generally with calcium as the exchangeable cation), kaolinite, illite, and finely ground quartz, in that order of prevalence. The high percentage of montmorillonite accounts for the high shrink-swell potential of the material. Previous desiccation of the clays results in significant overconsolidation to great depths, with preconsolidation pressure approaching 3 tons per square foot. In addition to preconsolidating the soil, the desiccation process, along with occasional rewetting, has resulted in a network of fissures and slickensides that are now closed but that represent potential planes of weakness within the stratum. The thicknesses of these clays range from 25 to 400 feet. The Lissie Formation underlies the Beaumont and consists primarily of sands and silty sands.

3.2 FIELD EXPLORATION

Limited field investigations were conducted for this project. Those conducted were limited to cone penetrometer testing along the proposed levee alignments at selected placement areas. In addition, probings were taken at selected environmental features to evaluate near-surface foundation issues. The majority of the subsurface data for the project was compiled from existing data – data from the channel that were collected for the 40-foot project and data from placement areas that have been collected during periodic levee-raising projects. Site subsurface data are presented on drawings F-1 through F-6 in Appendix 1 of the FFR. Recommendations for additional geotechnical investigation, both project channel and placement areas along with associated laboratory testing are provided in Section 6.0.

3.2.1 Core Borings and Laboratory Testing

Where noted on the plans, core borings were previously drilled to explore the subsurface conditions along the channel and at some placement areas. Unless otherwise indicated, the borings were drilled to obtain 3-inch-diameter undisturbed continuous samples of cohesive materials and split-spoon, disturbed samples of cohesionless materials. Consistencies of cohesive materials were determined in the field using a pocket penetrometer or a Torvane Shear test apparatus. Where cohesionless materials were encountered, disturbed samples were taken at approximately 5-foot depth intervals during the performance of standard penetration tests.

Laboratory testing was generally conducted on representative samples. Tests on cohesive materials consisted of determining moisture content, unit dry weight, sieve analyses, liquid limit, and plastic limit. Sieve analyses were performed on typical samples of cohesionless materials. The results of these tests were used to classify the various material layers. Unconsolidated undrained shear strengths of typical samples of cohesive materials were determined in the laboratory by performing unconfined compression tests, single point Unconsolidated Undrained "Q" Triaxial compression tests, and Torvane Shear tests.

3.2.2 Off-channel Probings

Probings, using a 1.5-inch-diameter, capped PVC pipe, were conducted off channel in selected areas intended for restoration features. These probings were used to evaluate the open-water foundation conditions. These data were used to estimate the thickness of soft bay-bottom mud and determine how much displacement may occur during hydraulic fill construction. This information was incorporated into the conceptual level design of these features.

3.2.3 Cone Penetrometer Testing

Cone penetrometer testing (CPT) was conducted at selected placement areas (PAs) in 2002 to evaluate levee and levee foundation conditions. PAs 5, 8, 9, 11, 12, 13, 14, 23, 24, 25, and 27B were evaluated. Except at PA 25, the CPTs were conducted by the USACE Vicksburg District using their in-house, truck-mounted electric cone penetrometer. At PA 25, CPTs were conducted by Fugro, Inc. under subcontract to URS Corporation (URS). URS also reviewed the data and prepared soil profile drawings. These data were used to develop embankment design recommendations and to provide recommendations for additional exploratory studies.

At PA 9, in addition to taking CPTs along the perimeter levees, URS performed in situ vane shear tests at selected locations in PA 9 to confirm the Nk value selected for analysis of the CPT field data.

3.3 DESIGN CONSIDERATIONS

3.3.1 Selection of Preliminary Design Parameters

The geotechnical design parameters used to develop the features presented in this feasibility study are varied and range from the traditional geotechnical parameters for shear strength and consolidation to hydraulic dredging parameters for bulking, retention, and shrinkage. These preliminary design parameters were developed from a variety of sources. These sources include contractor work by URS, recent in-house experience with the construction of hydraulic levees, historic in-house data associated with dredged material placement, and local knowledge based on the historic performance of foundation soils at specific placement areas.

3.3.2 Shoaling Rate

Shoaling rates for the new channel were developed by the USACE's Coastal and Hydraulics Laboratory at the Engineer Research and Development Center (ERDC) in Vicksburg, Mississippi (Reference 1). The study evaluated the existing reaches and calculated a combined shoaling factor. Initially this study was developed for a 50-foot-deep channel. Subsequently, the model was revised to reflect the 48-foot channel. The conclusion of this report states that annual dredging quantity in the SNWW would increase from an average of 8.1 million cubic yards (mcy) per year (407 mcy over 50 years) for the current 40-foot project to 13.0 mcy per year (650 mcy over 50 years) for the proposed 48-foot project. Three of the reaches evaluated are located offshore of the jetties. On average, the shoaling increased by 12 percent through the offshore portion of the waterway due primarily to the increased length of the offshore channel. These new shoaling rates have been used to develop the DMMP.

3.3.3 Bulking Factor

The bulking factor is a design parameter primarily used to develop levee height requirements. The factor is greater than 1 and generally ranges between 1.3 and 1.8. The bulking process is a result of the structural disruption of the dredged sediments and the entrainment of water into the sediments during dredging. This factor is traditionally defined as the ratio of the volume occupied by the dredged material in the placement area immediately after completion of dredging to the volume occupied by the same material in the channel before dredging. The amount of bulking varies with the type of sediments and the method of dredging (mechanical or hydraulic). Other factors that affect bulking include size of dredge, horsepower, and residence time in the pipeline. For dredged material placed in upland PAs or used in environmental features, dredging would be conducted hydraulically. Sediments include both new work clay and sand and maintenance materials. Some maintenance materials reportedly contain high sand contents. Generally, fine-grained sediments bulk more (exhibit a larger bulking factor) than coarse-grained sediments, and maintenance material bulks more than new work. Bulking occurs during dredging operations. Upon completion of pumping, the PA is dewatered, and shrinkage of the newly placed dredge sediments begins. The bulked volume in conjunction with freeboard and ponding requirements is calculated to develop the required levee crest elevations.

$$Bulking\ Factor = \frac{(Volume\ of\ Dredged\ Material\ in\ Placement\ Area)}{(Volume\ in\ Channel\ Prior\ to\ Dredging)}$$

Bulking factors for each reach of the SNWW were developed by URS using available geotechnical data from channel borings. These values ranged from 1.8 in the reaches where clay predominated to 1.2 where more coarse-grained materials were encountered.

3.3.4 Retention Factor

The retention factor is a parameter used in the design of hydraulically constructed levees. The design of hydraulic levees includes the evaluation of the dredge fill material, levee foundation, site conditions, and construction methods (type, size, and horsepower of dredge and pipeline distance). Typically, the design provides a final levee template that incorporates all of these components through the use of a retention factor. This factor quantifies the fact that not 100 percent of the actual dredged quantity would fall within the desired template while constructing a hydraulic levee. A retention factor is therefore calculated as the ratio of the apparent volume of retained fill divided by the actual dredged quantity:

$$Retention\ Factor = \frac{(Volume\ of\ Retained\ Fill)}{(Actual\ Dredging\ Quantity)}$$

The retention factor is a single number that includes allowances for material degradation (i.e., clay ball degradation), displacement of the foundation, depth of water, amount and distribution of sand within the dredge cut, the dredging operation itself (type and size of dredge, number of booster pumps, type of cutterhead used, and control of the cutterhead), and relative difference between the design template and the natural angle of repose of the dredge fill.

Hydraulic levees would be utilized on this project for restoration features. These marsh restoration features would be constructed in water depths ranging from 2 to 5 feet. Based on the District's experience with similar construction projects on the Houston Ship Channel (Atkinson Island and Mid Bay Marsh), retention factors typically range from 0.35 to 0.45. These values have been incorporated into preliminary design for this plan. Additional design documentation for these features is located in Reference 2. During final design of these features, the retention factor along with other design parameters would be reevaluated using site-specific data.

Hydraulic levees are also planned for new levee construction at new upland PAs. At these sites, the contractor is afforded more control over the dredge fill because the fill surface is emergent. The use of dredged material for construction can be maximized by building containment dikes ("potato rows") on the inside of the PA and other specific construction methods. Similar projects have been constructed on the Houston Ship Channel (Spillman Island and Alexander Island). Retention factors ranging from 0.60 to 0.70 are expected with these construction methods.

3.3.5 Shrinkage Factor

The shrinkage factor is a design parameter used to evaluate the long-term storage capacity of a PA for use in developing the DMMP. It is defined as the ratio of the long-term volume occupied by a certain quantity of dredged material in a PA, to the volume it occupied in the channel prior to dredging. Generally, this parameter is associated with maintenance material, but may also be associated with new work material.

$$Shrinkage\ Factor = \frac{(Long\text{-}term\ Volume\text{-}Disposal\ Area)}{(Volume\ Occupied\text{-}Channel\ Before\ Dredging)}$$

This factor is a measure of volume change between dredging and the long-term condition. As with the retention factor, the shrinkage factor includes allowances for material type and degradation and the dredging operation (type and size of dredge, number of booster pumps, type of cutterhead used, and control of the cutterhead). Additional components that contribute to the shrinkage factor include consolidation of the dredged material due to self weight and desiccation, climatological conditions, and maintenance, including drainage and usage schedule of the PA.

Determination of a precise shrinkage factor for a PA can be a complex task and includes modeling the consolidation and desiccation shrinkage based on laboratory test data, climatological data, drainage characteristics, and operational characteristics. Based on the District's experience along the SNWW, shrinkage factors generally range from 0.55 to 0.75, with coarse-grained material exhibiting less shrinkage. Along this waterway, PAs usage varies from 2 to 6 years per cycle. In addition, very little maintenance (i.e., dewatering) is conducted on the PAs between cycles.

3.3.6 Shear Strength

Shear strength values have been considered for two conditions – channel slopes and placement area levee/embankment slopes. Where channel slopes would be excavated for the new template, long-term drained shear strengths are generally considered critical. Under these conditions, pore pressures increase with time as the excavated material is relieved of the overburden pressure. This increase in pore pressure reduces the shear strength of the soil. Where fill slopes are located such as the levee slopes of PAs, undrained shear strengths are generally considered critical. Under these conditions, pore pressures increase immediately as the foundation is surcharged with new fill. These elevated pore pressures reduce the shear strength of the soil. Overtime, pore pressures dissipate and some strength gain is realized.

Shear strength values and associated design parameters for channel slopes were derived from available subsurface data including boring logs and laboratory test data. Reviewed data included borings along the project channels, borings taken in association with referenced bridges, and borings taken in association with the hurricane flood protection levee.

Shear strength values and associated design parameters for new levee and raised levee construction at the upland placement areas were developed by URS from newly taken CPTs. These data included undrained shear strengths of the cohesive soils. The undrained shear strength assigned to the weakest layers was 500 pounds per square foot (psf). The shear strength of the dredged material was assumed to increase slightly with consolidation over time. An undrained shear strength of 700 psf was assigned to the partially consolidated dredged material. The shear strength of cohesionless soils was based on correlations between CPT data and angle of internal friction.

Recommendations for additional investigation and laboratory testing to refine the design parameters are provided in Section 6.0.

3.3.7 Consolidation

Foundation settlement was evaluated where new levees are planned and where levee raisings are planned. Settlement characteristics of the founding soils were developed from existing subsurface data including soil borings and CPT. Laboratory consolidation tests were not available for review, and no additional testing was conducted for this study. Instead, empirical consolidation relationships were used based on the observed consistency of field samples taken from soil borings and CPT results.

3.4 SLOPE STABILITY AND FOUNDATION CONCERNS

3.4.1 Project Channels

The project channels include three reaches offshore of the Sabine Pass jetties and five reaches onshore (Table 3-1). The existing slope angles for these channels would be maintained for the proposed deepening. Slope angles of 1V:2H are utilized on all channels except the Sabine Pass Outerbar where the slope angle is 1V:10H. The onshore reaches would be deepened to 48 feet while the offshore reaches would be deepened to 50 feet. The channel bottom width onshore is generally 400 feet, while the offshore is generally 700 feet.

Table 3-1: Reaches of the SNWW

Offshore Reaches	Onshore Reaches
Extension Channel	Sabine Pass Channel
Sabine Bank Channel	Port Arthur Canal (including Taylor Bayou)
Sabine Pass Outerbar	Sabine-Neches Canal
Sabine Pass Jetty Channel	Neches River Channel

Channel slope stability was generally evaluated by assessing the performance of the existing slopes through a review of the historic cross-section surveys. In addition, four typical channel cross sections were analyzed by URS for stability using the Modified Bishop analyses. Results indicated that adequate factors of safety were maintained with the deepened channel.

A more detailed analysis of channel slope stability was conducted at the Port Arthur Canal along the alignment of the hurricane flood protection levee as well as at the three bridge locations. This effort was conducted to determine the potential impact to these structures as a result of the channel deepening. These studies revealed potential impacts with corresponding resolutions (Table 3-2).

Table 3-2: Channel Stability Analyses along the SNWW

Location (owner)	Potential Impacts	Resolution
Port Arthur Canal and Sabine-Neches Canal – Hurricane Flood Protection Levee (JCND)	Destabilize toe of hurricane flood protection levee	Shift channel centerline away from the hurricane flood protection levee
Sabine-Neches Canal – Martin Luther King Bridge (TxDOT)	Undermine pile cap and expose tops of piles, destabilize pier protection	Construction of a hardened structure to protect pile cap, piles, and piers
Neches River Channel – Rainbow Bridge (TxDOT)	Destabilize pier protection system	Replace pier protection system
Neches River Channel – Memorial Bridge (TxDOT)	Destabilize pier protection system	Replace pier protection system

JCND = Jefferson County Navigation District
TxDOT = Texas Department of Transportation

3.4.2 Upland Placement Areas

Both existing and new upland PAs would be used for this project. At the existing PAs, new work material would be hydraulically stockpiled on the interior of the levees. Conceptually, this footprint would extend 100 feet into the interior and would ring the levee. It is expected that this stockpile would displace soft material at the interior toe of the levee and create a stable platform on which to build subsequent levees. At the new PAs, the new work material would be used to build hydraulic levees.

After initial construction with new work material, the design of the final perimeter levee heights for the next 50 years was guided by the results of the slope stability analyses. Conceptual level slope stability analyses were conducted by URS on the levees using the Modified Bishop Method and Taylor's Charts. Analyses were performed for each PA for the selected critical section using the least favorable subsurface conditions encountered at the PA as determined using the CPT data. The overall stability of the PAs (i.e., limit on the maximum height) was controlled by the strength of the partially consolidated dredged material. The levee setbacks were selected to provide an acceptable factor of safety with the anticipated relatively low strength of the partially consolidated dredged material. The minimum factor of safety was found to be 1.2 for slope heights not greater than 40 feet above the levee toe for the design slopes and assumed setbacks. Details of the conceptual level design by URS are included in references 7 and 8. More-detailed analyses of the various slope configurations would be required during subsequent levee-raising efforts for specific PAs.

3.4.3 Beneficial Use Features

Preliminary design for the marsh restoration and nourishment sites was conducted in part by Turner Collie & Braden, Inc. (TCB) in the document Feasibility Site Concept Beneficial Use (BU) Development

(Reference 2). The preliminary design of other features was conducted in-house. These designs included hydraulic levees, foundations, consolidation of dredged material, and slope stability. More-detailed design would be conducted during subsequent PED phases.

3.5 CONSTRUCTION ISSUES

3.5.1 Excavatability

The proposed deepening would entail dredging new work material. Based on a review of limited existing soil boring data taken during previous studies, the material would range from very soft to very stiff clay and loose to dense sand. No rock is anticipated, and blasting would not be required.

The new work material within the offshore reaches (sections 4, 3, 2, 1, A, B, C, and D) and the adjacent onshore reaches (sections 5 and 6) is likely to consist of soft clay with pockets of stiff clay; some sand may also be encountered. These reaches are located within the historic delta region of the Sabine and Neches rivers where normally lightly consolidated materials are located. Materials in this area may vary as the rivers' discharge meandered through the deltaic zone.

New work material within the onshore reaches of the Port Arthur and Sabine-Neches canals (sections 7, 8, 9, 10, and 11) would likely consist of stiff to very stiff clay. These canals are part of the land cut section of the waterway and were excavated early in the 1900s. The stiff consistency of this material can be attributed to the overconsolidation pressure of the material that was previously overlying the canals.

The Neches River channel is located upstream of the Sabine-Neches canal. The new work material for this channel (sections 12 through 18) would vary from stiff clay to medium-dense sand. These variations can be attributed to the historic meanders of the Neches River, although sand was more abundant in the soil samples from sections 15, 16, 17, and 18. In addition, historically the maintenance dredging in these reaches has contained significant amounts of sand.

Throughout the waterway, conventional dredging plants may be used to dredge the new work material. However, in order to achieve the intent of the new work plan (i.e., stockpiling new work material and building hydraulic levees), larger dredge plants may be required to minimize the degradation of the stiff new work clays (clayball material). Plant requirements should be clearly identified in developing the plans and specifications for this work,

3.5.2 Dredging

Channel deepening of the inshore reaches would require the use of pipeline dredges of sufficient size and power to pump the new work materials to the areas indicated. Hopper dredges would be required to utilize the offshore sites and be capable of precise location and discharge of loads. The dredging industry has sufficient plants and equipment available in this area as well as nationwide, which are capable of accomplishing this work.

3.5.3 Placement Areas

Much of the material to be dredged would consist of new work material made up of stiff clays. The current New Work Plan (NWP) identifies this material to be used for levee building, where new levees are planned, or stockpiling, where existing levees are located. In stockpiled areas, the objective is to use the more dense new work material to displace soft foundation materials on the inside of the existing levees and thus provide a stable platform for future levee raisings. In addition, material may be borrowed from these stockpiles for future levee raisings.

While the new work material is expected to "stack" and be well suited for the proposed construction, specific dredging practices may influence the degree to which this material would stack. These practices include pump distances, pump size, and handling of the pump discharge. Pipeline dredges of sufficient size and power would be required to excavate and pump new work dredged materials to and completely along the inside of the existing perimeter levees. This would require constant monitoring and moving of the dredge discharge pipeline to ensure that the new work clay balls are properly stacked and placed in the proper location along the existing levee side slopes. Stacking of materials in discharge corridors, other than along the inside slopes of existing levees, may be allowed, depending upon the final preparation of plans and specifications for each particular reach of channel. Care should be taken in developing the first contract, plans and specifications to dredge new work material, to ensure that the intent of the NWP is achieved.

3.5.4 Beneficial Use Features

The BU features have been identified to receive both new work and maintenance dredged materials and are further discussed in Section 5.3. With the exception of the shoreline nourishment features, these sites would generally consist of marsh restoration features. Difficult access (shallow water) would be encountered at each of the marsh restoration sites. These conditions would require the use of marsh buggies, marsh backhoes, and other pontoon-supported equipment, and airboats. In addition, the size of the sites may limit discharge capacity into the feature and may require the use of Y-valves for more-efficient use of the dredge plant.

4.0 DREDGED MATERIAL QUANTITIES

4.1 NEW WORK MATERIAL

The term "new work" refers to the material below the existing SNWW channel template, which is needed to be removed in order to increase to the new project depth. The new work material quantities were calculated using an overall surface *.dtm generated by the InRoads software program. The surface is a 3-D representation of the existing SNWW conditions for year 2001. Each channel or canal had its own existing template and proposed template. The template is a trapezoidal shape, defined by bottom width and side slopes. The proposed new template also includes a standard advance maintenance and the allowable overdepth per reach (see tables 4-2 and 4-3). New work material volumes by reach and proposed PAs (the NWP) are presented in Table 4-1.

Table 4-1: Sabine-Neches Waterway New Work Dredging Volumes for 48-foot LPP Plan

Channel Reach	Channel Stations	Water-way Section	New Work Material Designation (PA #)	Estimated New Work Dredged Volume (cy)**	New Work Material Construction	New Work Material Used for Construction Volume (cy)	New Work Material Surplus Volume (cy)
Sabine Bank Extension	165+443 to 150+500	D	PA D (Offshore)	4,201,000	0	0	0
	150+500 to 132+000	C	PA C (Offshore)	4,648,000	0	0	0
	132+000 to 114+000	B	PA B (Offshore)	5,296,000	0	0	0
	114+000 to 95+734	A	PA A (Offshore)	4,592,000	0	0	0
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	8,307,000	0	0	0
Sabine Bank Channel	53+000 to 18+000	2	PA 2 (Offshore)	7,051,000	0	0	0
Sabine Outer Bar	18+000 to 0+000	3	PA 3 (Offshore)	5,923,000	0	0	0
Sabine Pass Jetty Channel	–214+88 to 0+00	4	PA 4 (Offshore)	2,978,000	0	0	0
Sabine Pass Channel	0+00 to 186+00	5	PA 5 (N and S)	4,459,600	New Hyd. levee; 400-foot-wide stockpile	3,104,137	1,093,593
	186+00 - 296+25	6	PA 5B	2,263,600	400-foot-wide stockpile	1,362,051	
			PA 5C		400-foot-wide stockpile	1,163,419	
Port Arthur Canal	0+00 –240+00	7	PA 8	5,026,000	Stockpile in southwest corner	5,026,000	0
	240+00 –325+84	8*	PA 8	6,671,200	Stockpile in southwest corner	3,691,462	0
			PA 9A		300-foot-wide stockpile	1,898,938	0
			PA 9B		300-foot-wide stockpile	1,080,800	0
Sabine-Neches Canal	0+00 –170+00	9	PA 8	3,092,000	Stockpile in northeast corner	3,092,000	0
	170+00 –592+91	10	PA 11	8,852,000	Stockpile in north-south corners	8,852,000	0

Table 4-1 Cont'd)

Channel Reach	Channel Stations	Water-way Section	New Work Material Designation (PA #)	Estimated New Work Dredged Volume (cy)**	New Work Material Construction	New Work Material Used for Construction Volume (cy)	New Work Material Surplus Volume (cy)
Neches River Channel	0+00 –96+00	11	PA 12	1,628,000	100-foot-wide stockpile	1,135,764	74,029
			PA 13		100-foot-wide stockpile	418,207	
	96+00 – 58+00	12	PA 14	698,000	100-foot-wide stockpile	522,906	–362,241
			PA 16		100-foot-wide stockpile	537,335	
	158+00 –292+00	13	Old River Cove	4,882,000	Marsh BU	4,882,000	0
	292+00 –422+00	14	PA 18	2,213,000	100-foot-wide stockpile	870,540	49,295
			PA 18A		New Hyd. Levee	293,164	
			Bessie Heights East		Hyd. Levee System	1,000,000	
	422+00 –522+00	15	PA 21	2,611,000	100-foot-wide stockpile	397,094	1,739,808
			PA 23A		New Hyd. Levee	474,098	
	522+00 –716+00	16	PA 23	4,106,000	400-foot-wide stockpile	2,728,359	–1,766,345
			PA 24		400-foot-wide stockpile	2,624,786	
			PA 24A		New Hyd. Levee	519,200	
	716+00 –776+00	17	PA 25	2,845,000	200-foot-wide stockpile	2,263,932	20,009
			PA 25A		New Hyd. levee; 100-foot-wide stockpile	561,060	
	776+00 –980+00	18	PA 25	6,031,000	50-foot-wide stockpile	421,197	96,456
			Rose City East		Hyd. Levee System	2,100,000	
			PA 26		400-foot-wide stockpile	1,773,504	
			PA 27A		200-foot-wide stockpile	1,136,376	
			PA 27C		New Hyd. Levee	283,200	
			PA 27D		New Hyd. Levee	220,267	
TOTAL				98,374,400		54,433,796	944,604

* Includes new material from Taylor Bayou (0+00 to 106+25).
** New work volume includes additional advance maintenance and proposed allowable overdepth.
cy = cubic yards

4.1.1 Allowable Overdepth

An additional depth outside the required template is permitted to allow for inaccuracies in the dredging process. District commanders may dredge a maximum of 2 feet of Allowable Overdepth in coastal regions and in inland navigation channels (ER 1130-2-520, *Navigation and Dredging Operations and Maintenance Policies)*. This additional dredging allowance is referred to as a dredging tolerance, or allowable overdepth (AO). AO for the existing channel varied between 1 to 2 feet AO. The proposed waterway would contain a constant 2 feet AO for the entire length (Table 4-2).

Table 4-2: Allowable Overdepth
Existing and Proposed Project

Reach	Allowable Overdepth (feet)
Port Arthur Canal (0+00 to 290+00)	1
Increase to Maximum Allowed	2
**Port Arthur Junction	1
Increase to Maximum Allowed	2
Taylor Bayou (Old Sta. 31+10 to 106+25, East TB)	1
Increase to Maximum Allowed	2
Sabine-Neches Canal (40+00 to 592+91)	1
Increase to Maximum Allowed	2
Neches River Channel (0+00 to 320+00)	1
Increase to Maximum Allowed	2
Neches River Channel (320+00 to 440+00)	1
Increase to Maximum Allowed	2
Neches River Channel (440+00 to 978+00)	1
Increase to Maximum Allowed	2

4.1.2 Nonpay Dredging

Nonpay dredging is dredging outside the paid AO that may occur due to such factors as unanticipated variations in substrate, incidental removal of submerged obstructions, or wind or wave conditions. There are no known conditions that would indicate that the contractor would require extensive dredging in order to cut the proposed channel template. Thus, the new work volumes do not include any estimate of nonpay dredging.

4.1.3 Non-Federal Dredging

Non-Federal dredging quantities vary throughout the length of the waterway. The non-Federal dredging quantity is defined as a percentage of the channel shoaling by section and can be found in Table 4-4. The non-Federal dredge quantity is based on the presence of local facilities, the square foot of the facility, and the shoaling rate of the adjacent channel. The non-Federal quantities are placed within the same placement areas for each waterway section.

4.2 ADVANCE MAINTENANCE

Advance maintenance consists of dredging deeper than the authorized channel dimensions so as to provide for the accumulation and storage of sediment. In critical and fast-shoaling areas, it is required to avoid frequent redredging and to ensure the reliability and least overall cost for operating and maintaining the project authorized dimensions. The existing waterway has a constant 2-foot advance maintenance depth. This 2 feet was assumed to remain constant for the proposed waterway. During Detail Design phase, an analysis was performed to determine any changes in dredging frequencies and if additional advance maintenance would be required. Results are presented in Table 4-3. The proposed advance maintenance increase is the depth that is required to allow the proposed dredging frequency to remain the same as the existing operations and maintenance (O&M) dredging frequency. The additional advance maintenance depths were calculated in 1-foot increments. Channel sections with additional advance maintenance are indicated on project maps in the Final Feasibility Report (FFR) and Final Environmental Impact Statement (FEIS).

Table 4-3: Advance Maintenance Increase

Reach	Proposed Advance Maintenance Increase (feet)
Outer Bar Channel (0+000 to 18+000)	4
Sabine Pass Channel (100+00 to 180+00)	3
Sabine Pass Channel (230+00 to 295+61)	3
Port Arthur Canal (0+00 to 290+00)	1
Port Arthur Junction (as shown on Drawing C-21 in Appendix 1 of the FFR)	5
Port Arthur Canal (285+00 to 326+37)	5
Taylor Bayou (0+00 to 41+20)	5
Taylor Bayou (31+10 to 106+25, East TB)	1
Sabine-Neches Canal (0+00 to 40+00)	5
Sabine-Neches Canal (31+10 to 592+91)	1
Neches River Channel (440+00 to 978+00)	2

4.3 DREDGING FREQUENCY

The dredging cycle of a channel is defined by the average number of years between the O&M dredging operations for a historical period. Each channel or canal has its own dredging frequency. The District's Dredging Histories Database Management System contains this information and is the major source for the ERDC's Sediment Study Report. It is assumed for the new project that the dredging frequency would not change and would remain identical to the existing waterway. Frequency can be seen in Table 4-4.

4.4 PREDICTED SHOALING RATES

The ERDC desktop study for sediment-related problems produced shoaling estimates based on entire reaches, and therefore, an adjustment was performed on the ERDC values to approximate the dredging sections. These dredging sections are defined as shown on the drawings and used for the construction contracts. Using the assumption that shoaling is linearly uniform along the width and length, the breakout for the following dredging sections can be seen in Table 4-4.

Table 4-4: Predicted Shoaling by Dredging Sections

Channel	Dredging Section	Channel Reach	O&M Cycle Frequency (year)	Shoaling cy/Cycle
Extension Channel	Section D	Stations 165+443 to 150+500	4	647,000
Extension Channel	Section C	Stations 150+500 to 132+000	4	801,000
Extension Channel	Section B	Stations 132+000 to 114+000	4	779,000
Extension Channel	Section A	Stations 114+000 to 95+734	4	791,000
Sabine Bank Channel	Section 1	Stations 95+734 to 53+000	4	1,508,000
Sabine Bank Channel	Section 2	Stations 53+000 to 18+000	2	3,131,000
Sabine Pass Outer Bar Channel	Section 3	Stations 18+000 to 0+000	1	4,473,000
Sabine Pass Jetty Channel	Section 4	Stations –214+88 to 0+00	5	1,352,700
Sabine Pass Channel	Section 5	Stations 0+00 to 186+00	3	977,900
Sabine Pass Channel	Section 6	Stations 186+00 to 296+25	3	1,195, 900
Port Arthur Canal	Section 7	Stations 0+00 to 240+00	3	2,148,600
Port Arthur Canal	Section 8*	Stations 240+00 to 325+84	2	1,939,200
Sabine-Neches Canal	Section 9	Stations 0+00 to 170+00	2	1,317,000
Sabine-Neches Canal	Section 10	Stations 170+00 to 592+91	4	3,360,000
Neches River Channel	Section 11	Stations 0+00 to 96+00	3	669,000
Neches River Channel	Section 12	Stations 96+00 to 158+00	3	432,000
Neches River Channel	Section 13	Stations 158+00 to 292+00	3	934,000
Neches River Channel	Section 14	Stations 292+00 to 422+00	4	1,163,000
Neches River Channel	Section 15	Stations 422+00 to 522+00	6	965,000
Neches River Channel	Section 16	Stations 522+00 to 716+00	6	1,879,000
Neches River Channel	Section 17	Stations 716+00 to 776+00	6	581,000
Neches River Channel	Section 18	Stations 776+00 to 980+00	6	1,976, 100

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

4.5 MAINTENANCE MATERIAL QUANTITIES

The 50-year quantity of maintenance material from the existing 40-foot project (Base Plan) is shown in Table 4-5. The quantity was determined by reviewing maintenance dredging contracts within the project area and applying an incremental increase due to the widened and deepened channel. Shoaling rates for the new channel were developed by the USACE's Coastal and Hydraulics Laboratory at ERDC in Vicksburg, Mississippi. Annual dredging quantity in the SNWW would increase from an average of 8.1 mcy for the current 40-foot project to 13.0 mcy for the proposed 48-foot project. Material from four of the reaches (Extension Channel, Sabine Bank Channel, Sabine Pass Outerbar Channel, and Sabine Pass Jetty Channel) is placed in Ocean Dredged Material Disposal Sites (ODMDSs) as described in Appendix B of the FEIS. The Environmental Protection Agency (EPA) must formally designate the four new ODMDSs A–D located along the Extension Channel before they can be used. The Gulf Shore BU Feature (TX 8-11 and LA 5-2/6-2), described in Section 5.3.5 below, was found to be a least-cost measure and it has been adopted for Section 5 of the Sabine Pass Channel as part of the Base Plan.

Table 4-5: 50-Year Maintenance Material Base Plan *

(SNWW FEASIBILITY STUDY – 40-FOOT PROJECT – 50-YEAR DMMP SUMMARY)

Channel Reach	Channel Stations	Waterway Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	50-Year Maintenance Material Total (cy)
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	2,512,800	4	12	30,153,600
	53+000 to 18+000	2	PA 2 (Offshore)	1,722,400	4	12	20,668,800
Sabine Pass Outer Bar Jetty Channel	18+000 to 0+000	3	PA 3 (Offshore)	1,993,700	1	50	99,685,000
Sabine Pass Jetty Channel	-215+59 to 0+00	4	PA 4 (Offshore)	1,138,500	5	10	11,385,000
Sabine Pass Channel	0+00 to 186+00	5	TX 8-11/LA 5-1/6-1	860,100	3	16	13,761,600
	186+00 to 295+60	6	PAs 5N, 5S, 5B, and 5C	1,051,800	3	16	16,828,800
Port Arthur Canal*	0+00 to 240+00	7	PA 8	1,890,000	3	16	30,240,000
	240+00 to 326+24	8*	PAs 8, 9, and 9A	2,320,350	2	25	58,008,750
Sabine-Neches Canal	0+00 to 170+00	9	PA 8	1,219,400	2	25	30,485,000
	170+00 to 592+91	10	PA 11	2,469,800	4	12	29,637,600
Neches River Channel	0+00 to 96+00	11	PAs 12 and 13	491,900	3	16	7,870,400
	96+00 to 158+00	12	PA 14	317,700	3	16	5,083,200
	158+00 to 292+00	13	PAs 16 and 17	686,600	3	16	10,985,600
	292+00 to 422+00	14	PAs 18 and 21	855,000	4	12	10,260,000
	422+00 to 522+00	15	PAs 23 and 23A	771,900	6	8	6,175,200
	522+00 to 716+00	16	PA 24	1,380,500	6	8	11,044,000
	716+00 to 776+00	17	PA 25	426,960	6	8	3,415,680
	776+00 to 980+00	18	PAs 25A, 26, 27A, 27C, and 27D	1,451,700	6	8	11,613,600
							407,301,830

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

5.0 BORROW AND DISPOSAL

5.1 PLANNING CONSIDERATIONS

The utilization of borrow material and the handling of disposal material is a complex order for this project given the length of channel improvements. An ODMDS plan (Appendix B of the SNWW CIP FEIS) and this DMMP, which includes an NWP, have been developed to evaluate borrow and disposal requirements of specific areas of the SNWW. These reports contain detailed information pertaining to the utilization of specific existing and new PAs and BU sites for disposal of new work and maintenance dredged materials. The placement plan for both new work and maintenance material incorporates BU features developed by the ICT. Engineering criteria for the DMMP were developed in-house with preliminary reports provided by URS (Reference 7). The ODMDS was developed by PBS&J in consultation with the EPA (Reference 3). These plans are summarized in the following paragraphs. Additional details can be found under the separate reports.

The dredged material management along the waterway was evaluated based on 22 subdivided dredging sections. Eight of these sections were located offshore, with Section 4 located at the jetties; sections 3, 2, and 1 extending offshore, within the existing channel alignment; and sections A, B, C, and D extending farther offshore as the channel extension for the new alignment. Fourteen dredging sections were located inshore, with Section 5 located upstream of the jetties and Section 18 located at the terminus of the channel at the Beaumont turning basin on the Neches River. These dredging sections were developed for cost-estimating purposes for the feasibility report. Actual dredging sections for contracting and construction may vary from those identified herein.

In developing the DMMP, a variety of uses, including BU, construction material, and general disposal, were identified for the dredged material, both new work and maintenance. Preliminary designs, including assumptions and quantity requirements, for these uses are presented in the DMMP and NWP and are briefly discussed in the following paragraphs. The following prioritization of use was established in developing these documents:

a. New hydraulic levee construction (highest priority for new work material)
b. Stockpile new work material along the interior of existing levees for future use
c. Feature construction with new work material for restoration and nourishment sites
d. Feature construction with maintenance material for restoration and nourishment sites
e. General disposal of new work and maintenance material in PAs

The DMMP was used as a tool to distribute both the new work and maintenance dredged materials for the feasibility level design. It is anticipated that this plan would change over time as scope or priorities change and contracts are developed. These changes would be reflected during subsequent PED phases, and changes affecting restoration and nourishment sites would be coordinated with the SNWW ICT to ensure that obligations for offsetting impacts of the SNWW CIP are fulfilled.

5.2 UPLAND PLACEMENT AREA DESCRIPTIONS

5.2.1 Overview

Sixteen PAs would be used to manage the CIP's new work and maintenance material over a 50-year period, as described below (Table 5-1). Twelve of these PAs are currently used on the existing project, while four PAs are currently not utilized. Two new cells to two existing PAs have been proposed. All of these PAs are confined with water discharged from the sites via controlled spillways to outfall canals and drainage ditches. For purposes of the DMMP and NWP, the levees are assumed to be at least 4 feet above the interior PA elevation. At some PAs, a stockpile of new work material would ring the perimeter levees as identified in the NWP. The stockpile would serve to displace soft material and provide a stable platform for future levee raising and also provide a material source for subsequent levee construction. Where new levees are required, hydraulic fill levees would be constructed using new work material. The design template provides a 100-foot crest width, 3:1 side slopes, and a 6-foot height. The locations of each PA are shown on drawings C-1 through C-12 in Appendix 1 of the FFR.

Table 5-1: Upland PAs for the Preferred Alternative

Placement Area	Additional Cell(s)	Size (acres)	Associated Waterway Section
5	N&S, B, C	957	Sabine Pass Channel (sections 5 and 6)
8		3,570	Port Arthur Canal (sections 7 and 8) Sabine-Neches Canal (Section 9)
9A	B	481	Port Arthur Canal (Section 8)
11		2,170	Sabine-Neches Canal (Section 10)
12		355	Neches River Channel (Section 11)
13		140	Neches River Channel (Section 11)
14		255	Neches River Channel (Section 12)
16		288	Neches River Channel (Section 12)
17		316	Not Used for New Work Material
18	A*	432	Neches River Channel (Section 14)
21		135	Neches River Channel (Section 15)
23	A**	773	Neches River Channel (sections 15 and 16)
24	A*	575	Neches River Channel (Section 16)
25	A**	820	Neches River Channel (sections 17 and 18)
26**		192	Neches River Channel (Section 18)
27	A, C**D**	270	Neches River Channel (Section 18)

* = New cells (PAs 18A and 24A), which enlarge existing PAs.
** = Undeveloped cells.

5.2.2 Levee Raisings

The DMMP identifies periodic levee raisings to accommodate specific dredging cycles. A summary of the final levee design elevations as developed for this study is presented in Table 5-2. A 4-foot levee raising was assumed for each increment. A maximum levee height of 40 feet was assumed. In developing the DMMP, minimal interior dewatering was assumed. Current practice along the waterway does not

include the use of an active Disposal Area Management Plan (DAMP) in which trenching and dewatering methods are used to maximize shrinkage and thus maximize storage within upland PAs. Therefore, in developing the DMMP for the FFR, it was assumed that DAMPing would not be used. A shrinkage factor of 0.80 was assumed. A regular DAMPing program has been used at select PAs on the Houston Ship Channel, and shrinkage factors on the order of 0.45 have been achieved.

Table 5-2: Summary of Placement Area Final Levee Design Elevations

PA	Assumed Initial Elevation	Final Elevation	Change in Height (feet)	PA	Assumed Initial Elevation	Final Elevation	Change in Height (feet)
5	18	26	8	18A	8	16	8
8	15	27	12	21	12.5	20.5	8
9A	28	36	8	23	13.5	17.5	4
9B	17	41	24	23A	8	12	4
11	11.2	23.2	12	24	14	30	16
12	24	28	4	24A	8	28	20
13	19	31	12	25	10	12	4
14	13	29	16	25A	8	20	12
16	13.5	21.5	8	26	22	34	12
17	12	20	8	27A	26	38	12
18	16	20	4	27C, D	17	29	12

5.2.3 LPP Placement Plans

The new work material placement plan for the proposed 48-foot LPP is summarized in Table 4.1. The 50-year plan for maintenance material is presented in Table 5-3. Plans for the utilization of each PA through the project life are provided below. The 16 existing PAs that would be used for the CIP are discussed first, followed by the two new PA cells that would be needed. The location of each PA is shown on drawings C-1 through C-12 in Appendix 1 of the FFR.

5.2.3.1 Existing PAs

Placement Area Nos. 5 (N&S), 5B, and 5C

PAs 5 (N&S), 5B, and 5C are located on the east bank of the Sabine Pass Channel in Louisiana and bounded on the east by State Highway (SH) 82 and marshlands. The combined PA consists of 957 acres and is located as shown on Drawing C-09 in Appendix 1 of the FFR. The area would be used to place approximately 6.7 mcy of new work dredged materials from the sections 5 and 6 of the Sabine Pass Channel portion of the project. Prior to placement of new work material, the existing levees would be initially raised about 5.5 feet and new levee reaches raised to match raised existing levees, to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. Three cells would have all the new work materials stockpiled, with berm widths approximately 400 feet placed around the existing levee perimeter. The PA would be used for management of maintenance material from Section 6. The maintenance material from Section 5 would be used for environmental features TX 8-11 and LA 5-2/6-2 – Shoreline Nourishment.

Table 5-3: SNWW Feasibility Study – 48-Foot Project – 50-Year DMMP Summary

Channel Reach	Channel Stations	Waterway Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	Dredging Cycle Schedule	50-Year Maintenance Material Total (cy)
Sabine Bank Extension	165+443 to 150+500	D	PA D (Offshore)	647,000	4	12	Cycle 1 through 12	7,764,000
	150+500 to 132+000	C	PA C (Offshore)	801,000	4	12	Cycle 1 through 12	9,612,000
	132+000 to 114+000	B	PA B (Offshore)	779,000	4	12	Cycle 1 through 12	9,348,000
	114+000 to 95+734	A	PA A (Offshore)	791,000	4	12	Cycle 1 through 12	9,492,000
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	1,508,000	4	12	Cycle 1 through 12	18,096,000
Sabine Bank Channel	53+000 to 18+000	2	PA 2 (Offshore)	3,131,000	2	25	Cycle 1 through 25	78,275,000
Sabine Outer Bar	18+000 to 0+000	3	PA 3 (Offshore)	4,473,000	1	50	Cycle 1 through 50	223,650,000
Sabine Pass Jetty Channel	–214+88 to 0+00	4	PA 4 (Offshore)	1,352,700	5	10	Cycle 1 through 10	13,527,000
Sabine Pass Channel	0+00 – 186+00	5	TX 8-11,	977,900	3	16	LA 5-6: Cycle 1, 3, 5, 7, 9, 11, 13, 15	15,646,400
			LA 5-6				TX 8-11: Cycle 2, 4, 6, 8, 10, 12, 14, 16	
	186+00 – 296+25	6	PA 5 (N and S)	824,700	3	16	Cycle 1 through 16	13,195,200
			PA 5B	243,700	3	16	Cycle 1 through 16	3,899,200
			PA 5C	127,500	3	16	Cycle 1 through 16	2,040,000
Port Arthur Canal	0+00 – 240+00	7	PA 8	2,148,600	3	16	Cycle 1 through16	34,377,600
	240+00 – 325+84	8*	PA 8	1,317,000	2	25	Cycle 1 through 25	32,925,000
			PA 9A	311,100	2	25	Cycle 1 through 25	7,777,500
			PA 9B	311,100	2	25	Cycle 1 through 25	7,777,500
Sabine-Neches Canal	0+00 – 170+00	9	PA 8	1,317,000	2	25	Cycle 1 through 25	32,925,000
	170+00 – 592+91	10	PA 11	3,360,000	4	12	Cycle 1 through 12	40,320,000

Table 5-3 (Cont'd)

Channel Reach	Channel Stations	Waterway Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	Dredging Cycle Schedule	50-Year Maintenance Material Total (cy)
Neches River Channel	0+00 – 96+00	11	PA 12	479,800	3	16	Cycle 1 through 16	7,676,800
			PA 13	189,200	3	16	Cycle 1 through 16	3,027,200
	96+00 – 158+00	12	PA 14	432,000	3	16	Cycle 1 through 16	6,912,000
	158+00 – 292+00	13	PA 16, TX 5-2	445,400	3	16	TX 5-2: Cycle 1–9, PA 16: Cycle 10–16	7,126,400
			PA 17, TX 5-2	488,600	3	16	TX 5-2: Cycle 1–9, PA 17: Cycle 10–16	7,817,600
	292+00 – 422+00	14	PA 18, TX 5-2	740,500	4	12	TX 5-2: Cycle 1–7, PA 18: Cycle 8–12	8,886,000
			PA 18A, TX 5-2	145,600	4	12	TX 5-2: Cycle 1–7, PA 18A: Cycle 8–12	1,747,200
			PA 21, TX 5-2	276,900	4	12	TX 5-2: Cycle 1–7, PA 21: Cycle 8–12	3,322,800
	422+00 – 522+00	15	PA 23, TX 5-2	629,200	6	8	TX 5-2: Cycle 1–4, PA 23: Cycle 5–8	5,033,600
			PA 23A, TX 5-2	335,800	6	8	TX 5-2: Cycle 1–4, PA 23A: Cycle 5–8	2,686,400
	522+00 – 716+00	16	PA 24	1,267,900	6	8	Cycle 1 through 8	10,143,200
			PA 24A	611,100	6	8	Cycle 1 through 8	4,888,800
	716+00 – 776+00	17	PA 25	581,000	6	8	Cycle 1 through 8	4,648,000
	776+00 – 980+00	18	PA 25A, TX 3-1E	542,900	6	8	TX 3-1E: Cycle 1, PA 25A: Cycle 2–8	4,343,200
			PA 26, TX 3-1E	595,600	6	8	TX 3-1E: Cycle 1, PA 26: Cycle 2–8	4,764,800
			PA 27A, TX 3-1E	397,100	6	8	TX 3-1E: Cycle 1, PA 27A: Cycle 2–8	3,176,800
			PA 27C, TX 3-1E	269,900	6	8	TX 3-1E: Cycle 1, PA 27C: Cycle 2–8	2,159,200
			PA 27D, TX 3-1E	170,600	6	8	TX 3-1E: Cycle 1, PA 27D: Cycle 2–8	1,364,800
*Includes maintenance material from Taylor Bayou (0+00 to 106+25)						**50-Year Maintenance Material Total**		**650,372,200**

Placement Area No. 8

PA 8 is located in Sabine Lake and is bounded by Sabine Lake to the east and Pleasure Island to the west. Reportedly, all but the far west side of this PA has been constructed of dredged material. The far west side of the PA was part of the original Sabine Lake shoreline before the waterway was dredged in the early 1900s. The PA is approximately 3,570 acres in size and is located as shown on drawings C-06, 07, and 08 in Appendix 1 of the FFR. Approximately 5.0 mcy of new work material from Section 7 would be dredged to this site. Approximately 3.7 mcy of new material would be dredged from a portion of Section 8 of the Port Arthur Canal and 3.9 mcy from Section 9 of the Sabine-Neches Canal. Prior to placement of new work material, the existing levees would be initially raised 1 foot to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. The new work material would be stockpiled within the southwest corner of the PA from Section 7 and Section

8 and the northeast corner from Section 9. The PA has also been designated to handle about 2.1 mcy of maintenance material from Section 7 on a 3-year cycle and about 2.6 mcy of maintenance material from sections 8 and 9 on a 2-year cycle.

Placement Area No. 9A and 9B

PA 9A is located on the west bank of the Port Arthur Turning Basin near the junction of the Gulf Intracoastal Waterway (GIWW) and Taylor Bayou. This placement area is approximately 318 acres in size and is located as shown on Drawing C-07 in Appendix 1 of the FFR. Placement Area No. 9B is located adjacent to and west of PA 9A at the intersection of the GIWW and Taylor Bayou. It is rectangular and encompasses about 163 acres with a perimeter of 8,200 linear feet as shown on Drawing C-07 in Appendix 1 of the FFR. Based on dated aerial photographs, the site appears to be ringed with a short levee. PA 9A, along with PA 9B, would be used to contain approximately 3.0 mcy of new work dredged material from predominantly from Taylor Bayou (Section 8). This material would be stockpiled (berm widths approximately 300 feet) around the existing levee along the entire perimeter of PAs 9A and 9B. Prior to placement of new work material at 9B, the existing levees would be initially raised about 2 feet to accommodate estimated new work capacity needs beyond the capacity anticipated to be available from existing levee conditions. PA 9A does not require a levee lift. Approximately 311,000 cy each of maintenance material would be placed in PAs 9A and 9B on a 2-year cycle.

Placement Area No. 11

PA 11 is located in Sabine Lake and is bound on the west by Pleasure Island. Like PA 8, PA 11 was apparently constructed of dredged material except along the west side of the island. The far west side of the PA was part of the original Sabine Lake shoreline before the waterway was dredged in the early 1900s. The SNND has photographs illustrating this land cut and the original shoreline. This PA is about 2,170 acres in size and is located as shown on drawings C-05 and C-06 in Appendix 1 of the FFR. It would be used to stockpile approximately 8.8 mcy of new work dredged material (at the north and south corners of the PA) from Section 10 and contain 3.4 mcy of maintenance dredged material from Section 10 of the Sabine-Neches Canal portion of the project. Section 10 would be dredged on a 4-year cycle.

Placement Area No. 12

PA 12 is located on the west side of an abandoned section of the Sabine-Neches Canal. It is bounded to the west by SH 87, on the north by PA 13, and to the south by low-lying areas and marshes. This placement area is 355 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 1.1 mcy of new work dredged material would be stockpiled in PA 12 around the existing levee along the perimeter, using a berm width of 100 feet. PA 12 would be used to contain 480,000 cy of maintenance dredged material per 3-year cycle from Section 11.

Placement Area No. 13

PA 13 is located on the south bank of the Neches River. It is bounded on the south by PA 12, on the west by SH 87, and on the east by a county road and a waterfront development area. The placement area is 140 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 400,000 cy of new work dredged material would be stockpiled in PA 13. PA 13 would be used to contain

190,000 cy of maintenance dredged material per 3-year cycle from Section 11 of the Neches River Channel portion of the project.

Placement Area No. 14

PA 14, located on the south bank of the Neches River, is bounded by a refinery to the north, marshlands to the south, a wastewater effluent ditch and SH 87 to the east, and an outfall canal to the west. This placement area is 255 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 525,000 cy of new work dredged material from Section 12 would be stockpiled within PA 14 around the existing levee along the perimeter, using a berm width of 100 feet. PA 14 would be used to contain 430,000 cy of maintenance dredged material per 3-year cycle from Section 12. The levee at PA 14 would require an initial 2 feet levee lift.

Placement Area No. 16

PA 16 is on the south bank of the Neches River and is enclosed by marshlands to the east, south, and west. This placement area is 288 acres in size and is located as shown on Drawing C-04 in Appendix 1 of the FFR. Approximately 540,000 cy of new work dredged material will be stockpiled in PA 16. PA 16 would be used to contain approximately 450,000 cy of maintenance dredged material per 3-year cycle from Section 13. However, the PA would not be utilized for maintenance material placement until year 30 of the 50-year plan. Material from the first nine maintenance dredging cycles would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2), including a large portion of available new work material from Section 14 during the initial deepening. The levee for PA 16 would require an initial 2.5 feet levee lift.

Placement Area No. 17

PA 17 is located on the south bank of the Neches River and is bordered by marshlands on the south and east and by marsh and industrial development to the west. This placement area is 316 acres in size and is located as shown on Drawing C-03 in Appendix 1 of the FFR. Beginning in year 30, it would be used to contain approximately 490,000 cy of maintenance dredged material per 3-year cycle from Section 13. Material from the first nine dredging cycles would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2). PA 17 is not planned to be used for new work material placement.

Placement Area No. 18

PA 18, located on the north bank of the Neches River, is bounded by the Neches River to the southwest and marshlands to the northeast. This placement area is 361 acres in size and is located as shown on Drawing C-03 in Appendix 1 of the FFR. Approximately 870,000 cy of new work dredged material from Section 14 would be stockpiled and placed in PA 18. Beginning in target year 32, PA 18 would be used to contain approximately 740,000 cy of maintenance dredged material per 4-year cycle from Section 14. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2). New work material placed in PA 18 would be stockpiled, berm width of approximately 100 feet, around the existing levee along the perimeter.

Placement Area No. 21

PA 21 is located on the north bank of the Neches River and is bounded by marsh areas to the east and north and an oxbow (abandoned portion of the river) to the west. This PA is 135 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. PA 21 would be used to place approximately 400,000 cy of new work material to be dredged from Section 15. This material would be stockpiled, berm width of approximately 100 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet of levee lift. Beginning in target year 32, PA 21 would be used to contain approximately 280,000 cy of maintenance dredged material from Section 14 on a 4-year cycle. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 23

PA 23 is located on the south bank of the Neches River. It is bounded by the Neches River on the north, marshlands on the west, railroad tracks on the south, and Smith Bluff on the east. This PA is 504 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. PA 23 would be used to place approximately 2.7 mcy of the new work material from Section 16. This material would be stockpiled, berm width of approximately 400 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet of levee lift. Beginning in target year 30, PA 23 would be used to contain approximately 630,000 cy of maintenance dredged material from Section 15 on a 6-year cycle. Initial material (from the first four dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 23A

PA 23A is located adjacent to and south of PA 23. This site is about 269 acres in size as shown on Drawing C-02 in Appendix 1 of the FFR. A pipeline corridor is located at the junction between PA 23 and PA 23A. PA 23A would be used to place approximately 470,000 cy of new work material from Section 15. Beginning in target year 30, PA 23A would be used to contain approximately 340,000 cy of maintenance dredged material from Section 15 on a 6-year cycle. Initial material (from the first four dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 24

PA 24 is located on the north bank of the Neches River and is bounded by the Neches River to the west, the MARAD Reserve Fleet Anchorage to the south, and marshlands to the northeast. This PA is 388 acres in size and is located as shown on Drawing C-02 in Appendix 1 of the FFR. Approximately 2.6 mcy of new work dredged material from Section 16 would be stockpiled in PA 24 around the existing levee along the perimeter, at a berm with of approximately 400 feet. PA 24 would be used to contain approximately 1.3 mcy of maintenance dredged material from Section 16 on a 6-year cycle.

Placement Area No. 25

PA 25 is located on the west bank of the Neches River and is bounded by privately maintained canals on the north and south, and by a railroad on the west. This PA is 645 acres in size and is located as shown on Drawing C-01 in Appendix 1 of the FFR. Approximately 2.7 mcy of new work dredged material from sections 17 and 18 would be stockpiled in PA 25, around the existing levee along the perimeter at a berm

width of approximately 250 feet. The levee would require an initial 2 feet levee lift. It would be used to contain approximately 580,000 cy of maintenance dredged material from Section 17 on a 6-year cycle.

Placement Area No. 25A

PA 25A is located adjacent to and west of PA 25. The site is about 175 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. Approximately 560,000 cy of new work material from Section 18 would be placed and stockpiled in PA 25A at a berm width of approximately 100 feet. PA 25A would contain approximately 540,000 cy of maintenance dredged material from Section 18 on a 6-year cycle. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E).

Placement Area No. 26

PA 26 is located on the north bank of the Neches River and is bounded on the northeast by Star Bayou and on the west by an oxbow. The Port Arthur Area office indicated that this PA was previously used and should be adequate for use on this project. Aerial photographs, supported by a site visit from district representatives, indicated that the levees are substantially adequate for the first filling. The site is about 192 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. PA 26 would be used to place approximately 1.8 mcy of new work material from Section 18. This material would be stockpiled, berm width of approximately 400 feet, around the existing levee along the perimeter. The levee would require an initial 2 feet levee lift. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E). Additionally, PA 26 would contain approximately 600,000 cy of maintenance dredged material from Section 18 on a 6-year cycle.

Placement Areas No. 27A, 27C, and 27D

PAs 27A, 27C, and 27D are located on the north bank of the Neches River and are bounded on the east and west by marshland and on the west by industry. PA 27A is 128 acres, PA 27C is 87 acres, and PA 27D is 55 acres in size as shown on Drawing C-01 in Appendix 1 of the FFR. PAs 27A, 27C, and 27D would be used to place approximately 1.6 mcy of the new work material from Section 18. This material would be stockpiled, berm width of approximately 200 feet, around the existing levee perimeter of PA 27A. In addition, the levee would require an initial levee lift of 2 feet. PAs 27C and 27D would have hydraulic levees constructed. These three PAs would contain approximately 840,000 cy of maintenance dredged material from Section 18 on a 6-year cycle. Initial material from the first maintenance dredging cycle would be used for the Rose City East Marsh Restoration feature (TX 3-1E).

5.2.3.2 New PAs

The project utilizes two new upland confined sites to manage new work material from the deepening and maintenance material through the 50-year design period, as described in the following paragraphs.

Placement Area No. 18A

PA 18A is located adjacent to and east of PA 18, at the south end of PA 18. The area is about 71 acres in size as shown on Drawing C-03 in Appendix 1 of the FFR. A new dewatering structure with conveyance ditches would be constructed. In addition to providing additional capacity, this PA would allow more-

efficient use of the existing PA 18. The existing ground appears to be flat. New hydraulic levees would be constructed at the site with a lift of 8 feet to a final elevation of 16 feet. PA 18A would receive approximately 300,000 cy of new work material from Section 14. This PA would contain approximately 150,000 cy of maintenance dredged material from Section 14 on a 4-year cycle. Initial material (from the first seven dredging cycles) would be used for the Bessie Heights East Marsh Restoration feature (TX 5-2).

Placement Area No. 24A

PA 24A is located adjacent to and north of PA 24. This PA is 187 acres in size and is located as shown on Drawing C-01 in Appendix 1 of the FFR. PA 24A would receive approximately 300,000 cy of new work material from Section 16. It would be used to contain approximately 610,000 cy of maintenance dredged material from Section 16 on a 6-year cycle.

5.3 Beneficial Use Features

5.3.1 Conceptual Design Development

The feasibility/conceptual level designs of the marsh restoration and shoreline nourishment sites were developed in-house and through a contractor (Table 5-4). The designs for some components of the Neches River BU Feature (Rose City East, Bessie Heights East) and the Gulf Shore BU Feature were developed by TCB (Reference 2). These designs included discussions of specific feature and constructability issues such as adequacy of foundation materials, hydraulic levee construction, levee protection, pumping distances, interior filling, circulation development, and plantings. TCB designs were used as the general concept for marsh restoration and shoreline nourishment, but actual plans for the CIP are somewhat different. New work dredged material would be utilized at three BU features (Rose City East, Bessie Heights East, and Old River Cove). Maintenance dredged material would also be used at four features (Rose City East, Bessie Heights East, Texas Point shoreline nourishment, and Louisiana Point shoreline nourishment).

Table 5-4: Summary of Environmental Restoration Sites

	Feature #	BU Feature	Component
New Work Material	TX 3-1E	Neches River BU Feature	Rose City East Marsh Restoration
	TX 5-2		Bessie Heights East Marsh Restoration
	TX 6-1A		Old River Cove Marsh Restoration
Maintenance Material	TX 3-1E	Neches River BU Feature	Rose City East Marsh Restoration
	TX 5-2		Bessie Heights East Marsh Restoration
	TX 8-11	Gulf Shore BU Feature	Texas Point Shoreline Nourishment
	LA 5-1/6-1		Louisiana Point Shoreline Nourishment

Conceptual designs for the measures and BU features were done during the Plan Formulation Phase. The terms “minimization” and “mitigation” are used throughout this appendix to refer to measures that were studied to avoid or compensate impacts from the deepening project. Over 300 minimization and mitigation alternatives were evaluated. General assumptions were used. The least-cost methods were generally used in developing designs. It was assumed that no relocations would be necessary and that rights-of-way and rights-of-entry would be available. Specific field and design data were provided by the Environmental Section. During the Detailed Design phase, the selected mitigation and BU features were individually evaluated and updated. Final measures for mitigation measures can be seen as shown in the FFR, FEIS, and Engineering drawings in Appendix 1 of the FFR. The majority of the measures are for marsh restoration as BU sites and mitigation measures, and these sites are accessible by water. Swamp accessible machinery would be required during construction. Hydraulic levees would be built with the new work dredged material at several sites. The dredge pipeline routes are assumed to be the shortest distance to the middle of the site. Levee side slopes have some type of slope protection: riprap, concrete cellular mats, and/or vegetation. Marsh fill would occur with selective placement of dredged material within the marsh site boundary. Marsh fill can be new work or maintenance material, depending on the measure. Where plantings occur, it is assumed that abundant local species are available. During PED, each site would be analyzed for local drainage requirements, so as not to impede existing area drainage. Also during PED, final marsh designs would be optimized for constructability. The complete descriptions and details can be found in planning documents. Site locations can be found in drawings C-01 through C-28 in Appendix 1 of the FFR.

5.3.2 Neches River BU Feature – Rose City

The conceptual plan calls for restoration of 345 acres of fresh marsh, improvement of 72 acres of shallow water, and nourishment of 151 acres of existing marsh in two construction events (first construction and first maintenance cycle). New work material (approximately 2.1 mcy) from Section 18 would be used to restore 225-acres of marsh and to construct hydraulic containment levees and higher-elevation features. Maintenance material (approximately 540,000 cy) from the first maintenance cycle from Section 18 would be used to restore an additional 120 acres of marsh.

The Rose City East Marsh Restoration Feature is shown on Drawing C-01 in Appendix 1 of the FFR. The marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

5.3.3 Neches River BU Feature – Bessie Heights East

The conceptual plan is to restore 679 acres of brackish and 1,190 acres of intermediate marsh, improve 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. The marsh would be constructed with maintenance material originating from Section 13 during the first nine maintenance cycles, Section 14 during the first seven maintenance cycles, and Section 15 during the first four

maintenance cycles. Approximately 1.0 mcy of new work material from Section 14 would be used to build the hydraulic containment levee.

The Bessie Heights East site is located within the much larger Bessie Heights Marsh (Drawing C-24 in Appendix 1 of the FFR). This was a natural emergent marsh that over time has seen the majority of its marsh acreage convert to open water. The site is located on Texas Parks and Wildlife Department (TPWD) property and privately owned land. Bessie Heights East totals 3,180 acres. The revision to the feasibility study design caused Bessie Heights West to be deleted.

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

5.3.4 Neches River BU Feature – Old River Cove

The Old River Cove site TX 6-1 is located north of the Neches River on property owned by TPWD (Drawing C-25 in Appendix 1 of the FFR). Approximately 5.0 mcy of new work material from Section 13 would be used to construct hydraulic levees and restore 639 acres of brackish marsh, improve 139 acres of shallow-water habitat, and nourish 432 acres of existing marsh, as suspended fine-grained sediments disperse beyond restored emergent marsh areas. Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora.

5.3.5 Gulf Shore BU Feature (Texas and Louisiana Points)

The shoreline nourishment sites (TX 8-11 and LA 5-2/6-2) are located on the east and west sides of the Sabine Pass jetties (Drawing C-27 in Appendix 1 of the FFR). Each area begins approximately 0.5 mile from the respective jetty and extends about 3.5 miles away. The land on the Texas side is part of the Texas Point National Wildlife Refuge, while the land on the Louisiana side is privately owned. The conceptual plan calls for placing maintenance material at the shoreline in an unconfined manner. The material would be placed using a pipeline dredge from Section 5 (approximately 1.0 mcy) of the Sabine Pass Channel. Placement would alternate between the Louisiana and Texas shorelines with each complete maintenance cycle, so that each side receives material every 6 years for the 50-year period of analysis, or eight placement episodes. The plan anticipates that much of the material would be redistributed into the littoral system.

5.4 OFFSHORE PLACEMENT AREAS

The project would utilize existing offshore placement sites termed ODMDSs to manage materials from the CIP and maintenance dredging through the 50-year period of analysis. Four existing ODMDSs (1–4) and four new sites (A–D) would be used. New work and maintenance quantities for the 50-year project are provided in Appendix B to the ODMDS FEIS and the Site Management and Monitoring Plan, which is attached as an exhibit to Appendix B of the FEIS.

6.0 ADDITIONAL BORINGS AND LABORATORY TESTING PROGRAM

6.1 SUBSURFACE INVESTIGATIONS

Limited subsurface data were used to develop the feasibility level designs for the project features. Additional explorations to obtain subsurface data would be required to verify and/or revise design assumptions for final design of these features subsequent to the authorization of the project during the PED phase. These explorations would include soil borings, CPTs, and probings. Initial recommendations for exploration and lab testing requirements were developed by URS for channel and placement area concerns and by TCB for environmental restoration concerns (see Reference 2). The initial recommendations were revised to reflect the final feasibility plan. A summary of these recommendations is presented in Table 6-1.

Table 6-1: Summary of Additional Subsurface Explorations

	Soil Borings (number – LF)	**CPTs**
Channel	84 – 4,720	n/a
Placement Areas	84 – 2,520	224, 11,208
Environmental Features	60 – 1,200	n/a

6.2 LABORATORY TESTING

Laboratory testing would also be required during the PED phase to verify design assumptions regarding the behavior of the foundation and dredged materials. A summary of anticipated lab tests is provided in Table 6-2. While an estimated cost for additional laboratory testing was provided for the feasibility cost estimate, specific quantities of tests would be developed during subsequent exploration and design tasks.

6.3 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE EVALUATION

Information on hazardous, toxic, and radioactive waste (HTRW) sites in the project area was conducted by PBS&J in June 2002; this is summarized in the FEIS. Information from this report was used to determine the probability and severity of encountering HTRW problems at PAs and restoration sites.

Based upon the HTRW assessment and additional in-house research, it has been determined that there are presently no known HTRW sites that would impact the SNWW CIP with the exception of sites of unknown significance in PA 17. Current regulatory agency investigations around PA 17 are being

monitored by USACE. If the Environmental Protection Agency investigations identify problems within PA 17, the affected area would be removed from the PA. In the event that investigations of identified sites within PA 17 do not provide sufficient information, waste identification and delineation investigations would have to be conducted by the non-Federal sponsor. If remediation is recommended, PA 17 would be resized to remove areas requiring remediation or abandoned.

Table 6-2: Summary of Additional Laboratory Tests

Moisture content
Atterberg Limits
Grain-size analysis
Consolidation
Triaxial shear
Unconfined compression
Density
Column settling
Self-weight consolidation
Void ratio

7.0 CONSTRUCTION

7.1 CONTRACT SCHEDULE

Fifteen construction contracts are planned. Contracts 1–5 would be constructed with hopper dredges and contracts 6–12 with hydraulic pipeline dredges. The dredging contracts would be accomplished over a period of about 6 years. The ecological mitigation contracts (13–15) would be accomplished early in the construction sequence. Dredging for the mitigation contracts does not involve the use of new work or maintenance material from the SNWW Preferred Alternative. Refer to the FEIS for a description of this work. The proposed sequence for dredge and construction is shown in Table 7-1.

7.2 CONSTRUCTION METHOD

The construction would utilize a combination of traditional and relatively new dredging techniques. Equipment used to dredge the channels would be those traditionally employed: hopper dredges in the offshore reaches and hydraulic pipeline dredges in the other reaches. Disposal of the new work material would be in conventional upland PAs and offshore PAs, as well as the innovative, nontraditional dredging technique of placement into marshes and adjacent shorelines. These techniques are mandated due to the requirements of the mitigation and DMMP restoration and nourishment features. Contracts would be written to not only emphasize the removal of material from the channel, but also emphasize successful completion of mitigation and restoration features so that they would perform to intended purposes.

Table 7-1: Construction Contract Schedule

Contract No.	Contract Schedule	Construction Start (Month/FY)	Construction Finish (Month/FY)
	Hopper Dredging:		
1	**Sabine Bank Extension**	October 2012	January 2013
	Section D Station 165+000 to 165+443		
	Section C Station 165+443 to 132+000		
2	Section B Station 132+000 to 114+000	February 2013	July 2014
	Section A Station 114+000 to 95+734		
3	**Sabine Bank Channel**	October 2015	August 2015
	Section 1 Station 95+734 to 53+000		
4	**Sabine Pass Outer Bar & Bank Channels**	October 2016	March 2017
	Section 2 Station 53+000 to 18+000		
	Section 3 Station 18+000 to 0+000		
5	**Sabine Pass Jetty Channel**	April 2017	September 2017
	Section 4 Station -214+88 to 0+00		
	Pipeline Dredging:		
6	**Sabine Pass Channel**	October 2016	January 2018
	Section 5 Station 0+00 to 186+00		
	Section 6 Station 186+00 to 296+25		
7	**Port Arthur Canal**	October 2012	July 2015
	Section 7 Station 0+00 to 240+00		
	Section 8 Station 240+00 to 325+84		
	Taylor Bayou Basin Area:		
8	**Sabine-Neches Canal**	April 2017	September 2018
	Section 9 Station 0+00 to 170+00		
9	Section 10 Station 170+00 to 592+94	April 2014	May 2017
10	**Neches River Channel**	October 2012	March 2014
	Section 11 Station 0+00 to 96+00		
	Section 12 Station 95+00 to 158+00		
	Section 13 Station 158+00 to 292+00		
11	Section 14 Station 292+00 to 422+00	April 2015	July 2018
	Section 15 Station 422+00 to 522+00		
	Section 16 Station 522+00 to 716+00		
12	Section 17 Station 716+00 to 776+00	October 2012	March 2015
	Section 18 Station 776+00 to 980+00		
13	**Mitigation for Willow Bayou, Louisiana**	October 2015	May 2018
14	**Mitigation for West Black Bayou, Louisiana**	October 2012	February 2014
15	**Mitigation for East Black Bayou, Louisiana**	October 2014	May 2015

7.3 MATERIAL SOURCES AND MATERIAL INVESTIGATIONS

Materials utilized for this project would consist primarily of dredged material, both new work and maintenance. These materials would be used to construct new levees, raise existing levees, create stockpiles, marsh restoration, and shoreline nourishment. In addition, minor amounts of riprap would be used for shoreline protection at selected PAs and for erosion control at outlet structures for all of the PAs.

Dredged material sources were evaluated using existing subsurface data as previously discussed. These data were used to determine various parameters for designing hydraulic levees, filling marsh cell and placement areas, and other related hydraulic structures. Some assumptions were made, based on previous experience with similar materials, regarding degradation of material during dredging operations, material losses during construction, and consolidation of new work and maintenance materials. These assumptions are based on both material types and construction methods. Deviations from these assumptions may impact the quantity of available material for construction. As such, additional investigation of the dredged material sources would be required for final design as discussed in Section 4.3. Furthermore, the final design documents should identify specific construction methods and monitoring methods to ensure that the desired construction outcome is achieved.

The structures and features presented herein are primarily associated with levees related to PAs and levees related to restoration features. These structures and features were sized to accommodate the proposed channel depth (48 feet). The specific types of dredged material would be confirmed during future evaluations as identified in Section 5.0. However, if the project is modified from the one identified in the report, the quantity of specific dredged material would change, and this change should be reflected in the specific design features of this study. That is, if a channel less than 48 feet is authorized, less material would be available for use, and thus the size of the associated features should be reduced accordingly.

Neither soil borings nor laboratory testing were conducted to study the proposed deepening for this feasibility study. Instead, existing data from previous projects were used to evaluate the new work materials. Subsurface data were collected at specific existing placement areas as well as at proposed environmental restoration features. These data are provided in referenced reports.

8.0 REFERENCES

1. *Desktop Study for Sediment-Related Problems at Sabine-Neches Project*, dated June 2005.
2. *Sabine-Neches Waterway Feasibility Site Concept Beneficial Use Development*, Turner Collie and Braden, Inc., July 14, 2003.
3. *Environmental Impact Statement, Sabine-Neches Waterway, Channel Improvement Project, Texas, Ocean Dredged Material Disposal Site Designation*, PBS&J, January 2006.
4. *Hurricane Flood Protection Design Memorandum No. 2 (General Design Memorandum)*, Volumes I and II, March 1965.
5. *Design Memorandum No. 2 (Sabine-Neches Waterway, Texas, 40-foot Project and Channel to Echo, Bridge Replacement at Port Arthur, dated May 1964)*, prepared by Modjeski and Masters, Inc.

6. *Excel Spreadsheet, SNWN Geotech 30 accts.xls*, outline of additional soil boring and laboratory testing requirements, May 8, 2006.
7. *Sabine-Neches Waterway, 50-foot Project, Dredged Material Management Plan*, prepared by URS Group, Inc., dated April 30, 2004.
8. *Sabine-Neches Waterway, Texas Feasibility Report, Draft Submission of Geotechnical Portion of Engineering Appendix*, prepared by URS Group, Inc. dated August 2004.

Appendix E

Clean Water Act Section 404(b)(1) Evaluation

APPENDIX E
SABINE–NECHES WATERWAY CHANNEL IMPROVEMENT PROJECT, TEXAS SECTION 404(b)(1) EVALUATION

I. Project Description

a. Location

The Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP) is located on the upper Texas Gulf Coast at the Texas-Louisiana state boundary. The existing 40-foot SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. All subsequent references to the SNWW in this report focus on the 77-mile-long channel flowing through Jefferson and Orange counties, Texas, and Cameron Parish, Louisiana (includes a 13.2-mile channel extension into the Gulf of Mexico [Gulf]). The SNWW begins offshore, follows the west side of Sabine Lake, and terminates just upstream of the Beaumont Turning Basin on the Neches River.

The project area for the Preferred Alternative is defined as areas that would be directly affected by implementation of the CIP (i.e., the proposed dredging footprint, existing and proposed placement areas [PAs] identified in the Dredged Material Management Plan [DMMP], and mitigation areas).

The study area includes a larger area for which environmental effects of alternatives have been analyzed. The study area encompasses 2,000 square miles, which contains the smaller project area, and includes the following water bodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, Neches River Channel up to the new Neches River Saltwater Barrier, Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf.

Further descriptions of the SNWW CIP can be found within chapters 1 and 3 and Figure 1.1-2 of the Final Environmental Impact Statement (FEIS).

b. General Description

This Section 404(b)1 evaluation addresses the discharge of dredged or fill material into the waters of the U.S. The objectives of the SNWW CIP include improvements to the efficiency of the deep-draft navigation system, and maintenance or enhancement of the quality of the area's coastal and estuarine resources. Maintenance and enhancement of the area's coastal and estuarine resources are associated with potential for reduced accidents and oil spills; beneficial use of dredged material; minimization of effects to oyster beds, seagrasses, and other valuable habitats; and avoiding areas of known cultural resources.

To achieve navigation efficiency objectives, the following is proposed:

- Deepening the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet.
- Deepening the existing SNWW Entrance Channel in the Gulf from 42 to 50 feet, plus advance maintenance and allowable overdepth, and constructing an extension of the offshore entrance channel (50 x 700 feet x 13.2 miles). Dredging would be conducted by hopper dredge. Additional details of this construction are provided below because of its potential to affected endangered sea turtles.
- Dredging in the Sabine Pass Jetty Channel would be conducted by hopper dredge, while the remaining inshore channels would be constructed with hydraulic pipeline dredges.
- Deepening the Taylor Bayou Channel and basins to 48 feet, and widening the entrance and connecting channels to improve vessel maneuverability.
- Dredging one new anchorage basin and two turning and anchorage basins on the Neches River Channel.
- Using 16 existing upland placement areas and two new expansions of existing placement areas for construction and maintenance of the Preferred Alternative. The quantity of maintenance material to be removed over the 50-year period of analysis is estimated to total approximately 650 million cubic yards (mcy).

To achieve coastal resource protection and ecological enhancement objectives, the following is proposed:

- Avoidance and minimization of resource impacts through alternative analyses.
- Avoidance of cultural and historical resources (e.g., Civil War–era shipwrecks).
- Implementation of Beneficial Use (BU) features for resource protection and restoration. Appropriate dredged materials, as part of the DMMP, would be beneficially used to restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat with the Neches River BU Feature (comprised of Rose City East, Bessie Heights East, and Old River Cove West), and regularly nourish approximately 6 miles of shoreline with the Gulf Shore BU Feature (Texas and Louisiana Points). Gulf shore nourishment, which affects piping plover Critical Habitat at Louisiana Point, is described in detail below.
- Unavoidable impacts of the Preferred Alternative in Texas are offset through the DMMP; impacts in Louisiana, however, required compensatory mitigation. Therefore, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. The amount of recommended mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the period of analysis.

The proposed plan is the least environmentally damaging practicable alternative.

c. Authority and Purpose

The Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, authorized the U.S. Army Corps of Engineers (USACE) to review previous USACE reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the ports of Beaumont, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively named the SNWW. The Sabine-Neches Navigation District (SNND), non-Federal sponsor of the existing channels to Beaumont and Port Arthur, requested that USACE initiate a reconnaissance study of potential channel improvements in September 1998. The reconnaissance investigation resulted in a finding that there was a Federal interest in the project and recommended that the study be continued into the feasibility phase. The SNND expressed its intent to act as the non-Federal sponsor for this phase of the study. The Final Feasibility Report (FFR) for the SNWW CIP would determine whether improvements to the existing Federal navigation project are justified, and provide documentation needed to request Congressional authorization and funding for construction of the project. The Sabine River Channel to Orange, Texas, was not included in this FFR due to expectations of continued low utilization of the existing 30-foot channel.

In March 2000, the USACE and the SNND signed an agreement to conduct an FFR and prepare a Final Environmental Impact Statement (FEIS) for the proposed CIP. The lead agency for the FEIS is USACE, with the U.S. Environmental Protection Agency (EPA) as a cooperating agency. The cost of the FFR and FEIS is shared by the USACE and the SNND.

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material

Extensive core borings were taken and analyzed in conjunction with the 1982 feasibility report for the SNWW (USACE, 1982). Profiles of these borings are shown in cross sections of the project plans, included in that report. These borings support the general information presented below.

Site Geology

The site geology is characterized by modern marine deposits overlaying recent Holocene deposits that in turn overlay the Beaumont and Lissie formations of the Pleistocene Series. The modern deposits are generally normally consolidated clays, silts, and fine sands that were deposited through natural overwash and sedimentation processes or through man-made depositional processes. The recent deposits of the Holocene consist of silts, clays, silty sands, clayey sands, and clayey silts that exhibit the characteristics of normally to lightly overconsolidated materials. These deposits are generally encountered to depths of 30 to 40 feet.

Beaumont Clay is the predominant Pleistocene formation whose eroded surface forms the upper limit of stiff to very stiff clay material. It is red, yellow, and brown calcareous stiff clay that weathers into black or gray soil at the surface. Lenses of fine-grained, poorly graded sand and silt, and a few calcareous nodules are sometimes encountered in this formation. The clay fraction is composed of montmorillonite

(generally with calcium as the exchangeable cation), kaolinite, illite, and finely ground quartz, in that order of prevalence. The high percentage of montmorillonite accounts for the high shrink-swell potential of the material. Previous desiccation of the clays results in significant overconsolidation to great depths, with preconsolidation pressure approaching 3 tons per square foot. In addition to preconsolidating the soil, the desiccation process, along with occasional rewetting, has resulted in a network of fissures and slickensides that are now closed but that represent potential planes of weakness within the stratum. The thicknesses of these clays range from 25 to 400 feet. The Lissie Formation underlies the Beaumont and consists primarily of sands and silty sands.

Field Exploration

Limited field investigations were conducted for this project. Those conducted were limited to cone penetrometer testing along the proposed levee alignments at selected placement areas. In addition, probings were taken at selected restoration and minimization features to evaluate near surface foundation issues. The majority of the subsurface data for the project was compiled from existing data—data from the channel that was collected for the 40-foot project and data from placement areas that have been collected during periodic levee raising projects.

Excavatability

The proposed deepening will entail dredging new work material. Based on a review of limited existing soil boring data taken during previous studies, the material will range from very soft to very stiff clay and loose to dense sand. No rock is anticipated and blasting will not be required.

The new work material within the offshore reaches (sections 4, 3, 2, 1, A, B, C, and D) and the adjacent onshore reaches (sections 5 and 6) is likely to consist of soft clay with pockets of stiff clay; some sand may also be encountered. These reaches are located within the historic delta region of the Sabine and Neches rivers where normally to lightly consolidated materials are located. Materials in this area may vary as the rivers' discharge meandered through the deltaic zone.

New work material within the onshore reaches of the Port Arthur and Sabine-Neches canals (sections 7, 8, 9, 10, and 11) will likely consist of stiff to very stiff clay. These canals are part of the land cut section of the waterway and were excavated early in the 1900s. The stiff consistency of this material can be attributed to the overconsolidation pressure of the material that was previously overlying the canals.

The Neches River Channel is located upstream of the Sabine-Neches Canal. The new work material for this channel (sections 12 through 18) will vary from stiff clay to medium-dense sand. These variations can be attributed to the historic meanders of the Neches River, although sand was more abundant in the soil samples from sections 15, 16, 17, and 18. In addition, historically the maintenance dredging in these reaches has contained significant amounts of sand.

(2) Quantity of Material

New Work Material

Construction of the Preferred Alternative would require the development of significantly more PA capacity than currently exists for the SNWW project. The existing project uses 16 upland PAs. Construction of the Preferred Alternative would generate 98 mcy of new work material. The term "new work" refers to the material below the existing Waterway channel template, which is needed to be removed in order to increase to the new project depth. The following table depicts the volume in cubic yards (cy) of new work material from all reaches of the Preferred Alternative:

Section	Station	To Station	Estimated New Work (cy)	Total Per Reach (cy)
D	165+443	150+500	4,201,000	
C	150+500	132+000	4,648,000	
B	132+000	114+000	5,296,000	
A	114+000	95+734	4,592,000	18,737,000
1	95+734	53+000	8,307,000	8,307,000
2	53+000	18+000	7,051,000	
3	18+000	0+000	5,923,000	12,974,000
4	0+00	–126	2,978,000	2,978,000
5	0+00	186+00	4,459,600	
6	186+00	296+25	2,263,600	6,723,200
7	0+00	240+00	5,026,000	
8	240+00	325+84	3,281,900	
8TB	0+00	106+24	3,893,000	11,697,200
9	0+00	170+00	3,092,000	
10	170+00	592+93	8,852,000	11,944,000
11	0+00	96+00	1,628,000	
12	96+00	158+00	698,000	
13	158+00	292+00	4,882,000	
14	292+00	420+00	2,213,000	
15	420+00	522+00	2,611,000	
16	522+00	716+00	4,106,000	
17	716+00	776+00	2,845,000	
18	776+00	980+00	6,031,000	25,014,000
			Total	**98,374,400**

Maintenance Material

Shoaling is projected to increase with the Preferred Alternative for several reasons. The Entrance Channel would extend an additional 13.2 miles into the Gulf, and this would result in higher offshore dredging quantities. The deeper channel would have a greater cross-sectional area, making it function as a larger sediment trap, and higher salinities would increase flocculation and the deposition of suspended sediment. Section 2.5.2 in the FEIS describes, in detail, the SNWW sediment system and the existing project

shoaling and sediment transport conditions. Shoaling and sediment transport conditions for the existing SNWW include all segments of the existing SNWW navigation system that are discussed in detail in the FEIS. The discussion in the FEIS begins with the upstream end of the SNWW (the Neches River Channel), and moves downstream through the confined Sabine-Neches and Port Arthur canals, the Sabine Pass Channel, and then offshore into the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, and the Sabine Bank Channel. Finally, the interaction of the channel and adjacent shoreline sections is described (refer to Section 2.5.2 in the FEIS).

The existing shoaling quantities for the 40-foot project are summarized in the following table (these quantities were summarized from Section 2.5.2.7 of the FEIS and the sediment study by Parchure [2005]):

Channel	Material Types	cy/year
Sabine Bank Channel	76% silt/clay, 24% clay	4,235.2
Sabine Pass Outer Bar Channel	96% silt/clay, 4% sand	1,993.7
Sabine Pass Jetty Channel	89% silt/clay, 11% sand	1,138.5
Sabine Pass Channel	70% silt/clay, 30% sand	1,911.9
Port Arthur Canal	84% silt/clay, 16% sand	4,210.4
Sabine-Neches Canal	78% silt/clay, 22% sand	3,689.2
Neches River Channel	62% silt/clay, 38% sand	6,382.3

It is expected that the material types for the projected maintenance dredging would be similar to the existing. The predicted shoaling quantities for the 48-foot project are summarized in the following table:

Channel	cy/year
Extension	3,018.0
Sabine Bank Channel	4,639.0
Sabine Pass Outer Bar Channel	4,473.0
Sabine Pass Jetty Channel	1,352.7
Sabine Pass Channel	2,173.8
Port Arthur Canal	4,087.8
Sabine-Neches Canal	4,677.0
Neches River Channel	8,599.1

The predicted shoaling by dredging sections are presented in the following table:

Channel	Dredging Section	Channel Reach	O&M Cycle Freq (Year)	Shoaling cy/Cycle
EXT	D	Station 165+443 to 150+500	4	647,000
EXT	C	Station 150+500 to 132+000	4	801,000
EXT	B	Station 132+000 to 114+000	4	779,000
EXT	A	Station 114+000 to 95+734	4	791,000
ENT	1	Station 95+734 to 53+000	4	1,508,000
ENT	2	Station 53+000 to 18+000	4	3,131,000
SPOB	3	Station 18+000 to 0+000	1	4,473,000
SPJ	4	Station -214+88 to 0+00	5	1,352,700
SPC	5	Station 0+00 to 186+00	3	977,900

Channel	Dredging Section	Channel Reach	O&M Cycle Freq (Year)	Shoaling cy/Cycle
SPC	6	Station 186+00 to 295+60	3	1,195,800
PAC	7	Station 0+00 to 240+00	3	2,148,600
PAC	8	Station 240+00 to 326+24	2	2,340,000
		TB 0+00 to 106+25	2	1,327,000
SNC	9	Station 0+00 to 170+00	2	1,317,000
SNC	10	Station 170+00 to 592+91	4	3,360,000
NRC	11	Station 0+00 to 96+00	3	669,000
NRC	12	Station 96+00 to 158+00	3	432,000
NRC	13	Station 158+00 to 292+00	3	934,000
NRC	14	Station 292+00 to 422+00	4	1,163,000
NRC	15	Station 422+00 to 522+00	6	965,000
NRC	16	Station 522+00 to 716+00	6	1,879,000
NRC	17	Station 716+00 to 776+00	6	581,000
NRC	18	Station 776+00 to 980+00	6	1,976,000

NOTE: This table only shows the predicted shoaling per section estimate

Because of this predicted shoaling, maintenance dredging is projected to increase for the entire channel, from 407 mcy to 650 mcy over the 50-year period of analysis. Expressed as average annual quantities, quantities will increase from 8.1 mcy per year to 13.0 mcy per year (an increase of approximately 60 percent). Fifty-seven percent of the maintenance quantities for the Preferred Alternative would originate from the offshore channels, and 43 percent from the inshore channels. As would be expected with the offshore channel extension, maintenance dredging volumes for the offshore channel would increase more than the inshore reaches, with an increase from 162 mcy to 370 mcy and 251 mcy to 281 mcy, respectively.

Finding areas suitable for the development of new upland PAs along the inshore reaches was difficult. The majority of land adjacent to the SNWW is either covered by residential and industrial development and existing PAs, or is coastal wetland. For this reason, considerable effort was directed toward evaluating alternatives for the placement of dredged material. Maintenance material would be used to the greatest extent possible in the resulting DMMP. A discussion of the process used to evaluate these alternatives, and a description of alternatives considered, is provided in Section 2.5 of the FEIS.

e. Description of the Proposed Discharge

(1) Location

Sixteen PAs would be used to manage the CIP's new work and maintenance material over a 50-year period (see tables below and refer to figures 2.4-1c–g of the FEIS). Twelve of these PAs are currently used on the existing project, while four PAs are currently not utilized. Two new cells to two existing PAs have been proposed. All of these PAs are confined with water discharged from the sites via controlled spillways to outfall canals and drainage ditches.

New work material volumes by reach and proposed PAs (the new work plan) are presented in the following table:

Channel Reach	Channel Stations	Water-way Section	New Work Material Designation	New Work Dredged Volume (cy)**	New Work Material Construction	New Work Material Used for Construction Volume (cy)	New Work Material Surplus Volume (cy)
Sabine Bank Extension	165+443 to 150+500	D	PA D (Offshore)	4,201,000	0	0	0
	150+500 to 132+000	C	PA C (Offshore)	4,648,000	0	0	0
	132+000 to 114+000	B	PA B (Offshore)	5,296,000	0	0	0
	114+000 to 95+734	A	PA A (Offshore)	4,592,000	0	0	0
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	8,307,000	0	0	0
Sabine Bank Channel	53+000 to 18+000	2	PA 2 (Offshore)	7,051,000	0	0	0
Sabine Outer Bar	18+000 to 0+000	3	PA 3 (Offshore)	5,923,000	0	0	0
Sabine Pass Jetty Channel	–214+88 to 0+00	4	PA 4 (Offshore)	2,978,000	0	0	0
Sabine Pass Channel	0+00 to 186+00	5	PA 5 (N and S)	4,459,600	New Hyd. levee; 400-foot-wide stockpile	3,104,137	1,093,593
	186+00 – 296+25	6	PA 5B	2,263,600	400-foot-wide stockpile	1,362,051	
			PA 5C		400-foot-wide stockpile	1,163,419	
Port Arthur Canal	0+00 –240+00	7	PA 8	5,026,000	Stockpile in southwest corner	5,026,000	0
	240+00 –325+84	8*	PA 8	6,671,200	Stockpile in southwest corner	3,691,462	0
			PA 9A		300 foot-wide stockpile	1,898,938	0
			PA 9B		300-foot-wide stockpile	1,080,800	0
Sabine-Neches Canal	0+00 – 170+00	9	PA 8	3,092,000	Stockpile in northeast corner	3,092,000	0
	170+00 – 592+91	10	PA 11	8,852,000	Stockpile in north-south corners	8,852,000	0

Channel Reach	Channel Stations	Water-way Section	New Work Material Designation	New Work Dredged Volume (cy)**	New Work Material Construction	New Work Material Used for Construction Volume (cy)	New Work Material Surplus Volume (cy)
Neches River Channel	0+00 – 96+00	11	PA 12	1,628,000	100-foot-wide stockpile	1,135,764	74,029
			PA 13		100-foot-wide stockpile	418,207	
	96+00 – 158+00	12	PA 14	698,000	100-foot-wide stockpile	522,906	–362,241
			PA 16		100-foot-wide stockpile	537,335	
	158+00 – 292+00	13	Old River Cove	4,882,000	Marsh BU	4,882,000	0
	292+00 – 422+00	14	PA 18	2,213,000	100-foot-wide stockpile	870,540	49,295
			PA 18A		New Hyd. Levee	293,164	
			Bessie Heights East		Hyd. Levee System	1,000,000	
	422+00 – 522+00	15	PA 21	2,611,000	100-foot-wide stockpile	397,094	1,739,808
			PA 23A		New Hyd. Levee	474,098	
	522+00 – 716+00	16	PA 23	4,106,000	400-foot-wide stockpile	2,728,359	–1,766,345
			PA 24		400-foot-wide stockpile	2,624,786	
			PA 24A		New Hyd. levee	519,200	
	716+00 – 776+00	17	PA 25	2,845,000	200-foot-wide stockpile	2,263,932	20,009
			PA 25A		New Hyd. levee; 100-foot-wide stockpile	561,060	
	776+00 – 980+00	18	PA 25	6,031,000	50-foot-wide stockpile	421,197	96,456
			Rose City East		Hyd. Levee System	2,100,000	
			PA 26		400-foot-wide stockpile	1,773,504	
			PA 27A		200-foot-wide stockpile	1,136,376	
			PA 27C		New Hyd. Levee	283,200	
			PA 27D		New Hyd. Levee	220,267	
					Total	54,433,796	944,604

* Includes new material from Taylor Bayou (0+00 to 106+25).

** New work volume includes additional advance maintenance and proposed allowable overdepth.

The 50-year plan for maintenance material is presented in the following table:

Chan. Reach	Channel Stations	Water-way Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	Dredging Cycle Schedule	50-Year Maint-enance Material Total (CY)
Sabine Bank Extension	165+443 to 150+500	D	PA D (Offshore)	647,000	4	12	Cycle 1 through 12	7,764,000
	150+500 to 132+000	C	PA C (Offshore)	801,000	4	12	Cycle 1 through 12	9,612,000
	132+000 to 114+000	B	PA B (Offshore)	779,000	4	12	Cycle 1 through 12	9,348,000
	114+000 to 95+734	A	PA A (Offshore)	791,000	4	12	Cycle 1 through 12	9,492,000
Sabine Bank Channel	95+734 to 53+000	1	PA 1 (Offshore)	1,508,000	4	12	Cycle 1 through 12	18,096,000
Sabine Bank Channel	53+000 to 18+000	2	PA 2 (Offshore)	3,131,000	2	25	Cycle 1 through 25	78,275,000
Sabine Outer Bar	18+000 to 0+000	3	PA 3 (Offshore)	4,473,000	1	50	Cycle 1 through 50	223,650,000
Sabine Pass Jetty Channel	–214+88 to 0+00	4	PA 4 (Offshore)	1,352,700	5	10	Cycle 1 through 10	13,527,000
Sabine Pass Channel	0+00 –186+00	5	TX 8-11,	977,900	3	16	LA 5-6: Cycle 1, 3, 5, 7, 9, 11, 13, 15	15,646,400
			LA 5-6				TX8-11: Cycle 2, 4, 6, 8, 10, 12, 14, 16	
	186+00 – 296+25	6	PA 5 (N and S)	824,700	3	16	Cycle 1 through 16	13,195,200
			PA 5B	243,700	3	16	Cycle 1 through 16	3,899,200
			PA 5C	127,500	3	16	Cycle 1 through 16	2,040,000
Port Arthur Canal	0+00 – 240+00	7	PA 8	2,148,600	3	16	Cycle 1 through 16	34,377,600
	240+00 – 325+84	8*	PA 8	1,317,000	2	25	Cycle 1 through 25	32,925,000
			PA 9A	311,100	2	25	Cycle 1 through 25	7,777,500
			PA 9B	311,100	2	25	Cycle 1 through 25	7,777,500
Sabine-Neches Canal	0+00 – 170+00	9	PA 8	1,317,000	2	25	Cycle 1 through 25	32,925,000
	170+00 – 592+91	10	PA 11	3,360,000	4	12	Cycle 1 through 12	40,320,000
Neches River Channel	0+00 – 96+00	11	PA 12	479,800	3	16	Cycle 1 through 16	7,676,800
			PA 13	189,200	3	16	Cycle 1 through 16	3,027,200
	96+00 – 158+00	12	PA 14	432,000	3	16	Cycle 1 through 16	6,912,000
	158+00 – 292+00	13	PA 16, TX 5-2	445,400	3	16	TX 5-2: Cycle 1–9, PA 16: Cycle 10–16	7,126,400
			PA 17, TX 5-2	488,600	3	16	TX 5-2: Cycle 1–9, PA 17: Cycle 10–16	7,817,600
	292+00 – 422+00	14	PA 18, TX 5-2	740,500	4	12	TX 5-2: Cycle 1–7, PA 18: Cycle 8–12	8,886,000
			PA 18A, TX 5-2	145,600	4	12	TX 5-2: Cycle 1–7, PA 18A: Cycle 8–12	1,747,200

Chan. Reach	Channel Stations	Water-way Section	Maintenance Material Designation	Dredge Quantity Per Cycle (cy)	Years Per Cycle	Total # of Cycles	Dredging Cycle Schedule	50-Year Maint-enance Material Total (CY)
			PA 21, TX 5-2	276,900	4	12	TX 5-2: Cycle 1–7, PA 21: Cycle 8–12	3,322,800
	422+00 – 522+00	15	PA 23, TX 5-2	629,200	6	8	TX 5-2: Cycle 1–4, PA 23: Cycle 5–8	5,033,600
			PA 23A, TX 5-2	335,800	6	8	TX 5-2: Cycle 1–4, PA 23A: Cycle 5–8	2,686,400
	522+00 – 716+00	16	PA 24	1,267,900	6	8	Cycle 1 through 8	10,143,200
			PA 24A	611,100	6	8	Cycle 1 through 8	4,888,800
	716+00 – 776+00	17	PA 25	581,000	6	8	Cycle 1 through 8	4,648,000
	776+00 – 980+00	18	PA 25A, TX 3-1E	542,900	6	8	TX 3-1E: Cycle 1, PA 25A: Cycle 2–8	4,343,200
			PA 26, TX 3-1E	595,600	6	8	TX 3-1E: Cycle 1, PA 26: Cycle 2–8	4,764,800
			PA 27A, TX 3-1E	397,100	6	8	TX 3-1E: Cycle 1, PA 27A: Cycle 2–8	3,176,800
			PA 27C, TX 3-1E	269,900	6	8	TX 3-1E: Cycle 1, PA 27C: Cycle 2–8	2,159,200
			PA 27D, TX 3-1E	170,600	6	8	TX 3-1E: Cycle 1, PA 27D: Cycle 2–8	1,364,800
							50-Year Maintenance Material Total	**650,372,200**

* Includes maintenance material from Taylor Bayou (0+00 to 106+25)

The CIP would also incorporate BU areas as part of the DMMP; the Preferred Alternative includes two BU features: Neches River BU Feature (includes Rose City East, Bessie Heights East, and Old River Cove West Marsh Restoration sites) and the Gulf Shore BU Feature (Texas and Louisiana Point Shoreline Nourishment). For detailed information, refer to the DMMP (Appendix D of the FEIS, tables 4-1 and 5-3), which depicts all discharge locations which include all PAs, and BU features.

(2) Size

Discharges within the 16 PAs would cover approximately 11,730 acres. BU features include restoration of 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow water habitat (Neches River BU Feature), and regularly renourish approximately 6 miles of shoreline (Gulf Shore BU Feature). Detailed information can be found in the DMMP (Appendix D of the FEIS, tables 5-1 and 5-3).

(3) Type of Site and Habitat

Placement would occur on subsided marsh (BU feature and mitigation), eroding beach shoreline along Texas and Louisiana Points (BU feature), and existing and confined PAs.

(4) Time and Duration of Discharge

Fifteen construction contracts are planned for dredging and discharging. Contracts 1–5 would be constructed with hopper dredges and contracts 6–12 with hydraulic pipeline dredges. The dredging contracts would be accomplished over a period of about 6 years. The ecological mitigation contracts (13–15) would be accomplished throughout the construction sequence. Dredging for the mitigation contracts does not involve the use of new work or maintenance material from the SNWW CIP. Refer to the FEIS for a description of this work. The proposed sequence for dredge and construction is shown in the following table.

Contract Number	Contract Schedule	Construction Start (month/fiscal year)	Construction Finish (month/fiscal year)
	Hopper Dredging:		
1	**Sabine Bank Extension**	October 2012	January 2013
	Section D Station 165+000 to 165+443		
	Section C Station 165+443 to 132+000		
2	Section B Station 132+000 to 114+000	February 2013	July 2014
	Section A Station 114+000 to 95+734		
3	**Sabine Bank Channel**	October 2015	August 2015
	Section 1 Station 95+734 to 53+000		
4	**Sabine Pass Outer Bar & Bank Channels**	October 2016	March 2017
	Section 2 Station 53+000 to 18+000		
	Section 3 Station 18+000 to 0+000		
5	**Sabine Pass Jetty Channel**	April 2017	September 2017
	Section 4 Station -214+88 to 0+00		
	Pipeline Dredging:		
6	**Sabine Pass Channel**	October 2016	January 2018
	Section 5 Station 0+00 to 186+00		
	Section 6 Station 186+00 to 296+25		
7	**Port Arthur Canal**	October 2012	August 2015
	Section 7 Station 0+00 to 240+00		
	Section 8 Station 240+00 to 325+84		
8	**Taylor Bayou Basin Area:**		
	Sabine-Neches Canal	April 2017	September 2018
	Section 9 Station 0+00 to 170+00		
9	Section 10 Station 170+00 to 592+94	April 2014	May 2017
10	**Neches River Channel**	October 2012	March 2014
	Section 11 Station 0+00 to 96+00		
	Section 12 Station 95+00 to 158+00		
	Section 13 Station 158+00 to 292+00		
11	Section 14 Station 292+00 to 422+00	April 2015	July 2018
	Section 15 Station 422+00 to 522+00		
	Section 16 Station 522+00 to 716+00		
12	Section 17 Station 716+00 to 776+00	October 2012	March 2015
	Section 18 Sta. 776+00 to 980+00		
13	**Mitigation for Willow Bayou, Louisiana**	October 2015	May 2018
14	**Mitigation for West Black Bayou, Louisiana**	October 2012	February 2014
15	**Mitigation for East Black Bayou, Louisiana**	October 2014	May 2015

f. Description of Disposal Method

The construction would utilize a combination of traditional and relatively new dredging techniques. Equipment used to dredge the channels would be those traditionally employed: hopper dredges in the offshore reaches, and hydraulic pipeline dredges in the other reaches. Disposal of the new work material

would be in conventional upland PAs and offshore PAs, as well as innovative, nontraditional dredging techniques of placement into marshes and adjacent shorelines. These techniques are mandated due to the requirements of the mitigation and DMMP restoration and nourishment features. Contracts would be written to not only emphasize the removal of material from the channel, but also emphasize successful completion of mitigation and restoration features so that they would perform to intended purposes. Best Management Practices (BMPs), such as silt curtains, may be implemented where appropriate to control and reduce turbidity during dredging and placement. BMPs would also be employed during construction of temporary containment levees and spill boxes for restoration sites. The DMMP (Appendix D of the FEIS) provides more information.

II. Factual Determinations

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope

Substrate elevations in BU features and mitigation areas would be approximately mean sea level. In PAs where new levees are required, hydraulic fill levees would be constructed using new work material. The design template provides a 100-foot crest width, 3:1 side slopes, and a 6-foot height.

(2) Sediment Type

From historical dredging records of the SNWW, dredged materials are expected to be composed of 51 percent silt, 31 percent clay, and 18 percent sand. Recent sediment tests for the Entrance Channel Extension, which consisted of grab samples from about the top foot of shore sediments, revealed predominantly sand: 26 percent of the samples contained >90 percent sand, 41 percent contained >80 percent sand, and only two samples had a sand content less than 50 percent. The maximum sand content was 99.1 percent. Section 3.4 of the FEIS discusses sediments further.

(3) Dredged/Fill Material Movement

Upland PAs would have containment levees to control fill movement after deposition; minor amounts of suspended solids may occur during construction, placement within BU features, or during mitigation efforts. BU marsh restoration areas would be protected from erosion by low levees, and BMPs may be implemented to control and reduce turbidity during discharge. The restored marshes would be stabilized initially by the planting of estuarine plants species (e.g., *Spartina* spp.); rapid natural colonization of marsh vegetation would also be expected based upon previous experience in the area. BU features targeting shoreline stabilization at Texas and Louisiana Points would include regular, unconfined discharge by hydraulic pipeline dredge. Section 2.5.3.2.2 of the FEIS describes predicted movement.

(4) Physical Effects on Benthos

Temporary and localized impacts to benthic organisms and their Gulf, estuarine and riverine water-bottom habitats would occur; however, benthic organisms are expected to quickly rebound from the short-term impacts from marsh restoration and shoreline nourishment. BMPs would be used where appropriate

to contain and control sediment and dredged material movement. Effects on aquatic organisms are discussed in Section 4.11 of the FEIS.

(5) Other Effects

None known.

(6) Actions Taken to Minimize Impacts

This project was fully coordinated with State and Federal resource agencies. Their recommendations were considered, incorporated, and described in the DMMP. Any unavoidable losses were mitigated. The BU features and mitigation sites are expected to lead to an overall increase in the diversity and productivity of estuarine and benthic habitat in the project area.

b. Water Circulation, Fluctuation, and Salinity Determinations

(1) Water

The dredging and placement operations are expected to have only minor, short-term impacts on water quality in the area. Impacts to water quality are discussed more fully in Section 4.4 of the FEIS. BMPs would be implemented where appropriate.

(a) Salinity

The Preferred Alternative would provide a deeper navigation channel that would allow a greater amount of tidal circulation and exchange with the Gulf than is currently the case. Changes in salinities over the SNWW estuarine system were projected with the hydrodynamic salinity (HS) model (Brown and Stokes, 2009) described in sections 4.1 and 4.2 of the FEIS, where the modeling efforts included mitigation measures, relative sea level rise, and alternatives. The HS model determined that approximately 211,500 acres will be impacted by the slight increase in salinity in Texas and Louisiana. The average water surface elevation through most of the study area would largely be unaffected by the 48-foot channel. However, both the amplitude and average elevation of the tide on the upper Neches River near the saltwater barrier could exhibit a measurable increase, on the order of an average increase in water surface elevation of 0.8 inch.

(b) Water Chemistry

Aside from a temporary increase in local suspended solids, no impacts are expected (Section 4.4 of the FEIS describes water quality impacts).

(c) Clarity

There may be a local and temporary increase in turbidity during dredging and placement operations. BMPs such as temporary containment levees and spill boxes would be implemented where appropriate to control and reduce turbidity during dredging and discharges into confined PAs, BU features, and

mitigation areas during construction. Water clarity is expected to return to normal background levels shortly after operations are completed.

(d) Color

Water immediately surrounding the construction area may become discolored temporarily due to disturbance of the sediment. BMPs would be implemented to reduce and control turbidity.

(e) Odor

The new work material is not expected to be anoxic, so there should be no odors associated with dredging and placement.

(f) Taste

No detectable impacts in the estuarine environment.

(g) Dissolved Gas Levels

No dissolved gas levels except, perhaps, minor amounts of hydrogen sulfide are expected.

(h) Nutrients

Nutrient levels may be elevated near the PAs during discharge but these increases would be local and temporary.

(i) Eutrophication

Nutrients are not expected to reach levels high enough for periods long enough to lead to eutrophication of the surrounding waters.

(j) Others as Appropriate

None known.

(2) Current Patterns and Circulation

Components of the Preferred Alternative (e.g., shoreline nourishment, marsh nourishment, and restoration) were not shown to significantly affect currents or circulation patterns (sections 4.4 and 4.6 of the FEIS describe currents and flows).

(a) Current Patterns and Flow

The Preferred Alternative would not have an effect on freshwater inflows to the system. The 48-foot project would not change large-scale circulation estuarine patterns, but it would cause the leading edge of the salinity wedge to intrude farther upstream.

(b) Velocity

The channel deepening would result in general increases in velocity along the entire channel; however, magnitudes are relatively minor, with less than 0.5 foot/second in most cases (Parchure et al., 2005). The largest changes would occur in the Sabine-Neches Channel, but the absolute magnitude is small.

(c) Stratification

No increase in stratification would be expected with the Preferred Alternative. The SNWW navigation channels would remain highly stratified with channel deepening.

(d) Hydrologic Regime

Although the Preferred Alternative would increase tidal exchange and slightly increase salinity levels, hydrologic and tidal regimes would not be altered on a large scale.

(3) Normal Water Level Fluctuations

The average water surface elevation through most of the study area would largely be unaffected by the 48-foot channel, and no significant increase in tidal amplitude would be expected.

(4) Salinity Gradients

The Preferred Alternative would provide a deeper navigation channel that would allow a greater amount of tidal circulation and exchange with the Gulf than is currently the case. Changes in salinities over the SNWW estuarine system were projected with the HS model (Brown and Stokes, 2009) described in sections 4.1 and 4.2 of the FEIS, where the modeling efforts included mitigation measures, relative sea level rise, and alternatives. During median flows, the transition would shift to near Bessie Heights on the Neches River, to Keith Lake on the Sabine-Neches Canal, and Johnson's Bayou on Sabine Lake. During low flows, the transition would shift to near Rose City on the Neches River, the Sabine River near Orange, Texas, and Willow Bayou on Sabine Lake. The 48-foot project would cause the leading edge of the salinity wedge to intrude further upstream.

(5) Actions That Will Be Taken to Minimize Impacts

The following objectives were established to offset or minimize impacts from the SNWW CIP. The objectives were developed by USACE in consultation with the Interagency Coordination Team (ICT).

- Minimize salinity impacts to the SNWW affected area
- Maximize the use of dredged material in marsh restoration measures
- Meet goal of no net loss of wetlands
- Replace lost habitat quality on a 1:1 ratio
- Replace habitats in-kind to the extent practicable
- offset or minimize losses in the state where they occur

- Share dredged material from Sabine Pass equally between Louisiana and Texas

Ultimately, unavoidable impacts of the Preferred Alternative in Texas are more than offset by benefits of the DMMP (which includes BU features); impacts in Louisiana, however, required compensatory mitigation. Therefore, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. The amount of impacts avoidance, minimization, or mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the 50-year period of analysis. Mitigation is fully described in Chapter 5 of the FEIS.

The Neches River BU Feature would offset or minimize impacts to Texas wetlands on the Sabine and Neches rivers by restoring 2,853 acres of emergent marsh, improve 871 acres of shallow-water habitat, and nourish 1,234 acres of existing marsh. The BU feature also offsets direct impacts from connecting 86 acres of freshwater marsh to a confined PA.

c. Suspended Particulate/Turbidity Determination

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

A temporary and localized increase in suspended particulates and turbidity levels is expected during dredging and placement operations of new work and maintenance material. BMPs would be implemented where appropriate.

(2) Effects on Chemical and Physical Properties of the Water Column

(a) Light Penetration

Turbidity levels would be temporarily increased during dredging and placement operations of new work and maintenance material.

(b) Dissolved Oxygen

No adverse impacts to dissolved oxygen (DO) are expected; a reduction in DO may occur at localized and temporary events during placement.

(c) Toxic metals and organics

Suspended particles resulting from placement would not result in detrimental effects to chemical and physical properties of the water column. Extensive chemical analyses, bioassays, and bioaccumulation studies of offshore sediment material were conducted in accordance with EPA Regulations and the *Ocean*

Testing Manual. Results indicate that there are no causes for concern related to chemical contaminants and that these sediments are suitable for ocean placement. Similar testing was performed numerous times on maintenance material dredged from the 22-mile existing SNWW Entrance Channel, and these sediments were always found to be acceptable for ocean placement. Section 4.5 of the FEIS discusses sediment testing results.

An examination of the sediment data presented in PBS&J (2004) and sediment data recently collected in March 2008 and April 2009 indicates no cause for concern, with the possible exception of elevated polycyclic aromatic hydrocarbons (PAHs) in one reach of the Neches River. There are nine sites listed in Table 3.3-1 in the FEIS that are considered to be priority Hazardous, Toxic, and Radioactive Waste (HTRW) sites, and there is a reach of the Neches River (stations 750 + 000 to 950 + 000, Figure 2.4-1g in the FEIS) that has higher sediment PAH concentrations than other reaches of the SNWW, but the location of the sites in Table 3.3-1 in the FEIS do not correlate to the higher-PAH reach of the Neches River. Additionally, none of those PAHs are found in the elutriate samples from the higher-PAH reach of the Neches River (Section 3.3 in the FEIS), so there is no indication that those PAHs would be released during dredging and/or placement. Taking all of this information into account, there appear to be no reaches of the SNWW that exhibit a cause for concern.

(d) Pathogens

None expected or found.

(e) Aesthetics

The PAs, BU features, and mitigation areas have been designed and selected with coordination between necessary and interested resource agencies to minimize environmental impacts and reduce or eliminate adverse aesthetic qualities.

(f) Others as Appropriate

None known.

(3) Effects on Biota

No impacts are expected on photosynthesis, suspension/filter feeders, and sight feeders, except for temporary and localized impacts from placement operations (e.g., burial of benthos or temporary increase of local turbidity levels).

Creating benefits for estuarine biota (species depend on estuaries at some time in their life cycle for protection, food, and as a nursery site), the Neches River BU Feature (comprised of Rose City East, Bessie Heights East, and Old River Cove West) would restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. The Gulf Shore BU Feature (Texas and Louisiana Points) involve regular nourishment of approximately 6 miles of shoreline. Additionally, the mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near

Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. Chapter 5 of the FEIS discusses mitigation for habitats.

(4) Actions Taken to Minimize Impacts

Construction and placement plans for the dredged materials have been closely coordinated with the resource agencies to assure minimal impacts to aquatic habitats. Additionally, a Wetland Value Assessment was performed for SNWW CIP impacts to ensure proper mitigation or replacement of estuarine vegetation communities. Dredged material has been used beneficially to the maximum extent possible, resulting in the offsetting of all project impacts in Texas, and offsetting of some impacts in Louisiana. In addition, new upland PAs were sited to avoid impacts to wetlands to the greatest extent possible. BMPs would include construction of temporary containment levees/spill boxes for restoration sites and could include silt curtains during discharges in BU features.

d. Contaminant Determinations

The USACE has collected and archived a significant amount of water and sediment chemistry data as well as elutriate data that provide information on those constituents that are dissolved into the water column during dredging and placement. The water and elutriate study results are summarized by channel station in Section 3.3.1 of the FEIS. Based on available data, there is no indication of current water or elutriate contaminant problems along the SNWW. In consideration of Louisiana Department of Environmental Quality (LDEQ) requirements, Sabine Pass sediment was compared to Louisiana's RECAP non-industrial Screening Standards. All detected analytes were below the lowest value for the respective standard. PBS&J also compared water and elutriate results to the Louisiana Surface Water Quality Standard (LWQS), and found no exceedances.

An examination of the sediment data presented in PBS&J (2004), and sediment data recently collected in March 2008 and April 2009, indicates no cause for concern, with the possible exception of elevated PAHs in one reach of the Neches River. There are nine sites listed in Table 3.3-1 in the FEIS that are considered to be priority HTRW sites, and there is a reach of the Neches River (stations 750 + 000 to 950 + 000, Figure 2.4-1g in the FEIS) that has higher sediment PAH concentrations than other reaches of the SNWW, but the location of the sites in Table 3.3-1 in the FEIS do not correlate to the higher-PAH reach of the Neches River. Additionally, none of those PAHs are found in the elutriate samples from the higher-PAH reach of the Neches River (Section 3.3 in the FEIS), so there is no indication that those PAHs would be released during dredging and/or placement. Taking all of this information into account, there appear to be no reaches of the SNWW that exhibit a cause for concern.

e. Aquatic Ecosystem and Organism Determinations

(1) Effects on Plankton

Construction and placement operations are expected to have only minor temporary, local impacts on plankton from increased turbidity levels.

(2) Effects on Benthos

Temporary and localized impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats would occur; however, benthic organisms are expected to quickly rebound from the short-term impacts from marsh restoration and shoreline nourishment.

(3) Effects on Nekton

Wright (1978) indicates that nekton is not directly affected by dredged material placement for marsh restoration in shallow, open-water areas and shoreline nourishment since they can avoid areas of high turbidity. The benthos within BU features, which would have been used as a food source, may be temporarily and detrimentally affected, but the restored marshes would ultimately improve habitat for benthic organisms. The elutriate analyses and bioassessments with undisturbed virgin sediment yielded no expectation of short-term water column or benthic toxicity from dredging or placement operations, except from increased turbidity. Therefore, no significant impacts to the nekton of the area from the proposed dredging and placement operations are expected.

(4) Effects on Aquatic Food Web

The estuarine and Gulf food web would benefit from greater productivity associated with marsh restoration in shallow, open-water areas and shoreline nourishment. Reductions in primary productivity from turbidity would be localized around the immediate area of the construction and maintenance dredge operations and would be limited to the duration of the plume at a given site.

(5) Effects on Special Aquatic Sites

The Preferred Alternative is not expected to have detrimental effects on special aquatic sites (i.e., sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle and pool complexes) in the study area. The Neches River BU Feature would offset impacts to Texas wetlands on the Sabine and Neches rivers by restoring 2,853 acres of emergent marsh, improving 871 acres of shallow-water habitat, and nourishing 1,234 acres of existing marsh. The BU feature also offsets direct impacts from connecting 86 acres of freshwater marsh to a confined PA. In addition, new upland PAs were sited to avoid impacts to wetlands to the greatest extent possible.

The mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in

and around the marsh restoration zone. The amount of recommended mitigation is based upon the amount of marsh acreage that could be lost as a result of the project, and the additional amount that would need to be restored in order to fully compensate for adverse changes to biological function of the remaining marsh throughout the affected area over the 50-year period of analysis. Chapter 5 of the FEIS discusses mitigation for estuarine habitats.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination

Preferred Alternative PAs would not require mixing zones as they include levees and dewatering designs. Mixing zones would occur during marsh restoration or shoreline nourishment; however, testing of elutriates prepared with maintenance material has not demonstrated contaminants or other causes for concern.

(2) Determination of Compliance with Applicable Water Quality Standards

Sediment analyses of new work material have been performed, and testing of elutriates prepared with maintenance material has not demonstrated any violation of applicable water quality standards. The State of Texas has issued a water quality certificate for current maintenance dredging of the SNWW, indicating that water quality standards are being met.

(3) Potential Effects on Human Use Characteristics

(a) Municipal and Private Water Supply

The proposed project would not impact any municipal or private water supplies. On the Neches River, water intakes are located upstream of the Neches River Saltwater Barrier; on the Sabine River, water intakes are located well upstream of the projected saltwater intrusion.

(b) Recreational and Commercial Fisheries

Recreational and commercial fishing in Sabine Pass areas and the immediate Gulf may benefit as a result of the marsh restoration efforts, which would increase estuarine habitats that are critical to the marine food web.

(c) Water-related Recreation

The project would improve navigation, which may improve water-related recreation.

(d) Aesthetics

The project is designed to minimize any adverse impacts to the environment and aesthetic qualities in the area.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

No special sites would be negatively impacted by the project.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

The project is expected to result in net benefits to the environment without adding to negative cumulative impacts in the aquatic ecosystem. A Wetland Value Assessment was performed to ensure adequate replacement of wetlands and ecological functions.

h. Determination of Secondary Effects on the Aquatic Ecosystem

No adverse significant secondary effects on the aquatic ecosystem should occur as a result of the recommended project, but secondary beneficial effects are expected from marsh restoration and shoreline nourishment efforts.

Literature Cited

Brown, G.L., and J. Stokes. 2009. Numerical Model Study of Potential Salinity Impacts Due to Proposed Navigation Improvements to the Sabine-Neches Waterway, Texas (August 2009 draft report). U.S. Army Engineer Research Development Center – Coastal and Hydraulics Laboratory (ERDC-CHL), Vicksburg, Mississippi.

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FINDINGS OF COMPLIANCE WITH
SECTION 404(b)(1) GUIDELINES
FOR SABINE–NECHES WATERWAY – CHANNEL IMPROVEMENT PROJECT
JEFFERSON AND ORANGE COUNTIES, TEXAS

1. No significant adaptations of the Guidelines were made relative to the evaluation for this project.

2. The recommended plan is the result of thorough evaluation of seven proposed alternatives (including the No-Action Alternative).

3. The recommended plan would not violate any applicable State or Federal water quality criteria or toxic effluent standards of Section 307 of the Clean Water Act.

4. The recommended plan would not adversely affect any federally or State-listed threatened or endangered species or their critical habitat or violate any protective measures for any sanctuary. Various resource agencies, including FWS and NMFS, have been consulted regarding potential issues of any federally or State-listed threatened or endangered species or their critical habitat (e.g., sea turtle avoidance measures would be implemented during operations).

5. The recommended plan would not result in adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The PAs, BU features, and mitigation sites would provide additional habitat for life stages of marine species and additional habitat for colonial waterbirds. There are no significant adverse impacts expected to the estuarine ecosystem diversity, productivity and stability, or recreational, aesthetic, and economic values.

6. Appropriate steps to minimize potential adverse impacts on the estuarine system include close coordination with State and Federal resource agencies during final design prior to construction to incorporate all valid suggestions. Special aquatic sites or sensitive habitat affected by channel deepening and expansion would be mitigated.

7. Based on the guidelines, the preferred alternative is specified as complying with the requirements of the Section 404(b)(1) guidelines.

Dolan Dunn — 4/29/10

Mr. Dolan Dunn
Chief–Planning, Environmental, and Regulatory Division
U.S. Army Corps of Engineers, Galveston District

Date

Appendix F

Final General Conformity Determination

Document No. 070057
PBS&J Job No. 100007609

FINAL
GENERAL CONFORMITY DETERMINATION
SABINE-NECHES CHANNEL IMPROVEMENT PROJECT
PORT OF BEAUMONT AND PORT OF PORT ARTHUR TEXAS

Prepared for:

U.S. Army Corps of Engineers
Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Prepared by:

PBS&J
6504 Bridge Point Parkway
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Austin, Texas 78730

June 2010

PROFESSIONAL ENGINEER STATEMENT

This Final General Conformity Determination Document and estimate of air contaminant emissions is released on September 8, 2010, under the authority of Ruben I. Velasquez, P.E., Registration No. 69126, for the purpose of evaluation and discussion. This preliminary document is not to be used for construction or bidding purposes.

STATE OF TEXAS
RUBEN I. VELASQUEZ
69126
REGISTERED
PROFESSIONAL ENGINEER

9-8-2010

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Acronyms and Abbreviations

AQCR	Air Quality Control Region
BPA	Beaumont-Port Arthur Nonattainment Area
CAA	Clean Air Act
CFR	Code of Federal Regulations
CIP	Channel Improvement Project
DOT	U.S. Department of Transportation
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
MVEB	Motor Vehicle Emissions Budget
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NO_x	nitrogen oxides
ROP	Rate-of-Progress
SIP	State Implementation Plan
SNWW	Sabine-Neches Waterway
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
tpy	tons per year
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) has joined in an agreement with the Sabine Neches Navigation District to prepare a Final Feasibility Report and a Final Environmental Impact Statement (FEIS) for proposed improvements to the Sabine-Neches Waterway (SNWW). The proposed SNWW Channel Improvement Project (CIP) is intended to improve the efficiency of the deep-draft navigation system while protecting the area's coastal and estuarine resources. As authorized by the Senate Committee on Environment and Public Works Resolution, dated June 5, 1997, the USACE has reviewed previous USACE reports on the SNWW and other pertinent reports to determine the feasibility of modifying the channels serving the Port of Beaumont and the Port of Port Arthur, Texas, in the interests of commercial navigation. These channels are collectively named the SNWW. The lead agency for the FEIS is the USACE, with several cooperating agencies. An FEIS was prepared as required by the National Environmental Policy Act (NEPA) to present an evaluation of potential impacts associated with the proposed CIP.

The proposed SNWW CIP will be located on the upper Texas Gulf Coast at the Texas-Louisiana state boundary within Jefferson and Orange counties in Texas and Cameron and Calcasieu parishes in Louisiana. Sabine Pass, Sabine Lake, and the Sabine River together form the southern boundary between the two states. The area surrounding the waterway is generally referred to as the "Golden Triangle," which refers to the metropolitan area's three major cities and their ports—Beaumont, Port Arthur, and Orange, Texas. The project area is defined as those areas that would be directly affected by construction of the CIP as detailed in the FEIS.

The counties of Jefferson and Orange are within an area designated as the Beaumont-Port Arthur (BPA) Air Quality Control Region (AQCR). Ozone is the only criteria pollutant from which the BPA fails to meet the National Ambient Air Quality Standards (NAAQS). The U.S. Environmental Protection Agency (EPA) has classified the BPA area as a "serious" nonattainment area under the 1-hour NAAQS for ozone and a "moderate" nonattainment area with regard to the 8-hour NAAQS for ozone. Under the current attainment classification, the BPA has until June 15, 2010, to attain the 8-hour NAAQS for ozone. However, 8-hour ozone data for 2005, 2006, and 2007 indicate that the BPA area is monitoring attainment of the standard. As a result, the Texas Commission on Environmental Quality (TCEQ) adopted a Texas State Implementation Plan (SIP) revision that includes a Redesignation Request and a Maintenance Plan under Section 175A of the Federal Clean Air Act (CAA) Amendments of 1990 for the BPA area (TCEQ, 2008). This maintenance plan is currently pending review by the EPA.

Calcasieu Parish is in the Lake Charles AQCR and Cameron Parish is in the Southern Louisiana-Southeast Texas AQCR. These parishes are currently classified as being in attainment with the NAAQS for all criteria pollutants.

For a nonattainment area, a General Conformity Determination is required when the total air contaminant emissions caused by the proposed project would equal or exceed a specific threshold for nitrogen oxides (NO_x) or volatile organic compounds (VOCs). Based on an evaluation of air contaminant emissions from the construction activities associated with the proposed SNWW CIP Preferred Alternative, it has been determined that a General Conformity Determination for NO_x emissions is required. Emissions of VOC for the project are exempt from a General Conformity Determination because they are below the emissions threshold requiring such an analysis.

This document represents the Final General Conformity Determination prepared on behalf of the USACE, Galveston District, pursuant to the CAA to document that emissions that would result from the USACE action in approving the proposed SNWW CIP Project are in conformity with the SIP for the BPA ozone nonattainment area.

2.0 REGULATORY BACKGROUND – GENERAL CONFORMITY

General conformity refers to the process of evaluating plans, programs, and projects to determine and demonstrate they meet the requirements of the CAA and the SIP. The General Conformity Rule requires conformity in coordination with and as part of the NEPA process. The proposed CIP project, as a Federal action, is subject to the General Conformity Rule (40 CFR Part 51, Subpart W). This rule implements the Federal CAA conformity provision in Title I, Section 176(c)(1), "Limitation on Certain Federal Assistance," which mandates that the Federal government not engage, support, or provide financial assistance for licensing or permitting, or approving any activity not conforming to an approved CAA implementation plan. In Texas, the applicable implementation plan is the Texas SIP, an EPA-approved plan for the regulation and enforcement of the NAAQS in each air quality region within the state. The General Conformity Rule is designed to ensure that Federal actions do not cause or contribute to degradation in air quality in an area that is designated as being a "nonattainment" area or a "maintenance" area with regard to meeting the NAAQS, thus supporting the achievement of State and Federal air quality goals. The General Conformity Rule is codified at Title 40 Code of Federal Regulations (CFR) Part 51, Subpart W, "Determining Conformity of Federal Actions to State or Federal Implementation Plans."

The TCEQ has promulgated a corresponding General Conformity Rule in 30 Texas Administrative Code (TAC) §101.30, "Conformity of General Federal Actions to State Implementation Plans." This rule applies to all Federal actions except programs and projects requiring funding or approval from the U.S. Department of Transportation (DOT), the Federal Highway Administration, the Federal Transit Administration, or the Metropolitan Planning Organization. These types of programs and projects must instead comply with the conformity provisions implemented in the Transportation Conformity Rule issued by the DOT on November 24, 1993.

The CAA defines conformity to the SIP as the upholding of "an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards." Conforming activities or actions should not, through additional air pollutant emissions, result in the following:

- Cause or contribute to new violations of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

Pursuant to the General Conformity Rule, a Federal agency must make a General Conformity Determination for all Federal actions in nonattainment or maintenance areas where the total of direct and indirect emissions of a nonattainment pollutant or its precursors exceeds levels established by this rule.

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3.0 APPLICABILITY

Consistent with Section 176(c)(1) of the CAA, a Federal action is generally defined as any activity engaged in or supported in any way by any department, agency, or instrumentality of the Federal government (40 CFR § 51.852). Federal actions include providing Federal financial assistance or issuing a Federal license, permit, or approval. Where the Federal action is a permit, license, or other approval for some aspect of a non-Federal undertaking, the relevant activity is the part, portion, or phase of the non-Federal undertaking that requires the Federal permit, license, or approval.

The proposed SNWW CIP requires approval from the USACE, as the lead agency, for dredge and fill activities related to the project. Only project activities subject to the jurisdiction of the USACE and within the boundaries of Texas would be subject to this conformity determination. Because the project alternatives are subject to the approval of the USACE, it constitutes a Federal action, and therefore, air contaminant emissions resulting from the Preferred Alternative must be evaluated under the General Conformity rules.

The BPA ozone nonattainment area is classified as "moderate" in terms of its degree of compliance with the current 8-hour ozone standard. This area is in attainment with all other criteria pollutants. Pursuant to the General Conformity rules, a General Conformity Determination is required for each year when the total of direct or indirect emissions caused by the CIP would equal or exceed 100 tons per year (tpy) of NO_x or 100 tpy of VOC (40 CFR §51.853). The rule does not apply (i.e., a General Conformity Determination is not required) to actions where the total of direct or indirect emissions is below these emissions levels. In addition, even if the total of direct and indirect emissions of VOC or NO_x do not exceed the 100 tpy threshold levels, when the total of direct and indirect emissions of any pollutant from the Federal action represents 10 percent or more of a nonattainment or maintenance area's total emissions of those pollutants, then the action is defined as a regionally significant action and a conformity determination would be still be applicable.

For purposes of the General Conformity Determination, the relevant direct and indirect emissions are those associated with the construction of the widening and deepening of the Sabine-Neches channel including emissions from dredging activities, construction equipment, and temporary employee vehicles. The General Conformity analysis would include only air emissions from project activities occurring within the Texas state line out to the boundary considered the natural resources limit, i.e., 9 miles out into the Gulf of Mexico.

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4.0 AIR EMISSIONS INVENTORY

The evaluation of an air emissions inventory associated with the proposed SNWW CIP was based on the identification of air contaminants and estimated emission rates for the Preferred Alternative. For purposes of this Draft General Conformity Determination, an air emissions inventory was prepared for project-related construction based on the construction schedule and other assumptions as developed for this project. Air emissions estimates were calculated using techniques appropriate for a specific emissions-generating activity or source. The basis, emission factors, and summary of emissions are provided in Appendix A.

4.1 Project Emissions

Project emissions were estimated for the projected years of construction, 2011 through 2018. The estimated emissions were based on projected equipment use and scheduling for offshore and onshore construction activities. The construction emissions inventory included emissions associated with dredging vessels and equipment, nonroad construction equipment, and on-road mobile sources, as follows:

- Dredging vessels and equipment – included dredges and support marine vessels;
- Nonroad construction equipment – included amphibious trackhoe, dozer, dragline, excavator, and rolligon; and
- On-road mobile sources – included employee commuter vehicles

4.1.1 Dredging Vessels and Equipment

Dredging emissions included those that would be expected to result from the use of tugboats and miscellaneous marine vessels in support of the dredging activities. Air emissions directly related with the dredging equipment were calculated on an annual basis based on the anticipated type of engine, activity, horsepower, and anticipated hours of operation. Estimated emissions from the use of dredging equipment were based on the emission factor algorithms referenced in EPA's technical report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data," EPA 420-R-00-002, February 2000. This technical report is a compilation of engine- and fuel-usage test data from various types of marine vessels including bulk carriers, container ships, dredges, tankers, and tugboats. This report was utilized to determine the load factors and emission factors for the various combustion engines that would be used in support of the dredging activities for the project. Emission factors were determined based on an emission factor algorithm that may be used to calculated air contaminant emission rates for these emission sources. The emission factor algorithm is applicable to all engine sizes since, according to the EPA's document, the emissions data showed no statistically significant difference across engine sizes.

4.1.2 Nonroad Construction Equipment

Air contaminant emissions from nonroad construction equipment used for onshore dredged material placement; i.e., filling, working, and compacting of dredged material, were calculated on an annual basis based on the anticipated type of equipment, activity, horsepower, and anticipated hours of operation. The operation of construction vehicles (e.g., amphibious trackhoe, dozer, dragline, excavator, and rolligon) will generate air emissions typical of vehicles powered by diesel-fueled internal combustion engines. The estimate of emissions for this equipment was based on emission factors generated using the EPA's NONROAD2005. This computer model may be used to calculate emissions for many nonroad equipment types, categorizing them by horsepower rating and fuel type available for specific years, for a specific geographic area, state, or county. The NONROAD model was run for the amphibious trackhoe, dozer, dragline, and excavator equipment from the population that may be found in Jefferson and Orange counties for each year of anticipated construction.

4.1.3 On-road Mobile Sources

Mobile source emissions associated with the SNWW CIP construction will be generated from employee commuter vehicles. Mobile on-road emissions associated with employee vehicles were calculated using EPA MOBILE6, a mobile source emissions model. A mix of light-duty gasoline vehicles and light-duty gasoline trucks was assumed for the makeup of the employee vehicles. An average commute of 25 miles each way was assumed for each vehicle. The total number of miles traveled was estimated by multiplying the number of miles per trip by the total number of days of construction activity for each year times the number of vehicles.

4.2 Summary of NO_X and VOC Emissions

For comparison with the thresholds defined in the General Conformity Rule, the average emissions of NO_x and VOC are summarized in tables 1 and 2 for each year of the anticipated construction activities. Emissions of carbon monoxide, sulfur dioxide, and particulate matter are not considered in the General Conformity evaluation as the study area is in attainment with the NAAQS for each of those pollutants.

As shown in Table 1, NO_x emissions for activities subject to USACE responsibility show the project would exceed the conformity threshold, i.e., greater than 100 tpy. Therefore, a General Conformity Determination for NO_x emissions would be required.

Table 1

Summary of Estimated Project NO_x Emissions (tpy)

Year	Dredge & Support Equipment	Nonroad Construction Equipment	On-road Mobile Emissions	Total
2011	217.77	34.05	0.29	252.11
2012	1,106.59	126.17	1.25	1,234.01
2013	1,120.03	120.72	1.29	1,242.05
2014	1,222.80	116.52	1.27	1,340.59
2015	1,208.15	104.22	1.28	1,313.65
2016	1,212.23	90.55	1.26	1,304.05
2017	1,312.36	87.97	1.32	1,401.65
2018	467.93	34.07	0.45	502.45

As shown in Table 2, VOC emissions for the activities subject to USACE responsibility are exempt from a General Conformity Determination because they are below the 100-tpy threshold.

Table 2

Summary of Estimated Project VOC Emissions (tpy)

Year	Dredge & Support Equipment	Nonroad Construction Equipment	On-road Mobile Emissions	Total
2011	2.57	3.12	0.42	6.10
2012	12.38	11.43	1.84	25.65
2013	12.54	10.99	1.91	25.44
2014	13.82	10.86	1.88	26.57
2015	13.94	9.90	1.89	25.73
2016	14.22	8.69	1.87	24.78
2017	15.40	8.73	1.94	26.07
2018	5.47	34.89	0.66	41.02

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5.0 ISSUANCE OF DRAFT GENERAL CONFORMITY DETERMINATION AND AGENCY RESPONSE

On December 16, 2009, the USACE, Galveston District issued a Draft General Conformity Determination concurrently with the Draft Environmental Impact Statement (EIS) for the proposed SNWW CIP. Copies of these documents were provided to various Federal and State agencies including the TCEQ and the EPA, Region VI. The USACE published the notice of availability of the Draft General Conformity Determination in newspapers of general circulation for the BPA and the Sulphur and Lake Charles, Louisiana, areas on January 21, 2010, in the *Beaumont Enterprise*, Beaumont, Texas; on January 20, 21, and 22, 2010, in the *Port Arthur News*, City of Port Arthur, Texas; on January 19, 20, 21, and 22, 2010, in the *Southwest Daily News*, Sulphur, Louisiana; and on January 21, 22, and 23, 2010, in the *Lake Charles American Press*, Lake Charles, Louisiana. Copies of these publications and publisher's affidavits are provided in Appendix B.

After the issuance of the Draft General Conformity Determination in December 2009, the TCEQ provided a General Conformity Concurrence letter dated April 15, 2010. A copy of this letter is provided in Appendix C.

In its letter, the TCEQ provided its General Conformity concurrence for the proposed SNWW CIP and a determination that emissions from the project would not exceed the emissions from the applicable SIP, the BPA Rate-of-Progress, adopted by the TCEQ on October 27, 2004, and approved by the EPA on February 22, 2006. In addition, the TCEQ suggested that the USACE adopt pollution prevention and/or reduction measures in conjunction with this and future projects including the following:

- Encourage construction contractors to apply for Texas Emission Reduction Plan grants;
- Establish bidding conditions that give preference to clean contractors;
- Direct construction contractors to exercise air quality best management practices;
- Direct contractors that will use tugboats during construction to use clean fuels;
- Direct operators of the assist tugboats used in maneuvering dredge vessels to use clean fuels;
- Select assist tugs based on lowest NO_x emissions instead of lowest price; or
- Purchase and permanently retire surplus NO_x offsets prior to commencement of operations.

No additional comments related to the Draft General Conformity Determination were received by the USACE.

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6.0 FINAL GENERAL CONFORMITY DETERMINATION

Based on the evaluation of the proposed project description, estimated air quality emissions, and with consideration of the General Conformity concurrence letter from the TCEQ, the USACE has determined that its approval of the proposed SNWW CIP will meet the General Conformity requirements of TCEQ Chapter 101, §101.30(h)(1)(E)(i)(I). This section of the TCEQ's General Conformity Rule applies to an ozone nonattainment area, where the EPA has approved a revision to an area's attainment demonstration after 1990, and the TCEQ makes a determination that the estimated air contaminant emissions from a proposed Federal action will not exceed the emissions budget in the SIP.

The emissions budget for General Conformity purposes is defined in the TCEQ General Air Quality Rules §101.30(8). The budget is established by the allowable emissions allocated to a subcategory of the emissions inventory in the applicable SIP revision. The applicable SIP for General Conformity purposes is the most recent revision of the SIP that has been approved by the EPA. For the BPA nonattainment area, the most recently approved SIP revision is entitled "Post 1996 Rate-of-Progress Demonstration for the Beaumont-Port Arthur Nonattainment Area" adopted by the TCEQ on October 27, 2004, and approved by the EPA on February 22, 2006. For the BPA nonattainment area, the attainment year used for analyses should be 2010. However, the emissions inventory budgets used in the development of the 1999 Rate-of-Progress (ROP) SIP are based on the attainment year 2005, and therefore, emissions budgets for NO_x and VOC are based on emissions inventories projected to 2005.

The total inventory of emissions of NO_x and VOC is summarized in information provided in support of the 1999 ROP SIP for four general categories of emission sources: stationary point, area, on-road mobile, and off-road (nonroad) mobile. The inventory of nonroad emissions of NO_x and VOC includes five general categories of emission sources: aircraft, ground support equipment, commercial marine vessels, locomotives, and NONROAD Model categories. The SIP also provides a summary of the 2005 ROP Motor Vehicle Emissions Budget (MVEB) for the BPA nonattainment area.

Based on information provided in the 1999 ROP SIP, the 2005 Nonroad Mobile emissions budget, inclusive of landside construction equipment and commercial marine vessels, is 27.43 tons per day (about 10,011 tpy) of NO_x. The 2005 MVEB in the 1999 ROP SIP for the BPA nonattainment area is 33.97 tons per day (12,399 tpy) of NO_x. For comparison to these emission budgets, the highest annual NO_x emission rates for the SNWW CIP Preferred Alternative are broken down as shown in Table 3. The basis, emission factors, and summary of emissions are provided in Appendix A.

Table 3

Project NO_X Emissions Compared to 1999 ROP SIP Emissions Inventory Budgets (tpy)

SIP Emissions Category	Project Activity	Maximum Annual NO_x Emissions (tons/year of maximum occurrence)	Maximum Daily NO_x Emissions (tons/day)	SIP Emissions Budget (tons/day)	% of SIP Emissions Budget
Nonroad Mobile	Dredging Vessel Equipment, Dredging Support Vessels, and Land-side Construction Equipment	1400.33 (2017)	0.80	27.43	2.9
On-road Mobile	On-Road – Employee Commuter Vehicles	1.32 (2017)	0.0008	33.97	0.002

As shown in Table 3, NO_x emissions from the project dredging activities during the project year 2017 would represent about 2.9 percent of the 2005 BPA Nonroad Mobile emissions budget. Air emissions from employee commuter vehicles would represent about 0.002 percent of the SIP 2005 MVEB.

Based on an evaluation of the proposed project emissions, the total emissions of NO_x resulting from the SNWW CIP Preferred Alternative would result in a level of emissions that is within the 2005 Nonroad Mobile emissions budget and the 2005 MVEB as shown in the 1999 ROP SIP for the BPA nonattainment area. Considering the inventory of other emission sources in the BPA area, it is anticipated that emissions from each year of the project would be less than an increase of 10 percent of the VOC and NO_x emissions inventories for the entire BPA nonattainment area. As such, emissions from the activities subject to the USACE action are not considered regionally significant for purposes of General Conformity. Therefore, it is expected that emissions from the project construction would not:

- Cause or contribute to new violation of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or interim emission reductions or other milestones in any area.

Based on a review of the Draft General Conformity Determination, the TCEQ has determined, pursuant to 30 TAC §101.30(h)(1)(E)(i)(I), that emissions from the proposed project will not exceed the emissions from the applicable SIP, the BPA Rate-of-Progress, adopted by the TCEQ on October 27, 2004, and approved by the EPA on February 22, 2006. Therefore, the USACE has determined that the proposed project complies with the requirements of the General Conformity Rule; Section 176 of the CAA, and the State regulations promulgated pursuant to this rule, and is in conformity with the currently approved BPA SIP.

7.0 REFERENCES

40 Code of Federal Regulations (CFR) Part 51, Subpart W (58 Federal Register (FR) 63,214). 1993. Preamble to the adoption of the Federal conformity requirements, November 30, 1993.

40 CFR Part 93, Subpart B. (58 Federal Register (FR) 63,253). 1993. Determining Conformity of General Federal Actions to State or Federal Implementation Plans, November 30, 1993.

Texas Commission on Environmental Quality (TCEQ). 1999. General Air Quality Rules, Chapter 101, §101.30, "Conformity of General Federal Actions to State Implementation Plan," Effective December 23, 1999.

———. 2004. Post 1996 Rate-of-Progress Demonstration for the Beaumont-Port Arthur Nonattainment Area. Texas Commission on Environmental Quality. Austin, Texas, Adopted October 27, 2004.

———. 2008. "Revisions to the State Implementation Plan (SIP) for the Control of Ozone Air Pollution: Eight-Hour Ozone Redesignation Request and Maintenance Plan for the Beaumont-Port Arthur Ozone Nonattainment Areas. Adopted December 10, 2008.

U.S. Environmental Protection Agency (EPA). 2000. Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data. EPA 420-R-00-002. February 2000.

———. 2006. Approval and Promulgation of State Implementation Plans; Texas; Revision to the Rate of Progress Plan for the Beaumont/Port Arthur Ozone Nonattainment Area. February 22, 2006. Federal Register, Volume 71, No. 35, pages 8962–8965.

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Appendix A

Summary of Estimated Air Emissions

Operating Hours

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper	1,500.00	772.50	750.00	1,500.00	516.00	300.00	103.13	2,100.00	722.25					8,264
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	1,212.77				545.74					606.38	2,910.64	242.55	242.55	5,761
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	900.00				405.00						2,160.00	180.00	180.00	3,825
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	1,000.00				450.00					500.00	2,400.00	200.00	200.00	4,750
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		4,612.77	772.50	750.00	1,500.00	1,916.74	300.00	103.13	2,100.00	722.25	1,106.38	7,470.64	622.55	622.55	**22,600**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper	6,000.00	3,090.00	3,000.00	6,000.00	2,064.00	1,200.00	412.50	8,400.00	2,889.00					33,056
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	4,851.06				2,182.98					2,425.53	11,642.55	970.21	970.21	23,043
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	3,600.00				1,620.00						8,640.00	720.00	720.00	15,300
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	4,000.00				1,800.00					2,000.00	9,600.00	800.00	800.00	19,000
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		18,451.06	3,090.00	3,000.00	6,000.00	7,666.98	1,200.00	412.50	8,400.00	2,889.00	4,425.53	29,882.55	2,490.21	2,490.21	**90,398**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper	500.00	257.50	250.00	500.00	172.00	100.00	34.38	700.00	240.75					2,755
2	Sabine Bank 132-95+734	Large Hopper	5,500.00	2,832.50	2,750.00	5,500.00	1,892.00	1,100.00	378.28	7,700.00	2,648.56					30,301
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	4,851.06				2,182.98					2,425.53	11,642.55	970.21	970.21	23,043
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	3,600.00				1,620.00						8,640.00	720.00	720.00	15,300
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	4,000.00				1,800.00					2,000.00	9,600.00	800.00	800.00	19,000
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	225.00				101.25					112.50	225.00	210.00	210.00	1,084
	YEAR 2013 TOTAL		18,676.06	3,090.00	3,000.00	6,000.00	7,768.23	1,200.00	412.65	8,400.00	2,889.31	4,538.03	30,107.55	2,700.21	2,700.21	**91,482**

Operating Hours

YEAR 2014

Contract No.	Location/Disposal Site	Dredge	Dredge: Dredging	Dredge: Propelling	Dredge: Pumping	Dredge: Generating	Dredge: Idling	Survey Boat: Propelling	Survey Boat: Idling	Trawler: Propelling	Trawler: Idling	Floating: Pumping	Tug: Propelling	Spill Barge: Main Engine	Crew Boat: Propelling	TOTAL
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper	3,500.00	1,802.50	1,750.00	3,500.00	1,204.00	700.00	240.72	4,900.00	1,685.44					19,283
3	Sabine Bank 95+734-53	Large Hopper	1,500.00	772.50	750.00	1,500.00	516.00	300.00	103.09	2,100.00	722.18					8,264
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	4,851.06				2,182.98					2,425.53	11,642.55	970.21	970.21	23,043
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	3,434.21				1,545.39						8,242.11	686.84	686.84	14,595
10	Neches River Channel 0-292	30" Cutter Suction	900.00				405.00						2,160.00	180.00	180.00	3,825
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	4,000.00				1,800.00					2,000.00	9,600.00	800.00	800.00	19,000
13	Sabine Lake	24" Cutter Suction	102.27				46.02					51.14	2,863.64	238.64	238.64	3,540
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	900.00				405.00					450.00	900.00	840.00	840.00	4,335
	YEAR 2014 TOTAL		19,187.55	2,575.00	2,500.00	5,000.00	8,104.40	1,000.00	343.81	7,000.00	2,407.63	4,926.67	35,408.29	3,715.69	3,715.69	**95,885**

YEAR 2015

Contract No.	Location/Disposal Site	Dredge	Dredge: Dredging	Dredge: Propelling	Dredge: Pumping	Dredge: Generating	Dredge: Idling	Survey Boat: Propelling	Survey Boat: Idling	Trawler: Propelling	Trawler: Idling	Floating: Pumping	Tug: Propelling	Spill Barge: Main Engine	Crew Boat: Propelling	TOTAL
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper	4,000.00	2,060.00	2,000.00	4,000.00	1,376.00	800.00	274.91	5,600.00	1,925.82					22,037
4	Sabine Pass Outer Bar 53-00	Large Hopper	1,500.00	772.50	750.00	1,500.00	516.00	300.00	103.17	2,100.00	722.33					8,264
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	964.29				433.93						2,314.29	192.86	192.86	4,098
7	Port Arthur Canal 0-240	30" Cutter Suction	3,234.04				1,455.32					1,617.02	7,761.70	646.81	646.81	15,362
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	4,578.95				2,060.53						10,989.47	915.79	915.79	19,461
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	3,118.05				1,403.12					1,559.02	7,483.32	623.61	623.61	14,811
12	Neches River Channel 716-980	30" Cutter Suction	1,000.00				450.00					500.00	2,400.00	200.00	200.00	4,750
13	Sabine Lake	24" Cutter Suction	409.09				184.09					204.55	11,454.55	954.55	954.55	14,161
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	375.00				168.75					187.50	375.00	350.00	350.00	1,806
	YEAR 2015 TOTAL		19,179.42	2,832.50	2,750.00	5,500.00	8,047.74	1,100.00	378.08	7,700.00	2,648.15	4,068.09	42,778.33	3,883.61	3,883.61	**104,750**

Operating Hours

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper	6,000.00	3,090.00	3,000.00	6,000.00	2,064.00	1,200.00	412.67	8,400.00	2,889.33					33,056
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	3,857.14				1,735.71						9,257.14	771.43	771.43	16,393
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	4,578.95				2,060.53						10,989.47	915.79	915.79	19,461
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	4,157.40				1,870.83					2,078.70	9,977.76	831.48	831.48	19,748
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	409.09				184.09					204.55	11,454.55	954.55	954.55	14,161
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		19,002.58	3,090.00	3,000.00	6,000.00	7,915.16	1,200.00	412.67	8,400.00	2,889.33	2,283.25	41,678.92	3,473.24	3,473.24	**102,818**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper	1,500.00	772.50	750.00	1,500.00	516.00	300.00	103.17	2,100.00	722.33					8,264
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper	3,000.00	1,545.00	1,500.00	3,000.00	1,032.00	600.00	206.00	4,200.00	1,444.00					16,527
6	Sabine Pass 0-295+60	30" Cutter Suction	3,857.14				1,735.71						9,257.14	771.43	771.43	16,393
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	3,256.03				1,465.21						7,814.47	651.21	651.21	13,838
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	1,907.89				858.55						4,578.95	381.58	381.58	8,109
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	4,157.40				1,870.83					2,078.70	9,977.76	831.48	831.48	19,748
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	409.09				184.09					204.55	11,454.55	954.55	954.55	14,161
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		18,087.56	2,317.50	2,250.00	4,500.00	7,662.40	900.00	309.17	6,300.00	2,166.33	2,283.25	43,082.87	3,590.24	3,590.24	**97,040**
YEAR 2018																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	321.43				144.64						771.43	64.29	64.29	1,366
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	3,243.97				1,459.79						7,785.53	648.79	648.79	13,787
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	2,067.15				930.22					1,033.58	4,961.16	413.43	413.43	9,819
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	170.45				76.70					85.23	4,772.73	397.73	397.73	5,901
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		5,803.00				2,611.35					1,118.80	18,290.85	1,524.24	1,524.24	**30,872**

Operating Hours

TOTAL

Contract No.	Location/Disposal Site	Dredge	Dredge: Dredging	Dredge: Propelling	Dredge: Pumping	Dredge: Generating	Dredge: Idling	Survey Boat: Propelling	Survey Boat: Idling	Trawler: Propelling	Trawler: Idling	Floating: Pumping	Tug: Propelling	Spill Barge: Main Engine	Crew Boat: Propelling	TOTAL
1	Sabine Bank 165-132	Large Hopper	9,000	4,635	4,500	9,000	3,096	1,800	619	12,600	4,334					49,584
2	Sabine Bank 132-95+734	Large Hopper	5,500	2,833	2,750	5,500	1,892	1,100	378	7,700	2,648					30,301
3	Sabine Bank 95+734-53	Large Hopper	9,000	4,635	4,500	9,000	3,096	1,800	619	12,600	4,334					49,584
4	Sabine Pass Outer Bar 53-00	Large Hopper	3,000	1,545	1,500	3,000	1,032	600	206	4,200	1,444					16,527
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper	9,000				4,050						21,600	1,800	1,800	38,250
6	Sabine Pass 0-295+60	30" Cutter Suction	19,000				8,550					9,500	45,600	3,800	3,800	90,250
7	Port Arthur Canal 0-240	30" Cutter Suction	6,500				2,925						15,600	1,300	1,300	27,625
8	Sabine-Neches Canal 0-170	30" Cutter Suction	14,500				6,525						34,800	2,900	2,900	61,625
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	9,000				4,050						21,600	1,800	1,800	38,250
10	Neches River Channel 0-292	30" Cutter Suction	13,500				6,075					6,750	32,400	2,700	2,700	64,125
11	Neches River Channel 292-716	30" Cutter Suction	14,000				6,300					7,000	33,600	2,800	2,800	66,500
12	Neches River Channel 716-980	30" Cutter Suction	1,500				675					750	42,000	3,500	3,500	51,925
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none	1,500				675					750	1,500	1,400	1,400	7,225
15	GIWW E. Of Orange	24" Cutter Suction	123,000	17,768	17,250	34,500	51,693	6,900	2,372	48,300	16,612	24,750	248,700	22,000	22,000	635,845
		TOTAL	**238,000**	**31,415**	**30,500**	**61,000**	**100,634**	**12,200**	**4,194**	**85,400**	**29,372**	**49,500**	**497,400**	**44,000**	**44,000**	**1,227,615**

Marine Engine Emission Factors and Fuel Consumption Algorithms
(in g/kW-hr, for all marine engines)

Statistical Parameter	Exponent (x)	Intercept (b)	Coefficient (a)
CO	1	0	0.8378
NO_X	1.5	10.4496	0.1255
PM	1.5	0.2551	0.0059
PM2.5	1.5	0.2551	0.0059
PM10	1.5	0.2551	0.0059
SO_X	n/a	0	2.3735
VOC (HC)	1.5	0	0.0667

Notes:

1.) All regressions but SO_2 are in the form of:

Emissions Rate (g/hp-hr) = (a*(Fractional Load)$^{-x}$ + b) * 0.7457

where the conversion factor of 0.7457 kW/hp is used to calculate the emission factor in g/hp-hr

2.) Fractional Load is equal to actual engine output divided by rated engine output.

3.) The SO_2 regression is the form of:

Emissions Rate (g/hp-hr) = a*(Fuel Sulfur Flow in g/hp-hr) + b

where Fuel Sulfur Flow is the Fuel Consumption times the sulfur content of the fuel;
The sulfur content for the fuel consumption regression was set to 3300 parts per million (0.33 wt%)

4.) **Fuel Consumption (g/hp-hr) = (14.12 / (Fractional Load) + 205.717) * 0.7457**

5.) n/a is not applicable, n/s is not statistically significant.

6.) All information shown above is detailed in Table 5-1 of the EPA technical report "Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data", EPA 420-R-00-002, February 2000.

Marine Equipment Load Factors and Emission Factors

	Dredge					Crew Boat		Trawler		Floating Booster	Tug	Spill Barge	Crew Boat
Operating Mode	Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling
Load Factor	0.8	0.8	0.8	0.8	0.2	0.4	0.2	0.4	0.2	0.8	0.4	0.4	0.4
EF (Gram/hp-hr)													
CO	0.780934	0.780934	0.780934	0.780934	3.123737	1.561869	3.123737	1.561869	3.123737	0.780934	1.561869	1.561869	1.561869
NO_X	7.923056	7.923056	7.923056	7.923056	8.838583	8.162195	8.838583	8.162195	8.838583	7.923056	8.162195	8.162195	8.162195
PM	0.196377	0.196377	0.196377	0.196377	0.239417	0.207619	0.239417	0.207619	0.239417	0.196377	0.207619	0.207619	0.207619
PM2.5	0.178703	0.178703	0.178703	0.178703	0.217870	0.188933	0.217870	0.188933	0.217870	0.178703	0.188933	0.188933	0.188933
PM10	0.188522	0.188522	0.188522	0.188522	0.229841	0.199314	0.229841	0.199314	0.229841	0.188522	0.199314	0.199314	0.199314
SO_X	1.304627	1.304627	1.304627	1.304627	1.613894	1.407716	1.613894	1.407716	1.613894	1.304627	1.407716	1.407716	1.407716
VOC (HC)	0.069511	0.069511	0.069511	0.069511	0.556090	0.196607	0.556090	0.196607	0.556090	0.069511	0.196607	0.196607	0.196607

Notes:

1.) The dredge type, engine type, horsepower, and fuel type were based on information provided by project sponsors.

2.) The engine load factors for the dredges and support equipment were determined from Table 5-2 of the EPA Report"Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data", February 2000.

A survey of dredge engine sizes along with input from project sponsors was used to determine which operating mode and hence which load factor applied to each engine. The following assumptions applied to the load factor determination:

A.) The main engines on the dredges were assumed to operate at full power (e.g. 0.8 "cruise" load factor from Table 5-2 of EPA report) for all hours of operation.

B.) The generators on the dredges were assumed to operate at 0.2 load factor during idling.

C.) The main engines or propulsion engines on the support equipment were assumed to operate at intermittent times during the dredging operations and were also determined to operate at the 0.4 "slow cruise" load factor.

D.) The auxiliary engines, if any, on the support equipment were assumed to operate sparingly during idling and were determined to operate at the 0.2 "maneuvering" load factor.

3.) The emission factors were calculated according to the algorithm table and formulas detailed on page 5-3 of the EPA report. The emissions Rate formula and algorithm table are also shown on Table A-4, "Marine Engine Emission Factor and Fuel Consumption Data", February 2000.

4.) The Emission Rate in tons/hr is based on the following formula: Emission Rate = hp*LF*EF*(0.0022046 lbs/gram)*(1 ton/2000 lbs).

CO (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		4.79	1.55	2.07	0.71	0.41	0.14	0.87	0.30					10.84
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.52				1.13					3.13	1.00	0.03	0.07	12.87
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.58				0.84						0.74	0.02	0.05	7.23
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	6.20				0.93					2.58	0.83	0.02	0.06	10.62
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**19.30**	**4.79**	**1.55**	**2.07**	**3.61**	**0.41**	**0.14**	**0.87**	**0.30**	**5.72**	**2.57**	**0.07**	**0.17**	**41.56**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		19.15	6.20	8.27	2.84	1.65	0.57	3.47	1.19					43.35
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	30.07				4.51					12.53	4.01	0.11	0.27	51.50
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	22.32				3.35						2.98	0.08	0.20	28.92
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	24.80				3.72					10.33	3.31	0.09	0.22	42.46
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		**77.18**	**19.15**	**6.20**	**8.27**	**14.42**	**1.65**	**0.57**	**3.47**	**1.19**	**22.86**	**10.29**	**0.28**	**0.69**	**166.23**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		1.60	0.52	0.69	0.24	0.14	0.05	0.29	0.10					3.61
2	Sabine Bank 132-95+734	Large Hopper		17.56	5.68	7.58	2.61	1.52	0.52	3.18	1.09					39.74
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	30.07				4.51					12.53	4.01	0.11	0.27	51.50
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	22.32				3.35						2.98	0.08	0.20	28.92
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	24.80				3.72					10.33	3.31	0.09	0.22	42.46
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.53				0.08					0.58	0.08	0.24	0.06	1.57
	YEAR 2013 TOTAL		**77.71**	**19.15**	**6.20**	**8.27**	**14.50**	**1.65**	**0.57**	**3.47**	**1.19**	**23.44**	**10.37**	**0.52**	**0.74**	**167.80**

CO (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		11.17	3.62	4.82	1.66	0.96	0.33	2.02	0.70					25.29
3	Sabine Bank 95+734-53	Large Hopper		4.79	1.55	2.07	0.71	0.41	0.14	0.87	0.30					10.84
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	30.07				4.51					12.53	4.01	0.11	0.27	51.50
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	21.29				3.19						2.84	0.08	0.19	27.59
10	Neches River Channel 0-292	30" Cutter Suction	5.58				0.84						0.74	0.02	0.05	7.23
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	24.80				3.72					10.33	3.31	0.09	0.22	42.46
13	Sabine Lake	24" Cutter Suction	0.24				0.04					0.26	0.99	0.03	0.07	1.62
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	2.11				0.33					2.32	0.31	0.96	0.23	6.27
	YEAR 2014 TOTAL		**84.08**	**15.96**	**5.17**	**6.89**	**15.00**	**1.38**	**0.47**	**2.89**	**0.99**	**25.45**	**12.19**	**1.29**	**1.02**	**172.79**
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		12.77	4.13	5.51	1.90	1.10	0.38	2.31	0.80					28.90
4	Sabine Pass Outer Bar 53-00	Large Hopper		4.79	1.55	2.07	0.71	0.41	0.14	0.87	0.30					10.84
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	5.98				0.90						0.80	0.02	0.05	7.75
7	Port Arthur Canal 0-240	30" Cutter Suction	20.05				3.01					8.35	2.67	0.07	0.18	34.33
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	28.38				4.26						3.78	0.10	0.25	36.78
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	19.33				2.90					8.05	2.58	0.07	0.17	33.10
12	Neches River Channel 716-980	30" Cutter Suction	6.20				0.93					2.58	0.83	0.02	0.06	10.62
13	Sabine Lake	24" Cutter Suction	0.96				0.15					1.06	3.94	0.11	0.26	6.48
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.88				0.14					0.97	0.13	0.40	0.10	2.61
	YEAR 2015 TOTAL		**81.77**	**17.56**	**5.68**	**7.58**	**14.89**	**1.52**	**0.52**	**3.18**	**1.09**	**21.01**	**14.73**	**0.80**	**1.07**	**171.41**
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		19.15	6.20	8.27	2.84	1.65	0.57	3.47	1.19					43.35
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	23.91				3.59						3.19	0.09	0.21	30.98
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	28.38				4.26						3.78	0.10	0.25	36.78
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	25.77				3.87					10.74	3.44	0.09	0.23	44.13
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.96				0.15					1.06	3.94	0.11	0.26	6.48
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**79.02**	**19.15**	**6.20**	**8.27**	**14.70**	**1.65**	**0.57**	**3.47**	**1.19**	**11.79**	**14.35**	**0.39**	**0.96**	**161.73**

CO (tpy)

YEAR 2017

Contract No.	Location/Disposal Site	Dredge	Dredge: Dredging	Dredge: Propelling	Dredge: Pumping	Dredge: Generating	Dredge: Idling	Survey Boat: Propelling	Survey Boat: Idling	Trawler: Propelling	Trawler: Idling	Floating: Pumping	Tug: Propelling	Spill Barge: Main Engine	Crew Boat: Propelling	TOTAL
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		4.79	1.55	2.07	0.71	0.41	0.14	0.87	0.30					10.84
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		9.58	3.10	4.13	1.42	0.83	0.28	1.74	0.60					21.67
6	Sabine Pass 0-295+60	30" Cutter Suction	23.91				3.59						3.19	0.09	0.21	30.98
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	20.18				3.03						2.69	0.07	0.18	26.16
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	11.83				1.77						1.58	0.04	0.11	15.33
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	25.77				3.87					10.74	3.44	0.09	0.23	44.13
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.96				0.15					1.06	3.94	0.11	0.26	6.48
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**82.65**	**14.37**	**4.65**	**6.20**	**14.54**	**1.24**	**0.43**	**2.60**	**0.90**	**11.79**	**14.84**	**0.41**	**0.99**	**155.59**

YEAR 2018

Contract No.	Location/Disposal Site	Dredge	Dredge: Dredging	Dredge: Propelling	Dredge: Pumping	Dredge: Generating	Dredge: Idling	Survey Boat: Propelling	Survey Boat: Idling	Trawler: Propelling	Trawler: Idling	Floating: Pumping	Tug: Propelling	Spill Barge: Main Engine	Crew Boat: Propelling	TOTAL
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	1.99				0.30						0.27	0.01	0.02	2.58
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	20.11				3.02						2.68	0.07	0.18	26.06
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	12.81				1.92					5.34	1.71	0.05	0.11	21.94
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.40				0.06					0.44	1.64	0.05	0.11	2.70
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		**35.31**				**5.30**					**5.78**	**6.30**	**0.17**	**0.42**	**53.29**

TOTAL

Contract No.	Location/Disposal Site	Dredge	Dredge: Dredging	Dredge: Propelling	Dredge: Pumping	Dredge: Generating	Dredge: Idling	Survey Boat: Propelling	Survey Boat: Idling	Trawler: Propelling	Trawler: Idling	Floating: Pumping	Tug: Propelling	Spill Barge: Main Engine	Crew Boat: Propelling	TOTAL
1	Sabine Bank 165-132	Large Hopper		25.54	8.27	11.02	3.79	2.20	0.76	4.63	1.59					57.80
2	Sabine Bank 132-95+734	Large Hopper		28.73	9.30	12.40	4.26	2.48	0.85	5.21	1.79					65.02
3	Sabine Bank 95+734-53	Large Hopper		17.56	5.68	7.58	2.61	1.52	0.52	3.18	1.09					39.74
4	Sabine Pass Outer Bar 53-00	Large Hopper		28.73	9.30	12.40	4.26	2.48	0.85	5.21	1.79					65.02
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		9.58	3.10	4.13	1.42	0.83	0.28	1.74	0.60					21.67
6	Sabine Pass 0-295+60	30" Cutter Suction	55.79				8.37						7.44	0.20	0.50	72.30
7	Port Arthur Canal 0-240	30" Cutter Suction	117.78				17.67					49.07	15.70	0.43	1.05	201.70
8	Sabine-Neches Canal 0-170	30" Cutter Suction	40.29				6.04						5.37	0.15	0.36	52.21
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	89.88				13.48						11.98	0.33	0.80	116.48
10	Neches River Channel 0-292	30" Cutter Suction	55.79				8.37						7.44	0.20	0.50	72.30
11	Neches River Channel 292-716	30" Cutter Suction	83.68				12.55					34.87	11.16	0.31	0.74	143.31
12	Neches River Channel 716-980	30" Cutter Suction	86.78				13.02					36.16	11.57	0.32	0.77	148.62
13	Sabine Lake	24" Cutter Suction	3.51				0.56					3.87	14.46	0.40	0.96	23.77
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	3.51				0.56					3.87	0.52	1.61	0.39	10.45
	PROJECT TOTAL		**537.02**	**110.14**	**35.64**	**47.52**	**96.96**	**9.50**	**3.27**	**19.96**	**6.86**	**127.85**	**85.65**	**3.95**	**6.06**	**1,090**

NO_x (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		48.58	15.72	20.96	2.01	2.16	0.40	4.54	0.84					95.22
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	76.27				3.19					31.78	5.24	0.14	0.35	116.97
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	56.60				2.37						3.89	0.11	0.26	63.22
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	62.89				2.63					26.20	4.32	0.12	0.29	96.45
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**195.76**	**48.58**	**15.72**	**20.96**	**10.20**	**2.16**	**0.40**	**4.54**	**0.84**	**57.98**	**13.44**	**0.37**	**0.90**	**371.87**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		194.33	62.89	83.85	8.04	8.64	1.61	18.14	3.38					380.89
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	305.09				12.76					127.12	20.95	0.58	1.40	467.89
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	226.41				9.47						15.55	0.43	1.04	252.89
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	251.56				10.52					104.82	17.28	0.48	1.15	385.81
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		**783.05**	**194.33**	**62.89**	**83.85**	**40.80**	**8.64**	**1.61**	**18.14**	**3.38**	**231.94**	**53.78**	**1.48**	**3.59**	**1,487.47**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		16.19	5.24	6.99	0.67	0.72	0.13	1.51	0.28					31.74
2	Sabine Bank 132-95+734	Large Hopper		178.14	57.65	76.87	7.37	7.92	1.47	16.63	3.10					349.15
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	305.09				12.76					127.12	20.95	0.58	1.40	467.89
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	226.41				9.47						15.55	0.43	1.04	252.89
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	251.56				10.52					104.82	17.28	0.48	1.15	385.81
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	5.35				0.24					5.90	0.40	1.26	0.30	13.44
	YEAR 2013 TOTAL		**788.40**	**194.33**	**62.89**	**83.85**	**41.04**	**8.64**	**1.61**	**18.14**	**3.38**	**237.83**	**54.18**	**2.74**	**3.89**	**1,500.92**

NO_x (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		113.36	36.69	48.91	4.69	5.04	0.94	10.58	1.97					222.18
3	Sabine Bank 95+734-53	Large Hopper		48.58	15.72	20.96	2.01	2.16	0.40	4.54	0.84					95.22
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	305.09				12.76					127.12	20.95	0.58	1.40	467.89
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	215.98				9.04						14.83	0.41	0.99	241.24
10	Neches River Channel 0-292	30" Cutter Suction	56.60				2.37						3.89	0.11	0.26	63.22
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	251.56				10.52					104.82	17.28	0.48	1.15	385.81
13	Sabine Lake	24" Cutter Suction	2.43				0.11					2.68	5.15	0.14	0.34	10.86
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	21.38				0.95					23.58	1.62	5.03	1.21	53.78
	YEAR 2014 TOTAL		**853.04**	**161.94**	**52.41**	**69.88**	**42.45**	**7.20**	**1.34**	**15.12**	**2.82**	**258.20**	**63.72**	**6.74**	**5.35**	**1,540.20**
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		129.55	41.93	55.90	5.36	5.76	1.07	12.09	2.25					253.92
4	Sabine Pass Outer Bar 53-00	Large Hopper		48.58	15.72	20.96	2.01	2.16	0.40	4.54	0.84					95.22
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	60.64				2.54						4.16	0.11	0.28	67.74
7	Port Arthur Canal 0-240	30" Cutter Suction	203.39				8.51					84.75	13.97	0.38	0.93	311.93
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	287.97				12.05						19.78	0.54	1.32	321.66
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	196.10				8.20					81.71	13.47	0.37	0.90	300.74
12	Neches River Channel 716-980	30" Cutter Suction	62.89				2.63					26.20	4.32	0.12	0.29	96.45
13	Sabine Lake	24" Cutter Suction	9.72				0.43					10.72	20.61	0.57	1.37	43.43
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	8.91				0.39					9.83	0.67	2.10	0.50	22.41
	YEAR 2015 TOTAL		**829.62**	**178.14**	**57.65**	**76.87**	**42.13**	**7.92**	**1.47**	**16.63**	**3.10**	**213.20**	**76.99**	**4.20**	**5.59**	**1,513.49**

NO_x (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		194.33	62.89	83.85	8.04	8.64	1.61	18.14	3.38					380.89
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	242.58				10.15						16.66	0.46	1.11	270.95
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	287.97				12.05						19.78	0.54	1.32	321.66
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	261.46				10.94					108.94	17.96	0.49	1.20	400.99
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	9.72				0.43					10.72	20.61	0.57	1.37	43.43
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**801.73**	**194.33**	**62.89**	**83.85**	**41.61**	**8.64**	**1.61**	**18.14**	**3.38**	**119.66**	**75.01**	**2.06**	**5.00**	**1,417.91**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		48.58	15.72	20.96	2.01	2.16	0.40	4.54	0.84					95.22
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		97.17	31.45	41.93	4.02	4.32	0.80	9.07	1.69					190.44
6	Sabine Pass 0-295+60	30" Cutter Suction	242.58				10.15						16.66	0.46	1.11	270.95
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	204.77				8.57						14.06	0.39	0.94	228.73
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	119.99				5.02						8.24	0.23	0.55	134.02
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	261.46				10.94					108.94	17.96	0.49	1.20	400.99
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	9.72				0.43					10.72	20.61	0.57	1.37	43.43
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**838.52**	**145.75**	**47.17**	**62.89**	**41.14**	**6.48**	**1.21**	**13.61**	**2.53**	**119.66**	**77.54**	**2.13**	**5.17**	**1,363.78**
YEAR 2018																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	20.21				0.85						1.39	0.04	0.09	22.58
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	204.01				8.53						14.01	0.39	0.93	227.88
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	130.00				5.44					54.17	8.93	0.25	0.60	199.38
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	4.05				0.18					4.47	8.59	0.24	0.57	18.09
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		**358.28**				**15.00**					**58.63**	**32.92**	**0.91**	**2.19**	**467.93**

NO_x (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
TOTAL																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		259.11	83.85	111.81	10.73	11.52	2.14	24.19	4.50					507.85
2	Sabine Bank 132-95+734	Large Hopper		291.50	94.34	125.78	12.07	12.96	2.41	27.21	5.07					571.33
3	Sabine Bank 95+734-53	Large Hopper		178.14	57.65	76.87	7.37	7.92	1.47	16.63	3.10					349.14
4	Sabine Pass Outer Bar 53-00	Large Hopper		291.50	94.34	125.78	12.07	12.96	2.41	27.21	5.07					571.33
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		97.17	31.45	41.93	4.02	4.32	0.80	9.07	1.69					190.44
6	Sabine Pass 0-295+60	30" Cutter Suction	566.01				23.68						38.87	1.07	2.59	632.23
7	Port Arthur Canal 0-240	30" Cutter Suction	1,194.92				49.99					497.88	82.07	2.26	5.47	1,832.58
8	Sabine-Neches Canal 0-170	30" Cutter Suction	408.79				17.10						28.08	0.77	1.87	456.61
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	911.91				38.15						62.63	1.72	4.18	1,018.58
10	Neches River Channel 0-292	30" Cutter Suction	566.01				23.68						38.87	1.07	2.59	632.23
11	Neches River Channel 292-716	30" Cutter Suction	849.02				35.52					353.76	58.31	1.60	3.89	1,302.10
12	Neches River Channel 716-980	30" Cutter Suction	880.47				36.83					366.86	60.47	1.66	4.03	1,350.32
13	Sabine Lake	24" Cutter Suction	35.64				1.58					39.31	75.59	2.08	5.04	159.23
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	35.64				1.58					39.31	2.70	8.39	2.02	89.63
	PROJECT TOTAL		**5,448.40**	**1,117.40**	**361.62**	**482.16**	**274.36**	**49.67**	**9.25**	**104.31**	**19.42**	**1,297.11**	**447.58**	**20.62**	**31.67**	**9,664**

PM (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2010																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		1.20	0.39	0.52	0.05	0.05	0.01	0.12	0.02					2.37
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	1.89				0.09					0.79	0.13	0.00	0.01	2.91
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	1.40				0.06						0.10	0.00	0.01	1.58
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	1.56				0.07					0.65	0.11	0.00	0.01	2.40
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2010 TOTAL		**4.85**	**1.20**	**0.39**	**0.52**	**0.28**	**0.05**	**0.01**	**0.12**	**0.02**	**1.44**	**0.34**	**0.01**	**0.02**	**9.26**
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		4.82	1.56	2.08	0.22	0.22	0.04	0.46	0.09					9.49
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.56				0.35					3.15	0.53	0.01	0.04	11.64
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.61				0.26						0.40	0.01	0.03	6.30
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	6.24				0.29					2.60	0.44	0.01	0.03	9.60
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**19.41**	**4.82**	**1.56**	**2.08**	**1.11**	**0.22**	**0.04**	**0.46**	**0.09**	**5.75**	**1.37**	**0.04**	**0.09**	**37.03**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		0.40	0.13	0.17	0.02	0.02	0.00	0.04	0.01					0.79
2	Sabine Bank 132-95+734	Large Hopper		4.42	1.43	1.91	0.20	0.20	0.04	0.42	0.08					8.70
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.56				0.35					3.15	0.53	0.01	0.04	11.64
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.61				0.26						0.40	0.01	0.03	6.30
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	6.24				0.29					2.60	0.44	0.01	0.03	9.60
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.13				0.01					0.15	0.01	0.03	0.01	0.34
	YEAR 2012 TOTAL		**19.54**	**4.82**	**1.56**	**2.08**	**1.11**	**0.22**	**0.04**	**0.46**	**0.09**	**5.89**	**1.38**	**0.07**	**0.10**	**37.36**

PM (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		2.81	0.91	1.21	0.13	0.13	0.03	0.27	0.05					5.53
3	Sabine Bank 95+734-53	Large Hopper		1.20	0.39	0.52	0.05	0.05	0.01	0.12	0.02					2.37
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.56				0.35					3.15	0.53	0.01	0.04	11.64
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	5.35				0.24						0.38	0.01	0.03	6.01
10	Neches River Channel 0-292	30" Cutter Suction	1.40				0.06						0.10	0.00	0.01	1.58
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	6.24				0.29					2.60	0.44	0.01	0.03	9.60
13	Sabine Lake	24" Cutter Suction	0.06				0.00					0.07	0.13	0.00	0.01	0.27
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.53				0.03					0.58	0.04	0.13	0.03	1.34
	YEAR 2013 TOTAL		**21.14**	**4.01**	**1.30**	**1.73**	**1.15**	**0.18**	**0.04**	**0.38**	**0.08**	**6.40**	**1.62**	**0.17**	**0.14**	**38.35**
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		3.21	1.04	1.39	0.15	0.15	0.03	0.31	0.06					6.33
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.20	0.39	0.52	0.05	0.05	0.01	0.12	0.02					2.37
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	1.50				0.07						0.11	0.00	0.01	1.69
7	Port Arthur Canal 0-240	30" Cutter Suction	5.04				0.23					2.10	0.36	0.01	0.02	7.76
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	7.14				0.33						0.50	0.01	0.03	8.01
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	4.86				0.22					2.03	0.34	0.01	0.02	7.48
12	Neches River Channel 716-980	30" Cutter Suction	1.56				0.07					0.65	0.11	0.00	0.01	2.40
13	Sabine Lake	24" Cutter Suction	0.24				0.01					0.27	0.52	0.01	0.03	1.09
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.22				0.01					0.24	0.02	0.05	0.01	0.56
	YEAR 2014 TOTAL		**20.56**	**4.42**	**1.43**	**1.91**	**1.14**	**0.20**	**0.04**	**0.42**	**0.08**	**5.28**	**1.96**	**0.11**	**0.14**	**37.69**

PM (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		4.82	1.56	2.08	0.22	0.22	0.04	0.46	0.09					9.49
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	6.01				0.27						0.42	0.01	0.03	6.75
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	7.14				0.33						0.50	0.01	0.03	8.01
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	6.48				0.30					2.70	0.46	0.01	0.03	9.98
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.24				0.01					0.27	0.52	0.01	0.03	1.09
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2015 TOTAL		**19.87**	**4.82**	**1.56**	**2.08**	**1.13**	**0.22**	**0.04**	**0.46**	**0.09**	**2.97**	**1.91**	**0.05**	**0.13**	**35.32**
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.20	0.39	0.52	0.05	0.05	0.01	0.12	0.02					2.37
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		2.41	0.78	1.04	0.11	0.11	0.02	0.23	0.05					4.74
6	Sabine Pass 0-295+60	30" Cutter Suction	6.01				0.27						0.42	0.01	0.03	6.75
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	5.08				0.23						0.36	0.01	0.02	5.70
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	2.97				0.14						0.21	0.01	0.01	3.34
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	6.48				0.30					2.70	0.46	0.01	0.03	9.98
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.24				0.01					0.27	0.52	0.01	0.03	1.09
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**20.78**	**3.61**	**1.17**	**1.56**	**1.11**	**0.16**	**0.03**	**0.35**	**0.07**	**2.97**	**1.97**	**0.05**	**0.13**	**33.97**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	0.50				0.02						0.04	0.00	0.00	0.56
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	5.06				0.23						0.36	0.01	0.02	5.68
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	3.22				0.15					1.34	0.23	0.01	0.02	4.96
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.10				0.00					0.11	0.22	0.01	0.01	0.46
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**8.88**				**0.41**					**1.45**	**0.84**	**0.02**	**0.06**	**11.66**

TOTAL

PM (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		6.42	2.08	2.77	0.29	0.29	0.06	0.62	0.12					12.65
2	Sabine Bank 132-95+734	Large Hopper		7.22	2.34	3.12	0.33	0.33	0.07	0.69	0.14					14.23
3	Sabine Bank 95+734-53	Large Hopper		4.42	1.43	1.91	0.20	0.20	0.04	0.42	0.08					8.70
4	Sabine Pass Outer Bar 53-00	Large Hopper		7.22	2.34	3.12	0.33	0.33	0.07	0.69	0.14					14.23
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		2.41	0.78	1.04	0.11	0.11	0.02	0.23	0.05					4.74
6	Sabine Pass 0-295+60	30" Cutter Suction	14.03				0.64						0.99	0.03	0.07	15.75
7	Port Arthur Canal 0-240	30" Cutter Suction	29.62				1.35					12.34	2.09	0.06	0.14	45.59
8	Sabine-Neches Canal 0-170	30" Cutter Suction	10.13				0.46						0.71	0.02	0.05	11.38
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	22.60				1.03						1.59	0.04	0.11	25.38
10	Neches River Channel 0-292	30" Cutter Suction	14.03				0.64						0.99	0.03	0.07	15.75
11	Neches River Channel 292-716	30" Cutter Suction	21.04				0.96					8.77	1.48	0.04	0.10	32.40
12	Neches River Channel 716-980	30" Cutter Suction	21.82				1.00					9.09	1.54	0.04	0.10	33.60
13	Sabine Lake	24" Cutter Suction	0.88				0.04					0.97	1.92	0.05	0.13	4.00
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.88				0.04					0.97	0.07	0.21	0.05	2.23
	PROJECT TOTAL		**135.04**	**27.70**	**8.96**	**11.95**	**7.43**	**1.26**	**0.25**	**2.65**	**0.53**	**32.15**	**11.38**	**0.52**	**0.81**	**241**

$PM_{2.5}$ (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		1.10	0.35	0.47	0.05	0.05	0.01	0.10	0.02					2.16
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	1.72				0.08					0.72	0.12	0.00	0.01	2.65
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	1.28				0.06						0.09	0.00	0.01	1.43
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	1.42				0.06					0.59	0.10	0.00	0.01	2.18
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**4.42**	**1.10**	**0.35**	**0.47**	**0.25**	**0.05**	**0.01**	**0.10**	**0.02**	**1.31**	**0.31**	**0.01**	**0.02**	**8.42**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		4.38	1.42	1.89	0.20	0.20	0.04	0.42	0.08					8.63
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	6.88				0.31					2.87	0.49	0.01	0.03	10.59
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.11				0.23						0.36	0.01	0.02	5.73
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	5.67				0.26					2.36	0.40	0.01	0.03	8.74
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		**17.66**	**4.38**	**1.42**	**1.89**	**1.01**	**0.20**	**0.04**	**0.42**	**0.08**	**5.23**	**1.24**	**0.03**	**0.08**	**33.70**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		0.37	0.12	0.16	0.02	0.02	0.00	0.03	0.01					0.72
2	Sabine Bank 132-95+734	Large Hopper		4.02	1.30	1.73	0.18	0.18	0.04	0.38	0.08					7.91
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	6.88				0.31					2.87	0.49	0.01	0.03	10.59
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.11				0.23						0.36	0.01	0.02	5.73
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	5.67				0.26					2.36	0.40	0.01	0.03	8.74
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.12				0.01					0.13	0.01	0.03	0.01	0.30
	YEAR 2013 TOTAL		**17.78**	**4.38**	**1.42**	**1.89**	**1.01**	**0.20**	**0.04**	**0.42**	**0.08**	**5.36**	**1.25**	**0.06**	**0.09**	**34.00**

$PM_{2.5}$ (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		2.56	0.83	1.10	0.12	0.12	0.02	0.24	0.05					5.04
3	Sabine Bank 95+734-53	Large Hopper		1.10	0.35	0.47	0.05	0.05	0.01	0.10	0.02					2.16
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	6.88				0.31					2.87	0.49	0.01	0.03	10.59
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	4.87				0.22						0.34	0.01	0.02	5.47
10	Neches River Channel 0-292	30" Cutter Suction	1.28				0.06						0.09	0.00	0.01	1.43
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	5.67				0.26					2.36	0.40	0.01	0.03	8.74
13	Sabine Lake	24" Cutter Suction	0.05				0.00					0.06	0.12	0.00	0.01	0.25
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.48				0.02					0.53	0.04	0.12	0.03	1.22
	YEAR 2014 TOTAL		**19.24**	**3.65**	**1.18**	**1.58**	**1.05**	**0.17**	**0.03**	**0.35**	**0.07**	**5.82**	**1.48**	**0.16**	**0.12**	**34.89**
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		2.92	0.95	1.26	0.13	0.13	0.03	0.28	0.06					5.76
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.10	0.35	0.47	0.05	0.05	0.01	0.10	0.02					2.16
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	1.37				0.06						0.10	0.00	0.01	1.54
7	Port Arthur Canal 0-240	30" Cutter Suction	4.59				0.21					1.91	0.32	0.01	0.02	7.06
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	6.50				0.30						0.46	0.01	0.03	7.29
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	4.42				0.20					1.84	0.31	0.01	0.02	6.81
12	Neches River Channel 716-980	30" Cutter Suction	1.42				0.06					0.59	0.10	0.00	0.01	2.18
13	Sabine Lake	24" Cutter Suction	0.22				0.01					0.24	0.48	0.01	0.03	0.99
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.20				0.01					0.22	0.02	0.05	0.01	0.51
	YEAR 2015 TOTAL		**18.71**	**4.02**	**1.30**	**1.73**	**1.04**	**0.18**	**0.04**	**0.38**	**0.08**	**4.81**	**1.78**	**0.10**	**0.13**	**34.30**

$PM_{2.5}$ (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		4.38	1.42	1.89	0.20	0.20	0.04	0.42	0.08					8.63
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	5.47				0.25						0.39	0.01	0.03	6.14
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	6.50				0.30						0.46	0.01	0.03	7.29
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	5.90				0.27					2.46	0.42	0.01	0.03	9.08
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.22				0.01					0.24	0.48	0.01	0.03	0.99
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**18.08**	**4.38**	**1.42**	**1.89**	**1.03**	**0.20**	**0.04**	**0.42**	**0.08**	**2.70**	**1.74**	**0.05**	**0.12**	**32.14**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.10	0.35	0.47	0.05	0.05	0.01	0.10	0.02					2.16
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		2.19	0.71	0.95	0.10	0.10	0.02	0.21	0.04					4.32
6	Sabine Pass 0-295+60	30" Cutter Suction	5.47				0.25						0.39	0.01	0.03	6.14
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	4.62				0.21						0.33	0.01	0.02	5.19
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	2.71				0.12						0.19	0.01	0.01	3.04
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	5.90				0.27					2.46	0.42	0.01	0.03	9.08
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.22				0.01					0.24	0.48	0.01	0.03	0.99
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**18.91**	**3.29**	**1.06**	**1.42**	**1.01**	**0.15**	**0.03**	**0.31**	**0.06**	**2.70**	**1.79**	**0.05**	**0.12**	**30.92**
YEAR 2018																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	0.46				0.02						0.03	0.00	0.00	0.51
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	4.60				0.21						0.32	0.01	0.02	5.17
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	2.93				0.13					1.22	0.21	0.01	0.01	4.51
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.09				0.00					0.10	0.20	0.01	0.01	0.41
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		**8.08**				**0.37**					**1.32**	**0.76**	**0.02**	**0.05**	**10.61**

TOTAL

$PM_{2.5}$ (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		5.84	1.89	2.52	0.26	0.27	0.05	0.56	0.11					11.51
2	Sabine Bank 132-95+734	Large Hopper		6.57	2.13	2.84	0.30	0.30	0.06	0.63	0.12					12.95
3	Sabine Bank 95+734-53	Large Hopper		4.02	1.30	1.73	0.18	0.18	0.04	0.38	0.08					7.91
4	Sabine Pass Outer Bar 53-00	Large Hopper		6.57	2.13	2.84	0.30	0.30	0.06	0.63	0.12					12.95
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		2.19	0.71	0.95	0.10	0.10	0.02	0.21	0.04					4.32
6	Sabine Pass 0-295+60	30" Cutter Suction	12.77				0.58						0.90	0.02	0.06	14.33
7	Port Arthur Canal 0-240	30" Cutter Suction	26.95				1.23					11.23	1.90	0.05	0.13	41.49
8	Sabine-Neches Canal 0-170	30" Cutter Suction	9.22				0.42						0.65	0.02	0.04	10.35
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	20.57				0.94						1.45	0.04	0.10	23.09
10	Neches River Channel 0-292	30" Cutter Suction	12.77				0.58						0.90	0.02	0.06	14.33
11	Neches River Channel 292-716	30" Cutter Suction	19.15				0.88					7.98	1.35	0.04	0.09	29.48
12	Neches River Channel 716-980	30" Cutter Suction	19.86				0.91					8.27	1.40	0.04	0.09	30.57
13	Sabine Lake	24" Cutter Suction	0.80				0.04					0.89	1.75	0.05	0.12	3.64
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.80				0.04					0.89	0.06	0.19	0.05	2.03
	PROJECT TOTAL		**122.89**	**25.20**	**8.16**	**10.88**	**6.76**	**1.15**	**0.23**	**2.41**	**0.48**	**29.26**	**10.36**	**0.48**	**0.73**	**219**

PM_{10} (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		1.16	0.37	0.50	0.05	0.05	0.01	0.11	0.02					2.28
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	1.81				0.08					0.76	0.13	0.00	0.01	2.79
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	1.35				0.06						0.09	0.00	0.01	1.51
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	1.50				0.07					0.62	0.11	0.00	0.01	2.30
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**4.66**	**1.16**	**0.37**	**0.50**	**0.27**	**0.05**	**0.01**	**0.11**	**0.02**	**1.38**	**0.33**	**0.01**	**0.02**	**8.89**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		4.62	1.50	2.00	0.21	0.21	0.04	0.44	0.09					9.11
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.26				0.33					3.02	0.51	0.01	0.03	11.18
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.39				0.25						0.38	0.01	0.03	6.05
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	5.99				0.27					2.49	0.42	0.01	0.03	9.21
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		**18.63**	**4.62**	**1.50**	**2.00**	**1.06**	**0.21**	**0.04**	**0.44**	**0.09**	**5.52**	**1.31**	**0.04**	**0.09**	**35.55**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		0.39	0.12	0.17	0.02	0.02	0.00	0.04	0.01					0.76
2	Sabine Bank 132-95+734	Large Hopper		4.24	1.37	1.83	0.19	0.19	0.04	0.41	0.08					8.35
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.26				0.33					3.02	0.51	0.01	0.03	11.18
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	5.39				0.25						0.38	0.01	0.03	6.05
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	5.99				0.27					2.49	0.42	0.01	0.03	9.21
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.13				0.01					0.14	0.01	0.03	0.01	0.32
	YEAR 2013 TOTAL		**18.76**	**4.62**	**1.50**	**2.00**	**1.07**	**0.21**	**0.04**	**0.44**	**0.09**	**5.66**	**1.32**	**0.07**	**0.09**	**35.87**

PM_{10} (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		2.70	0.87	1.16	0.12	0.12	0.02	0.26	0.05					5.31
3	Sabine Bank 95+734-53	Large Hopper		1.16	0.37	0.50	0.05	0.05	0.01	0.11	0.02					2.28
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	7.26				0.33					3.02	0.51	0.01	0.03	11.18
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	5.14				0.23						0.36	0.01	0.02	5.77
10	Neches River Channel 0-292	30" Cutter Suction	1.35				0.06						0.09	0.00	0.01	1.51
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	5.99				0.27					2.49	0.42	0.01	0.03	9.21
13	Sabine Lake	24" Cutter Suction	0.06				0.00					0.06	0.13	0.00	0.01	0.26
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.51				0.02					0.56	0.04	0.12	0.03	1.29
	YEAR 2014 TOTAL		**20.30**	**3.85**	**1.25**	**1.66**	**1.10**	**0.18**	**0.03**	**0.37**	**0.07**	**6.14**	**1.56**	**0.16**	**0.13**	**36.81**
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		3.08	1.00	1.33	0.14	0.14	0.03	0.30	0.06					6.07
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.16	0.37	0.50	0.05	0.05	0.01	0.11	0.02					2.28
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	1.44				0.07						0.10	0.00	0.01	1.62
7	Port Arthur Canal 0-240	30" Cutter Suction	4.84				0.22					2.02	0.34	0.01	0.02	7.45
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	6.85				0.31						0.48	0.01	0.03	7.69
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	4.67				0.21					1.94	0.33	0.01	0.02	7.18
12	Neches River Channel 716-980	30" Cutter Suction	1.50				0.07					0.62	0.11	0.00	0.01	2.30
13	Sabine Lake	24" Cutter Suction	0.23				0.01					0.26	0.50	0.01	0.03	1.05
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.21				0.01					0.23	0.02	0.05	0.01	0.54
	YEAR 2015 TOTAL		**19.74**	**4.24**	**1.37**	**1.83**	**1.10**	**0.19**	**0.04**	**0.41**	**0.08**	**5.07**	**1.88**	**0.10**	**0.14**	**36.18**

PM_{10} (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		4.62	1.50	2.00	0.21	0.21	0.04	0.44	0.09					9.11
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	5.77				0.26						0.41	0.01	0.03	6.48
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	6.85				0.31						0.48	0.01	0.03	7.69
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	6.22				0.28					2.59	0.44	0.01	0.03	9.58
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.23				0.01					0.26	0.50	0.01	0.03	1.05
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**19.08**	**4.62**	**1.50**	**2.00**	**1.08**	**0.21**	**0.04**	**0.44**	**0.09**	**2.85**	**1.83**	**0.05**	**0.12**	**33.91**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.16	0.37	0.50	0.05	0.05	0.01	0.11	0.02					2.28
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		2.31	0.75	1.00	0.10	0.11	0.02	0.22	0.04					4.55
6	Sabine Pass 0-295+60	30" Cutter Suction	5.77				0.26						0.41	0.01	0.03	6.48
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	4.87				0.22						0.34	0.01	0.02	5.47
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	2.86				0.13						0.20	0.01	0.01	3.21
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	6.22				0.28					2.59	0.44	0.01	0.03	9.58
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.23				0.01					0.26	0.50	0.01	0.03	1.05
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**19.95**	**3.47**	**1.12**	**1.50**	**1.07**	**0.16**	**0.03**	**0.33**	**0.07**	**2.85**	**1.89**	**0.05**	**0.13**	**32.61**
YEAR 2018																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	0.48				0.02						0.03	0.00	0.00	0.54
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	4.85				0.22						0.34	0.01	0.02	5.45
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	3.09				0.14					1.29	0.22	0.01	0.01	4.76
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.10				0.00					0.11	0.21	0.01	0.01	0.44
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		**8.53**				**0.39**					**1.40**	**0.80**	**0.02**	**0.05**	**11.19**

TOTAL

PM_{10} (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		6.17	2.00	2.66	0.28	0.28	0.06	0.59	0.12					12.14
2	Sabine Bank 132-95+734	Large Hopper		6.94	2.24	2.99	0.31	0.32	0.06	0.66	0.13					13.66
3	Sabine Bank 95+734-53	Large Hopper		4.24	1.37	1.83	0.19	0.19	0.04	0.41	0.08					8.35
4	Sabine Pass Outer Bar 53-00	Large Hopper		6.94	2.24	2.99	0.31	0.32	0.06	0.66	0.13					13.66
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		2.31	0.75	1.00	0.10	0.11	0.02	0.22	0.04					4.55
6	Sabine Pass 0-295+60	30" Cutter Suction	13.47				0.62						0.95	0.03	0.06	15.12
7	Port Arthur Canal 0-240	30" Cutter Suction	28.43				1.30					11.85	2.00	0.06	0.13	43.77
8	Sabine-Neches Canal 0-170	30" Cutter Suction	9.73				0.44						0.69	0.02	0.05	10.92
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	21.70				0.99						1.53	0.04	0.10	24.36
10	Neches River Channel 0-292	30" Cutter Suction	13.47				0.62						0.95	0.03	0.06	15.12
11	Neches River Channel 292-716	30" Cutter Suction	20.20				0.92					8.42	1.42	0.04	0.09	31.10
12	Neches River Channel 716-980	30" Cutter Suction	20.95				0.96					8.73	1.48	0.04	0.10	32.25
13	Sabine Lake	24" Cutter Suction	0.85				0.04					0.94	1.85	0.05	0.12	3.84
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.85				0.04					0.94	0.07	0.20	0.05	2.14
	PROJECT TOTAL		**129.64**	**26.59**	**8.60**	**11.47**	**7.13**	**1.21**	**0.24**	**2.55**	**0.51**	**30.86**	**10.93**	**0.50**	**0.77**	**231**

SO_2 (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		8.00	2.59	3.45	0.37	0.37	0.07	0.78	0.15					15.79
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	12.56				0.58					5.23	0.90	0.02	0.06	19.36
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	9.32				0.43						0.67	0.02	0.04	10.49
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	10.36				0.48					4.31	0.74	0.02	0.05	15.97
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**32.23**	**8.00**	**2.59**	**3.45**	**1.86**	**0.37**	**0.07**	**0.78**	**0.15**	**9.55**	**2.32**	**0.06**	**0.15**	**61.61**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		32.00	10.36	13.81	1.47	1.49	0.29	3.13	0.62					63.16
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	50.24				2.33					20.93	3.61	0.10	0.24	77.45
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	37.28				1.73						2.68	0.07	0.18	41.94
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	41.42				1.92					17.26	2.98	0.08	0.20	63.86
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		**128.94**	**32.00**	**10.36**	**13.81**	**7.45**	**1.49**	**0.29**	**3.13**	**0.62**	**38.19**	**9.28**	**0.26**	**0.62**	**246.42**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		2.67	0.86	1.15	0.12	0.12	0.02	0.26	0.05					5.26
2	Sabine Bank 132-95+734	Large Hopper		29.33	9.49	12.66	1.35	1.37	0.27	2.87	0.57					57.90
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	50.24				2.33					20.93	3.61	0.10	0.24	77.45
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	37.28				1.73						2.68	0.07	0.18	41.94
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	41.42				1.92					17.26	2.98	0.08	0.20	63.86
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.88				0.04					0.97	0.07	0.22	0.05	2.23
	YEAR 2013 TOTAL		**129.82**	**32.00**	**10.36**	**13.81**	**7.49**	**1.49**	**0.29**	**3.13**	**0.62**	**39.16**	**9.35**	**0.47**	**0.67**	**248.65**

SO_2 (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		18.67	6.04	8.05	0.86	0.87	0.17	1.83	0.36					36.84
3	Sabine Bank 95+734-53	Large Hopper		8.00	2.59	3.45	0.37	0.37	0.07	0.78	0.15					15.79
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	50.24				2.33					20.93	3.61	0.10	0.24	77.45
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	35.56				1.65						2.56	0.07	0.17	40.01
10	Neches River Channel 0-292	30" Cutter Suction	9.32				0.43						0.67	0.02	0.04	10.49
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	41.42				1.92					17.26	2.98	0.08	0.20	63.86
13	Sabine Lake	24" Cutter Suction	0.40				0.02					0.44	0.89	0.02	0.06	1.83
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	3.52				0.17					3.88	0.28	0.87	0.21	8.93
	YEAR 2014 TOTAL		**140.46**	**26.67**	**8.63**	**11.51**	**7.75**	**1.24**	**0.24**	**2.61**	**0.51**	**42.52**	**10.99**	**1.16**	**0.92**	**255.21**
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		21.33	6.90	9.21	0.98	0.99	0.20	2.09	0.41					42.11
4	Sabine Pass Outer Bar 53-00	Large Hopper		8.00	2.59	3.45	0.37	0.37	0.07	0.78	0.15					15.79
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	9.99				0.46						0.72	0.02	0.05	11.24
7	Port Arthur Canal 0-240	30" Cutter Suction	33.49				1.55					13.95	2.41	0.07	0.16	51.63
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	47.42				2.20						3.41	0.09	0.23	53.35
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	32.29				1.50					13.45	2.32	0.06	0.15	49.78
12	Neches River Channel 716-980	30" Cutter Suction	10.36				0.48					4.31	0.74	0.02	0.05	15.97
13	Sabine Lake	24" Cutter Suction	1.60				0.08					1.77	3.56	0.10	0.24	7.33
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	1.47				0.07					1.62	0.12	0.36	0.09	3.72
	YEAR 2015 TOTAL		**136.61**	**29.33**	**9.49**	**12.66**	**7.69**	**1.37**	**0.27**	**2.87**	**0.57**	**35.11**	**13.28**	**0.72**	**0.96**	**250.92**

SO_2 (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		32.00	10.36	13.81	1.47	1.49	0.29	3.13	0.62					63.16
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	39.94				1.85						2.87	0.08	0.19	44.94
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	47.42				2.20						3.41	0.09	0.23	53.35
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	43.05				2.00					17.94	3.10	0.09	0.21	66.38
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	1.60				0.08					1.77	3.56	0.10	0.24	7.33
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**132.01**	**32.00**	**10.36**	**13.81**	**7.60**	**1.49**	**0.29**	**3.13**	**0.62**	**19.70**	**12.94**	**0.36**	**0.86**	**235.16**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		8.00	2.59	3.45	0.37	0.37	0.07	0.78	0.15					15.79
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		16.00	5.18	6.90	0.73	0.74	0.15	1.56	0.31					31.58
6	Sabine Pass 0-295+60	30" Cutter Suction	39.94				1.85						2.87	0.08	0.19	44.94
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	33.72				1.56						2.43	0.07	0.16	37.94
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	19.76				0.92						1.42	0.04	0.09	22.23
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	43.05				2.00					17.94	3.10	0.09	0.21	66.38
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	1.60				0.08					1.77	3.56	0.10	0.24	7.33
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**138.07**	**24.00**	**7.77**	**10.36**	**7.51**	**1.12**	**0.22**	**2.35**	**0.46**	**19.70**	**13.37**	**0.37**	**0.89**	**226.19**
YEAR 2018																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	3.33				0.15						0.24	0.01	0.02	3.75
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	33.59				1.56						2.42	0.07	0.16	37.80
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	21.41				0.99					8.92	1.54	0.04	0.10	33.00
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.67				0.03					0.74	1.48	0.04	0.10	3.06
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		**59.00**				**2.74**					**9.65**	**5.68**	**0.16**	**0.38**	**77.60**

TOTAL

SO_2 (tpy)			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		42.67	13.81	18.41	1.96	1.99	0.39	4.17	0.82					84.21
2	Sabine Bank 132-95+734	Large Hopper		48.00	15.53	20.71	2.20	2.23	0.44	4.69	0.93					94.74
3	Sabine Bank 95+734-53	Large Hopper		29.33	9.49	12.66	1.35	1.37	0.27	2.87	0.57					57.90
4	Sabine Pass Outer Bar 53-00	Large Hopper		48.00	15.53	20.71	2.20	2.23	0.44	4.69	0.93					94.74
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		16.00	5.18	6.90	0.73	0.74	0.15	1.56	0.31					31.58
6	Sabine Pass 0-295+60	30" Cutter Suction	93.20				4.32						6.70	0.18	0.45	104.86
7	Port Arthur Canal 0-240	30" Cutter Suction	196.76				9.13					81.98	14.15	0.39	0.94	303.35
8	Sabine-Neches Canal 0-170	30" Cutter Suction	67.31				3.12						4.84	0.13	0.32	75.73
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	150.16				6.97						10.80	0.30	0.72	168.94
10	Neches River Channel 0-292	30" Cutter Suction	93.20				4.32						6.70	0.18	0.45	104.86
11	Neches River Channel 292-716	30" Cutter Suction	139.80				6.49					58.25	10.06	0.28	0.67	215.54
12	Neches River Channel 716-980	30" Cutter Suction	144.98				6.73					60.41	10.43	0.29	0.70	223.52
13	Sabine Lake	24" Cutter Suction	5.87				0.29					6.47	13.04	0.36	0.87	26.89
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	5.87				0.29					6.47	0.47	1.45	0.35	14.89
	PROJECT TOTAL		**897.15**	**183.99**	**59.55**	**79.39**	**50.10**	**8.57**	**1.69**	**17.99**	**3.55**	**213.59**	**77.19**	**3.56**	**5.46**	**1,602**

VOC (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2011																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		0.43	0.14	0.18	0.13	0.05	0.03	0.11	0.05					1.11
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	0.67				0.20					0.28	0.13	0.00	0.01	1.29
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	0.50				0.15						0.09	0.00	0.01	0.75
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	0.55				0.17					0.23	0.10	0.00	0.01	1.06
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2011 TOTAL		**1.72**	**0.43**	**0.14**	**0.18**	**0.64**	**0.05**	**0.03**	**0.11**	**0.05**	**0.51**	**0.32**	**0.01**	**0.02**	**4.21**
YEAR 2012																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		1.70	0.55	0.74	0.51	0.21	0.10	0.44	0.21					4.46
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	2.68				0.80					1.12	0.50	0.01	0.03	5.15
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	1.99				0.60						0.37	0.01	0.02	2.99
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	2.21				0.66					0.92	0.42	0.01	0.03	4.24
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2012 TOTAL		**6.87**	**1.70**	**0.55**	**0.74**	**2.57**	**0.21**	**0.10**	**0.44**	**0.21**	**2.03**	**1.30**	**0.04**	**0.09**	**16.84**
YEAR 2013																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		0.14	0.05	0.06	0.04	0.02	0.01	0.04	0.02					0.37
2	Sabine Bank 132-95+734	Large Hopper		1.56	0.51	0.67	0.46	0.19	0.09	0.40	0.19					4.09
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	2.68				0.80					1.12	0.50	0.01	0.03	5.15
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction	1.99				0.60						0.37	0.01	0.02	2.99
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	2.21				0.66					0.92	0.42	0.01	0.03	4.24
13	Sabine Lake	24" Cutter Suction														
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.05				0.01					0.05	0.01	0.03	0.01	0.16
	YEAR 2013 TOTAL		**6.92**	**1.70**	**0.55**	**0.74**	**2.58**	**0.21**	**0.10**	**0.44**	**0.21**	**2.09**	**1.31**	**0.07**	**0.09**	**17.00**

VOC (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2014																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper		0.99	0.32	0.43	0.30	0.12	0.06	0.25	0.12					2.60
3	Sabine Bank 95+734-53	Large Hopper		0.43	0.14	0.18	0.13	0.05	0.03	0.11	0.05					1.11
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction														
7	Port Arthur Canal 0-240	30" Cutter Suction	2.68				0.80					1.12	0.50	0.01	0.03	5.15
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	1.89				0.57						0.36	0.01	0.02	2.85
10	Neches River Channel 0-292	30" Cutter Suction	0.50				0.15						0.09	0.00	0.01	0.75
11	Neches River Channel 292-716	30" Cutter Suction														
12	Neches River Channel 716-980	30" Cutter Suction	2.21				0.66					0.92	0.42	0.01	0.03	4.24
13	Sabine Lake	24" Cutter Suction	0.02				0.01					0.02	0.12	0.00	0.01	0.19
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.19				0.06					0.21	0.04	0.12	0.03	0.64
	YEAR 2014 TOTAL		**7.48**	**1.42**	**0.46**	**0.61**	**2.67**	**0.17**	**0.08**	**0.36**	**0.18**	**2.27**	**1.53**	**0.16**	**0.13**	**17.54**
YEAR 2015																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper		1.14	0.37	0.49	0.34	0.14	0.07	0.29	0.14					2.97
4	Sabine Pass Outer Bar 53-00	Large Hopper		0.43	0.14	0.18	0.13	0.05	0.03	0.11	0.05					1.11
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	0.53				0.16						0.10	0.00	0.01	0.80
7	Port Arthur Canal 0-240	30" Cutter Suction	1.78				0.54					0.74	0.34	0.01	0.02	3.43
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	2.53				0.76						0.48	0.01	0.03	3.81
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	1.72				0.52					0.72	0.32	0.01	0.02	3.31
12	Neches River Channel 716-980	30" Cutter Suction	0.55				0.17					0.23	0.10	0.00	0.01	1.06
13	Sabine Lake	24" Cutter Suction	0.09				0.03					0.09	0.50	0.01	0.03	0.75
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.08				0.02					0.09	0.02	0.05	0.01	0.27
	YEAR 2015 TOTAL		**7.28**	**1.56**	**0.51**	**0.67**	**2.65**	**0.19**	**0.09**	**0.40**	**0.19**	**1.87**	**1.85**	**0.10**	**0.13**	**17.51**

VOC (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
YEAR 2016																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		1.70	0.55	0.74	0.51	0.21	0.10	0.44	0.21					4.46
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	2.13				0.64						0.40	0.01	0.03	3.21
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction														
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	2.53				0.76						0.48	0.01	0.03	3.81
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	2.29				0.69					0.96	0.43	0.01	0.03	4.41
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.09				0.03					0.09	0.50	0.01	0.03	0.75
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2016 TOTAL		**7.03**	**1.70**	**0.55**	**0.74**	**2.62**	**0.21**	**0.10**	**0.44**	**0.21**	**1.05**	**1.81**	**0.05**	**0.12**	**16.63**
YEAR 2017																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper		0.43	0.14	0.18	0.13	0.05	0.03	0.11	0.05					1.11
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		0.85	0.28	0.37	0.25	0.10	0.05	0.22	0.11					2.23
6	Sabine Pass 0-295+60	30" Cutter Suction	2.13				0.64						0.40	0.01	0.03	3.21
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	1.80				0.54						0.34	0.01	0.02	2.71
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	1.05				0.32						0.20	0.01	0.01	1.59
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	2.29				0.69					0.96	0.43	0.01	0.03	4.41
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.09				0.03					0.09	0.50	0.01	0.03	0.75
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2017 TOTAL		**7.36**	**1.28**	**0.41**	**0.55**	**2.59**	**0.16**	**0.08**	**0.33**	**0.16**	**1.05**	**1.87**	**0.05**	**0.12**	**16.00**
YEAR 2018																
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper														
2	Sabine Bank 132-95+734	Large Hopper														
3	Sabine Bank 95+734-53	Large Hopper														
4	Sabine Pass Outer Bar 53-00	Large Hopper														
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper														
6	Sabine Pass 0-295+60	30" Cutter Suction	0.18				0.05						0.03	0.00	0.00	0.27
7	Port Arthur Canal 0-240	30" Cutter Suction														
8	Sabine-Neches Canal 0-170	30" Cutter Suction	1.79				0.54						0.34	0.01	0.02	2.70
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction														
10	Neches River Channel 0-292	30" Cutter Suction														
11	Neches River Channel 292-716	30" Cutter Suction	1.14				0.34					0.48	0.22	0.01	0.01	2.19
12	Neches River Channel 716-980	30" Cutter Suction														
13	Sabine Lake	24" Cutter Suction	0.04				0.01					0.04	0.21	0.01	0.01	0.31
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction														
	YEAR 2018 TOTAL		**3.14**				**0.94**					**0.51**	**0.79**	**0.02**	**0.05**	**5.47**

TOTAL

VOC (tpy)

			Dredge					Survey Boat		Trawler		Floating	Tug	Spill Barge	Crew Boat	TOTAL
			Dredging	Propelling	Pumping	Generating	Idling	Propelling	Idling	Propelling	Idling	Pumping	Propelling	Main Engine	Propelling	
Contract No.	**Location/Disposal Site**	**Dredge**														
1	Sabine Bank 165-132	Large Hopper		2.27	0.74	0.98	0.67	0.28	0.13	0.58	0.28					5.94
2	Sabine Bank 132-95+734	Large Hopper		2.56	0.83	1.10	0.76	0.31	0.15	0.66	0.32					6.69
3	Sabine Bank 95+734-53	Large Hopper		1.56	0.51	0.67	0.46	0.19	0.09	0.40	0.19					4.09
4	Sabine Pass Outer Bar 53-00	Large Hopper		2.56	0.83	1.10	0.76	0.31	0.15	0.66	0.32					6.69
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper		0.85	0.28	0.37	0.25	0.10	0.05	0.22	0.11					2.23
6	Sabine Pass 0-295+60	30" Cutter Suction	4.97				1.49						0.94	0.03	0.06	7.48
7	Port Arthur Canal 0-240	30" Cutter Suction	10.48				3.15					4.37	1.98	0.05	0.13	20.16
8	Sabine-Neches Canal 0-170	30" Cutter Suction	3.59				1.08						0.68	0.02	0.05	5.40
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	8.00				2.40						1.51	0.04	0.10	12.05
10	Neches River Channel 0-292	30" Cutter Suction	4.97				1.49						0.94	0.03	0.06	7.48
11	Neches River Channel 292-716	30" Cutter Suction	7.45				2.23					3.10	1.40	0.04	0.09	14.32
12	Neches River Channel 716-980	30" Cutter Suction	7.72				2.32					3.22	1.46	0.04	0.10	14.85
13	Sabine Lake	24" Cutter Suction	0.31				0.10					0.34	1.82	0.05	0.12	2.75
14	Channel to Orange	none														
15	GIWW E. Of Orange	24" Cutter Suction	0.31				0.10					0.34	0.07	0.20	0.05	1.07
	PROJECT TOTAL		**47.80**	**9.80**	**3.17**	**4.23**	**17.26**	**1.20**	**0.58**	**2.51**	**1.22**	**11.38**	**10.78**	**0.50**	**0.76**	**111**

Summary of Dredge Emissions (tons per year)

YEAR 2011

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper	10.8	95.2	2.4	2.2	2.3	15.8	1.1
2	Sabine Bank 132-95+734	Large Hopper							
3	Sabine Bank 95+734-53	Large Hopper							
4	Sabine Pass Outer Bar 53-00	Large Hopper							
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction							
7	Port Arthur Canal 0-240	30" Cutter Suction	12.9	117.0	2.9	2.6	2.8	19.4	1.3
8	Sabine-Neches Canal 0-170	30" Cutter Suction							
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction							
10	Neches River Channel 0-292	30" Cutter Suction	7.2	63.2	1.6	1.4	1.5	10.5	0.7
11	Neches River Channel 292-716	30" Cutter Suction							
12	Neches River Channel 716-980	30" Cutter Suction	10.6	96.5	2.4	2.2	2.3	16.0	1.1
13	Sabine Lake	24" Cutter Suction							
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction							
	YEAR 2011 TOTAL		**41.6**	**371.9**	**9.3**	**8.4**	**8.9**	**61.6**	**4.2**

YEAR 2012

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper	43.3	380.9	9.5	8.6	9.1	63.2	4.5
2	Sabine Bank 132-95+734	Large Hopper							
3	Sabine Bank 95+734-53	Large Hopper							
4	Sabine Pass Outer Bar 53-00	Large Hopper							
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction							
7	Port Arthur Canal 0-240	30" Cutter Suction	51.5	467.9	11.6	10.6	11.2	77.5	5.1
8	Sabine-Neches Canal 0-170	30" Cutter Suction							
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction							
10	Neches River Channel 0-292	30" Cutter Suction	28.9	252.9	6.3	5.7	6.0	41.9	3.0
11	Neches River Channel 292-716	30" Cutter Suction							
12	Neches River Channel 716-980	30" Cutter Suction	42.5	385.8	9.6	8.7	9.2	63.9	4.2
13	Sabine Lake	24" Cutter Suction							
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction							
	YEAR 2012 TOTAL		**166.2**	**1,487.5**	**37.0**	**33.7**	**35.5**	**246.4**	**16.8**

Summary of Dredge Emissions (tons per year)

YEAR 2013

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper	3.6	31.7	0.8	0.7	0.8	5.3	0.4
2	Sabine Bank 132-95+734	Large Hopper	39.7	349.1	8.7	7.9	8.3	57.9	4.1
3	Sabine Bank 95+734-53	Large Hopper							
4	Sabine Pass Outer Bar 53-00	Large Hopper							
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction							
7	Port Arthur Canal 0-240	30" Cutter Suction	51.5	467.9	11.6	10.6	11.2	77.5	5.1
8	Sabine-Neches Canal 0-170	30" Cutter Suction							
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction							
10	Neches River Channel 0-292	30" Cutter Suction	28.9	252.9	6.3	5.7	6.0	41.9	3.0
11	Neches River Channel 292-716	30" Cutter Suction							
12	Neches River Channel 716-980	30" Cutter Suction	42.5	385.8	9.6	8.7	9.2	63.9	4.2
13	Sabine Lake	24" Cutter Suction							
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction	1.6	13.4	0.3	0.3	0.3	2.2	0.2
	YEAR 2013 TOTAL		**167.8**	**1,500.9**	**37.4**	**34.0**	**35.9**	**248.7**	**17.0**

YEAR 2014

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper							
2	Sabine Bank 132-95+734	Large Hopper	25.3	222.2	5.5	5.0	5.3	36.8	2.6
3	Sabine Bank 95+734-53	Large Hopper	10.8	95.2	2.4	2.2	2.3	15.8	1.1
4	Sabine Pass Outer Bar 53-00	Large Hopper							
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction							
7	Port Arthur Canal 0-240	30" Cutter Suction	51.5	467.9	11.6	10.6	11.2	77.5	5.1
8	Sabine-Neches Canal 0-170	30" Cutter Suction							
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	27.6	241.2	6.0	5.5	5.8	40.0	2.9
10	Neches River Channel 0-292	30" Cutter Suction	7.2	63.2	1.6	1.4	1.5	10.5	0.7
11	Neches River Channel 292-716	30" Cutter Suction							
12	Neches River Channel 716-980	30" Cutter Suction	42.5	385.8	9.6	8.7	9.2	63.9	4.2
13	Sabine Lake	24" Cutter Suction	1.6	10.9	0.3	0.2	0.3	1.8	0.2
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction	6.3	53.8	1.3	1.2	1.3	8.9	0.6
	YEAR 2014 TOTAL		**172.8**	**1,540.2**	**38.3**	**34.9**	**36.8**	**255.2**	**17.5**

Summary of Dredge Emissions (tons per year)

YEAR 2015

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper							
2	Sabine Bank 132-95+734	Large Hopper							
3	Sabine Bank 95+734-53	Large Hopper	28.9	253.9	6.3	5.8	6.1	42.1	3.0
4	Sabine Pass Outer Bar 53-00	Large Hopper	10.8	95.2	2.4	2.2	2.3	15.8	1.1
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction	7.7	67.7	1.7	1.5	1.6	11.2	0.8
7	Port Arthur Canal 0-240	30" Cutter Suction	34.3	311.9	7.8	7.1	7.5	51.6	3.4
8	Sabine-Neches Canal 0-170	30" Cutter Suction							
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	36.8	321.7	8.0	7.3	7.7	53.3	3.8
10	Neches River Channel 0-292	30" Cutter Suction							
11	Neches River Channel 292-716	30" Cutter Suction	33.1	300.7	7.5	6.8	7.2	49.8	3.3
12	Neches River Channel 716-980	30" Cutter Suction	10.6	96.5	2.4	2.2	2.3	16.0	1.1
13	Sabine Lake	24" Cutter Suction	6.5	43.4	1.1	1.0	1.0	7.3	0.7
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction	2.6	22.4	0.6	0.5	0.5	3.7	0.3
	YEAR 2015 TOTAL		**171.4**	**1,513.5**	**37.7**	**34.3**	**36.2**	**250.9**	**17.5**

YEAR 2016

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper							
2	Sabine Bank 132-95+734	Large Hopper							
3	Sabine Bank 95+734-53	Large Hopper							
4	Sabine Pass Outer Bar 53-00	Large Hopper	43.3	380.9	9.5	8.6	9.1	63.2	4.5
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction	31.0	271.0	6.8	6.1	6.5	44.9	3.2
7	Port Arthur Canal 0-240	30" Cutter Suction							
8	Sabine-Neches Canal 0-170	30" Cutter Suction							
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	36.8	321.7	8.0	7.3	7.7	53.3	3.8
10	Neches River Channel 0-292	30" Cutter Suction							
11	Neches River Channel 292-716	30" Cutter Suction	44.1	401.0	10.0	9.1	9.6	66.4	4.4
12	Neches River Channel 716-980	30" Cutter Suction							
13	Sabine Lake	24" Cutter Suction	6.5	43.4	1.1	1.0	1.0	7.3	0.7
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction							
	YEAR 2016 TOTAL		**161.7**	**1,417.9**	**35.3**	**32.1**	**33.9**	**235.2**	**16.6**

Summary of Dredge Emissions (tons per year)

YEAR 2017

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper							
2	Sabine Bank 132-95+734	Large Hopper							
3	Sabine Bank 95+734-53	Large Hopper							
4	Sabine Pass Outer Bar 53-00	Large Hopper	10.8	95.2	2.4	2.2	2.3	15.8	1.1
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper	21.7	190.4	4.7	4.3	4.6	31.6	2.2
6	Sabine Pass 0-295+60	30" Cutter Suction	31.0	271.0	6.8	6.1	6.5	44.9	3.2
7	Port Arthur Canal 0-240	30" Cutter Suction							
8	Sabine-Neches Canal 0-170	30" Cutter Suction	26.2	228.7	5.7	5.2	5.5	37.9	2.7
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	15.3	134.0	3.3	3.0	3.2	22.2	1.6
10	Neches River Channel 0-292	30" Cutter Suction							
11	Neches River Channel 292-716	30" Cutter Suction	44.1	401.0	10.0	9.1	9.6	66.4	4.4
12	Neches River Channel 716-980	30" Cutter Suction							
13	Sabine Lake	24" Cutter Suction	6.5	43.4	1.1	1.0	1.0	7.3	0.7
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction							
	YEAR 2017 TOTAL		**155.6**	**1,363.8**	**34.0**	**30.9**	**32.6**	**226.2**	**16.0**

YEAR 2018

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper							
2	Sabine Bank 132-95+734	Large Hopper							
3	Sabine Bank 95+734-53	Large Hopper							
4	Sabine Pass Outer Bar 53-00	Large Hopper							
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper							
6	Sabine Pass 0-295+60	30" Cutter Suction	2.6	22.6	0.6	0.5	0.5	3.7	0.3
7	Port Arthur Canal 0-240	30" Cutter Suction							
8	Sabine-Neches Canal 0-170	30" Cutter Suction	26.1	227.9	5.7	5.2	5.5	37.8	2.7
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction							
10	Neches River Channel 0-292	30" Cutter Suction							
11	Neches River Channel 292-716	30" Cutter Suction	21.9	199.4	5.0	4.5	4.8	33.0	2.2
12	Neches River Channel 716-980	30" Cutter Suction							
13	Sabine Lake	24" Cutter Suction	2.7	18.1	0.5	0.4	0.4	3.1	0.3
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction							
	YEAR 2018 TOTAL		**53.3**	**467.9**	**11.7**	**10.6**	**11.2**	**77.6**	**5.5**

Summary of Dredge Emissions (tons per year)

TOTAL

Contract No.	Location/Disposal Site	Dredge	CO	NO_x	PM	$PM_{2.5}$	PM_{10}	SO_2	VOC
1	Sabine Bank 165-132	Large Hopper	57.8	507.8	12.7	11.5	12.1	84.2	5.9
2	Sabine Bank 132-95+734	Large Hopper	65.0	571.3	14.2	13.0	13.7	94.7	6.7
3	Sabine Bank 95+734-53	Large Hopper	39.7	349.1	8.7	7.9	8.3	57.9	4.1
4	Sabine Pass Outer Bar 53-00	Large Hopper	65.0	571.3	14.2	13.0	13.7	94.7	6.7
5	Sabine Pass Jetty Ch - 215+29-00	Large Hopper	21.7	190.4	4.7	4.3	4.6	31.6	2.2
6	Sabine Pass 0-295+60	30" Cutter Suction	72.3	632.2	15.8	14.3	15.1	104.9	7.5
7	Port Arthur Canal 0-240	30" Cutter Suction	201.7	1,832.6	45.6	41.5	43.8	303.4	20.2
8	Sabine-Neches Canal 0-170	30" Cutter Suction	52.2	456.6	11.4	10.4	10.9	75.7	5.4
9	Sabine-Neches Canal 170-592+91	30" Cutter Suction	116.5	1,018.6	25.4	23.1	24.4	168.9	12.1
10	Neches River Channel 0-292	30" Cutter Suction	72.3	632.2	15.8	14.3	15.1	104.9	7.5
11	Neches River Channel 292-716	30" Cutter Suction	143.3	1,302.1	32.4	29.5	31.1	215.5	14.3
12	Neches River Channel 716-980	30" Cutter Suction	148.6	1,350.3	33.6	30.6	32.3	223.5	14.9
13	Sabine Lake	24" Cutter Suction	23.8	159.2	4.0	3.6	3.8	26.9	2.7
14	Channel to Orange	none							
15	GIWW E. Of Orange	24" Cutter Suction	10.5	89.6	2.2	2.0	2.1	14.9	1.1
		TOTAL	**1,090.4**	**9,663.6**	**240.6**	**219.0**	**231.0**	**1,601.8**	**111.2**

Annual Dredge Emission (tpy)
Sabine Neches Waterway

	CO	NO_X	PM	PM2.5	PM10	SO_2	VOC
Year 2011	41.56	371.87	9.26	8.42	8.89	61.61	4.21
Year 2012	166.23	1,487.47	37.03	33.70	35.55	246.42	16.84
Year 2013	167.80	1,500.92	37.36	34.00	35.87	248.65	17.00
Year 2014	172.79	1,540.20	38.35	34.89	36.81	255.21	17.54
Year 2015	171.41	1,513.49	37.69	34.30	36.18	250.92	17.51
Year 2016	161.73	1,417.91	35.32	32.14	33.91	235.16	16.63
Year 2017	155.59	1,363.78	33.97	30.92	32.61	226.19	16.00
Year 2018	53.29	467.93	11.66	10.61	11.19	77.60	5.47

Appendix B

Public Notices and Publisher’s Affidavits

Affidavit of Publication

STATE OF LOUISIANA
Parish of Calcasieu

Before me the undersigned authority, personally came and appeared

Marlana Bergeron

who being duly sworn, deposes and says:

He/She is a duly authorized agent of
LAKE CHARLES AMERICAN PRESS
a newspaper published daily at 4900 Highway 90 East,
Lake Charles, Louisiana, 70615. (Mail address: P.O. Box 2893
Lake Charles, LA 70602)

The attached Notice was published in said newspaper in its issue(s) dated:

00585027 - $688.50
January 21, 2010
January 22, 2010
January 23, 2010

Marlana Bergeron
Duly Authorized Agent

Subscribed and sworn to before me on this 25th day of January, 2010 at Lake Charles, LA

Gwendolyn R. Dugas
Notary Public

00080648

CROUCH ENVIRONMENTAL

Gwendolyn R. Dugas
#056523

14TH JUDICIAL DISTRICT COURT: DWIS

Sentences were imposed on 13 people who pleaded either guilty or no contest recently in 14th Judicial District Court to drunken driving charges and on one other who was found guilty following nonjury trial.

Most of the sentences were recommended by state and defense attorneys and were accepted by the court. Amendments and dismissals were made by the prosecutors.

Judge David Ritchie imposed a suspended four-month jail term on **Tyra A. Duke II,** 23, 1315 Joseph St. in Sulphur, for first-offense DWI. Banks was placed on one year of probation with special conditions the defendant perform 10 eight-hour days of court-approved community service, attend 12 weekly meetings of a support group for either alcohol or drug abusers, attend one victim's-impact session sponsored by Mothers Against Drunk Driving and pay a fine of $400 and court costs or serve 30 days in jail.

Ritchie imposed suspended 90-day jail terms plus fines of $400 and court costs on the following all for first-offense DWI:

Clint Thibodeaux, 26, 4788 Nick Clair Lane, Iowa.

Summer Statum, 32, 129 Lewis Statum Road, Starks.

Derek Milburn, 45, 4127 Long Pine Lane.

Marty Droddy Sr., 53, 2010 Patton St., Lot 39, Sulphur.

Stephen Saucier, 28, 42 Raintree Cove.

Each of those defendants was placed on one year of probation with the condition they each attend one victim's-impact session.

Saucier was ordered to perform eight days of community service, while each of the other defendants was ordered to perform four days.

On a charge of aggravated assault, Saucier was sentenced to a suspended five-month jail term and was placed on probation for two years.

On a charge of illegal carrying of a weapon, he was sentenced to a suspended six-month jail term and was placed on two years of probation with conditions he pay a fine of $750 and court costs, submit to testing and/or treatment for drug abuse, obtain anger-management counseling, forfeit the pistol involved and neither possess nor consume any alcohol.

Defendants and their charges and the sentences imposed by Judge Robert Wyatt:

Russell S. Campbell, 37, 4314 S. La. 27, Sulphur; one count of second-offense DWI and one count of first-offense — jail terms totaling 90 days to be served after prison terms totaling five years imposed when Campbell's probation on prior convictions for issuing worthless checks, theft in excess of $500 and possession of stolen goods valued at $300-$500 was revoked; charges of simple burglary, theft in excess of $500 and distribution of a false controlled drug were dismissed.

Alice Hinton, 48, 910 Broussard St., Iowa; second-offense DWI — 60 days in jail with all except 48 hours of home incarceration suspended, one year of probation, $750 and court costs or 60 days in jail, 30 days of community service, one victim's-impact session; charges of reckless driving and hit-and-run were dismissed.

Jesse J. Combs, 29, 2562 Montfort Drive; same charge and sentence as Hinton with the addition of $200 to the Public Defenders Office as partial payment for legal services.

Clayton Trahan, 25, Jennings; second-offense DWI — 60 days in jail with all except 48 hours suspended, two years probation, $750 and court costs or 90 days in jail, 30 days of community service, one victim's-impact session.

Brandon Bottley, 29, 2549 13th St.; first-offense DWI — suspended 60-day jail term, one year of probation, $400 and court costs or 60 days in jail, four days of community service, one victim's-impact session.

George Hartfield, 64, Orange, Texas; first-offense DWI — suspended 30-day jail term, one year of probation, $350 and court costs or 30 days in jail, four days of community service, one victim's-impact session.

Stephanie Miller, also known as **Stephanie O'Quain**, 30, 4314 La. 27 South; two counts of first-offense DWI — suspended imposition of any jail term, one year of probation, fines totaling $600 and court costs, eight days of community service, one victim's-impact session, restitution for a dismissed worthless check charge.

If Miller successfully completes probation, she may have her criminal record changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

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14TH JUDICIAL

Probation was revol and previously suspen prison or jail terms impo on 25 people following he ings conducted recently 14th Judicial District Cour

Judge Robert Wy revoked the probation of following people — lis here with their convictio and the sentences they m now serve:

Charley Leday Jr., 47, 19 Winterhalter St., Apt. C; o count each of second- an third-offense possession marijuana; prison terms totaling five years.

Christopher O. Hasty, 2 2208 Belden St.; indecent behavior with a juvenile; seven years in prison.

Aaron Young, 21, 2425 Conoco St.; possession of cocaine; three years in prison.

James P. Spangler, 28, 6 Jones St.; burglary and the prison terms totaling two years.

Miracle L. Chatman, 23, 1739 O'Brien St.; two cou of distribution of controlle drugs; prison terms totali three years.

Judge Kent Savoie revok the probation of the followi people — listed here wi their convictions and the s tences they must now serve

Keith W. Robertson, 29, 709 10th St.; carnal knowledge of a juvenile a unauthorized entry of an inhabited dwelling; prison terms totaling five years.

Michael R. Sigler, 20, 160 W. Fourth St.; simple burglary; three years in prison.

Byron L. Jackson, 19, 424

POLICE BLOTTE

The following arrests h been reported by area l enforcement agencies.

Drugs

Kardayle Sherard Brown

reportedly found a gallon-size bag containing marijuana, a smaller bag of marijuana and $3,012 in cash.

■

Rashad Johnson, 24; and **Michael Pepp**, 22, both of Leesville — possession of controlled dangerous substance (CDS) schedule I (marijuana) with intent to distribute and illegal carrying of weapons.

Joseph Lopez, 18, of New Llano — possession of drugs that included five crack cocaine "cookies" with an estimated street value of $15,000 and a handgun.

■

Keith Washington, 28, **Brandon Leone**, 20, both of Leesville, **Ebony Miles**, 25, of Reserve — possession of marijuana, possession of drug paraphernalia, illegal use of CDS in presence of minors, illegal carrying of weapons.

The three were arrested by

charged with operating without an occupational license.

Forgery

Allen P. Conner, 25, of Singer; two counts of forgery and one court of simple burglary of an inhabited dwelling.

Beauregard sheriff's officials said Conner was arrested in connection with a complaint received of checks missing from a Singer residence.

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Former teacher-coach admits to sex charges

BATON ROUGE — A former Redemptorist High School teacher and coach has pleaded guilty to charges that accuse him of having sex with a 15-year-old female student and rubbing and kissing the neck of a 14-year-old female student in 2006.

After his arrest in January 2007, The Advocate reports 26-year-old Ray Samuel Clement III resigned from his job at the school where he taught earth sciences and algebra and also coached track and field.

Two suspects held in slaying of teen

PLAQUEMINE — A state judge has ordered two construction workers suspected in the slaying of a Plaquemine teenager held without bail pending trial.

Judge Alvin Batiste Jr. denied bail on Tuesday to 25-year-old Channing Paul Touchet and 19-year-old Nicholas Lee Gorring in the Dec. 19 drive-by shooting death of 17-year-old Jamarius Riley.

Police tell The Advocate that Touchet and Gorringe were in the Plaquemine area looking to buy illegal drugs at the time of the slaying.

00582371

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NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine-Neches Navigation District on:

WEDNESDAY, JANUARY 27, 2010
OPEN HOUSE 5:30-7:00 PM PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments with regard to the EIS and the ODMDS EIS must be postmarked by February 10, 2010. Note that written comments with regard to the draft general conformity determination must be postmarked by 30 days from the date this notice is published.

Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS ATTN:
MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

Jermaine O'Brien, 27, 409 N. Simmons St.; first-offense DWI — suspended 90-day jail term, six months of unsupervised probation, $400 and court costs, eight days of community service.

Donna Lankford, 52, 1111 Henning Drive, Apt. B, Sulphur; first-offense DWI — 30 days in jail.

Shawn McCorvey, 38,

Sasovetz, Hebert, Levier and Murry successfully complete probation, they may have their records changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

VINCENT LUPO

Check out the Jambalaya pages on weekdays, Saturdays for your crossword and horoscope.

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over their cash. Cox reached for his wallet, saying he didn't have 50 cents. That's when he was shot, Rudell said.

Cox dropped face first into sewage pumped from the man-

Medical personnel reluctantly let her see her husband before the surgery.

"The pillow was just soaked in his blood. I grabbed his hand and told him, 'Don't

DWIS

June 23, 2006, and insisted on searching it without a warrant or permission from anyone.

They said they were look-

50,000-volt stun gun.

That left him unable to walk; police dragged him to a squad car and took him to jail, according to the ACLU.

The Cowboy Way

offer other services are being held at several area Walgreens. The screenings are through Friday, Jan. 29.

p.m., Walgreens, 2636 Ryan St., Lake Charles; Sunday, Jan. 24, 11 a.m. – 5p.m.

Help with energy bills available for eligible residents

The U.S. Department of Health and Human Services on Wednesday announced the release of $6.3 million in Low-Income Home Energy Assistance Program funds for eligible homeowners and renters in Louisiana.

The program offers assistance for heating, cooling and other energy costs, as well as helping to weatherize families' homes.

The funds are in addition to basic LIHEAP funding states receive automatically.

To apply for energy assistance, contact the local or state LIHEAP agency. In Calcasieu, call the parish Office of Community Services at 437-3567.

For more information, vis www.acf.hhs.gov/program ocs/liheap or ww acf.hhs.gov/programs/oc liheap/brochure/brochu html.

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LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

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Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS ATTN:
MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

WHAT'S AHEAD

Sowela e-commerce course scheduled

Beginning Thursday, Jan. 28, Sowela Technical Community College will offer a 10-week e-commerce course to teach students how to better navigate the Internet and start a Web-based business.

The course is 5:30-8:30 p.m. Thursdays and costs $150, plus fees.

www.americanpress.com

Board to exp

BY DORIS MARI
AMERICAN P

JENNINGS — Jeff Da Parish students who exce the LEAP and iLEAP t will have the opportunit continue their fun and le ing even when school lets for the summer.

The Jeff Davis Pa School Board began cussing plans Thursda expand its summer camp gram to include a high s

GoRun
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2010
Train Hard Train Smart
REGISTRATION Sat., Jan. 23 & 30 • 6:30
Lake Charles Civic Center
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KAREN WINK / AMERICAN PRESS

ler way

BY MIKE JONES
AMERICAN PRESS

A historic warehouse that

Paperwork has been submitted

PUBLISHER'S AFFIDAVIT

Tear Sheet Attached
Crouch Environmental Svc

STATE OF TEXAS
COUNTY OF JEFFERSON

BEFORE ME, THE UNDERSIGNED AUTHORITY, ON THIS DAY, PERSONALLY APPEARED Nelta Dumes WHO BEING BY ME DULY SWORN, DEPOSES AND SAYS THAT HE/SHE IS THE Classified Sales Exec. OF THE BEAUMONT ENTERPRISE; THAT SAID NEWSPAPER IS REGULARLY PUBLISHED IN JEFFERSON, HARDIN, TYLER, NEWTON, CHAMBERS, ORANGE , JASPER, LIBERTY, SABINE, SAN AUGUSTINE, ANGELINA AND GALVESTON COUNTY (COUNTIES), TEXAS; THAT THE ATTACHED NOTICE WAS PUBLISHED IN THE BEAUMONT ENTERPRISE ON THE FOLLOWING DATE(S), TO WIT January 21, 2010.

NEWSPAPER REPRESENTATIVE SIGNATURE

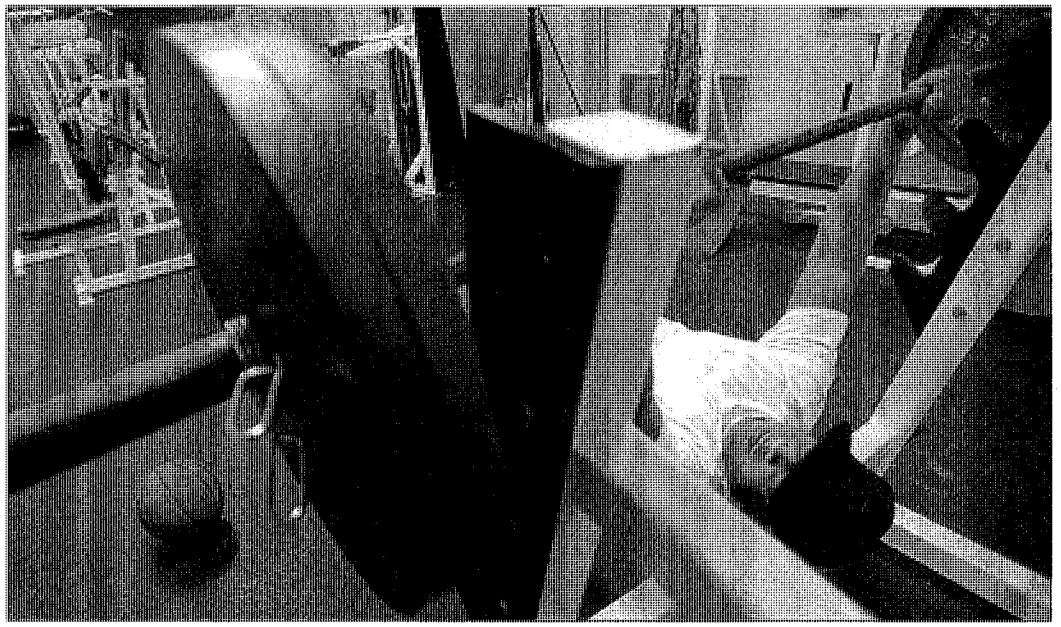
SWORN AND SUBSCRIBED TO BEFORE ME ON THIS THE 25th DAY OF January 2010, TO CERTIFY WHICH WITNESS MY HAND AND SEAL OF OFFICE.

Robin R Hillin
NOTARY PUBLIC IN AND FOR THE STATE OF TEXAS

ROBIN R. HILLIN
MY COMMISSION EXPIRES
04-29-2010

PRINT OR TYPE NAME OF NOTARY PUBLIC
MY COMMISSION EXPIRES

ROBIN R HILLIN
Notary Public, State Of Texas
My Commission Expires
04-29-2010



Tammy McKinley/ The Enterprise

Nelson Brown works out at the YMCA in Beaumont on Wednesday.

YMCA needs 1,000 new members

BEAUMONT

By Mike D. Smith
MDSmith@BeaumontEnterprise.com
(409) 880-0753

The Beaumont Metropolitan YMCA is considering an aggressive community effort to grab the up to 1,000 additional memberships needed to save the L.L. Melton Branch.

The "commitment campaign" is another effort by the YMCA to save the facility at 3455 Sarah St., which operates on a budget that hemorrhages up to $25,000 a month, Beaumont YMCA CEO Jeff Moore said.

Operating losses have forced YMCA officials to reduce hours.

The YMCA only plans to open the building on Saturday will continue at off-site locations throughout the community, Moore said.

The YMCA has been seeking an entity to take over the Melton Branch the past year. Antioch Missionary Baptist Church expressed interest, but backed out of talks last autumn. The YMCA also has approached the Beaumont City Council to consider a city takeover.

However, a quick resolution to the Melton Branch's dilemma might be nowhere in sight.

The center is tied up in a contractual agreement between the city and the YMCA.

The city used $1 million from the U.S. Department of Housing and Urban Development to build a new gym at the Melton facility in 2001, payment schedule on that $1 million amount using block grant funds.

The city will continue to make those payments, Hayes said.

If the Melton facility ceases being a YMCA facility, ownership of the building goes to the city, and the city could seek at least a partial repayment from the YMCA, Hayes said.

Meanwhile, talks slowly continue.

Moore said the group's last proposal to the city in December included starting a health initiative under which city employees would have discounted memberships.

Memberships would have generated enough money to patch the facility's deficits and keep the center afloat while the YMCA developed a but they chose not to do it," Moore said.

Beaumont Ward 4 Councilman Jamie Smith, whose district includes the Melton, said the city would have had to pay $200,000 under the deal, no matter how many of the city's 1,300 employees used the center.

"It was a little unfair saying 'this is what we're paying for,'" Smith said. "Then you're pushing something on the employees they may not be happy with."

Smith said he thinks solutions are still possible, including possibly relocating the YMCA's Parkdale Mall operations into the Melton Branch.

Smith said the branch could also be operated similar to the city-run Sterling Pruitt Recreation Center,

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine Neches Navigation District on:

TUESDAY, JANUARY 26, 2010
OPEN HOUSE 5:30-7:00 PM
PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

BEAUMONT CIVIC CENTER
701 MAIN STREET
BEAUMONT, TX 77701

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The Port Arthur News
A Division of Newspaper Holdings, Inc.
Port Arthur, Texas

AFFIDAVIT OF PUBLICATION

The State of Texas
County of Jefferson,
City of Port Arthur

***Tara Ford*, being duly sworn deposes and says:**

That she is a resident citizen of Jefferson County, Texas and that she is of lawful age; that she is the Classified Representative of the PORT ARTHUR NEWS, a division of Newspaper Holdings, Inc., same being a newspaper published and having a general circulation in the City of Port Arthur, Jefferson County, Texas; that said newspaper has been continuously and regularly published for a period of more than one year in Jefferson County, Texas, and that the advertising of Crouch Environmental, Ad # 16223P was published in said newspaper in the issue of January 20th, 21st + 22nd, 2010 which were the regular publication days of said issues; and that said issues were actually published, circulated and distributed.

Tara Ford

SUBSCRIBED AND sworn to before me,
this the 3rd day of February, A.D. 2010

Notary Public in and for Jefferson County, Texas

Jeree Powell
Notary Public, State of Texas
My Commission Expires:
April 25, 2010

WEDNESDAY, JANUARY 20, 2010

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PORT ARTHUR The News

Mr. Seat 41

Scott lands crucial win for GOP

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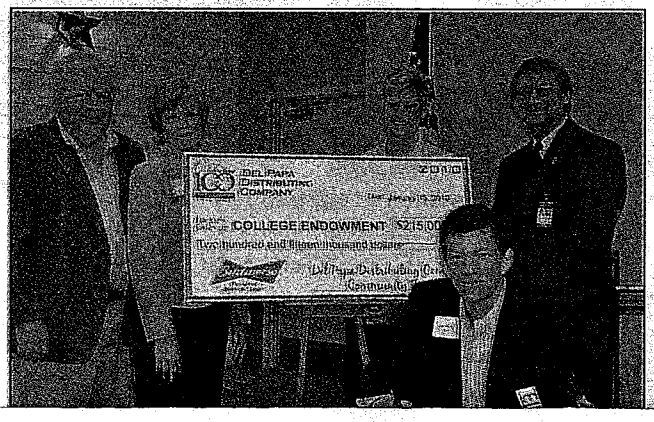
Del Papa Distributing creates scholarships for local colleges



As part of Del Papa Distributing Company's 100th anniversary celebration, the company announced that it will endow scholarships to 13 community and four-year colleges located in the 17 counties Del Papa services.

Lamar State College-Port Arthur, Lamar Institute of Technology, Lamar State College–Orange and Lamar University are among

Fuel gas leak isolated at Total in Port Arthur

By Mary Meaux
The News staff writer

A fuel gas leak at the Total Port Arthur Refinery has been isolated and plans are made to make necessary repairs, Pat Avery, administrative manager, said.

The gaseous leak occurred between 2 and 3 a.m. Wednesday. An unknown number of contract workers within the facility were sent home as per company policy, Avery said. When an incident such as this occurs, extra persons are kept out of the facility.

Air monitoring at the fence line has been ongoi

"We are conducting monitoring at the fence l and no unsafe levels vapors have been detecte she said.

The Texas Commiss on Environmental Qua has been notified of the i dent, as is required.

mmeaux@panews.com

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE - NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

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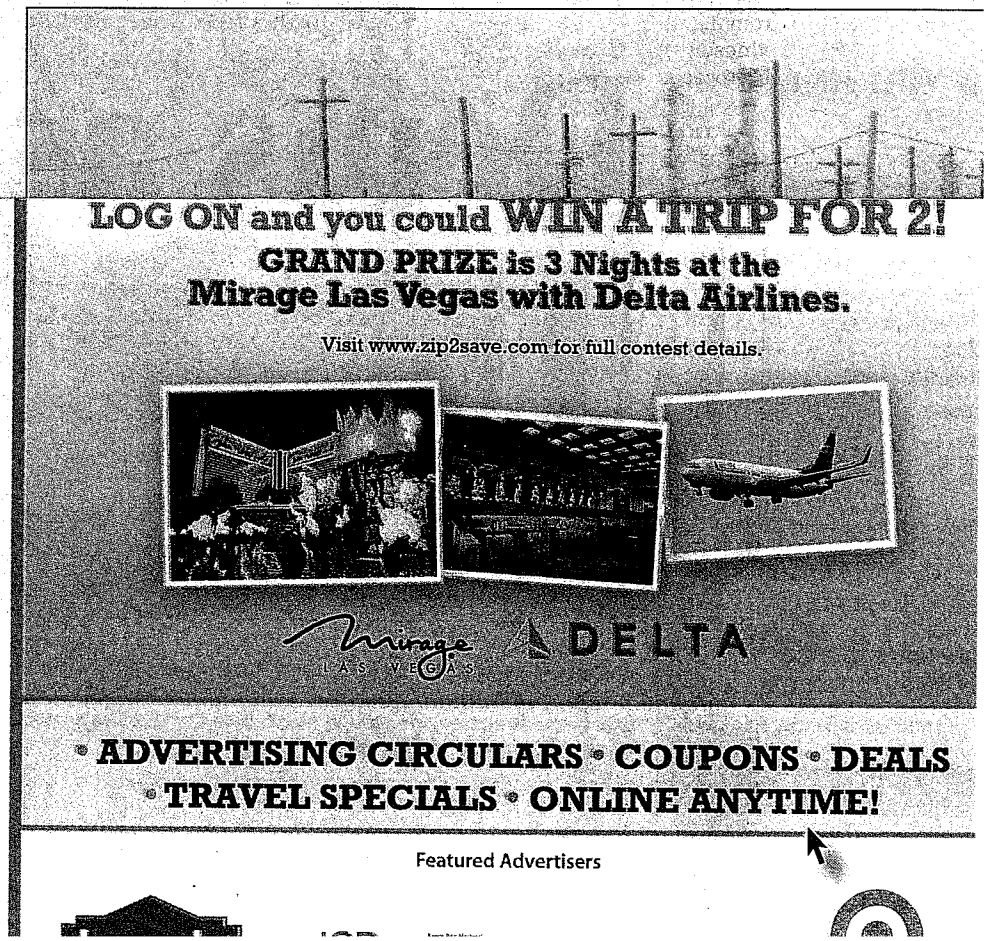

Exhibit explores legacy of women in Pop

PHILADELPHIA (AP) — As radical social changes rocked 1960s America, the contemporary art world remained largely a boys' club that largely ignored female Pop artists as their male counterparts grew to become

retrospective of dancer and experimental filmmaker Yvonne Rainer. Why, he wondered, were she and other female artists of the 1960s not included in the art canon alongside Andy Warhol, Robert Indiana, Claes Oldenburg and Roy

tinues to create groundbreaking art with her trademark hallucinatory polka-dot motifs.

Soft sculptures popularized by Oldenburg's huge deflated fans and use of repetition like Warhol's multicolor Marilyns were

wave didn't carry female contemporary artists to the levels of recognition and respect reached by their male counterparts, said University of the Arts professor and art historian Nancy Heller.

She said women have

older are invited to stop in

Saturday. Ages 21 and older

to be Honky Tonk Texas in

Global warming opens up Arctic for undersea cable

ANCHORAGE, Alaska (AP) — Global warming has melted so much Arctic ice that a telecommunication group is moving forward with a project that was unthinkable just a few years ago: laying undersea

hiseconds."

The project, while still facing many significant obstacles, also serves as an example of how warming has altered the Arctic landscape in profound ways

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State of Louisiana

Parish of Calcasieu

Before me, the undersigned authority, personally came and appeared JOEANN BENOIT who, being duly sworn, deposes and says: That he is the manager of the

SOUTHWEST DAILY NEWS

A newspaper published daily (Sunday, Tuesday, Wednesday, Thursday, Friday and Saturday) in Sulphur, Louisiana.

That the hereto attached notice was published in said newspaper in its issues dated the 01/19/10
01/20/10
01/21/10
01/22/10

NOTICE OF PUBLIC MEETING

GALVESTON DISTRICT, CORPS OF ENGINEERS

Manager, Joe Ann Benoit

Sworn and subscribed to at my office in Sulphur, Louisiana, on this 15 day of JANUARY A.D., 2010 Before me.

Linda Duggan
Notary Public
LINDA DUGGAN ID#1848

to come in a little later, but the damage is not as bad as the industry first believed, LSU AgCenter experts said.

Regina Bracy, LSU AgCenter horticulturist at the LSU AgCenter's Hammond Research Station, said the crop could be set back for nearly a month.

"It takes 21 days from flower to berry. So if the growers lose all of their flowers and berries at this time, then they will not have another crop for 21 days," she said.

"We've lost about 95 percent of the bloom crop that's out there right now and a good bit of our green berries due to cold-weather damage and the freeze," said Eric Morrow, a Ponchatoula grower with 13 acres.

William Fletcher, another Ponchatoula grower, said he lost about 80 percent of what was on the plants.

"I expect a market drop in production for about a month. If we don't see any more cold weather, production should come back," Fletcher said.

The peak season for Louisiana strawberries is usually in March and ers is November, December and January.

Bracy said Louisiana produces about 300 acres of strawberries, which is down from 1,000 acres 10 years ago.

"We're seeing the decrease in acres, but we're also seeing some young farmers coming in, and that gives us some hope that the industry is going to continue in this area," she said.

Bracy said the cold weather doesn't affect the quality of the berries if they are protected and not damaged.

"The berries that come out after this weather will be as good as any we've had," she said. "In fact, cold weather does less damage than applying too much water or having too much rain."

Information from: The Advocate, http://www.2theadvocate.com

of $524.54 each for deer, and $55 a foot and $2.21 a pound for alligators.

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PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER
JEAN LAFITTE ROOM
700 LAKESHORE DR.
LAKE CHARLES, LA 70601

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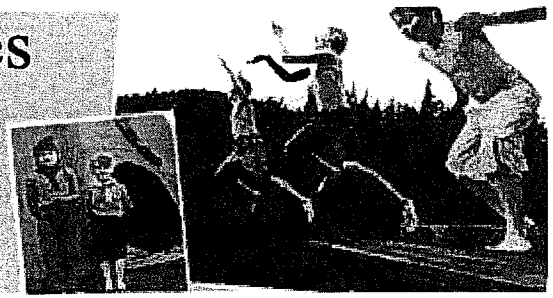
Mark Charlie, Manager

Share your Scouting memories

This year marks the 100th anniversary of the Boy Scouts of America, and we would like you to submit your memories and photos of your Scouting days. Scouting offers adventure and a sense of service that often become the fabric of our lives. Send us your photos and stories from your Scouting days to share with the community.

SUBMIT PHOTOS & STORIES Submit your photos and Scouting memories to Southwest Daily News at 716 E. Napoleon as soon as possible, and we'll run them in our print edition and online at sdneditorial@yahoo.com



Affidavit of Publication

STATE OF LOUISIANA
Parish of Calcasieu

Before me the undersigned authority, personally came and appeared

Marlana Bergeron

who being duly sworn, deposes and says:

He/She is a duly authorized agent of
LAKE CHARLES AMERICAN PRESS
a newspaper published daily at 4900 Highway 90 East,
Lake Charles, Louisiana, 70615. (Mail address: P.O. Box 2893
Lake Charles, LA 70602)

The attached Notice was published in said newspaper in its issue(s) dated:

00585027 - $688.50
January 21, 2010
January 22, 2010
January 23, 2010

Marlana Bergeron
Duly Authorized Agent

Subscribed and sworn to before me on this 25th day of January, 2010 at Lake Charles, LA

Gwendolyn R. Dugas
Notary Public

00080648

CROUCH ENVIRONMENTAL

Gwendolyn R. Dugas
#056523

14TH JUDICIAL DISTRICT COURT: DWIS

Sentences were imposed on 13 people who pleaded either guilty or no contest recently in 14th Judicial District Court to drunken driving charges and on one other who was found guilty following nonjury trial.

Most of the sentences were recommended by state and defense attorneys and were accepted by the court. Amendments and dismissals were made by the prosecutors.

Judge David Ritchie imposed a suspended four-month jail term on **Tyra A. Duke II,** 23, 1315 Joseph St. in Sulphur, for first-offense DWI. Banks was placed on one year of probation with special conditions the defendant perform 10 eight-hour days of court-approved community service, attend 12 weekly meetings of a support group for either alcohol or drug abusers, attend one victim's-impact session sponsored by Mothers Against Drunk Driving and pay a fine of $400 and court costs or serve 30 days in jail.

Ritchie imposed suspended 90-day jail terms plus fines of $400 and court costs on the following all for first-offense DWI:

Clint Thibodeaux, 26, 4788 Nick Clair Lane, Iowa.

Summer Statum, 32, 129 Lewis Statum Road, Starks.

Derek Milburn, 45, 4127 Long Pine Lane.

Marty Droddy Sr., 53, 2010 Patton St., Lot 39, Sulphur.

Stephen Saucier, 28, 42 Raintree Cove.

Each of those defendants was placed on one year of probation with the condition they each attend one victim's-impact session.

Saucier was ordered to perform eight days of community service, while each of the other defendants was ordered to perform four days.

On a charge of aggravated assault, Saucier was sentenced to a suspended five-month jail term and was placed on probation for two years.

On a charge of illegal carrying of a weapon, he was sentenced to a suspended six-month jail term and was placed on two years of probation with conditions he pay a fine of $750 and court costs, submit to testing and/or treatment for drug abuse, obtain anger-management counseling, forfeit the pistol involved and neither possess nor consume any alcohol.

Defendants and their charges and the sentences imposed by Judge Robert Wyatt:

Russell S. Campbell, 37, 4314 S. La. 27, Sulphur; one count of second-offense DWI and one count of first-offense — jail terms totaling 90 days to be served after prison terms totaling five years imposed when Campbell's probation on prior convictions for issuing worthless checks, theft in excess of $500 and possession of stolen goods valued at $300-$500 was revoked; charges of simple burglary, theft in excess of $500 and distribution of a false controlled drug were dismissed.

Alice Hinton, 48, 910 Broussard St., Iowa; second-offense DWI — 60 days in jail with all except 48 hours of home incarceration suspended, one year of probation, $750 and court costs or 60 days in jail, 30 days of community service, one victim's-impact session; charges of reckless driving and hit-and-run were dismissed.

Jesse J. Combs, 29, 2562 Montfort Drive; same charge and sentence as Hinton with the addition of $200 to the Public Defenders Office as partial payment for legal services.

Clayton Trahan, 25, Jennings; second-offense DWI — 60 days in jail with all except 48 hours suspended, two years probation, $750 and court costs or 90 days in jail, 30 days of community service, one victim's-impact session.

Brandon Bottley, 29, 2549 13th St.; first-offense DWI — suspended 60-day jail term, one year of probation, $400 and court costs or 60 days in jail, four days of community service, one victim's-impact session.

George Hartfield, 64, Orange, Texas; first-offense DWI — suspended 30-day jail term, one year of probation, $350 and court costs or 30 days in jail, four days of community service, one victim's-impact session.

Stephanie Miller, also known as **Stephanie O'Quain**, 30, 4314 La. 27 South; two counts of first-offense DWI — suspended imposition of any jail term, one year of probation, fines totaling $600 and court costs, eight days of community service, one victim's-impact session, restitution for a dismissed worthless check charge.

If Miller successfully completes probation, she may have her criminal record changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

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14TH JUDICIAL

Probation was revol and previously suspen prison or jail terms impo on 25 people following he ings conducted recently 14th Judicial District Cour

Judge Robert Wy revoked the probation of following people — lis here with their convictio and the sentences they m now serve:

Charley Leday Jr., 47, 19 Winterhalter St., Apt. C; o count each of second- an third-offense possession marijuana; prison terms totaling five years.

Christopher O. Hasty, 2 2208 Belden St.; indecent behavior with a juvenile; seven years in prison.

Aaron Young, 21, 2425 Conoco St.; possession of cocaine; three years in prison.

James P. Spangler, 28, 6 Jones St.; burglary and the prison terms totaling two years.

Miracle L. Chatman, 23, 1739 O'Brien St.; two cou of distribution of controlle drugs; prison terms totali three years.

Judge Kent Savoie revok the probation of the followi people — listed here wi their convictions and the s tences they must now serve

Keith W. Robertson, 29, 709 10th St.; carnal knowledge of a juvenile a unauthorized entry of an inhabited dwelling; prison terms totaling five years.

Michael R. Sigler, 20, 160 W. Fourth St.; simple burglary; three years in prison.

Byron L. Jackson, 19, 424

POLICE BLOTTE

The following arrests h been reported by area l enforcement agencies.

Drugs

Kardayle Sherard Brown

reportedly found a gallon-size bag containing marijuana, a smaller bag of marijuana and $3,012 in cash.

■

Rashad Johnson, 24; and **Michael Pepp**, 22, both of Leesville — possession of controlled dangerous substance (CDS) schedule I (marijuana) with intent to distribute and illegal carrying of weapons.

Joseph Lopez, 18, of New Llano — possession of drugs that included five crack cocaine "cookies" with an estimated street value of $15,000 and a handgun.

■

Keith Washington, 28, **Brandon Leone**, 20, both of Leesville, **Ebony Miles**, 25, of Reserve — possession of marijuana, possession of drug paraphernalia, illegal use of CDS in presence of minors, illegal carrying of weapons.

The three were arrested by

charged with operating without an occupational license.

Forgery

Allen P. Conner, 25, of Singer; two counts of forgery and one court of simple burglary of an inhabited dwelling.

Beauregard sheriff's officials said Conner was arrested in connection with a complaint received of checks missing from a Singer residence.

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BRIEFLY

BY THE ASSOCIATED PRESS

Former teacher-coach admits to sex charges

BATON ROUGE — A former Redemptorist High School teacher and coach has pleaded guilty to charges that accuse him of having sex with a 15-year-old female student and rubbing and kissing the neck of a 14-year-old female student in 2006.

After his arrest in January 2007, The Advocate reports 26-year-old Ray Samuel Clement III resigned from his job at the school where he taught earth sciences and algebra and also coached track and field.

Two suspects held in slaying of teen

PLAQUEMINE — A state judge has ordered two construction workers suspected in the slaying of a Plaquemine teenager held without bail pending trial.

Judge Alvin Batiste Jr. denied bail on Tuesday to 25-year-old Channing Paul Touchet and 19-year-old Nicholas Lee Gorring in the Dec. 19 drive-by shooting death of 17-year-old Jamarius Riley.

Police tell The Advocate that Touchet and Gorringe were in the Plaquemine area looking to buy illegal drugs at the time of the slaying.

00582371

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WEDNESDAY, JANUARY 27, 2010
OPEN HOUSE 5:30-7:00 PM PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER JEAN LAFITTE ROOM
700 LAKESHORE DR. LAKE CHARLES, LA 70601

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MS. JANELLE STOKES P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

Jermaine O'Brien, 27, 409 N. Simmons St.; first-offense DWI — suspended 90-day jail term, six months of unsupervised probation, $400 and court costs, eight days of community service.

Donna Lankford, 52, 1111 Henning Drive, Apt. B, Sulphur; first-offense DWI — 30 days in jail.

Shawn McCorvey, 38,

Sasovetz, Hebert, Levier and Murry successfully complete probation, they may have their records changed to reflect acquittals.

Most of the defendants were also ordered to complete the Safety Council of Southwest Louisiana's defensive driving and substance abuse education programs.

VINCENT LUPO

Check out the Jambalaya pages on weekdays, Saturdays for your crossword and horoscope.

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over their cash. Cox reached for his wallet, saying he didn't have 50 cents. That's when he was shot, Rudell said.

Cox dropped face first into sewage pumped from the man-

Medical personnel reluctantly let her see her husband before the surgery.

"The pillow was just soaked in his blood. I grabbed his hand and told him, 'Don't

DWIS

June 23, 2006, and insisted on searching it without a warrant or permission from anyone.

They said they were look-

50,000-volt stun gun.

That left him unable to walk; police dragged him to a squad car and took him to jail, according to the ACLU.

The Cowboy Way

offer other services are being held at several area Walgreens. The screenings are through Friday, Jan. 29.

p.m., Walgreens, 2636 Ryan St., Lake Charles; Sunday, Jan. 24, 11 a.m. – 5p.m.

Help with energy bills available for eligible residents

The U.S. Department of Health and Human Services on Wednesday announced the release of $6.3 million in Low-Income Home Energy Assistance Program funds for eligible homeowners and renters in Louisiana.

The program offers assistance for heating, cooling and other energy costs, as well as helping to weatherize families' homes.

The funds are in addition to basic LIHEAP funding states receive automatically.

To apply for energy assistance, contact the local or state LIHEAP agency. In Calcasieu, call the parish Office of Community Services at 437-3567.

For more information, vis www.acf.hhs.gov/program ocs/liheap or ww acf.hhs.gov/programs/oc liheap/brochure/brochu html.

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GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

00585027

WHAT'S AHEAD

Sowela e-commerce course scheduled

Beginning Thursday, Jan. 28, Sowela Technical Community College will offer a 10-week e-commerce course to teach students how to better navigate the Internet and start a Web-based business.

The course is 5:30-8:30 p.m. Thursdays and costs $150, plus fees.

www.americanpress.com

Board to exp

BY DORIS MARI
AMERICAN P

JENNINGS — Jeff Da Parish students who exce the LEAP and iLEAP t will have the opportunit continue their fun and le ing even when school lets for the summer.

The Jeff Davis Pa School Board began cussing plans Thursda expand its summer camp gram to include a high s

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BY MIKE JONES
AMERICAN PRESS

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Paperwork has been submitted

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Tear Sheet Attached
Crouch Environmental Svc

STATE OF TEXAS
COUNTY OF JEFFERSON

BEFORE ME, THE UNDERSIGNED AUTHORITY, ON THIS DAY, PERSONALLY APPEARED Nelta Dumes WHO BEING BY ME DULY SWORN, DEPOSES AND SAYS THAT HE/SHE IS THE Classified Sales Exec. OF THE BEAUMONT ENTERPRISE; THAT SAID NEWSPAPER IS REGULARLY PUBLISHED IN JEFFERSON, HARDIN, TYLER, NEWTON, CHAMBERS, ORANGE , JASPER, LIBERTY, SABINE, SAN AUGUSTINE, ANGELINA AND GALVESTON COUNTY (COUNTIES), TEXAS; THAT THE ATTACHED NOTICE WAS PUBLISHED IN THE BEAUMONT ENTERPRISE ON THE FOLLOWING DATE(S), TO WIT January 21, 2010.

NEWSPAPER REPRESENTATIVE SIGNATURE

SWORN AND SUBSCRIBED TO BEFORE ME ON THIS THE 25th DAY OF January 2010, TO CERTIFY WHICH WITNESS MY HAND AND SEAL OF OFFICE.

Robin R Hillin
NOTARY PUBLIC IN AND FOR THE STATE OF TEXAS

ROBIN R. HILLIN
MY COMMISSION EXPIRES
04-29-2010

PRINT OR TYPE NAME OF NOTARY PUBLIC
MY COMMISSION EXPIRES

ROBIN R HILLIN
Notary Public, State Of Texas
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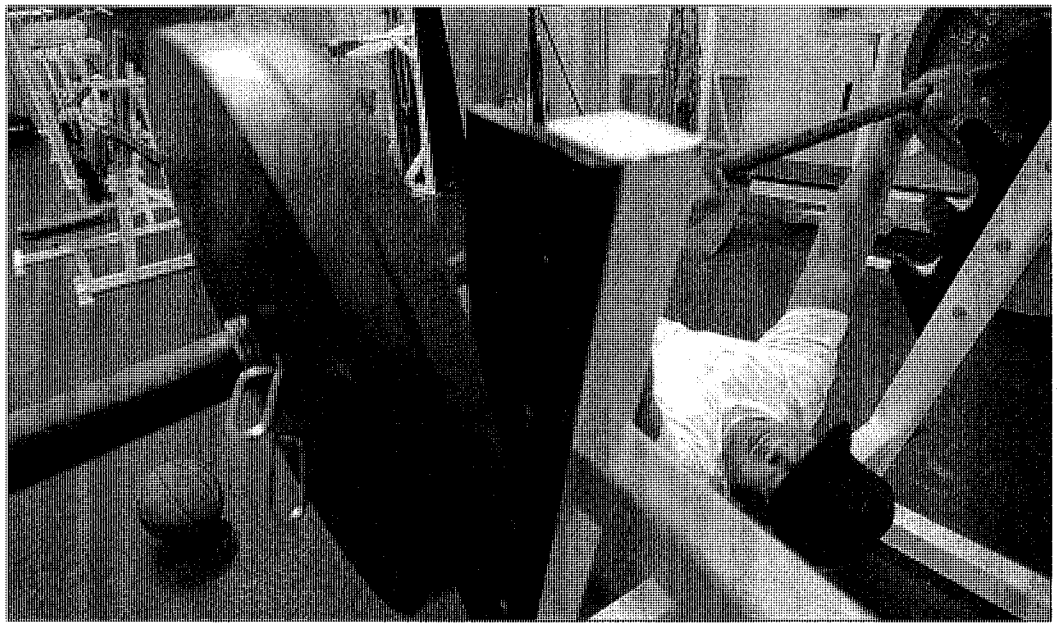
04-29-2010



Tammy McKinley/ The Enterprise

Nelson Brown works out at the YMCA in Beaumont on Wednesday.

YMCA needs 1,000 new members

BEAUMONT

By Mike D. Smith
MDSmith@BeaumontEnterprise.com
(409) 880-0753

The Beaumont Metropolitan YMCA is considering an aggressive community effort to grab the up to 1,000 additional memberships needed to save the L.L. Melton Branch.

The "commitment campaign" is another effort by the YMCA to save the facility at 3455 Sarah St., which operates on a budget that hemorrhages up to $25,000 a month, Beaumont YMCA CEO Jeff Moore said.

Operating losses have forced YMCA officials to reduce hours.

The YMCA only plans to open the building on Saturday will continue at off-site locations throughout the community, Moore said.

The YMCA has been seeking an entity to take over the Melton Branch the past year. Antioch Missionary Baptist Church expressed interest, but backed out of talks last autumn. The YMCA also has approached the Beaumont City Council to consider a city takeover.

However, a quick resolution to the Melton Branch's dilemma might be nowhere in sight.

The center is tied up in a contractual agreement between the city and the YMCA.

The city used $1 million from the U.S. Department of Housing and Urban Development to build a new gym at the Melton facility in 2001, payment schedule on that $1 million amount using block grant funds.

The city will continue to make those payments, Hayes said.

If the Melton facility ceases being a YMCA facility, ownership of the building goes to the city, and the city could seek at least a partial repayment from the YMCA, Hayes said.

Meanwhile, talks slowly continue.

Moore said the group's last proposal to the city in December included starting a health initiative under which city employees would have discounted memberships.

Memberships would have generated enough money to patch the facility's deficits and keep the center afloat while the YMCA developed a but they chose not to do it," Moore said.

Beaumont Ward 4 Councilman Jamie Smith, whose district includes the Melton, said the city would have had to pay $200,000 under the deal, no matter how many of the city's 1,300 employees used the center.

"It was a little unfair saying 'this is what we're paying for,'" Smith said. "Then you're pushing something on the employees they may not be happy with."

Smith said he thinks solutions are still possible, including possibly relocating the YMCA's Parkdale Mall operations into the Melton Branch.

Smith said the branch could also be operated similar to the city-run Sterling Pruitt Recreation Center,

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The Port Arthur News
A Division of Newspaper Holdings, Inc.
Port Arthur, Texas

AFFIDAVIT OF PUBLICATION

The State of Texas
County of Jefferson,
City of Port Arthur

***Tara Ford*, being duly sworn deposes and says:**

That she is a resident citizen of Jefferson County, Texas and that she is of lawful age; that she is the Classified Representative of the PORT ARTHUR NEWS, a division of Newspaper Holdings, Inc., same being a newspaper published and having a general circulation in the City of Port Arthur, Jefferson County, Texas; that said newspaper has been continuously and regularly published for a period of more than one year in Jefferson County, Texas, and that the advertising of Crouch Environmental, Ad # 16223P was published in said newspaper in the issue of January 20th, 21st + 22nd, 2010 which were the regular publication days of said issues; and that said issues were actually published, circulated and distributed.

Tara Ford

SUBSCRIBED AND sworn to before me,
this the 3rd day of February, A.D. 2010

Notary Public in and for Jefferson County, Texas

Jeree Powell
Notary Public, State of Texas
My Commission Expires:
April 25, 2010

WEDNESDAY, JANUARY 20, 2010

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PORT ARTHUR The News

Mr. Seat 41

Scott lands crucial win for GOP

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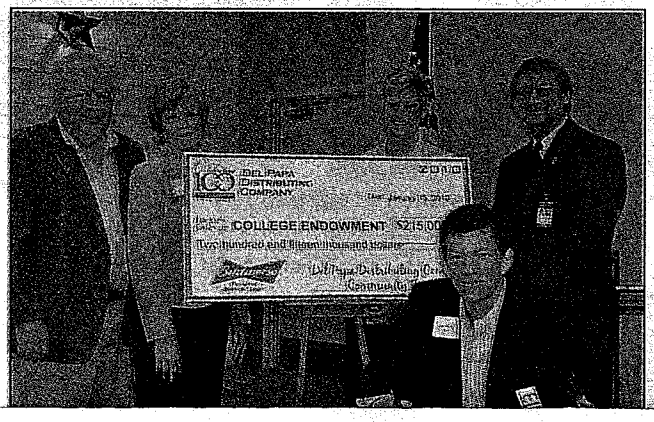

As part of Del Papa Distributing Company's 100th anniversary celebration, the company announced that it will endow scholarships to 13 community and four-year colleges located in the 17 counties Del Papa services.

Lamar State College-Port Arthur, Lamar Institute of Technology, Lamar State College–Orange and Lamar University are among

Fuel gas leak isolated at Total in Port Arthur

By Mary Meaux
The News staff writer

A fuel gas leak at the Total Port Arthur Refinery has been isolated and plans are made to make necessary repairs, Pat Avery, administrative manager, said.

The gaseous leak occurred between 2 and 3 a.m. Wednesday. An unknown number of contract workers within the facility were sent home as per company policy, Avery said. When an incident such as this occurs, extra persons are kept out of the facility.

Air monitoring at the fence line has been ongoi

"We are conducting monitoring at the fence l and no unsafe levels vapors have been detecte she said.

The Texas Commiss on Environmental Qua has been notified of the i dent, as is required.

mmeaux@panews.com

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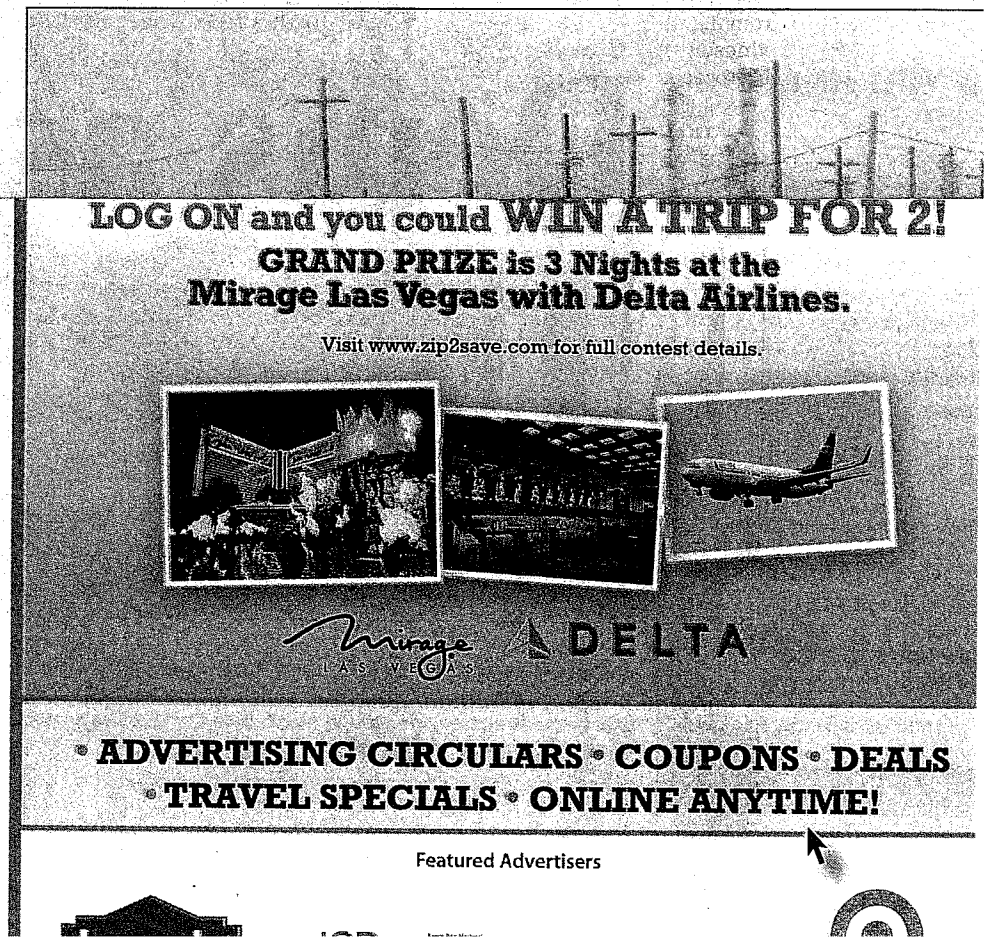

Exhibit explores legacy of women in Pop

PHILADELPHIA (AP) — As radical social changes rocked 1960s America, the contemporary art world remained largely a boys' club that largely ignored female Pop artists as their male counterparts grew to become

retrospective of dancer and experimental filmmaker Yvonne Rainer. Why, he wondered, were she and other female artists of the 1960s not included in the art canon alongside Andy Warhol, Robert Indiana, Claes Oldenburg and Roy

tinues to create groundbreaking art with her trademark hallucinatory polka-dot motifs.

Soft sculptures popularized by Oldenburg's huge deflated fans and use of repetition like Warhol's multicolor Marilyns were

wave didn't carry female contemporary artists to the levels of recognition and respect reached by their male counterparts, said University of the Arts professor and art historian Nancy Heller.

She said women have

older are invited to stop in

Saturday. Ages 21 and older

to be Honky Tonk Texas in

Global warming opens up Arctic for undersea cable

ANCHORAGE, Alaska (AP) — Global warming has melted so much Arctic ice that a telecommunication group is moving forward with a project that was unthinkable just a few years ago: laying undersea

hiseconds."

The project, while still facing many significant obstacles, also serves as an example of how warming has altered the Arctic landscape in profound ways

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State of Louisiana

Parish of Calcasieu

Before me, the undersigned authority, personally came and appeared JOEANN BENOIT who, being duly sworn, deposes and says: That he is the manager of the

SOUTHWEST DAILY NEWS

A newspaper published daily (Sunday, Tuesday, Wednesday, Thursday, Friday and Saturday) in Sulphur, Louisiana.

That the hereto attached notice was published in said newspaper in its issues dated the 01/19/10
01/20/10
01/21/10
01/22/10

NOTICE OF PUBLIC MEETING

GALVESTON DISTRICT, CORPS OF ENGINEERS

Manager, Joe Ann Benoit

Sworn and subscribed to at my office in Sulphur, Louisiana, on this 15 day of JANUARY A.D., 2010 Before me.

Linda Duggan
Notary Public
LINDA DUGGAN ID#1848

to come in a little later, but the damage is not as bad as the industry first believed, LSU AgCenter experts said.

Regina Bracy, LSU AgCenter horticulturist at the LSU AgCenter's Hammond Research Station, said the crop could be set back for nearly a month.

"It takes 21 days from flower to berry. So if the growers lose all of their flowers and berries at this time, then they will not have another crop for 21 days," she said.

"We've lost about 95 percent of the bloom crop that's out there right now and a good bit of our green berries due to cold-weather damage and the freeze," said Eric Morrow, a Ponchatoula grower with 13 acres.

William Fletcher, another Ponchatoula grower, said he lost about 80 percent of what was on the plants.

"I expect a market drop in production for about a month. If we don't see any more cold weather, production should come back," Fletcher said.

The peak season for Louisiana strawberries is usually in March and ers is November, December and January.

Bracy said Louisiana produces about 300 acres of strawberries, which is down from 1,000 acres 10 years ago.

"We're seeing the decrease in acres, but we're also seeing some young farmers coming in, and that gives us some hope that the industry is going to continue in this area," she said.

Bracy said the cold weather doesn't affect the quality of the berries if they are protected and not damaged.

"The berries that come out after this weather will be as good as any we've had," she said. "In fact, cold weather does less damage than applying too much water or having too much rain."

Information from: The Advocate, http://www.2theadvocate.com

of $524.54 each for deer, and $55 a foot and $2.21 a pound for alligators.

NOTICE OF PUBLIC MEETING AND AVAILABILITY OF DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR SABINE-NECHES WATERWAY PROPOSED CHANNEL IMPROVEMENT PROJECT, DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR TEXAS OCEAN DREDGED MATERIAL DISPOSAL SITES DESIGNATION AND DRAFT GENERAL CONFORMITY DETERMINATION

Interested parties are hereby notified of and invited to attend an open house and public meeting to be conducted by the U.S. Army Corps of Engineers and the Sabine Neches Navigation District on:

WEDNESDAY, JANUARY 27, 2010
OPEN HOUSE 5:30-7:00 PM
PUBLIC MEETING 7:00-9:00 PM
(REGISTRATION BEGINS AT 5:30 PM)

LAKE CHARLES CIVIC CENTER
JEAN LAFITTE ROOM
700 LAKESHORE DR.
LAKE CHARLES, LA 70601

The meeting will provide an opportunity for all persons to comment on the proposed project, the ocean dredged material disposal sites (ODMDS) designation, and draft determination. Those unable to attend may find the draft project EIS, ODMDS EIS, and draft conformity determination at www.swg.usace.army.mil. Written comments with regard to the EIS and the ODMDS EIS must be postmarked by February 10, 2010. Note that written comments with regard to the draft general conformity determination must be postmarked by 30 days from the date this notice is published.

Comments may be mailed or emailed to:
GALVESTON DISTRICT, CORPS OF ENGINEERS
ATTN: MS. JANELLE STOKES
P.O. BOX 1229
GALVESTON, TEXAS 77553

Or Janelle.S.Stokes@usace.army.mil

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and God Bless you.
Mark Charlie, Manager

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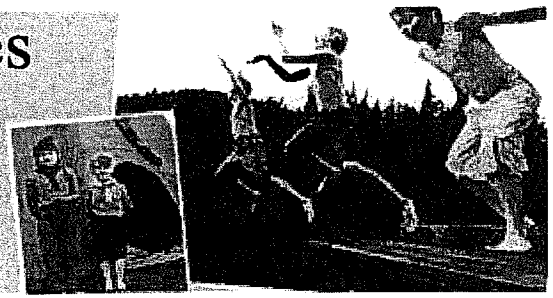
SUBMIT PHOTOS & STORIES Submit your photos and Scouting memories to Southwest Daily News at 716 E. Napoleon as soon as possible, and we'll run them in our print edition and online at sdneditorial@yahoo.com



Appendix C

TCEQ General Conformity Concurrence Letter

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

April 15, 2010

Ms. Janelle Stokes
Regional Environmental Specialist
United States Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, Texas 77553-1229

Re: General conformity concurrence for the Sabine-Neches Waterway Channel Improvement Project

Dear Ms. Stokes:

This letter provides general conformity concurrence for the proposed Sabine-Neches Waterway Channel Improvement project. The Texas Commission on Environmental Quality (TCEQ) reviewed the project in accordance with Title 40 Code of Federal Regulations Part 93, and Title 30 Texas Administrative Code (TAC) § 101.30 of the TCEQ general rules. The proposed project is located in the Beaumont-Port Arthur (BPA) area and is classified as moderate nonattainment for the 1997 ozone standard, and emissions are expected to be above the 100 tons per year *de minimis* threshold. Therefore, a general conformity analysis is required.

The TCEQ has determined, pursuant to 30 TAC §101.30(h)(1)(E)(i)(I), that emissions from the proposed project will not exceed the emissions from the applicable state implementation plan, the BPA Rate-of-Progress adopted by the TCEQ Commission on October 27, 2004, and approved by the United States Environmental Protection Agency on February 22, 2006. This general conformity determination is based upon information provided in a September 2009 Draft General Conformity Determination prepared for the U.S. Army Corps of Engineers (USACE).

In support of the ozone National Ambient Air Quality Standard, the TCEQ suggests the USACE adopt pollution prevention and/or reduction measures in conjunction with this and future projects, such as the following:

- encourage construction contractors to apply for Texas Emission Reduction Plan grants;
- establish bidding conditions that give preference to clean contractors;
- direct construction contractors to exercise air quality best management practices;
- direct contractors that will use tugboats during construction to use clean fuels;
- direct operators of the assist tugboats used in maneuvering dredge vessels to use clean fuels;
- select assist tugs based on lowest nitrogen oxides (NO_X) emissions instead of lowest price; or
- purchase and permanently retire surplus NO_X offsets prior to commencement of operations.

Thank you for providing the necessary information and staff assistance for our review. We would also appreciate update(s), as appropriate, as this project moves forward. I look forward to working with you in the future on any upcoming projects you may have that affect air quality in your district. If you require further assistance on this matter, please contact Mr. Koy Howard at (512) 239-2306 or kohoward@tceq.state.tx.us.

Sincerely,

David Brymer, Director
Air Quality Division

DB/KH/kb

cc: Ruben Velasquez, P.E., PBS&J

Appendix G

Biological Assessment and Biological Opinion

Appendix G1

Biological Assessment

Document No. 060201
PBS&J Job No. 100007609/441206

BIOLOGICAL ASSESSMENT FOR IMPACTS TO ENDANGERED AND THREATENED SPECIES RELATIVE TO THE SABINE-NECHES WATERWAY CHANNEL IMPROVEMENTS PROJECT TEXAS AND LOUISIANA

Prepared for:

U.S. Army Corps of Engineers
Galveston District
2000 Fort Point Road
Galveston, Texas 77550

Prepared by:

PBS&J
6504 Bridge Point Parkway
Suite 200
Austin, Texas 78730

June 2010

Printed on recycled paper

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A Agency Correspondence
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Acronyms and Abbreviations

°F	degrees Fahrenheit
AOU	American Ornithologist's Union
BA	Biological Assessment
BOOTS	Bulk Oil Offshore Transfer System
CFR	Code of Federal Regulations
DMMP	Dredged Material Management Plan
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FR	Federal Register
GIWW	Gulf Intracoastal Waterway
GSMFC	Gulf States Marine Fisheries Commission
Gulf	Gulf of Mexico
HU	Hydrologic Unit
HWG	Habitat Workgroup
ICT	Interagency Coordination Team
LCWCR/WCRA	Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority
LNHP	Louisiana Natural Heritage Program
LOOP	Louisiana Offshore Oil Port
mcy	million cubic yards
MLLW	mean low low water
NDD	Natural Diversity Database
NED	National Economic Development
NFWL	National Fish and Wildlife Laboratories
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRC	National Research Council
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
ODMDS	Ocean Dredged Material Disposal Sites
PCE	primary constituent element
Plan	Recommended Plan
ppt	parts per thousand
SNWW	Sabine-Neches Waterway
STSSN	Sea Turtle Stranding and Salvage Network
TED	turtle excluder devices
TPWD	Texas Parks and Wildlife Department
USACE	U.S. Army Corps of Engineer
USFWS	U.S. Fish and Wildlife Service
VTS	vessel traffic service
WMA	Wildlife Management Area

1.0 INTRODUCTION

1.1 PURPOSE OF THE BIOLOGICAL ASSESSMENT

This revised Biological Assessment (BA) has been prepared in fulfillment of the U.S. Army Corps of Engineers' (USACE) responsibilities under Section (7)(c) of the Endangered Species Act (ESA) of 1973, as amended. Originally, a proposed 48-foot deepening and widening project was coordinated with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) by letters dated February 21, 2007. The 2007 BA concluded that the 48-foot deepening and widening project was not likely to adversely affect federally listed terrestrial species or designated terrestrial critical habitat. However, since it was determined that the project could affect federally listed marine species, USACE requested initiation of formal consultation pursuant to 50 Code of Federal Regulations (CFR) 402.14 to evaluate the effects of that project on threatened and endangered sea turtles. This consultation concluded with the NMFS's issuance of a Biological Opinion, dated August 13, 2007 (Appendix G2).

For the purposes of the BA, we define the "project area" as those areas that would be directly affected by construction of the Recommended Plan (Plan). This includes the proposed dredging footprint, existing and proposed placement areas identified in the Dredged Material Management Plan (DMMP), DMMP restoration and nourishment areas, and compensatory mitigation areas (Figure 1).

The "study area" includes a larger area for which environmental effects of the Plan have been analyzed (see Figure 1). The study area encompasses a 2,000-square-mile area, which contains the smaller project area, and includes the following waterbodies and adjacent coastal wetlands: Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf of Mexico.

The "Project" refers to the Recommended Plan of navigation improvements for a 48-foot channel. Details of the Plan are provided in Section 1.4.

The proposed Federal action (Project) requiring the assessment is the deepening of the Sabine-Neches Waterway (SNWW) in Texas and Louisiana. This BA evaluates the potential impacts the Project may have on federally listed endangered and listed species. The "Project" refers to the Recommended Plan of navigation improvements for a 48-foot channel. Details of the Plan are provided in Section 1.4 of the Final Environmental Impact Statement (FEIS).

This update is being provided because the proposed plan of navigation improvements has been modified. The proposed depth and length of the navigation improvements remain the same, but proposed widening of the Sabine Pass Jetty Channel, Sabine Pass Channel, and Port Arthur Canal has been dropped from

proposed improvements. Potential effects to federally listed species remain essentially unchanged. Modifications to the formerly proposed plan are as follows:

1. Widening the Sabine Pass Jetty Channel, the Sabine Pass Channel, and the Port Arthur Canal to 700 feet have been dropped from the plan. The current 500-foot-width and centerline of these channels would be maintained with proposed deepening.

2. Turning/Anchorage Basins 2, 3, 5, 6, and 7 have been dropped from the recommended plan. However, the project sponsor may choose to construct them at a later date, so their impacts are still being addressed by this BA and Final Environmental Impact Statement (FEIS).

3. Some components of the proposed Neches River Beneficial Use feature have been dropped or modified: Rose City West has been dropped, the size of Rose City East has been reduced, and Bessie Heights West has been dropped. There are no changes to the remaining components of the Neches River Beneficial Use Feature (Bessie Heights East and Old River Cove) or the Gulf Shore Beneficial Use Feature.

4. There are no changes to proposed marsh mitigation measures in Louisiana. However, oyster reef mitigation is no longer proposed since there would be no widening impacts.

5. There are no changes to offshore channels or Ocean Dredged Material Disposal Sites (ODMDS) disposal plans for these channels. However, the quantity of material from the Sabine Pass Jetty Channel has been reduced because widening has been dropped.

An FEIS, to which this BA is attached as an appendix, has been prepared to address the impacts of the Project.

1.2 PROJECT SETTING

The existing project is a 65-mile-long deep-draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont. The Channel to Orange segment of the SNWW was not included in the feasibility study, and no improvements to this waterway segment are included in the Plan. The east jetty is 4.8 miles long, while the west jetty is 4.15 miles long.

The study area (not to be confused with the project area) includes the SNWW and a much broader geographical range covering approximately 2,000 square miles inland. Due to potential additional saltwater intrusion into the Sabine Lake estuary resulting from the Project, hydrologic features associated with the SNWW and Sabine Lake are an important consideration for overall project impacts.

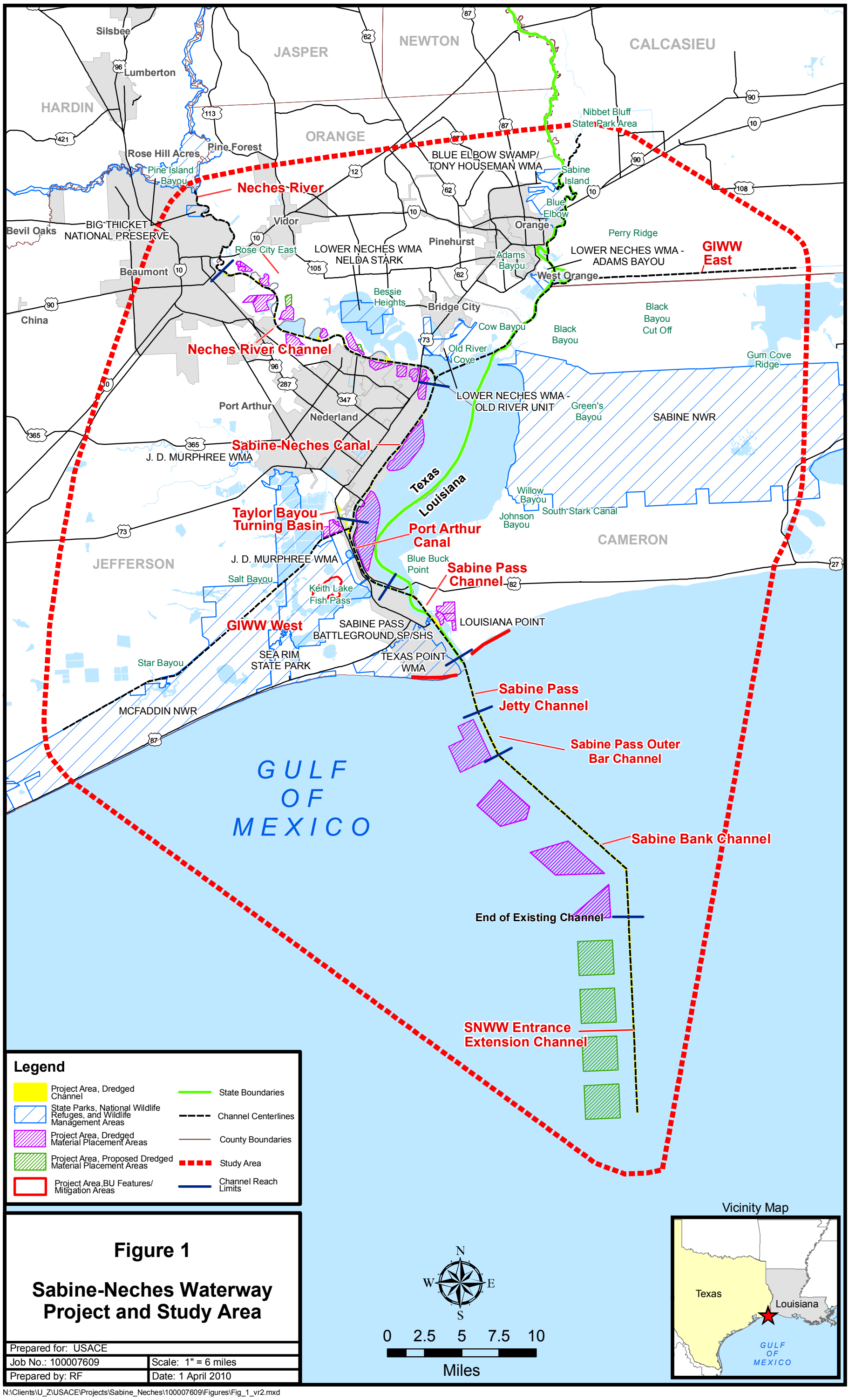

Figure 1

Sabine-Neches Waterway Project and Study Area

Prepared for: USACE	
Job No.: 100007609	Scale: 1" = 6 miles
Prepared by: RF	Date: 1 April 2010

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1.2.1 Study Area Habitat Description

The study area is located in the Austroriparian biotic province (Blair, 1950), which extends from east Texas, along the Gulf coastal plain, to the Atlantic coast. The study area is characterized by a diversity of features that are a result of the natural transition between marine and freshwater environments and anthropogenic impacts. The study area is located within the Gulf Coast Prairies and Marshes and Pineywoods vegetation areas (Hatch et al., 1990). The vegetation communities include marshes, swamps, bottomland hardwood forests, upland forests, and upland grassland and rangeland. The study area includes an important ecosystem called the Chenier Plain, which is composed of paleo-beach ridges that parallel the shoreline (USFWS, 1998; White et al., 1987) fanning out where they are cut by river mouths. The upland habitat of the cheniers supports the Coastal Live Oak-Sugarberry Series (*Quercus virginiana-Celtis laevigata*), a maritime woodland or forest of the Upper Gulf Coast that is unique to the Chenier Plain (USFWS, 1998). The Chenier Plain is separated from the Pleistocene Prairie Complex to the north by a broad low area, which is dominated by brackish marshes (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCR/WCRA], 1998). Wildlife native to the study area include those that inhabit the Austroriparian Biotic Province (Blair, 1950). Diversity in the study area is high with large numbers of vertebrate and invertebrate species. The Austroriparian Biotic Province is situated in the eastern portion of Texas and extends southward to the Gulf coast and east through Louisiana to the Atlantic Ocean. The vertebrate fauna of the Austroriparian Biotic Province in Texas and Louisiana, with few exceptions, is the typical vertebrate fauna of the Austroriparian Biotic Province eastward to the Atlantic seaboard. According to Blair (1950), at least 47 species of mammals, 29 species of snakes, 10 lizards, 2 land turtles, 17 anurans, and 18 urodeles occur or have occurred there. Additional detail on project and study area habitats can be found in Section 3 of the FEIS to which this BA is appended.

1.3 ALTERNATIVES CONSIDERED

A lengthy array of alternatives was considered during plan formulation. The alternatives were developed from ideas provided by the public, resource agencies, USACE, and the non-Federal sponsor. Alternatives considered were the “no-action” plan, a nonstructural plan, an alternative commodity transport plan, and over 120 variations of channel depths and widths.

All of the alternatives were evaluated in terms of whether they met planning objectives and produced a positive preliminary benefit to cost ratio. Planning objectives consisted of improving the navigational efficiency and safety of the waterway, and maintaining or restoring existing coastal and estuarine resources.

1.3.1 No-Action Alternative

The No-Action Alternative forms the basis against which all other alternative plans are measured. Under the No-Action Alternative, the Federal Government and the non-Federal sponsor would not implement

the Project and the objectives of improving the navigational efficiency and safety of the waterway, and restoring existing coastal and estuarine resources would not be met.

The No-Action Alternative would retain the 40-x-500-foot SNWW navigation channel with no improvements. The current channel dimensions do not allow the existing fleet to use the channel efficiently. Ships are limited either by the current channel depth of 40 feet or by the narrow channel width and safety limitations, which cause the waterway to be operated with one-way and daylight-only sailing restrictions. The need to lighter products and/or light-load vessels increases overall vessel trips and shipping costs, and decreases the efficiency of the vessels using the waterway. Safety would continue to be good because of stringent pilot rules. Pilot rules would continue to limit the possibility of vessels meeting in the Sabine-Neches channel reach. Vessel and shallow-draft tow movements would be scheduled through both vessel traffic service (VTS) and communication between vessel pilots.

1.3.2 Nonstructural Alternative

Three Nonstructural Alternatives were evaluated: an alternative mode of commodity transport, a VTS, and modification of existing pilot rules. Offshore oil terminals were evaluated as an alternative mode of commodity transport. Economic analyses were conducted to determine if it would be more economical for the primary users of the waterway (crude oil tankers) to utilize existing or proposed deepwater ports like the Louisiana Offshore Oil Port (LOOP). The estimated cost of offshore ports has usually been so high that they are not typically considered beyond the initial planning stage. Their efficiency is diminished by their ability to serve only one commodity (i.e., crude oil) and high cost and complexity required to deal with various grades and blends of crude oil and multi-party usage. The offshore terminal alternative does not meet the efficiency objective for all waterway users and was eliminated from further consideration.

The existing Port Arthur VTS was also evaluated as a nonstructural alternative. The VTS is designed to expedite vessel movements, increase efficiency of the transportation system, improve all-weather operating capability, and enhance vessel safety. It is a voluntary system operated in accordance with U.S. Coast Guard regulations. While the VTS would relieve congestion and improve safety to some degree, its role is limited to specific circumstances when the waterway is congested or experiencing hazardous conditions. The VTS assists vessel operators in making independent decisions regarding the safe navigation of their vessels, for which they retain complete responsibility. In this sense, VTS should be considered primarily a navigational aid, a tool for mariners to use along with other tools to facilitate safe navigation, and thus would not change deep-draft navigation inefficiencies created by the need for lightering and associated vessel delays. It was also eliminated from further consideration.

Relaxation of the existing pilot rules for the waterway was considered as a nonstructural alternative. However, because of concerns about vessel handling and associated safety issues, and the fact that vessels utilizing the waterway are wider than those using the channel even 5 to 10 years ago, the Sabine Pilots Association would not consider relaxing the rules. The expectation for the with- and without-project

future is that pilot rules would continue to limit the possibility of vessel meetings in the Sabine-Neches Canal reach and that both vessel and shallow-draft tow movements would be scheduled through both VTS and communication between vessel pilots.

1.4 RECOMMENDED PLAN

Evaluation of various structural alternatives resulted in the selection of the 48-x-500-foot alternative as the Plan. The 48-x-500-foot alternative was recommended as the locally preferred plan as it was preferred by the project sponsor over the National Economic Development (NED) Plan (49-x-500-foot alternative). Structural modifications of the 48-x-500-foot alternative meet the planning objective for increased navigational efficiency, and DMMP restoration/nourishment features and compensatory mitigation measures have been developed, which effectively avoid and mitigate all environmental impacts. Details of the plan include (additional detail can be found in the Final Feasibility Report bound with the FEIS to which this BA is appended):

- Deepening the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet, plus advance maintenance and allowable overdraft. Dredging in the Sabine Pass Jetty Channel would be conducted by hopper dredge, while the remaining inshore channels would be constructed with hydraulic pipeline dredges.

- Deepening the existing SNWW Entrance Channel in the Gulf from 42 to 50 feet, plus advance maintenance and allowable overdepth, and constructing an extension of the offshore entrance channel (50 x 700 feet x 13.1 miles). Dredging would be conducted by hopper dredge. Additional details of this construction are provided below because of its potential to affected endangered sea turtles.

- Bend easings in three areas on the Sabine-Neches Canal and three areas on the Neches River Channel.

- Deepening the Taylor Bayou Navigation Channel and turning basins to 48 feet, and widening the entrance and connecting channels to improve vessel maneuverability.

- Dredging a new anchorage basin (AB 8) and two turning and anchorage basins (TAB 1 and 4) on the Neches River Channel, and reducing the existing Sabine Pass anchorage basin in size by approximately 50 percent.

- Beneficially using dredged material, as part of the DMMP, to restore three degraded marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove) and nourish Gulf shorelines at Texas and Louisiana Points. Gulf shore nourishment, which affects piping plover Critical Habitat at Louisiana Point, is described in detail below. Construction of the Project would yield a total of approximately 98 million cubic yards (mcy) of new work material.

- Restoring six degraded marsh areas near Willow and Black bayous, Louisiana, as mitigation for unavoidable salinity impacts from the Project. Dedicated dredging using a hydraulic pipeline

dredge of a 2.1 miles long by 1,100-foot-wide borrow trench in Sabine Lake would provide material for the marsh restoration near Willow Bayou. Material from hydraulic pipeline maintenance dredging of the Channel to Orange would be used to restore one marsh area north of Black Bayou. Material accumulated in the GIWW/Lake Charles Deepwater Channel would be hydraulically dredged and used to restore degraded marsh areas near the Black Bayou Cut-off Canal.

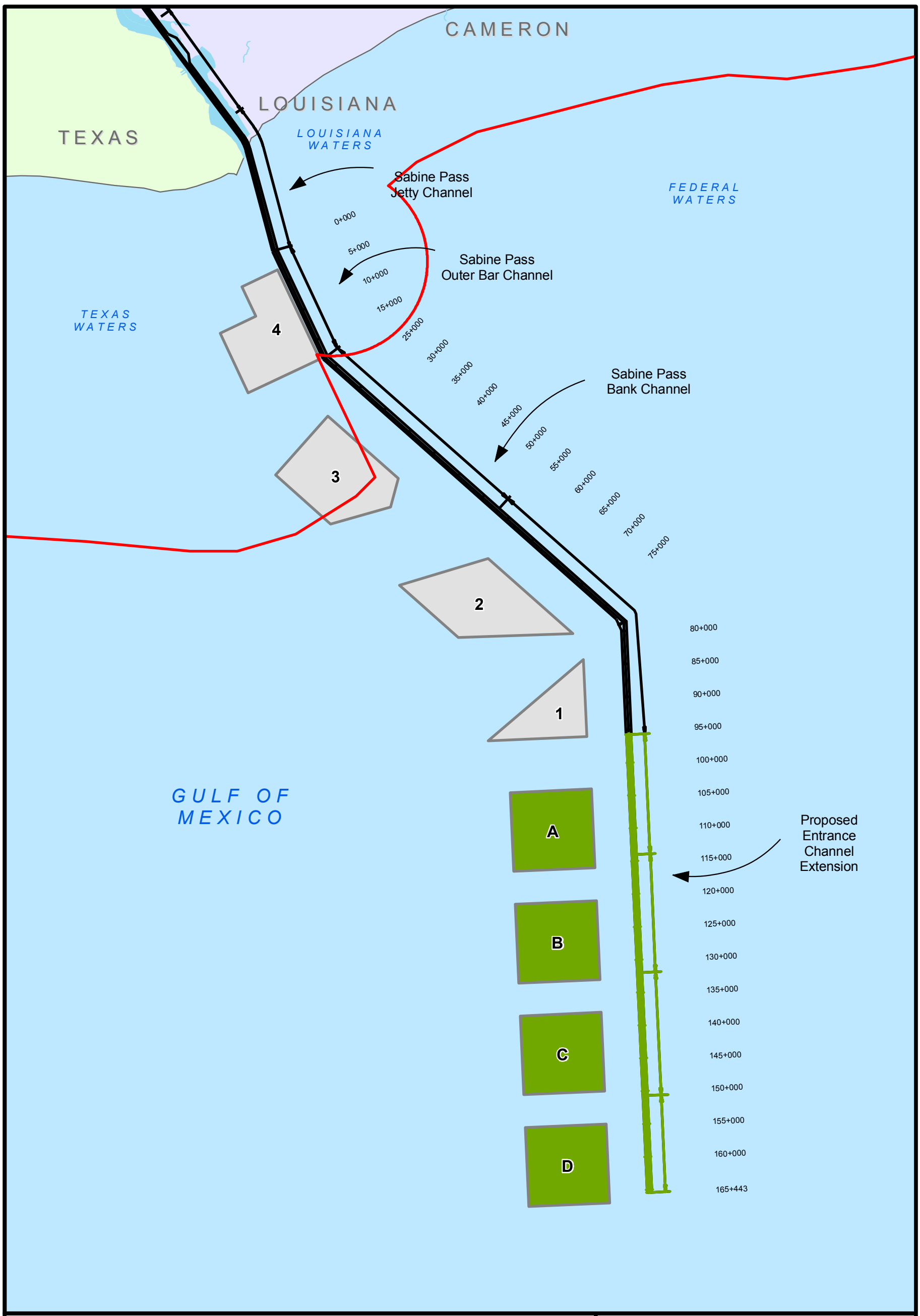
- Adding four new ODMDS sites in the Gulf along the 13-mile channel extension.
- Using 16 existing upland placement areas and 2 new expansions of existing placement areas for construction and maintenance of the Project. The quantity of maintenance material to be removed over the 50-year project life is estimated to total approximately 650 mcy.

1.4.1 Hopper Dredging

New work dredging in the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel would be accomplished using a hopper dredge (Figure 2). The total length of the four channel reaches is approximately 35 miles. The new Sabine Pass Jetty Channel would begin and end at approximately the same location as the existing channel. The new Sabine Pass Outer Bar Channel and the Sabine Bank Channel would begin and end at the same location as the existing channel, but the bottom width of the latter would be reduced from 800 to 700 feet. The new Extension Channel would begin at the end of the Sabine Bank Channel with a bottom width of 700 feet. The alignment would remain the same as the existing and extend at the same bearing.

With advance maintenance and allowable overdepth dredging, it is projected that construction of the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel would require approximately 6 years to complete, with no contracts running simultaneously. Because of the length of the offshore channels, the contracts would average 15 months in length.

Dredged material management for construction and maintenance material from the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel would incorporate the use of four existing and four proposed ODMDSs. Existing ODMDSs 1 through 4 average approximately 3,535 acres in size and would accommodate 24.3 mcy of new work material over the approximately 14,000 acres. They are located between 4.8 and 18.4 miles from shore in water depths ranging from 16 to 43 feet. Maintenance dredging cycles for these sites would range from 1 to 5 years, with an average of 2.6 mcy deposited per cycle. Proposed ODMDSs A through D average approximately 3,392 acres in size and would accommodate 18.7 mcy of new work material over the approximately 13,500 acres. They would be located between 21 and 30 miles from shore in water depths ranging from 44 to 46 feet. The maintenance dredging frequency for these sites is estimated to be 4 years, with an average of 0.75 mcy deposited per cycle. The existing and proposed ODMDSs are located in a dispersive



Legend

- Line of Federal Jurisdiction
- Proposed Chanel
- Existing Channel
- Existing ODMDS
- Proposed ODMS

N

0 15,000 30,000 45,000

Feet

Figure 2

Offshore Reaches

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Prepared by: A. C./A.P.	Date: 3-14-2007
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environment, and therefore no long-term accumulation of dredged material would be expected. No beneficial use sites are proposed for the offshore portion of the Project.

1.4.2 Gulf Shoreline Nourishment

The DMMP would include Gulf shoreline nourishment at Louisiana Point and Texas Point. Over the 50-year period of analysis, beach nourishment activities using maintenance material from the adjacent Sabine Pass channel would result in the creation of new saline marsh along a 3-mile stretch of shore (mile 0.5 to 3.5) at Louisiana Point and the same at Texas Point. The placement of material from each 3-year Sabine Pass dredging cycle would alternate between Texas and Louisiana Points, so that placement of materials at each shoreline would occur every 6 years.

Historic dredging records indicate that the material from Sabine Pass would average 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the nearshore zone, and some material is expected to flow over existing marsh while the remainder flows into the nearshore waters. Marsh plantings would occur as soon as possible on the inland half of the emergent berm, to assist in stabilization. Recent experience with a similar project constructed at Texas Point indicates that the dredged material would dissipate quickly during a placement event, with 60 percent remaining and forming a shelf on the shallow nearshore slope in front of the existing marsh edge. Since the material would be unconsolidated and prone to erosion, it is estimated that 50 percent of the material that remains after each placement episode would erode away by the end of each 6-year cycle. New material added every 6 years would add to the remaining sediment, eventually accumulating to form new saline marsh by the end of the period of analysis at each Point.

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2.0 STATUS OF THE LISTED SPECIES

To assess the potential impacts of the proposed Project on endangered and threatened species, PBS&J personnel (1) conducted a literature review and searched for other scientific data to determine species distributions, habitat needs, and other biological requirements; (2) interviewed recognized experts on the listed species, including local and regional authorities and Federal (USFWS [Clear Lake and Lafayette Ecological Field Offices] and NMFS) and State (Texas Parks and Wildlife Department [TPWD] and Louisiana Natural Heritage Program [LNHP]) wildlife personnel; (3) conducted an on-site inspection of the biological resources of the project area; and (4) compiled lists of threatened and endangered species that were requested from USFWS and NMFS (Table 1).

Significant literature sources consulted for this report include the USFWS series on endangered species of the seacoast of the U.S. (National Fish and Wildlife Laboratories [NFWL], 1980), Federal status reports and recovery plans, job reports of the TPWD, peer-reviewed journals, and other standard references, including USFWS and NMFS websites for listed species by county or parish. Habitat assessments were initially based on aerial photography and National Wetlands Inventory (NWI) mapping and then field-verified. Field visits were conducted on various occasions by PBS&J ecologists and members of the Habitat Workgroup (HWG) of the Interagency Coordination Team (ICT). Input was also solicited from State and Federal resource agency personnel and from personnel from Federal National Wildlife Refuge (NWR) and State WMAs in the area.

2.1 LOGGERHEAD SEA TURTLE

2.1.1 Reasons for Status

USFWS listed the loggerhead sea turtle (*Caretta caretta*) as threatened throughout its range on July 28, 1978 (43 Federal Register [FR] 32808). The decline of the loggerhead, like that of most sea turtles, is the result of overexploitation by man, inadvertent mortality associated with fishing and trawling activities, and natural predation. The most significant threats to its population are coastal development, commercial fisheries, and pollution (NMFS, 2006a).

2.1.2 Habitat

The loggerhead occurs in the open seas as far as 500 miles from shore, but mainly over the continental shelf, and in bays, estuaries, lagoons, creeks, and mouths of rivers. It favors warm temperate and subtropical regions not far from shorelines. The adults occupy various habitats, from turbid bays to clear waters of reefs. Subadults occur mainly in nearshore and estuarine waters. Hatchlings move directly to sea after hatching, and often float in masses of sargassum. They may remain associated with sargassum for perhaps 3 to 5 years (NMFS and USFWS, 1991a).

TABLE 1

FEDERALLY LISTED ENDANGERED AND THREATENED
FISH AND WILDLIFE SPECIES OF POSSIBLE OCCURRENCE IN
JEFFERSON AND ORANGE COUNTIES, TEXAS
AND
CALCASIEU AND CAMERON PARISHES, LOUISIANA[1]

Common Name[2]	Scientific Name[2]	Status[3]	Jurisdiction
REPTILES			
Leatherback sea turtle	*Dermochelys coriacea*	E	NMFS
Atlantic hawksbill sea turtle	*Eretmochelys imbricata imbricata*	E	NMFS
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	NMFS
Loggerhead sea turtle	*Caretta caretta*	T	NMFS
Green sea turtle	*Chelonia mydas*	T	NMFS
BIRDS			
Piping plover	*Charadrius melodus*	T w/CH	FWS
Red-cockaded woodpecker	*Picoides borealis*	E	FWS
MAMMALS			
Red wolf (Extirpated)	*Canis rufus*	E	FWS
Sei whale	*Balaenoptera borealis*	E	FWS
Blue whale	*Balaenoptera musculus*	E	FWS
Finback whale	*Balaenoptera physalus*	E	FWS
Humpback whale	*Megaptera novaeangliae*	E	FWS
Sperm whale	*Physeter macrocephalus*	E	FWS
West Indian manatee	*Trichechus manatus*	E	FWS
Louisiana black bear	*Ursus americanus luteolus*	E	FWS
Black bear	*Ursus americanus*	T/SA; NL	FWS
FISHES			
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	T	NMFS
Dusky shark	*Carcharhinus obscurus*	SOC	NMFS
Sand tiger shark	*Carcharias taurus*	SOC	NMFS
Night shark	*Carcharhinus signatus*	SOC	NMFS
Saltmarsh topminnow	*Fundulus jenkinsi*	SOC	NMFS
Warsaw grouper	*Epinephelus nigritus*	SOC	NMFS
Speckled hind	*Epinephelus drummondhayi*	SOC	NMFS
Smalltooth sawfish	*Pristis pectinata*	E	NMFS
INVERTEBRATES			
Elkhorn coral	*Acropora palmata*	T	NMFS
Staghorn coral	*Acropora cervicornis*	T	NMFS
Ivory tree coral	*Oculina varicosa*	SOC	NMFS

[1] According to Natural Diversity Database (NDD, 2005a, 2005b), NMFS (2009), USFWS (2009).

[2] Nomenclature follows American Ornithologist's Union (AOU, 1998, 2000, 2002, 2003, 2004, 2005, 2006), Crother et al. (2000, 2001, 2003), NDD (2005a, 2005b), and USFWS (2005, 2006).

[3] FWS – U.S. Fish and Wildlife Service; NMFS – National Marine Fisheries Service.

E – Endangered; E w/CH – Endangered, with Critical Habitat; T – Threatened; DL – Federally delisted; NL – Not listed; T/SA – Threatened because of similarity of appearance to another threatened/endangered species; T w/CH - Threatened, with Critical Habitat; SOC – Species of Concern.

Commensurate with their use of varied habitats, loggerheads consume a wide variety of both benthic and pelagic food items, which they crush before swallowing. Conches, shellfish, horseshoe crabs, prawns and other crustacea, squid, sponges, jellyfish, basket stars, fish (carrion or slow-moving species), and even hatchling loggerheads have all been recorded as loggerhead prey (Hughes, 1974; Rebel, 1974; Mortimer, 1982). Adults forage primarily on the bottom, but also take jellyfish from the surface. The young feed on prey concentrated at the surface, such as gastropods, fragments of crustaceans, and sargassum.

Nesting occurs usually on open sandy beaches above the high-tide mark and seaward of well-developed dunes. They nest primarily on high-energy beaches on barrier islands adjacent to continental land masses in warm-temperate and subtropical regions. Steeply sloped beaches with gradually sloped offshore approaches are favored. In Florida, nesting on urban beaches was strongly correlated with the presence of tall objects (trees or buildings), which apparently shield the beach from city lights (Salmon et al., 1995).

2.1.3 Range

The loggerhead is widely distributed in tropical and subtropical seas, being found in the Atlantic Ocean from Nova Scotia to Argentina, Gulf of Mexico, Indian and Pacific oceans (although it is rare in the eastern and central Pacific), and the Mediterranean Sea (Rebel, 1974; Ross, 1982; Iverson, 1986). In the continental U.S., loggerheads nest along the Atlantic coast from Florida to as far north as New Jersey (Musick, 1979) and sporadically along the Gulf Coast. In recent years, a few have nested on barrier islands along the Texas coast. The loggerhead is the most abundant sea turtle species in U.S. coastal waters (NMFS, 2006a).

2.1.4 Distribution in Texas and Louisiana

The loggerhead is the most abundant turtle in Texas marine waters, preferring shallow inner continental shelf waters, and occurring only very infrequently in the bays. It often occurs near offshore oil rig platforms, reefs, and jetties. Loggerheads are probably present year-round but are most noticeable in the spring when a favored food item, the Portuguese man-of-war (*Physalia physalis*), is abundant. Loggerheads constitute a major portion of the dead or moribund turtles washed ashore (stranded) on the Texas coast each year. This species has also been stranded on the Louisiana coast (Sea Turtle Stranding and Salvage Network [STSSN], 2006). A large proportion of these deaths are the result of accidental capture by shrimp trawlers, where caught turtles drown and their bodies are dumped overboard. Before 1977, no positive documentation of loggerhead nests in Texas existed (Hildebrand, 1982). Since that time, several nests have been recorded along the Texas coast. In 1999, two loggerhead nests were confirmed in Texas, while in 2000, five loggerhead nests were confirmed (Shaver, 2000). For the last 5 years, up to five nests per year have been recorded from the Texas coast (Shaver, 2006). Like the worldwide population, the population of loggerheads in Texas has declined. Prior to World War I, the species was taken in Texas for local consumption and a few were marketed (Hildebrand, 1982). Today, even with protection, insufficient loggerheads exist to support a fishery. The loggerhead is the second most abundant sea turtle in Louisiana (Fuller et al., 1987).

2.1.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of loggerheads exist from Jefferson County, Texas (Dixon, 2000). It is of potential occurrence in the project area.

2.2 KEMP'S RIDLEY SEA TURTLE

2.2.1 Reasons for Status

Kemp's ridley sea turtle (*Lepidochelys kempii*) was listed as endangered throughout its range on December 2, 1970 (35 FR 18320). Populations of this species have declined since 1947, when an estimated 42,000 females nested in one day (Hildebrand, 1963), to a total nesting population of approximately 1,000 in the mid-1980s. The decline of this species was primarily due to human activities including collection of eggs, fishing for juveniles and adults, killing adults for meat and other products, and direct take for indigenous use. In addition to these sources of mortality, Kemp's ridleys have been subject to high levels of incidental take by shrimp trawlers (USFWS and NMFS, 1992; NMFS, 2006a). The National Research Council's (NRC) Committee on Sea Turtle Conservation estimated in 1990 that 86 percent of the human-caused deaths of juvenile and adult loggerheads and Kemp's ridleys resulted from shrimp trawling (Campbell, 1995). It is estimated that before the implementation of turtle excluder devices (TED) the commercial shrimp fleet killed between 500 and 5,000 Kemp's ridleys each year (NMFS, 2006a). Kemp's ridleys have also been taken by pound nets, gill nets, hook and line, crab traps, and longlines.

Another problem shared by adult and juvenile sea turtles is the ingestion of man-made debris and garbage. Postmortem examinations of sea turtles found stranded on the south Texas coast from 1986 through 1988 revealed 54 percent (60 of the 111 examined) of the sea turtles had eaten some type of marine debris. Plastic materials were most frequently ingested and included pieces of plastic bags, Styrofoam, plastic pellets, balloons, rope, and fishing line. Nonplastic debris such as glass, tar, and aluminum foil were also ingested by the sea turtles examined. Much of this debris comes from offshore oil rigs, cargo ships, commercial and recreational fishing boats, research vessels, naval ships, and other vessels operating in the Gulf. Laws enacted during the late 1980s to regulate this dumping are difficult to enforce over vast expanses of water. In addition to trash, pollution from heavy spills of oil or waste products pose additional threats (Campbell, 1995).

Further threats to this species include collisions with boats, explosives used to remove oil rigs, and entrapment in coastal power plant intake pipes (Campbell, 1995). Dredging operations affect Kemp's ridley turtles through incidental take and by degrading the habitat. Incidental take of ridleys has been documented with hopper dredges. In addition to direct take, channelization of the inshore and nearshore areas can degrade foraging and migratory habitat through dredged material placement, degraded water quality/clarity, and altered current flow (USFWS and NMFS, 1992).

Sea turtles are especially subject to human impacts during the time the females come ashore for nesting. Modifications to nesting areas can have a devastating effect on sea turtle populations. In many cases, prime sea turtle nesting sites are also prime real estate. If a nesting site has been disturbed or destroyed, female turtles may nest in inferior locations where the hatchlings are less likely to survive, or they may not lay any eggs at all. Artificial lighting from developed beachfront areas often disorients nesting females and hatchling sea turtles, causing them to head inland by mistake, often with fatal results. Adult females also may avoid brightly lit areas that would otherwise provide suitable nesting sites.

Kemp's ridley appears to be in the earliest stages of recovery. Approximately 6,000 Kemp's ridley nests were recorded on Mexican beaches during the 2000 nesting season (Shaver, 2000); just over 10,000 nests were recorded there during the 2005 nesting season (Shaver, 2006). Similarly, increased nesting activity has been recorded on the Texas beaches in the last decade or so from four nests in 1995 to 51 nests in 2005 (National Park Service [NPS], 2006; Shaver, 2006). Some of these nests were from headstarted ridleys. Of 46 Kemp's ridley nests encountered in the continental U.S. during 2004, 42 were on Texas beaches (NPS, 2006). The increase likely can be attributed to two primary factors: full protection of nesting females and their nests in Mexico, and the requirement to use TEDs in shrimp trawls both in the U.S. and in Mexico (NMFS, 2006a).

2.2.2 Habitat

Kemp's ridleys inhabit shallow coastal and estuarine waters, usually over sand or mud bottoms. Adults are primarily shallow-water benthic feeders that specialize on crabs, especially portunid crabs, while juveniles feed on sargassum (*Sargassum* sp.) and associated infauna, and other epipelagic species of the Gulf (USFWS and NMFS, 1992). In some regions the blue crab (*Callinectes sapidus*) is the most common food item of adults and juveniles. Other food items include shrimp, snails, bivalves, sea urchins, jellyfish, sea stars, fish, and occasional marine plants (Pritchard and Marquez, 1973; Shaver, 1991; Campbell, 1995).

2.2.3 Range

Adults are primarily restricted to the Gulf, although juveniles may range throughout the Atlantic Ocean since they have been observed as far north as Nova Scotia (Musick, 1979) and in coastal waters of Europe (Brongersma, 1972). Important foraging areas include Campeche Bay, Mexico, and Louisiana coastal waters.

Almost the entire population of Kemp's ridleys nests on an 11-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 miles south of the Rio Grande. A secondary nesting area occurs at Tuxpan, Veracruz, and sporadic nesting has been reported from Mustang Island, Texas, southward to Isla Aquada, Campeche. Several scattered isolated nesting attempts have occurred from North Carolina to Colombia.

Because of the dangerous population decline at the time, a head-starting program was carried out from 1978 to 1988. Eggs were collected from Rancho Nuevo and placed into polystyrene foam boxes containing Padre Island sand so that the eggs never touched the Ranch Nuevo sand. The eggs were flown to the U.S. and placed in a hatchery on Padre Island and incubated. The resulting hatchlings were allowed to crawl over the Padre Island beaches into the surf for imprinting purposes before being recovered from the surf and taken to Galveston for rearing. They were fed a diet of high-protein commercial floating pellets for 7 to 15 months before being released into Texas (mainly) or Florida waters (Caillouet et al., 1995). This program has shown some results. The first nesting from one of these headstarted individuals occurred at Padre Island in 1996, and more nesting has occurred since (Shaver, 2000).

2.2.4 Distribution in Texas and Louisiana

Kemp's ridley occurs in Texas in small numbers and in many cases may well be in transit between crustacean-rich feeding areas in the northern Gulf and breeding grounds in Mexico. It has nested sporadically in Texas in the last 50 years. Nests were found near Yarborough Pass in 1948 and 1950, and in 1960 a single nest was located at Port Aransas. The number of nestings, however, has increased in recent years: 1995 (4 nests); 1996 (6 nests); 1997 (9 nests); 1998 (13 nests); 1999 (16 nests); 2000 (12 nests); 2001 (8 nests); 2002 (38 nests); 2003 (19 nests); 2004 (42 nests); and 2005 (51 nests) (Shaver, 2000, 2006; NPS, 2006). As noted above, some of these nests were from headstarted ridleys. Of the 51 Kemp's ridley nests recorded for Texas in 2005, 28 were at the Padre Island National Seashore (Shaver, 2006). Such nestings, together with the proximity of the Rancho Nuevo rookery, probably account for the occurrence of hatchlings and subadults in Texas. According to Hildebrand (1982, 1986, 1987), sporadic ridley nesting in Texas has always been the case. This is in direct contradiction, however, to Lund (1974), who believed that Padre Island historically supported large numbers of nesting Kemp's ridleys, but that the population became extirpated because of excessive egg collection. Kemp's ridley also occurs in small numbers in Louisiana; however, it is the most frequently reported sea turtle species (Fuller et al., 1987).

2.2.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of Kemp's ridleys exist from Jefferson County, Texas (Dixon, 2000). Thus, it is of potential occurrence in the project area.

2.3 HAWKSBILL SEA TURTLE

2.3.1 Reasons for Status

The hawksbill sea turtle (*Eretmochelys imbricata*) was federally listed as endangered on June 2, 1970 (35 FR 8495) with Critical Habitat designated in Puerto Rico on May 24, 1978 (43 FR 22224). The greatest threat to this species is harvest to supply the market for tortoiseshell and stuffed turtle curios (Meylan and Donnelly, 1999). Hawksbill shell (bekko) commands high prices. Japanese imports of raw bekko between

1970 and 1989 totaled 713,850 kilograms, representing more than 670,000 turtles. The hawksbill is also used in the manufacture of leather, oil, perfume, and cosmetics (NMFS, 2006a).

Other threats include destruction of breeding locations by beach development, incidental take in lobster and Caribbean reef fish fisheries, pollution by petroleum products (especially oil tanker discharges), entanglement in persistent marine debris (Meylan, 1992), and predation on eggs and hatchlings. See USFWS (1998) for detailed information on certain threats, including beach erosion, beach armoring, beach nourishment, sand mining, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, predation, and poaching.

In 1998, NMFS designated Critical Habitat near Isla Mona and Isla Monito, Puerto Rico, seaward to 3.9 miles (63 FR 46693–46701). There is no Critical Habitat within the study area.

2.3.2 Habitat

Hawksbills generally inhabit coastal reefs, bays, rocky areas, passes, estuaries, and lagoons, where they occur at depths of less than 70 feet. Like some other sea turtle species, hatchlings are sometimes found floating in masses of marine plants (e.g., sargassum rafts) in the open ocean (NFWL, 1980). Hawksbills reenter coastal waters when they reach a carapace length of approximately 7.9 to 9.8 inches. Coral reefs are widely recognized as the resident foraging habitat of juveniles, subadults, and adults. This habitat association is undoubtedly related to their diet of sponges, which need solid substrate for attachment. Hawksbills also occur around rocky outcrops and high-energy shoals, which are also optimum sites for sponge growth. In Texas, juvenile hawksbills are associated with stone jetties (NMFS, 2006a).

While this species is omnivorous, it prefers invertebrates, especially encrusting organisms, such as sponges, tunicates, bryozoans, mollusks, corals, barnacles, and sea urchins. Pelagic species consumed include jellyfish and fish, and plant material such as algae, sea grasses, and mangroves, have been reported as food items for this turtle (Carr, 1952; Rebel, 1974; Pritchard, 1977; Musick, 1979; Mortimer, 1982). The young are reported to be somewhat more herbivorous than adults (Ernst and Barbour, 1972).

Terrestrial habitat is typically limited to nesting activities. The hawksbill, which is typically a solitary nester, nests on undisturbed, deep-sand beaches, from high-energy ocean beaches to tiny pocket beaches about 10 feet wide bounded by crevices of cliff walls. Typically, the sand beaches are low energy, with woody vegetation, such as sea grape (*Coccoloba uvifera*), near the waterline (NRC, 1990).

2.3.3 Range

The hawksbill is circumtropical, occurring in tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans (Witzell, 1983). This species is probably the most tropical of all marine turtles, although it does occur in many temperate regions. The hawksbill sea turtle is widely distributed in the Caribbean Sea and western Atlantic Ocean, with representatives of at least some life history stages regularly occurring in southern Florida and the northern Gulf (especially Texas), south to Brazil (NMFS, 2006a). In the

continental U.S., the hawksbill largely nests in Florida where it is sporadic at best (NFWL, 1980). However, a major nesting beach exists on Mona Island, Puerto Rico. Elsewhere in the western Atlantic, hawksbills nest in small numbers along the Gulf Coast of Mexico, the West Indies, and along the Caribbean coasts of Central and South America (Musick, 1979).

2.3.4 Distribution in Texas and Louisiana

Texas is the only state outside of Florida where hawksbills are sighted with any regularity. Most of these sightings involve posthatchlings and juveniles, and are primarily associated with stone jetties. These small turtles are believed to originate from nesting beaches in Mexico (NMFS, 2006a). On June 13, 1998, the first hawksbill nest recorded on the Texas coast was found at Padre Island National Seashore. This nest remains the only documented hawksbill nest on the Texas coast (NPS, 2006; Shaver, 2006). The hawksbill has been reported from Louisiana, but it is rare (Fuller et al., 1987).

2.3.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), and no documented records of hawksbills exist from Jefferson or Orange counties, Texas (Dixon, 2000), and they are not expected to be present in the project area.

2.4 GREEN SEA TURTLE

2.4.1 Reasons for Status

The green sea turtle (*Chelonia mydas*) was listed on July 28, 1978, as threatened except for Florida and the Pacific Coast of Mexico (including the Gulf of California) where it was listed as endangered (43 FR 32808). The greatest cause of decline in green sea turtle populations is commercial harvest for eggs and food. Other turtle parts are used for leather and jewelry, and small turtles are sometimes stuffed for curios. Incidental catch during commercial shrimp trawling is a continued source of mortality that adversely affects recovery. It is estimated that before the implementation of TED requirements, the offshore commercial shrimp fleet captured about 925 green sea turtles a year, of which approximately 225 would die. Most turtles killed are juveniles and subadults. Various other fishing operations also negatively affect this species (NMFS, 2006a). Epidemic outbreaks of fibropapilloma or “tumor” infections recently have occurred on green sea turtles, especially in Hawaii and Florida, posing a severe threat. The cause of these outbreaks is largely unknown, but it could be caused by a viral infection (Barrett, 1996). This species is also subject to various negative impacts shared by sea turtles in general.

2.4.2 Habitat

The green sea turtle primarily utilizes shallow habitats such as lagoons, bays, inlets, shoals, estuaries, and other areas with an abundance of marine algae and seagrasses. Individuals observed in the open ocean are believed to be migrants en route to feeding grounds or nesting beaches (Meylan, 1982). Hatchlings often

float in masses of sea plants (e.g., rafts of sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. The adults are primarily herbivorous, while the juveniles consume more invertebrates. Foods consumed include seagrasses, macroalgae, and other marine plants, mollusks, sponges, crustaceans, and jellyfish (Mortimer, 1982; Derek Green, unpubl. data).

Terrestrial habitat is typically limited to nesting activities, although in some areas, such as Hawaii and the Galápagos Islands, they will bask on beaches (Balazs, 1980; Green, unpubl. data). They prefer high-energy beaches with deep sand, which may be coarse to fine, with little organic content. At least in some regions, they generally nest consistently at the same beach, which is apparently their natal beach (Meylan et al., 1990; Allard et al., 1994), although an individual might switch to a different nesting beach within a single nesting season (Derek Green, unpubl. data).

2.4.3 Range

The green sea turtle is a circumglobal species in tropical and subtropical waters. In U.S. Atlantic waters, it occurs around the U.S. Virgin Islands, Puerto Rico, and continental U.S. from Massachusetts to Texas. Major nesting activity occurs on Ascension Island, Aves Island (Venezuela), Costa Rica, and in Surinam. Relatively small numbers nest in Florida, with even smaller numbers in Georgia, North Carolina, and Texas (NMFS and USFWS, 1991b; Hirth, 1997).

2.4.4 Distribution in Texas and Louisiana

The green sea turtle in Texas inhabits shallow bays and estuaries where its principal foods, the various marine grasses, grow (Bartlett and Bartlett, 1999). Its population in Texas has suffered a decline similar to that of its world population. In the mid to late nineteenth century, Texas waters supported a green sea turtle fishery. Most of the turtles were caught in Matagorda Bay, Aransas Bay, and the lower Laguna Madre, although a few also came from Galveston Bay. Many live turtles were shipped to places such as New Orleans or New York and from there to other areas. Others were processed into canned products such as meat or soup prior to shipment. By 1900, however, the fishery had virtually ceased to exist. Turtles continued to be hunted sporadically for a while, the last Texas turtler hanging up his nets in 1935. Incidental catches by anglers and shrimpers were sometimes marketed prior to 1963, when it became illegal to do so (Hildebrand, 1982).

Green sea turtles still occur in these same bays today but in much-reduced numbers (Hildebrand, 1982). While green sea turtles prefer to inhabit bays with seagrass meadows, they may also be found in bays that are devoid of seagrasses. The green sea turtles in these Texas bays are mainly small juveniles. Adults, juveniles, and even hatchlings are occasionally caught on trotlines or by offshore shrimpers or are washed ashore in a moribund condition.

Green sea turtle nests are rare in Texas. Five nests were recorded at the Padre Island National Seashore in 1998, none in 1999, and one in 2000 (Shaver, 2000; NPS, 2006). For the last 5 years, up to five nests per year have been recorded from the Texas coast (Shaver, 2006). Green sea turtles, however, nest more in

Florida and in Mexico. Since long migrations of green sea turtles from their nesting beaches to distant feeding grounds are well documented (Meylan, 1982; Green, 1984), the adult green sea turtles occurring in Texas may be either at their feeding grounds or in the process of migrating to or from their nesting beaches. The juveniles frequenting the seagrass meadows of the bay areas may remain there until they move to other feeding grounds or, perhaps, once having attained sexual maturity, return to their natal beaches outside of Texas to nest. Green sea turtles are uncommon in Louisiana. Most of the reported sightings are of juveniles (Fuller et al., 1987).

2.4.5 Presence in the Study Area

There are no records of green sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of green sea turtles exist from Jefferson County, Texas (Dixon, 2000). It is of potential occurrence in the project area.

2.5 LEATHERBACK SEA TURTLE

2.5.1 Reasons for Status

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on June 2, 1970 (35 FR 8495), with Critical Habitat designated in the U.S. Virgin Islands on September 26, 1978 and March 23, 1979 (43 FR 43688–43689 and 44 FR 17710–17712, respectively). Its decline is attributable to overexploitation by man and incidental mortality associated with commercial shrimping and fishing activities. Use of turtle meat for fish bait and the consumption of litter by turtles are also causes of mortality, the latter phenomenon apparently occurring when plastic is mistaken for jellyfish (Rebel, 1974). Nesting populations of leatherback sea turtles are especially difficult to estimate because the females frequently change nesting beaches; however, Spotila et al. (1996) estimated the 1995 worldwide population of nesting female leatherbacks at 26,000 to 42,000. The major threat is egg collecting, although they are jeopardized to some extent by destruction or degradation of nesting habitat (NatureServe, 2006). This species is probably more susceptible than other turtles to drowning in shrimp trawlers equipped with TEDs because adult leatherbacks are too large to pass through the TED exit opening. Because leatherbacks nest in the tropics during hurricane season, a potential exists for storm-generated waves and wind to erode nesting beaches, resulting in nest loss (NMFS and USFWS, 1992).

Critical Habitat for the leatherback sea turtle includes St. Croix, Virgin Islands; Santa Rosa NP., Costa Rica; and sites in Mexico. NMFS (FR, May 12, 1995) established a leatherback conservation zone extending from Cape Canaveral to the Virginia-North Carolina border and including all inshore and offshore waters; this zone is subject to shrimping closures when high abundance of leatherbacks is documented. Mortality associated with the swordfish gillnet fisheries in Peru and Chile represents the single largest source of mortality for East Pacific leatherbacks (Eckert and Sarti, 1997).

2.5.2 Habitat

The leatherback sea turtle is mainly pelagic, inhabiting the open ocean, and seldom approaches land except for nesting (Eckert, 1992). It is most often found in coastal waters only when nesting or when following concentrations of jellyfish (TPWD, 2006), when it can be found in inshore waters, bays, and estuaries. It dives almost continuously, often to great depths.

Despite their large size, the diet of leatherbacks consists largely of jellyfish and sea squirts. They also consume sea urchins, squid, crustaceans, fish, blue-green algae, and floating seaweed (NFWL, 1980). The leatherback typically nests on beaches with a deepwater approach (Pritchard, 1971).

2.5.3 Range

The leatherback is probably the most wide-ranging of all sea turtle species. It occurs in the Atlantic, Pacific, and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain, and Norway; as far south as Australia, Cape of Good Hope, and Argentina; and in other water bodies such as the Mediterranean Sea (NFWL, 1980). Leatherbacks nest primarily in tropical regions; major nesting beaches include Malaysia, Mexico, French Guiana, Surinam, Costa Rica, and Trinidad (Ross, 1982). Leatherbacks nest only sporadically in some of the Atlantic and Gulf states of the continental U.S., with one nesting reported as far north as North Carolina (Schwartz, 1976). In the Atlantic and Caribbean, the largest nesting assemblages occur in the U.S. Virgin Islands, Puerto Rico, and Florida (NMFS, 2006a).

The leatherback migrates farther and ventures into colder water than any other marine reptile. Adults appear to engage in routine migrations between boreal, temperate, and tropical waters, presumably to optimize both foraging and nesting opportunities. The longest-known movement is that of an adult female that traveled 3,666 miles to Ghana, West Africa, after nesting in Surinam (NMFS and USFWS, 1992). During the summer, leatherbacks tend to occur along the East Coast of the U.S. from the Gulf of Maine south to the middle of Florida.

2.5.4 Distribution in Texas and Louisiana

Apart from occasional feeding aggregations such as the large one of 100 animals reported by Leary (1957) off Port Aransas in December 1956, or possible concentrations in the Brownsville Eddy in winter (Hildebrand, 1983), leatherbacks are rare along the Texas coast, tending to keep to deeper offshore waters where their primary food source, jellyfish, occurs. In the Gulf, the leatherback is often associated with two species of jellyfish: the cabbagehead (*Stomolophus* sp.) and the moon jellyfish (*Aurelia* sp.) (NMFS and USFWS, 1992). According to USFWS (1981), leatherbacks never have been common in Texas waters. No nests of this species have been recorded in Texas for at least 70 years (NPS, 2006). The last two, one from the late 1920s and one from the mid-1930s, were both from Padre Island (Hildebrand, 1982, 1986). Leatherbacks in Louisiana are rare and restricted to offshore waters (Fuller et al., 1987).

2.5.5 Presence in the Study Area

There are no records of sea turtles nesting on Louisiana Point or anywhere in that area (Firmin, 2006), but documented records of leatherbacks exist from Jefferson County, Texas (Dixon, 2000); however, the species is unlikely to occur in the project area since only one has been captured by a relocation trawler (1.5 miles offshore of Aransas Pass), and there is no record of a take by a hopper dredge (NMFS, 2003).

2.6 RED-COCKADED WOODPECKER

2.6.1 Reason for Status

USFWS listed the red-cockaded woodpecker (*Picoides borealis*) as endangered on October 13, 1970 (35 FR 16047–16048). Reasons for listing included its perceived rarity, documented declines in local populations, and reductions in available nesting habitat (USFWS, 1985). The primary impacts of human activity include cavity tree and foraging habitat loss resulting from short-rotation, even-aged forest management, conversion of forest (i.e., conversion from forest to nonforest and conversion from longleaf pine to slash pine), and suppression of fires (Jackson, 1994).

Logging is the primary reason for the initial decline in suitable habitat. Subsequently, fire suppression and silvicultural practices resulted in further declines of remnant habitat. These have led to hardwood encroachment and increases in suboptimal pine species within the species range. The overall lack of suitable habitat has now resulted in insufficient numbers of cavities and cavity trees; habitat fragmentation and a subsequent reduction in genetic variation, dispersal, and demography; lack of foraging habitat; and increased vulnerability to random demographic, environmental, genetic, and catastrophic events (USFWS, 2003).

2.6.2 Habitat

Red-cockaded woodpeckers require mature open pine forest naturally maintained by periodic wildfire, a habitat that has declined over much of the species' range. Common species occurring in suitable habitat include longleaf pine (*Pinus palustris*), loblolly pine (*Pinus taeda*), slash pine (*Pinus elliottii*), shortleaf pine (*Pinus echinata*), Virginia pine (*Pinus virginiana*), pond pine (*Pinus serotina*), and pitch pine (*Pinus rigida*). Cavity trees must be within open stands containing little to no hardwood midstory or overstory. The species depends on live mature pines for excavating cavities. Mature pines have the sufficient heartwood necessary to house a cavity at the preferred heights and are more likely to have red heart fungus, an infection that helps facilitate cavity excavation (USFWS, 2003). Live trees are critical to the species, as they produce large amounts of resin, which exudes following excavation and acts as a barrier to predators, particularly snakes (USFWS, 2003). Suitable foraging habitat consists of mature pines with an open canopy and little to no hardwood or pines in the midstory, little to no overstory hardwoods, and an abundance of native bunchgrass and/or forb groundcover (USFWS, 2003).

2.6.3 Range

Red-cockaded woodpeckers historically ranged throughout the southeastern U.S., from New Jersey and Pennsylvania, south and west to Missouri and southeastern Oklahoma (USFWS, 1985; Jackson, 1994). Today the species is still rather widespread, although populations are highly fragmented. The species' current range includes all southern and southeastern coastal states from eastern Texas to southern Virginia, with small interior populations in southeastern Oklahoma and southern Arkansas (USFWS, 2003). The largest populations are within Federal and State lands in the Carolinas, Florida, Georgia, Alabama, Mississippi, Louisiana, and eastern Texas (USFWS, 2003).

In east Texas, known populations occur on State and Federal lands including the Sabine, Angelina, Davy Crockett, and Sam Houston national forests, the L.D. Fairchild and W.G. Jones state forests, the Huntsville State Fish Hatchery, the Alabama-Coushatta Indian Reservation, and on two private properties, Brushy Creek (International Paper) and Scrappin' Valley (Temple Inland Corporation) (USFWS, 2003). In Louisiana, the species occurs on State and Federal lands including the Kisatchie National Forest, the Upper Ouachita, D'Arbonne, and Black Bayou Lake NWRs, the Peason Ridge and Fort Polk military installations, and Crossett Forest (Plum Creek Timber Company) (USFWS, 2003). Other populations may occur elsewhere on private lands in east Texas and Louisiana, where suitable habitat is present.

2.6.4 Presence in the Study Area

No known current populations occur in any of the study area counties or parishes, and suitable habitat is absent in the study area. Thus, the species is unlikely to occur in the study area.

2.7 PIPING PLOVER

2.7.1 Reasons for Status

USFWS listed the piping plover (*Charadrius melodus*) as threatened and endangered on December 11, 1985 (50 FR 50726–50734). The piping plover is a federally listed endangered species in the Great Lakes watershed, while the birds breeding on the Atlantic Coast and northern Great Plains are federally listed as threatened. Piping plovers wintering in Texas and Louisiana are part of the northern Great Plains and Great Lakes populations and, therefore, are listed as threatened.

Shorebird hunting during the early 1900s caused the first known major decline of piping plovers (Bent, 1929). Since then, loss or modification of habitat resulting from commercial, residential, and recreational developments, dune stabilization, damming and channelization of rivers (eliminating sandbars, encroachment of vegetation, and altering water flows), and wetland drainage have further contributed to the decline of the species (USFWS, 1995a). Additional threats include human disturbances through recreational use of habitat, and predation of eggs by feral pets (USFWS, 1995a).

2.7.2 Habitat

Piping plovers typically inhabit shorelines of oceans, rivers, and inland lakes. Nest sites include sandy beaches, especially where scattered tufts of grass are present; sandbars; causeways; bare areas on dredge-created and natural alluvial islands in rivers; gravel pits along rivers; silty flats; and salt-encrusted bare areas of sand, gravel, or pebbly mud on interior alkali lakes and ponds (Haig and Elliott-Smith, 2004). On the wintering grounds, these birds use beaches, mudflats, sandflats, dunes, and offshore emergent placement areas (USFWS, 1995a; AOU, 1998).

2.7.3 Range

The piping plover breeds on the northern Great Plains (Iowa, northwestern Minnesota, Montana, Nebraska, North and South Dakota, Alberta, Manitoba, and Saskatchewan), in the Great Lakes (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario), and along the Atlantic Coast from Newfoundland to Virginia and (formerly) North Carolina. It winters on the Atlantic and Gulf coasts from North Carolina to Mexico, including coastal Texas, and, less commonly, in the Bahamas and West Indies (AOU, 1998; 50 FR 50726, December 11, 1985). Migration occurs both through the interior of North America east of the Rocky Mountains (especially in the Mississippi Valley) and along the Atlantic Coast (AOU, 1998). Few data exist on the migration routes of this species.

2.7.4 Presence in the Study Area

Approximately 35 percent of the known global population of piping plovers winters along the Texas Gulf Coast, where they spend 60 to 70 percent of the year (Campbell, 1995; Haig and Elliott-Smith, 2004). The species is a common migrant and rare to uncommon winter resident on the upper Texas coast (Richardson et al., 1998; Lockwood and Freeman, 2004). Piping plover concentrations in Texas occur in the following counties: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kleberg, Matagorda, Nueces, San Patricio, and Willacy (USFWS, 1988). In Louisiana, the piping plover is a rare migrant statewide and uncommon winter resident along the Gulf Coast in Cameron and Jefferson parishes (USFWS, 1994). Piping plovers may occur in the study area, but suitable habitat is of limited extent.

Critical Habitat: USFWS has designated Critical Habitat for the species in its nesting and wintering range (65 FR 41781–41812, July 6, 2000). Designation of Critical Habitat became final on July 10, 2001 (66 FR 36038–36143). Within Louisiana, USFWS has designated critical wintering habitat for the piping plover along the entire shoreline from the east side of Sabine Pass (Texas-Louisiana border) east approximately 16 miles to the west end of Constance Beach (Hydrologic Unit [HU] LA-1, in part). Critical habitat includes the land from the seaward boundary of mean low low water (MLLW) to where densely vegetated habitat, not used by the species, begins and where the constituent elements no longer occur. Primary constituent elements (PCEs) are defined in 66 FR 36065 as “Important components (primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. In some cases, these flats may be covered or partially covered by a mat of bluegreen algae. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially

for roosting piping plovers. Such sites may have debris, detritus (decaying organic matter), or microtopographic relief (less than 20 inches above substrate surface) offering refuge from high winds and cold weather. Important components of the beach/dune ecosystem include surf-cast algae for feeding of prey, sparsely vegetated backbeach (beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road) for roosting and refuge during storms, spits (a small point of land, especially sand, running into water) for feeding and roosting. . . .” No USFWS-designated Critical Habitat for the piping plover is present within the Texas portions of the project area.

2.8 RED WOLF

2.8.1 Reason for Status

USFWS listed the red wolf (*Canis rufus*) as endangered on March 11, 1967 (32 FR 4001). Later it received protection under the ESA of 1973. The primary reasons for the species’ decline include human persecution (i.e., hunting and trapping) and land-clearing activities (i.e., drainage projects, logging, farming, and mineral exploration) (USFWS, 1990). Land-clearing activities in the mid-twentieth century resulted in the loss of vast areas of forest and woodland habitat, which allowed the coyote (*Canis latrans*) to expand its range eastward and subsequently, resulted in hybridization of the two species and suppression of the genetic identity of the red wolf (USFWS, 1990; Schmidly, 2004).

2.8.2 Habitat

Red wolves formerly inhabited a variety of wooded habitats including pine forests, bottomland hardwood forests, swamps, marshes, and coastal prairies (Schmidly, 1983). USFWS (1990) indicates that the species requires large areas of habitat (greater than 170,000 acres).

2.8.3 Range

Red wolves originally occurred in woodlands and forests throughout the southeastern U.S.; however, the species was apparently extinct in the wild by 1980. Captive breeding colonies of red wolves now exist at several locations throughout the country. Beginning in 1987, USFWS began the reintroduction of red wolves to the Alligator River NWR, North Carolina. Between 1987 and 1992, USFWS released 42 wolves in Alligator River NWR, and at least 23 wolves were born in the wild. As of August 1992, the Alligator River NWR population numbered at least 24 wolves. Additionally, USFWS has released red wolf pairs on Bull’s Island, South Carolina, St. Vincent Island, Florida, and Horn Island, Mississippi, but breeding and survival on these islands have been limited. Most recently, USFWS has reintroduced red wolves to the Great Smoky Mountains National Park.

2.8.4 Presence in the Study Area

Red wolves historically ranged throughout the eastern half of Texas and Louisiana, but the species is extirpated in these areas and is not present in the study area.

2.9 WEST INDIAN MANATEE

2.9.1 Reason for Status

USFWS listed the West Indian manatee (*Trichechus manatus*) as endangered on March 11, 1967 (32 FR 4001). Later it received protection under the ESA of 1973. The largest known human-related cause of manatee mortality is collisions with hulls and/or propellers of boats and ships. The second-largest human-related cause of mortality is entrapment in floodgates and navigation locks. Other known causes of human-related manatee mortality include poaching and vandalism, entrapment in shrimp nets and other fishing gear, entrapment in water pipes, and ingestion of marine debris (USFWS, 2001). Hunting and fishing pressures were responsible for much of its original decline because of the demand for meat, hides, and bones, which resulted in near extirpation of the specie (USFWS, 1995a).

A prominent cause of natural mortality in some years is cold stress, and major die-offs associated with the outbreaks of red tide have occurred, where manatees appear to have died because of ingestion of filter-feeding tunicates that had accumulated the neurotoxin-producing dynoflagellates responsible for causing the red tide (USFWS, 2001). The low reproductive rate and habitat loss make it difficult for manatee populations to recover.

2.9.2 Habitat

The West Indian manatee inhabits shallow coastal waters, estuaries, bays, rivers, and lakes. Throughout most of its range, it appears to prefer rivers and estuaries to marine habitats, although manatees inhabit marine habitats in the Greater Antilles (Lefebvre et al., 1989). It is not averse to traveling through dredged canals or using quiet marinas. Manatees are apparently not able to tolerate prolonged exposure to water colder than 68 degrees Fahrenheit (°F). In the northern portions of their range, during October through April, they congregate in warmer water bodies, such as spring-fed rivers and outfalls from power plants. They prefer waters that are at least 3.3 to 6.6 feet in depth; along coasts, they are often in water 10 to 16 feet deep. They usually avoid areas with strong currents (NatureServe, 2006).

Manatees are primarily dependent upon submergent, emergent, and floating vegetation, with the diet varying according to plant availability. They may opportunistically eat other foods such as acorns in early winter in Florida or fish caught in gill nets in Jamaica (O'Shea and Ludlow, 1992).

2.9.3 Range

The manatee ranges from the southeastern U.S. and coastal regions of the Gulf, through the West Indies and Caribbean, to northern South America. U.S. populations occur primarily in Florida (NatureServe,

2006), where they are effectively isolated from other populations by the cooler waters of the northern Gulf and the deeper waters of the Straits of Florida (Domning and Hayek, 1986).

2.9.4 Presence in the Study Area

The West Indian manatee historically inhabited the Laguna Madre, the Gulf, and tidally influenced portions of rivers. It is currently, however, extremely rare in Texas waters and the most recent sightings are likely individuals migrating or wandering from Mexican waters. Historical records from Texas waters include Cow Bayou, Sabine Lake, Copano Bay, the Bolivar Peninsula, and the mouth of the Rio Grande (Schmidly, 2004). In May 2005, a live manatee appeared in the Laguna Madre near Port Mansfield (Blankinship, 2005). Although the West Indian manatee is chiefly a marine species, its occurrence in the study area is unlikely.

2.10 LOUISIANA BLACK BEAR/BLACK BEAR

2.10.1 Reason for Status

USFWS listed the Louisiana black bear (*Ursus americanus luteolus*) as threatened on January 7, 1992 (57 FR 588–595). The Service also designates other free-living bears of the species *U. americanus*, within the Louisiana black bear's historic range, as threatened because of similarity in appearance. The primary threats to the Louisiana black bear are habitat destruction and modification. Human activities have reduced or fragmented much of the species' habitat throughout its historic range. Additional threats include human related mortality (i.e., hunting and trapping, automobile-related mortality) (USFWS, 1995b).

2.10.2 Habitat

Black bear habitat must have a combination of adequate food, water, cover, and denning sites within sufficiently large and remote blocks of land. The Louisiana black bear requires large, relatively remote blocks of bottomland hardwood forest (USFWS, 1995b). Forest types within the range of the species include bald cypress (*Taxodium distichum*), bald cypress-water tupelo (*T. distichum-Nyssa aquatica*), river birch-American sycamore (*Betula nigra-Platanus occidentalis*), cottonwood (*Populus deltoides*), sugarberry-American elm-green ash (*Celtis laevigata-Ulmus americana-Fraxinus pennsylvanica*), Nuttall oak-American elm-green ash (*Quercus nuttallii-Ulmus americana-F. pennsylvanica*), overcup oak-water hickory (*Q. lyrata-Carya aquatica*), sweetgum-water oak (*Liquidambar styraciflua-Q. nigra*), and swamp chestnut oak-cherrybark oak (*Q. michauxii-Q. falcata*) (USFWS, 1995b). Other habitat types include freshwater and brackish marshes, agricultural fields, wooded levees along canals and bayous, and salt domes (USFWS, 1995b).

A key component of Louisiana black bear habitat is remoteness, which is relative to forest tract size and the presence of roads (USFWS, 1995b). Optimal habitat generally consists of tracts larger than 2,500 acres that are at least 0.5 mile from well-maintained roads and development, or tracts with 0.3 mile

or less of road per 0.4 square miles of forest (USFWS, 1995b). Larger, undisturbed tracts of forest decrease the likelihood of human disturbance.

2.10.3 Range

While *U. americanus* is a widely distributed species, its range has declined since European colonization of North America. The species formerly ranged from northern Alaska and northern Canada, south to central northern Mexico (USFWS, 1995b). The Louisiana subspecies once occurred in southern Mississippi, all of Louisiana, and eastern Texas (USFWS, 1995b). In Texas, Louisiana black bears occurred in all counties east of and including Cass, Marion, Harrison, Upshur, Rusk, Cherokee, Anderson, Leon, Robertson, Burleson, Washington, Lavaca, Victoria, Refugio, and Aransas (USFWS, 1995b). Today, the only remaining Louisiana black bear populations occur in the Tensas and Atchafalaya river basins in Louisiana (USFWS, 1995b).

2.10.4 Presence in the Study Area

Garner (1996) indicates that suitable habitat for the Louisiana black bear in east Texas is restricted to the Big Thicket National Preserve, the Sulphur River Bottom, the Middle Neches Corridor, and the Lower Neches River Corridor. While recent reports of black bears exist from east Texas and southwestern Louisiana, it is unlikely that these represent individuals of the subspecies *U. a. luteolus*. Suitable black bear habitat may occur within the study area, but it is highly unlikely that black bears are present in the study area.

2.11 GULF STURGEON

2.11.1 Reason for Status

USFWS and NMFS listed the Gulf sturgeon (*Acipenser oxyrinchus desotoi*), a subspecies of the Atlantic sturgeon (*A. oxyrhinchus*), as threatened on September 30, 1991 (56 FR 49653–49658). As with other sturgeon species, the damming of rivers has been the most significant threat to the Gulf sturgeon (NMFS, 2006b). Dams are now present on all of the major rivers within the Gulf sturgeon's range (Pearl, Mississippi, and Alabama rivers), which prevents upstream migration for spawning. Other threats to the species include overexploitation, incidental catch, dredging activities, the removal of snags, and dredged material placement associated with channel improvements and maintenance (USFWS and Gulf States Marine Fisheries Commission [GSMFC], 1995; NMFS, 2006b).

2.11.2 Habitat

The Gulf sturgeon is anadromous, which means the species breeds in freshwater environments (i.e., river systems) but spends the remainder of the year in marine and estuarine environments. Spawning occurs in the deeper portions of rivers on clean rock or rubble bottoms. Mud and sand bottoms and seagrass communities are likely important marine habitats (USFWS and GSMFC, 1995).

2.11.3 Range

The Gulf sturgeon historically ranged along the northeastern Gulf, in major rivers from the Mississippi delta in Louisiana, east to Charlotte Harbor, Florida, and in marine waters of the central and eastern Gulf (USFWS and GSMFC, 1995; NMFS, 2006b). Its current range extends from Lake Pontchartrain and the Pearl River in Louisiana and Mississippi east to the Suwannee River in Florida. Sporadic records exist from as far west as the Rio Grande between Texas and Mexico, and as far east and south as Florida Bay. Viable populations exist in the Mississippi, Pearl, Escambia, Yellow, Choctawhatchee, Appachicola, and Suwannee rivers (NMFS, 2006b).

2.11.4 Presence in the Study Area

The study area is not within the known historic range of the Gulf sturgeon. Fish are mobile species and frequently occur outside of their normal ranges; however, it is unlikely that the species is present in the study area.

2.12 ELKHORN CORAL

Elkhorn coral was listed as threatened on May 9, 2006 (71 FR 26852) and is found on coral reefs in southern Florida and the Bahamas, and throughout the Caribbean. Its northern limit is Biscayne National Park, Florida. This species is particularly susceptible to damage from sedimentation. Neither the project area nor the study area are located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

2.13 SMALLTOOTH SAWFISH

2.13.1 Reason for Status

Smalltooth sawfish (*Pristis pectinata*) were listed as endangered by the NMFS on April 1, 2003 (50 CFR 224, p. 15674–15680), and the USFWS on November 16, 2005 (50 CFR 17, p. 69464–69466). They may grow up to 23 feet in length, live up to 30 years, and females give birth to live young, up to 15 to 20 at a time. Data indicate the smalltooth sawfish is found over about 10 percent of its original U.S. distribution, and the population size may have been reduced by 95 percent. These reductions probably have resulted from incidental entanglement in nets, reduced habitat, and the sawtooth's low birth rate. Additionally, little is known about the habitat utilized by juvenile sawfish (NMFS and USFWS, 2009).

2.13.2 Habitat

Smalltooth sawfish are usually found in shallow (typically less than 33 feet), warm (water temperatures exceeding 16 °C) coastal waters, close to shore, over muddy and sandy bottoms. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths on inshore bars, near mangrove edges, or over seagrass. Critical habitat for smalltooth sawfish has been proposed along the southwestern Florida coast from Charlotte Harbor south to Florida Bay (50 CFR 226, p. 70290–70308).

2.13.3 Range

The U.S. population is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida, and along the East Coast from Florida to Cape Hatteras. The current range of this species has contracted to peninsular Florida, and smalltooth sawfish are relatively common only in the Everglades region at the southern tip of the state. No accurate estimates of abundance trends over time are available for this species. However, available records indicate that abundance of this species has declined dramatically in U.S. waters over the last century. The last published report of smalltooth sawfish in Texas was in 1984.

2.13.4 Presence in the Study Area

The most recent verified report of a smalltooth sawfish from Texas waters was in 1998. All recent observations of smalltooth sawfish have been in southwestern Florida. It is unlikely there are smalltooth sawfish in the project area. Since the smalltooth sawfish prefer shallow water, it is unlikely they would be encountered in the project areas that would be dredged.

2.14 STAGHORN CORAL

Staghorn coral was listed as threatened on May 9, 2006 (71 FR 26852) and is found throughout the Florida Keys, the Bahamas, and the Caribbean islands. This coral occurs in the western Gulf of Mexico, but it is absent from U.S. waters in the Gulf of Mexico. Neither the project area nor the study area are located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

2.15 WHALES

NMFS identifies five endangered whale species of potential occurrence in the Gulf. These are the sei whale (*Balaenoptera borealis*), blue whale (*Balaenoptera musculus*), fin (or finback) whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter macrocephalus*). These species are generally restricted to deeper offshore waters; therefore, it is unlikely that any of these five species would regularly occur in the study area (NMFS, 2003).

2.16 SPECIES OF CONCERN

2.16.1 Dusky Shark

The dusky shark is a large shark with a wide-ranging distribution in warm-temperate and tropical continental waters. It is coastal and pelagic in its distribution, where it occurs from the surf zone to well offshore. Habitat for this species does exist in the project area.

2.16.2 Night Shark

The night shark is a deep-water shark reported in waters from Delaware south to Brazil, including the Gulf of Mexico. This shark is usually found at depths greater than 150–200 fathoms during the day and 100 fathoms at night. Habitat for this shark does not exist in the project area.

2.16.3 Saltmarsh Topminnow

This fish is endemic to the north-central coast of the Gulf of Mexico from Galveston Bay eastward to western Florida. They tend to live in salt marshes and brackish water. This species requires shallow flooded marsh surfaces for breeding and feeding. Coastal erosion and loss of marsh is thought to be the greatest threat to this species. It is possible that this species occurs in the project area.

2.16.4 Sand Tiger Shark

The sand tiger shark has a broad inshore distribution. In the western Atlantic, this shark occurs from the Gulf of Maine to Florida, in the northern Gulf of Mexico, in the Bahamas, and in Bermuda. They are generally coastal, usually being found in the surf zone down to depths around 75 feet. They may also be found in shallow bays. They usually live near the bottom, but may be found throughout the water column. Their biggest threat is over fishing. Habitat for this species may exist in the project area.

2.16.5 Speckled Hind

The speckled hind inhabits warm, moderately deep waters from North Carolina to Cuba, including Bermuda, the Bahamas, and the Gulf of Mexico. The preferred habitat is hard-bottom reefs in depths ranging from 150 to 300 feet. Habitat for this species does not exist in the project area.

2.16.6 Warsaw Grouper

The Warsaw grouper is a very large fish found in the deep-water reefs of the southeastern U.S. This fish ranges from North Carolina to the Florida Keys and throughout much of the Caribbean and Gulf of Mexico to the northern coast of South America. This species inhabits deepwater reefs on the continental shelf break in waters 350 to 650 feet deep. Habitat for this species does not exist in the project area.

2.16.7 Ivory Tree Coral

Colonies of ivory tree coral are found to depths of 500 feet on substrates of limestone rubble, low-relief limestone outcrops, and high-relief, steeply sloping prominences. The project area is not located within the historical range for this species, nor does suitable habitat exist in the project vicinity.

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3.0 ANALYSIS OF EFFECTS

3.1 DIRECT EFFECTS

Direct effects of the Project are those associated with navigation channel improvements, and the placement of dredged material. They include (1) impacts to benthic organisms and their Gulf, estuarine, and riverine water-bottom habitats resulting from dredging to construct navigation improvements, offshore placement areas, borrow areas for mitigation measures, and marsh restoration in shallow, open-water areas; (2) dredging impacts to bottom-feeding and pelagic organisms such as sea turtles, (3) impacts to marshes and upland habitats from the enlargement of placement areas; and (4) impacts to shorebirds and their habitat from the regular placement of maintenance material on the Gulf shoreline.

The discussion of direct Project impacts provided below is limited to those having the potential to affect threatened or endangered species or their Critical Habitat that may occur in the study area. The following species are unlikely to occur in the study area and, therefore, no impacts are expected: least tern (interior population), red wolf, Louisiana black bear/black bear, gulf sturgeon, and listed whale and coral species.

3.1.1 Sea Turtles

Sea turtles may be present in the project area during certain times of the year. Thus, construction activities could result in impacts to the sea turtle, should they be present in the project area. These impacts, however, would be temporary and local in nature. Feeding opportunities within the proposed channel could attract sea turtles, where they might be exposed to additional risks from boat traffic, contaminants, fishing activities, tangled fishing lines, and accumulated plastic detritus, but that is true at the existing channel.

A pipeline dredge would be used in those reaches of the SNWW inland of the Jetty Channel and a hopper dredge would be used in the Sabine Pass Jetty Channel, the Sabine Pass Outer Bar Channel, the Sabine Bank Channel, and the Extension Channel. Sea turtles easily avoid pipeline dredges because of the slow movement of the dredge. The potential for incidental take of sea turtles by hopper dredges would be minimized by the use of draghead deflectors and the other measures noted in Section 4.1 of this BA. Construction dredging of the offshore channels is expected to take at least 6 years with individual contracts lasting an average of 15 months. Therefore, accommodation of a winter dredging window for construction is unlikely. An agreement between NMFS and USACE is in place and implemented regarding take of sea turtles with hopper dredges to ensure that significant impacts do not occur, but that BO only applies to maintenance dredging. Between 1996 and 2005, maintenance dredging in the Sabine Pass Outer Bar and Sabine Bank channels by hopper dredges resulted in the lethal take of two sea turtles, a Kemp’s ridley in 1997 and a loggerhead in 2002 (Rob Hauch, pers. comm., 2006). In 2006, maintenance dredging in the Sabine Bank Channel resulted in the lethal take of one Kemp’s ridley, but there were no lethal takes in the 2008 dredging of the Sabine Outer Bar Channel (USACE, 2009). Details of the sea turtle avoidance plan are included in Section 4.1.

The effects of placing dredged material at the proposed ODMDSs include (1) a collision potential from the vessel; (2) the deposition of dredged material on turtles and forage areas, and (3) the possibility of trash and debris from the dredge operation. Regarding the deposition of dredged material, modeling indicates that most of the dredged material is confined to a relatively small area. Because this is a short-term effect, and considering the mobility of the turtle species and the lack of limestone ledges in the proposed ODMDSs, the turtles should easily be able to avoid a descending plume, and available food sources should not be seriously reduced (NMFS, 2003). Regarding the vessel and debris possibility, it is the combined effect of many marine activities (e.g., oil spills, oil and gas operations, commercial fishing, marine transportation, etc.) that constitute the hazard and not a single activity such as a dredge operation. As noted in Section 4.11.2 of the SNWW Channel Improvement FEIS to which this document is appended, it has been determined that the proposed ODMDS designation does not constitute an adverse impact on listed sea turtles.

The existing offshore channels (Outer Bar and Sabine Bank) would be deepened with effects similar to but of longer duration than routine maintenance dredging. The Entrance Channel Extension would begin 18 miles offshore where sea turtles should be more dispersed than nearer the jetties. Only two lethal takes have been observed during maintenance dredging between 1996 and 2005, a period that entailed water temperatures ranging from 49 to 90°F. Based on the facts listed above, the proposed Project may affect and is likely to adversely affect sea turtles. No Critical Habitat for sea turtles is present within the study area; therefore, the Project is unlikely to adversely affect Critical Habitat.

3.1.2 Piping Plover

Dredging activities, which would occur in open water, would not directly affect the piping plover. The greatest potential for impacts to the piping plover would be associated with the placement of dredged material or beach nourishment activities in areas of suitable habitat. USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (HU LA 1, in part) as Critical Habitat for the piping plover. Proposed beach nourishment activities at Louisiana Point would occur along approximately 3 miles of this unit, beginning approximately 0.5 mile east of Sabine Pass. A survey of both the Texas and Louisiana shore nourishment areas was conducted in July 2006 (see Attachment B to the BA). No habitat was found on the Texas side, just an eroding bank with marsh vegetation on the top of the bank. There was some habitat on the Louisiana side: a 1.65-mile-long, narrow tidal sand/mudflat spit that ranged from 500 yards off the beach on its western end to confluence with the beach at its eastern end; a 1-mile-long, narrow offshore sand bar that ranged from 1,400 yards offshore on the west to 400 yards offshore on the east end; and sandy beaches, ranging from 50 to 300 feet in width, beginning 2 miles east of the east jetty and extending east beyond the potential nourishment area. Shoreward of the beach was an eroded shoreline, above which there were flats with sometimes extensive stands of dense vegetation.

Therefore, Critical Habitat on Louisiana Point would only include the beach, since no other PCEs appear to be present. The current shoreline within the proposed nourishment area on Texas Point is an eroding marsh and contains no beach. Details of the beach nourishment activities are included in Section 4.2.

Placement of dredged materials (i.e., Gulf shoreline nourishment) at Texas Point and Louisiana Point would not adversely affect piping plovers or designated Critical Habitat for the piping plover. These activities should result in positive effects on the piping plover by increasing the extent of suitable habitat in the study area. On the Louisiana side, where Critical Habitat is designated, additional beach may allow saltation to create some microtopographic relief on the backbeach, providing another PCE. Based on the information listed above, the proposed Project is not likely to adversely affect the species or its Critical Habitat.

3.1.3 West Indian Manatee

No recent records of West Indian manatee exist from the study area, and such an occurrence would be rare. If a manatee was to enter the project area, the greatest threats to it would be from boat traffic or dredging operations. The proposed Project should have no effect on the West Indian manatee.

3.2 INDIRECT EFFECTS

Indirect effects of the Project result from small salinity increases, which increase wetland loss rates and decrease biological productivity in some aquatic habitats in the study area. In Texas, 33,500 acres of intertidal marsh and swamp may be negatively impacted by these small salinity increases. In Louisiana, negative impacts are projected to affect 182,000 acres of intertidal marsh. Construction of the Neches River Beneficial Use Feature and the Texas portion of the Gulf Shore Beneficial Use Feature may offset all the indirect effects in Texas and some of the indirect effects in Louisiana. These beneficial use features would result in the net creation of 2,853 acres of restored, emergent fresh, and intermediate, and brackish marsh in Texas. Additionally, a mitigation plan has been proposed to restore 2,783 acres of emergent marsh, improve 957 acres of shallow-water habitat, and nourish 4,355 acres of existing marsh in Louisiana. This mitigation plan is intended to offset the indirect negative impacts to Louisiana wetlands from the project. No loss of saline marsh or bottomland hardwood acreage is projected. Salinities are projected to increase throughout the study area. The highest projected increases are +1.1 to 1.8 parts per thousand (ppt) in the Old River Cove marsh at Sabine Lake along its north shore and in the marshes fringing the east shore of Sabine Lake, +1.6 ppt in the freshwater marshes along the north GIWW, +1.0 to 1.5 in the Sabine River south of Orange, +0.8 ppt in the Texas Point marshes at Sabine Pass, and +0.6 ppt along the Sabine River near the City of Orange and to the north. The effects of the salinity increases on tidal marshes have been mitigated by marsh restoration, and the small salinity increase on the upper Sabine River would have negligible effects on the cypress-tupelo swamps and bottomland hardwood forests. No impacts to threatened or endangered species or Critical Habitats that may occur in the study area would result from the indirect effects of salinity increases or marsh loss.

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4.0 VOLUNTARY AVOIDANCE AND CONSERVATION MEASURES

4.1 SEA TURTLE AVOIDANCE PLAN

Avoidance measures would include an avoidance plan for hopper dredge impacts to sea turtles. This avoidance plan includes reasonable and prudent measures that have largely been incorporated in USACE regulatory and civil works projects throughout the Gulf for more than a decade. These measures include use of temporal dredging windows, when possible; intake and overflow screening; use of sea turtle deflector dragheads; observer reporting requirements; and sea turtle relocation/abundance trawling:

- Hopper Dredging: Hopper dredging activities in Gulf waters from the Mexico-Texas border to Key West, Florida, up to 1 mile into rivers shall be completed, whenever possible, between December 1 and March 31 when sea turtle abundance is lowest throughout Gulf coastal waters. USACE should coordinate with National Oceanic and Atmospheric Administration (NOAA) should dredging need to occur outside of this window.

- Nonhopper-type Dredging: Pipeline or hydraulic dredges, which are not known to take turtles, must be used whenever possible between April 1 and November 30 in Gulf waters up to 1 mile into rivers.

- Observers: The USACE shall arrange for NOAA Fisheries–approved observers to be aboard the hopper dredges to monitor the hopper soil, screening, and dragheads for sea turtles and their remains. Observer coverage sufficient for 100 percent monitoring (i.e., two observers) of hopper dredging operations is required aboard the hopper dredges year-round in Texas waters between April 1 and November 30, and whenever surface water temperatures are 52°F or greater.

- Screening: When observers are required on hopper dredges, 100 percent inflow screening of dredged material is required and 100 percent overflow screening is recommended. If conditions prevent 100 percent inflow screening, screening may be reduced gradually, but 100 percent overflow screening is then required.

- Sea Turtle Deflecting Draghead: A state-of-the-art rigid deflector draghead must be used on all hopper dredges in all Gulf channels and sand-mining sites at all times of the year.

- Dredge Take Reporting: Observer reports of incidental take by hopper dredges must be reported to NOAA Fisheries by onboard endangered species observers within 24 hours of any observed sea turtle take. A preliminary report summarizing the results of the hopper dredging and any documented sea turtle takes must be submitted to NOAA Fisheries within 30 working days of completion of any dredging project. In addition, an annual report (based on fiscal year) must be

submitted to NOAA Fisheries summarizing hopper dredging projects and documented incidental takes.

- Relocation Trawling: Relocation trawling shall be undertaken by the USACE where any of the following conditions are met: (a) two or more turtles are taken in a 24-hour period in the project; (b) four or more turtles are taken in the project; or, (c) when 75 percent of a District's sea turtle species quota for a particular species has previously been met. Handling of sea turtles captured during relocation trawling in association with hopper dredging project in Gulf navigation channels and sand-mining areas shall be conducted by NOAA Fisheries–approved endangered species observers.

Other conditions may also apply. A detailed outline of the conditions of the USACE's sea turtle avoidance is included in the NMFS Biological Opinion for dredging of Gulf navigation channels and sand-mining areas using hopper dredges (Consultation Number F/SER/2000/01287).

4.2 GULF SHORELINE NOURISHMENT

The unconfined placement on the shoreline would have a net beneficial effect on this environment. Placement events would affect shallow nearshore waters and marsh. Benthic organisms in the nearshore zone would quickly rebound from the short-term impacts of each placement event, as would marsh areas that are nourished with additional sediment. The potential for the nourishment activity to affect threatened and endangered species was evaluated. USFWS has designated the entire shoreline between Constance Beach and Sabine Pass (HU LA 1, in part) as Critical Habitat for the piping plover; however, the shoreline in the proposed nourishment area has no, or only a narrow, beach. Therefore, minimal intertidal beaches, dunes, or sand flats used by the plover as its wintering range would be affected by this measure. Should beach nourishment occur when piping plovers are utilizing the project area, they would be temporarily displaced to nearby habitat to the east, but would not be permanently excluded from using the project area, and nourishment would only occur every 6 years. Piping plover Critical Habitat would benefit from the creation of an additional PCE. Effects to existing piping plover Critical Habitat would occur during each beach nourishment cycle, but the overall condition of the nourishment area would be improved for piping plovers. While it is unlikely that the creation of more beach on Louisiana Point would allow sea turtle nesting, it certainly would have no adverse impacts on potential nesting habitat.

5.0 SUMMARY

The proposed Project may affect a few federally listed endangered or threatened species. The following species are unlikely to occur in the project area and, therefore, no impacts are expected: least tern (interior population), red-cockaded woodpecker, red wolf, Louisiana black bear/black bear, gulf sturgeon, the leatherback sea turtle, and listed whale and coral species. The Project is expected to have no effect on the West Indian manatee. The Project may affect and is likely to result in adverse effects to the following species: loggerhead sea turtle, Kemp's ridley sea turtle, hawksbill sea turtle, and green sea turtle. The piping plover and its Critical Habitat would experience a beneficial effect from the proposed Project resulting from habitat enhancement (i.e., shoreline nourishment) through beneficial use of dredged material. The only designated Critical Habitat in the project area is a portion of HU LA 1 at Louisiana Point, which was designated as Critical Habitat for the wintering range of the piping plover. The Project is not likely to adversely affect the piping plover or its designated Critical Habitat since the Project is expected to have only a beneficial effect.

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Attachment A

Agency Correspondence

PBS&J

An employee-owned company

September 14, 2004

Mr. Frederick Werner
U.S. Fish and Wildlife Service
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051

Dear ~~Mr. Werner~~ Fred,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. You initially responded to our data request for this proposed project in a letter dated June 3, 2002, however, we are currently updating our agency contacts. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts. If there has been no change since your 2002 response (attached), please let us know and we will utilize your earlier information.

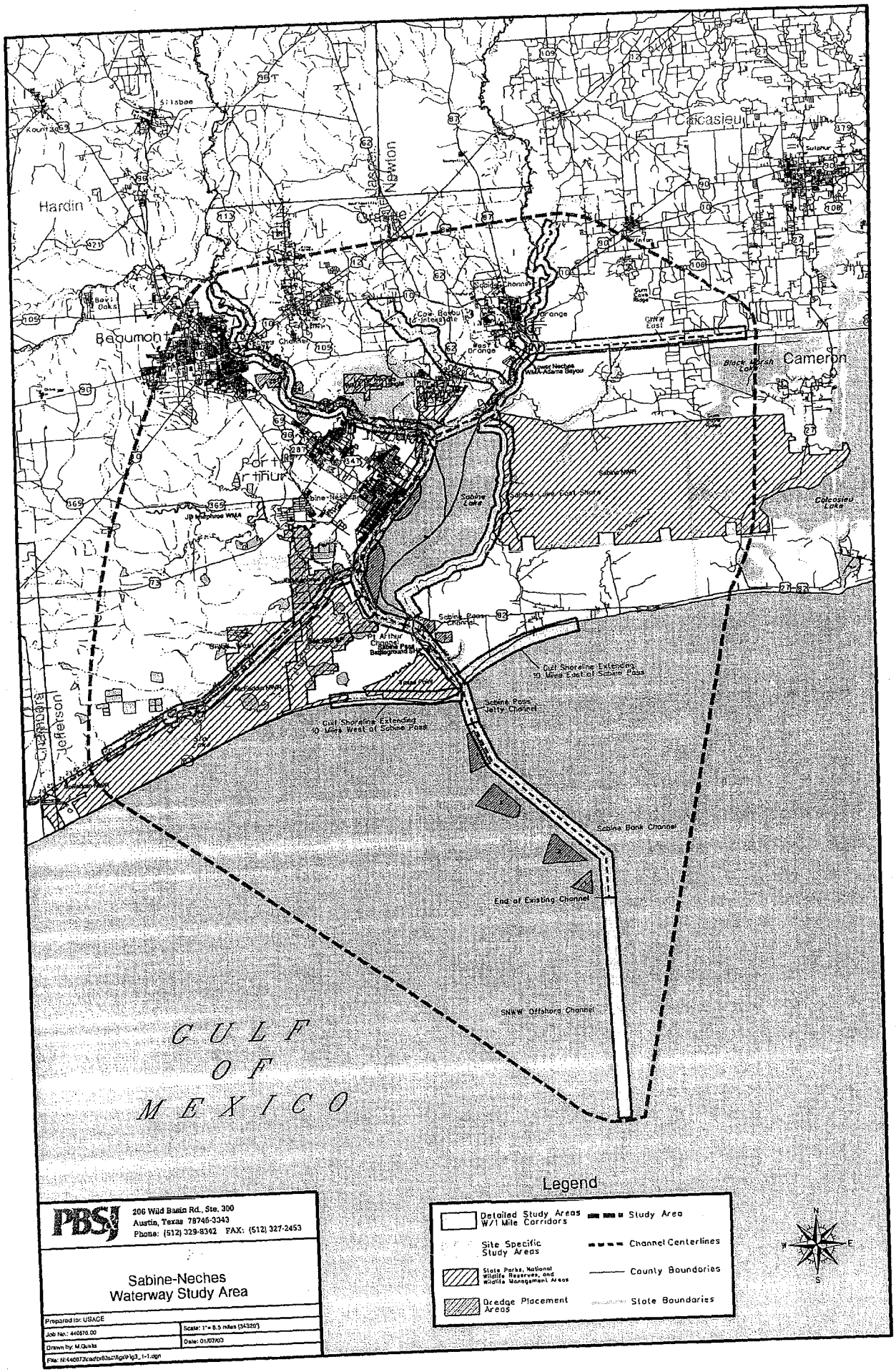
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachments

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com



PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453

Sabine-Neches
Waterway Study Area

Prepared for: USACE	
Job No.: 440870.00	Scale: 1" = 8.5 miles (34320')
Drawn by: M.Quiles	Date: 01/07/03

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882

June 3, 2002

Lisa Vitale
PBS&J
206 Wild Basin Road, Suite 300
Austin, Texas 78746

Dear Ms. Vitale:

This responds to your March 27, 2002 letter requesting information on the Sabine-Neches Waterway Project. The Galveston District Corps of Engineers proposes to widen and deepen the entire 75 mile long deep draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and the Neches River Channel to Beaumont.

The inventory of federally listed threatened and endangered species located within our area of jurisdiction is enclosed. You should also contact our Lafayette Office for threatened and endangered species information for Calcasieu and Cameron Parishes in Louisiana. They can be reached at 646 Cajundome Boulevard, Suite 400 ,Lafayette, Louisiana 70506-4290 or at 337/291-3100.

The National Marine Fisheries Service should be contacted about potential impacts to sea turtles and marine mammals. They can be contacted at 4700 Avenue U, Building 308, Galveston, Texas 77551-5997 or at 409-766-3699.

If you have any questions or if we can be of further assistance, please contact Edith Erfling at 281/286-8282.

Sincerely,

Frederick T. Werner
Assistant Project Leader, Clear Lake ES Field Office

Enclosure

COUNTY LISTING OF LISTED AND CANDIDATE SPECIES WITHIN CLEAR LAKE FIELD OFFICE AREA OF RESPONSIBILITY

(JANUARY 2002)

E = Federally listed as endangered T = Federally listed as threatened

H = historical occurrence only / M = migrant only / N = nesting activity / W = winter concentration

C= candidate species: sufficient information exists to support listing but is precluded by other listing actions.

* Candidates have no legal status and receive no protection under the Endangered Species Act. They are identified for project planning purposes only and to alert you to the possibility that they may be proposed for listing at some future time.

ANGELINA COUNTY

T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Louisiana pine snake	*Pituophis melanoleucus ruthveni*

AUSTIN COUNTY

E	HOUSTON TOAD	*Bufo houstonensis*
E	ATTWATER'S GREATER PRAIRIE-CHICKEN	*Tympanuchus cupido attwateri*

BRAZORIA COUNTY

T	BALD EAGLE (N)	*Haliaeetus leucocephalus*
E	BROWN PELICAN (N)	*Pelecanus occidentalis*
T	PIPING PLOVER (W)	*Charadrius melodus*
T	GREEN SEA TURTLE	*Chelonia mydas*
E	KEMP'S RIDLEY SEA TURTLE	*Lepidochelys kempii*
T	LOGGERHEAD SEA TURTLE	*Caretta caretta*

CHAMBERS COUNTY

T	BALD EAGLE (N)	*Haliaeetus leucocephalus*
E	BROWN PELICAN	*Pelecanus occidentalis*
T	PIPING PLOVER (W)	*Charadrius melodus*
T	GREEN SEA TURTLE	*Chelonia mydas*
E	KEMP'S RIDLEY SEA TURTLE	*Lepidochelys kempii*
T	LOGGERHEAD SEA TURTLE	*Caretta caretta*

COLORADO COUNTY

E	HOUSTON TOAD	*Bufo houstonensis*
E	ATTWATER'S GREATER PRAIRIE-CHICKEN	*Tympanuchus cupido attwateri*
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*

FAYETTE COUNTY

T	BALD EAGLE (N)	*Haliaeetus leucocephalus*

FORT BEND COUNTY

E	PRAIRIE DAWN	*Hymenoxys texana*
T	BALD EAGLE (N)	*Haliaeetus leucocephalus*

GALVESTON COUNTY

E	ATTWATER'S GREATER PRAIRIE-CHICKEN	*Tympanuchus cupido attwateri*
E	BROWN PELICAN (N)	*Pelecanus occidentalis*
T	PIPING PLOVER (W)	*Charadrius melodus*
T	GREEN SEA TURTLE	*Chelonia mydas*
E	KEMP'S RIDLEY SEA TURTLE	*Lepidochelys kempii*
T	LOGGERHEAD SEA TURTLE	*Caretta caretta*

HARDIN COUNTY

E	TEXAS TRAILING PHLOX	*Phlox nivalis* var. *texensis*
E	RED-COCKADED WOODPECKER	*Picoides borealis*

HARRIS COUNTY		
E	PRAIRIE DAWN	*Hymenoxys texana*
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
HOUSTON COUNTY		
T	BALD EAGLE (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Neches River rose-mallow	*Hibiscus dasycalyx*
JASPER COUNTY		
E	NAVASOTA LADIES'-TRESSES	*Spiranthes parksii*
T	BALD EAGLE (N)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Louisiana pine snake	*Pituophis melanoleucus ruthveni*
JEFFERSON COUNTY		
T	PIPING PLOVER (W)	*Charadrius melodus*
T	GREEN SEA TURTLE	*Chelonia mydas*
E	KEMP'S RIDLEY SEA TURTLE	*Lepidochelys kempii*
T	LOGGERHEAD SEA TURTLE	*Caretta caretta*
LIBERTY COUNTY		
T	BALD EAGLE (N)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
MATAGORDA COUNTY		
T	BALD EAGLE (N)	*Haliaeetus leucocephalus*
E	BROWN PELICAN (N)	*Pelecanus occidentalis*
T	PIPING PLOVER (W)	*Charadrius melodus*
T	GREEN SEA TURTLE	*Chelonia mydas*
E	KEMP'S RIDLEY SEA TURTLE	*Lepidochelys kempii*
T	LOGGERHEAD SEA TURTLE	*Caretta caretta*
MONTGOMERY COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
NACOGDOCHES COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Texas golden gladecress (introduced)	*Leavenworthia texana*
NEWTON COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
T	LOUISIANA BLACK BEAR (H)	*Ursus americanus luteolus*
C	Louisiana pine snake	*Pituophis melanoleucus ruthveni*
ORANGE COUNTY		
T	BALD EAGLE (M)	*Haliaeetus leucocephalus*

POLK COUNTY		
E	TEXAS TRAILING PHLOX	*Phlox nivalis* var. *texensis*
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
SABINE COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
T	LOUISIANA BLACK BEAR (H)	*Ursus americanus luteolus*
C	Texas golden gladecress (H)	*Leavenworthia texana*
C	Louisiana pine snake	*Pituophis melanoleucus ruthveni*
SAN AUGUSTINE COUNTY		
E	WHITE BLADDERPOD	*Lesquerella pallida*
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Texas golden gladecress	*Leavenworthia texana*
SAN JACINTO COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
SHELBY COUNTY (Sabine National Forest only)		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
T	LOUISIANA BLACK BEAR (H)	*Ursus americanus luteolus*
TRINITY COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Neches River rose-mallow	*Hibiscus dasycalyx*
TYLER COUNTY		
E	TEXAS TRAILING PHLOX	*Phlox nivalis* var. *texensis*
T	BALD EAGLE (N)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
C	Louisiana pine snake	*Pituophis melanoleucus ruthveni*
WALKER COUNTY		
T	BALD EAGLE (N) + (W)	*Haliaeetus leucocephalus*
E	RED-COCKADED WOODPECKER	*Picoides borealis*
WALLER COUNTY		
T	BALD EAGLE (M)	*Haliaeetus leucocephalus*
WHARTON COUNTY		
T	BALD EAGLE (N)	*Haliaeetus leucocephalus*

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 / (FAX) 281/488-5882

November 2, 2004

Martin Arhelger
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Dear Mr. Arhelger:

This responds to your request for updated threatened and endangered species information for Jefferson County Navigation District (JCND)'s proposed Sabine-Neches Waterway (SNWW) widening and deepening project. The SNWW is located in Jefferson and Orange Counties in Texas, and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine Neches Canal, and Neches River Channel to the Port of Beaumont, Texas.

The species list dated January 2002 accurately reflects the federally listed species that may occur in Jefferson and Orange Counties, Texas. Species information and a county by county listing of those federally listed threatened and endangered species that occur within this office's work area can be found on the Service website at (http://ifw2es.fws.gov/endangeredspecies/lists/ListSpecies.cfm). Therefore, future updates to species lists for your projects would not require contact with this office.

According to Section 7(a)(2) of the Act and the implementing regulations, it is the responsibility of each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any listed species. You should use the updated species list and other current information to determine if the proposed project "may affect" a listed species. Should your determination indicate that the proposed project "may affect" federally listed species, this office should be contacted for further evaluation. The Service's Consultation Handbook is available online (http://endangered.fws.gov/consultations/s7hndbk/s7hndbk.htm) for further information on definitions and process.

Finally, colonial waterbird rookeries are known to occur within the project area. To avoid disturbing colonial waterbirds as they nest and rear their young, we recommend all project activity stay a minimum of 1000 feet away during the peak nesting season from February 15 to September 1.

If you have any questions, or if we can be of further assistance, please contact Catherine Yeargan at 281/286-8282.

Sincerely,

Frederick T. Werner
Assistant Field Supervisor, Clear Lake Field Office

TAKE PRIDE IN AMERICA

PBS&J

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September 14, 2004

Mr. Darryl Clark
U.S. Fish and Wildlife Service
646 Cajundome Blvd.
Suite 4000
Lafayette, Louisiana 70506

Dear ~~Mr. Clark~~ Darryl,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

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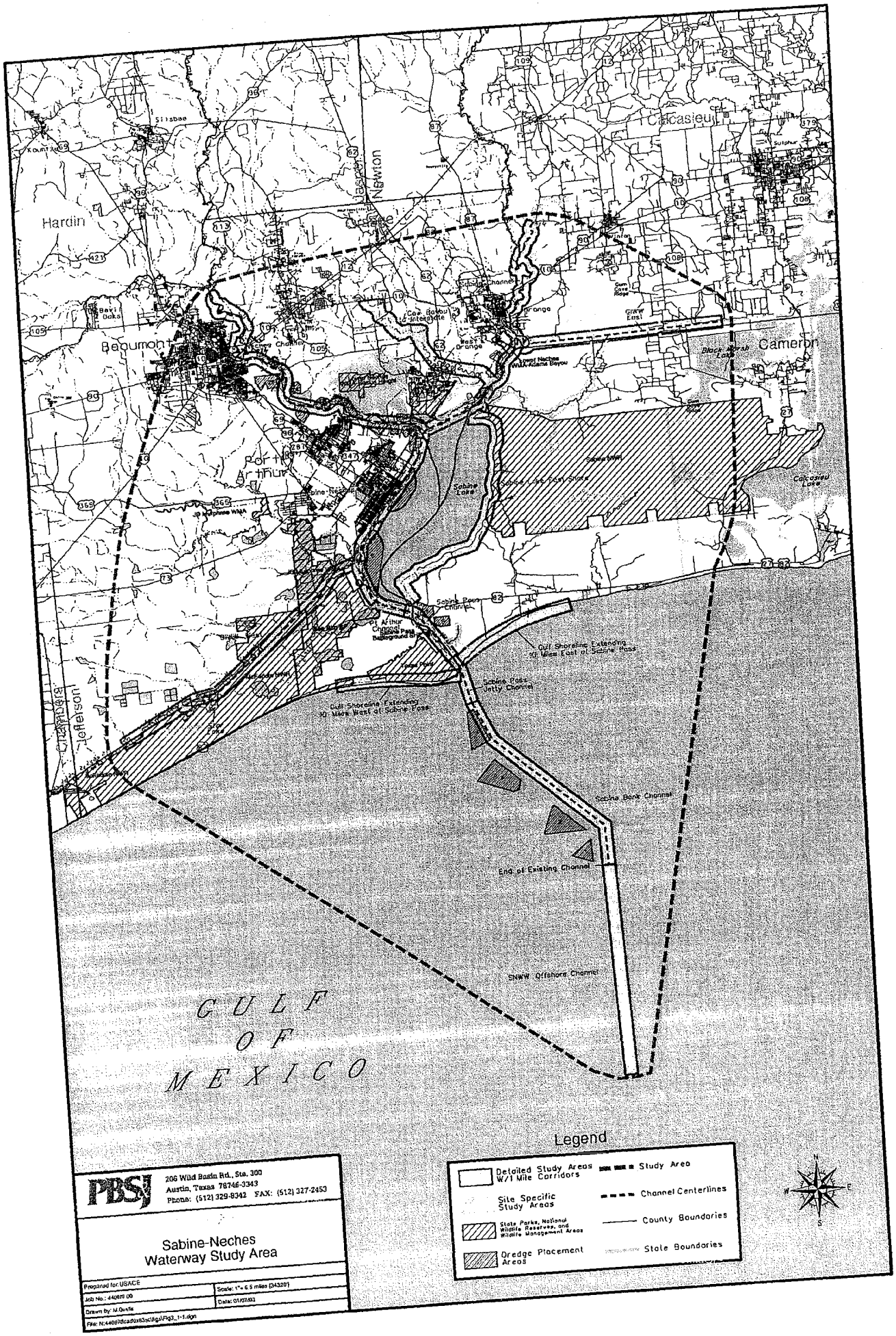


PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453

Sabine-Neches
Waterway Study Area

Prepared for: USACE	Scale: 1" = 6.5 miles (34320')
Job No.: 44089.00	Date: 01/07/03
Drawn by: M.Gwafa	
File: N:\44089\cad\ds83sc\fig\Fig3_1-1.dgn	

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 29, 2004

Mr. Martin Arhelger
Project Manager
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Dear Mr. Arhelger:

Please reference your September 14, 2004, letter requesting information regarding threatened and endangered species that may occur within the proposed study area for the Sabine-Neches Waterway (SNWW) project. The U.S. Army Corps of Engineers (Corps) has proposed to widen and deepen the SNWW bordering Jefferson and Orange Counties in Texas, and Calcasieu and Cameron Parishes in Louisiana. The proposed project area would include the SNWW from the Gulf of Mexico, passing through the jettied channel at Sabine Pass, the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, and an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The U.S. Fish and Wildlife Service's (Service) Lafayette, Louisiana, Field Office has reviewed the information provided, and offers the following comments on the Louisiana-portion of the proposed project, in accordance with provisions of the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Migratory Bird Treaty Act (MBTA; 40 Stat. 755, as amended; 16 U.S.C. 703 et seq.). For information regarding Federal-trust resources in Texas, please contact the Service's Houston, Texas, (i.e., Clear Lake) Field Office (17629 El Camino Real, Suite 211, Houston, TX 77058-3051, phone: 281-286-8282).

West Indian manatees (*Trichechus manatus*) may rarely occur along the Gulf coast in southwestern Louisiana during the summer months (i.e., June through September). They have declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

Bald eagles (*Haliaeetus leucocephalus*) nest in Louisiana from October through mid-May. Although we are not aware of active eagle nests within the proposed project area, there is an inactive nest located on the east side of the Sabine River and south of Interstate Highway 10; nests that are not currently listed in our database may also be present within areas containing suitable habitat. Eagles typically nest in bald cypress trees near fresh to intermediate marshes or open water. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Bald eagles usually return to the same nest year after year, but they may also use alternate nests in the same general vicinity in different years. Bald eagles are most vulnerable to disturbance during courtship, nest building, egg laying, incubation and brooding (roughly the first 12 weeks of the nesting cycle). Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus lessening their chance of survival. Should the proposed project or associated work activities encroach within 1,500 feet of an eagle nest during the nesting season (October through mid-May), further ESA consultation with this office will be necessary. We further caution that the proposed activity should not damage any portion of the eagle nest trees, including their root systems (i.e., through soil compaction or disturbance).

Federally listed as endangered, brown pelicans (*Pelecanus occidentalis*) feed along the southwestern Louisiana coast in shallow estuarine waters, using sand spits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance. Should you determine that the proposed project may directly or indirectly affect brown pelicans, further ESA consultation with this office will be necessary.

Federally listed as threatened, the piping plover (*Charadrius melodus*), as well as its designated critical habitat, occur along the southwestern Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change.

On July 10, 2001, the U.S. Fish and Wildlife Service designated critical habitat for wintering piping plovers. In Louisiana, the proposed project would be located adjacent to Unit LA-1, a unit which includes ". . . the land from the seaward boundary of mean low low water to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. . ." (50 CFR Part 17, Volume 66, No. 132, Page 36127). Designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to

development, disturbance by humans and pets, and predation. Should you determine that the proposed project may directly or indirectly affect the piping plover or its critical habitat, further ESA consultation with this office will be necessary.

Endangered and threatened sea turtles forage in the near-shore waters, bays and sounds of southwestern Louisiana. The National Marine Fisheries Service (NMFS) is responsible for aquatic marine threatened or endangered species. Please contact Mr. Eric Hawk (727/570-5312) in St. Petersburg, Florida, for information concerning those species in the aquatic environment.

The proposed project area may encompass areas containing suitable nesting habitat for colonial wading birds. Colonies that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries may also be present. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed project area for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, depending on species present).

2. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, depending on species present).

3. We recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and avoid impacting them during the breeding season.

The Service's Sabine National Wildlife Refuge (NWR) is located along the eastern bank of the Sabine Lake. Please be aware that the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd through 668ee) requires that activities on NWRs must be compatible with NWR purposes. Please contact the Sabine NWR Manager at 337/762-3816 for additional information, and to ascertain the need for a NWR Special Use Permit for that portion of the proposed project.

The proposed project may also affect the Black Bayou Hydrologic Restoration (CS-27), Gulf Intracoastal Waterway – Perry Ridge West Bank Stabilization (CS-30), and East Sabine Lake Hydrologic Restoration (CS-32) Projects. Those projects are authorized by the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA). The Service recommends avoiding direct impacts to specific project features (e.g., canal plugs, rock dikes, levees, water control structures, diversion canals, etc.). The exact locations of specific project features may be obtained at http://www.lacoast.gov/projects/list.asp, which contains detailed information on those CWPPRA projects. Please be aware that Section 303(d) of CWPPRA requires that all Federal activities be

consistent with the purposes of that Act and take into account the need to protect the public investment in the above-listed CWPPRA projects.

We appreciate the opportunity to provide comments during the early planning stages of the proposed action. If you have any questions or require further information on the Louisiana portion of the proposed project, please contact Brigette Firmin (337/291-3108) of this office.

Sincerely,

Russell C. Watson
Supervisor
Louisiana Field Office

cc: FWS, Houston, TX
Sabine NWR, Hackberry, LA
NMFS, St. Petersburg, FL
NMFS, Baton Rouge, LA
LDNR, CMD, Baton Rouge, LA
LDWF, Baton Rouge, LA
LDWF, Natural Heritage Program, Baton Rouge, LA

PBS&J

An employee-owned company

September 14, 2004

National Marine Fisheries Service
Southeast Regional Office
Mr. Andreas Mager
9721 Executive Center Drive north
Saint Petersburg, Florida 33702-2449

Dear Mr. Mager,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding federally protected species within the study area. Your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

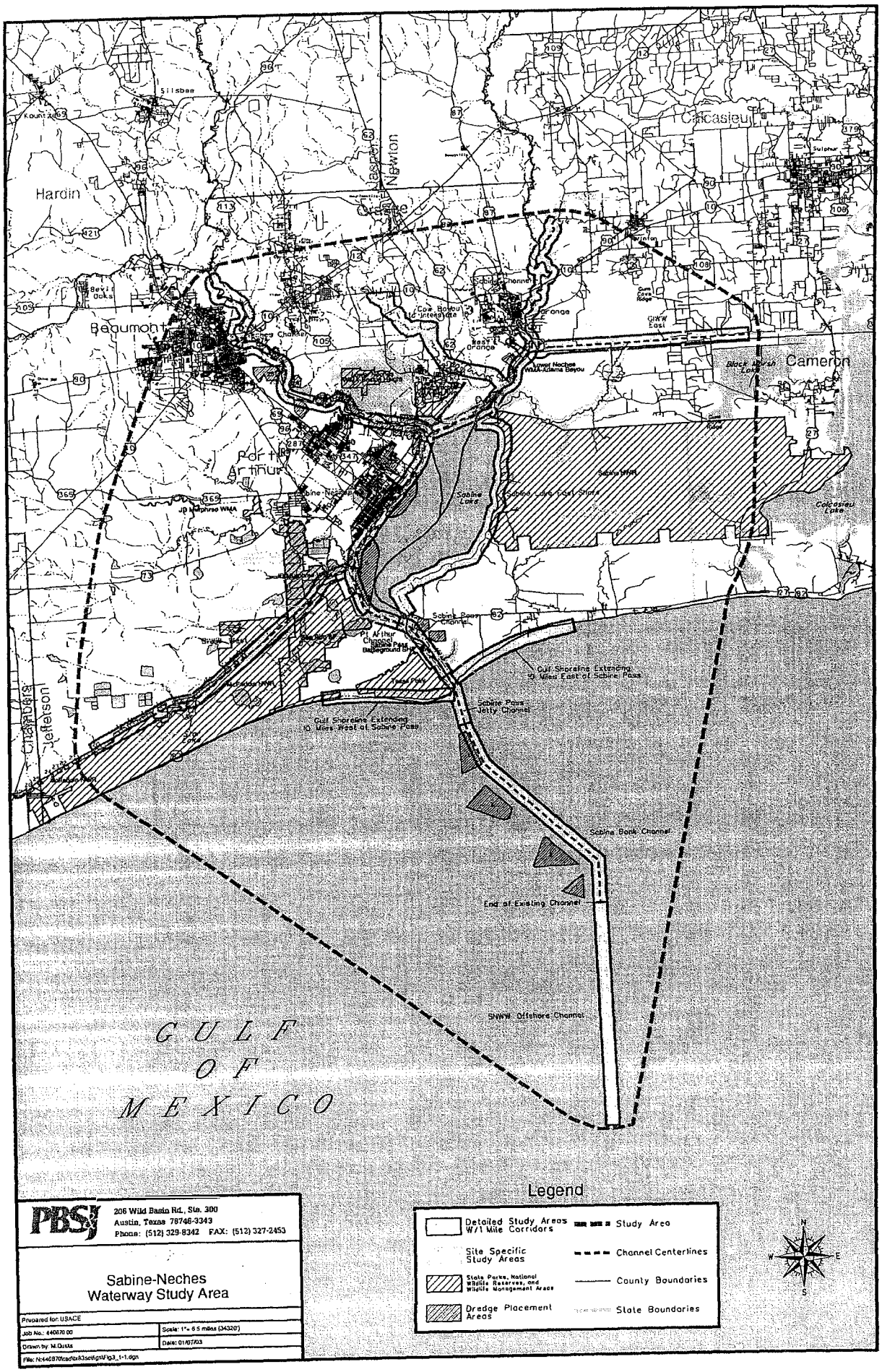
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com


Silsbee
Hardin
Jasper
Newton
Calcasieu
Beaumont
Port Arthur
Orange
Cameron
Jefferson
Chambers
Sabine Lake
Calcasieu Lake
Sabine Pass Jetty Channel
Sabine Bank Channel
End of Existing Channel
SNWW Offshore Channel
GULF OF MEXICO
Legend
Detailed Study Areas W/1 Mile Corridors
Site Specific Study Areas
State Parks, National Wildlife Reserves, and Wildlife Management Areas
Dredge Placement Areas
Study Area
Channel Centerlines
County Boundaries
State Boundaries
PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453
Sabine-Neches
Waterway Study Area
Prepared for USACE
Job No.: 440870.00
Scale: 1" = 6.5 miles (34320')
Drawn by: M.Quiala
Date: 01/07/03

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312, FAX 570-5517
http://sero.nmfs.noaa.gov

Dear Colleague:

The National Marine Fisheries Service (NOAA Fisheries) Protected Resources Division has reviewed your letter pursuant to section 7(a)(2) of the Endangered Species Act (ESA) concerning the determination of a construction site in proximity to critical habitat (permit number LAR200000).

_____**There are no ESA-listed species** or designated critical habitat under our purview in the action area.

_____**We cannot determine** impacts to threatened or endangered species, or designated critical habitat, under NOAA Fisheries' purview because the letter lacks sufficient information to evaluate the project. **Enclosed are guidelines** to conduct a proper biological evaluation.

_____**Please provide a letter** from the lead federal action agency designating you to conduct ESA section 7 consultation with this office.

__✓__**Enclosed is a list** of federally-protected species under the jurisdiction of NOAA Fisheries for the state of **Louisiana.** Biological information on federally-protected species and candidate species can be found at the following website addresses: http://www.nmfs.noaa.gov/prot_res/prot_res.html; http://noflorida.fws.gov/SeaTurtles/seaturtle-info.htm); http://endangered.fws.gov/wildlife.html#Species; http://www.cmc-ocean.org/main.php3; http://floridaconservation.org/psm/turtles/turtle.htm; http://obis.env.duke.edu/data/sp_profiles.php; www.mote.org/~colins/Sawfish/SawfishHomePage.html; www.floridasawfish.com; www.flmnh.ufl.edu/fish/sharks/InNews/sawprop.htm;.Gulf sturgeon critical habitat rule and maps (http://alabama.fws.gov/gs/); http://www.cccturtle.org;.

_____**It is NOAA Fisheries opinion that the project will have no effect** on listed species or critical habitat protected by the ESA under NOAA Fisheries' purview. No further consultation with NOAA Fisheries pursuant to section 7(a)(2) of the ESA is required unless the project description changes.

Consultation with NOAA Fisheries, Habitat Conservation Division (HCD), pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's requirements for essential fish habitat consultation may be required. Please contact HCD at (727) 570-5317. If you have any ESA questions, please contact our ESA section 7 coordinator, Eric Hawk, at (727) 570-5312, or by e-mail at eric.hawk@noaa.gov.

____**Other**: _____

Sincerely,

David Bernhart
Assistant Regional Administrator
for Protected Resources

_X_ Enclosure
Ref: I/SER/2004/
File:1514-22.

Endangered and Threatened Species and Critical Habitats
under the Jurisdiction of the NOAA Fisheries

NOAA Fisheries

Louisiana

Listed Species	Scientific Name	Status	Date Listed
Marine Mammals			
blue whale	*Balaenoptera musculus*	Endangered	12/02/70
finback whale	*Balaenoptera physalus*	Endangered	12/02/70
humpback whale	*Megaptera novaengliae*	Endangered	12/02/70
sei whale	*Balaenoptera borealis*	Endangered	12/02/70
sperm whale	*Physeter macrocephalus*	Endangered	12/02/70
Turtles			
green sea turtle	*Chelonia mydas*	Threatened[1]	07/28/78
hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	12/02/70
leatherback sea turtle	*Dermochelys coriacea*	Endangered	06/02/70
loggerhead sea turtle	*Caretta caretta*	Threatened	07/28/78
Fish			
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened	09/30/91

Designated Critical Habitat
Gulf Sturgeon: A final rule designating Gulf sturgeon critical habitat was published on March 19, 2003 (68 FR 13370) and 14 geographic areas (units) among the Gulf of Mexico rivers and tributaries were identified. Maps and details regarding the final rule can be found ~~at alabama.fws.gov/gs~~ Enclosed

Species Proposed for Listing
None

Proposed Critical Habitat
None

[1] Green turtles are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific Coast of Mexico, which are listed as endangered

NOAA Fisheries

Louisiana

Candidate Species[2]	Scientific Name
Invertebrates	
elkhorn coral	*Acropora palmata*
staghorn coral	*Acropora cervicornis*
fused-staghorn coral	*Acropora prolifera*

Species of Concern[3]	Scientific Name
Fish	
dusky shark	*Carcharhinus obscurus*
goliath grouper	*Epinephelus itijara*
night shark	*Carcharinus signatus*
saltmarsh topminnow	*Fundulus jenkinsi*
sand tiger shark	*Odontaspis taurus*
speckled hind	*Epinephelus drummondhayi*
Warsaw grouper	*Epinephelus nigritus*
white marlin	*Tetrapturus albidus*
Invertebrates	
ivory bush coral	*Oculina varicosa*

[2] The Candidate Species List has been renamed the Species of Concern List. The term "candidate species" is limited to species that are the subject of a petition to list and for which NOAA Fisheries has determined that listing may be warranted (69 FR 19975).

[3] Species of Concern are not protected under the Endangered Species Act, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

Federal Register

Wednesday,
March 19, 2003

Part II

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Department of Commerce

National Oceanic and Atmospheric Administration

50 CFR Part 226

Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Gulf Sturgeon; Final Rule

PBS&J

An employee-owned company

April 24, 2006

Rusty Swafford
National Marine Fisheries Service
Habitat Conservation Division
4700 Avenue U
Galveston, Texas 77551-5997

RE: Sabine-Neches Waterway Project
PBS&J Job Number 440870

Dear Mr. Swafford:

PBS&J has contracted with the Galveston District of the U.S. Army Corps of Engineers (Galveston District) to prepare the EIS for the Sabine-Neches Waterway Project (project) located in Jefferson and Orange Counties, Texas and Calcasieu and Cameron Parish, Louisiana. The Galveston District is engaged in a potential widening and deepening of the Sabine-Neches Waterway. The project sponsor is the Jefferson County Navigation District. Alternatives are in the process of being developed.

PBS&J is collecting data for the EIA. The level of detail for our assessment will be as necessary to describe existing conditions and to provide analysis of future conditions due to project impacts. The project study area is in the vicinity of Beaumont, Port Arthur, and Sabine Pass, Texas and encompasses the entire 75-mile long deep draft channel from the Gulf of Mexico through a jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to Beaumont and adjacent areas that may be affected by proposed project alternatives.

PBS&J is submitting this letter to request information on Essential Fish Habitat occurring in the project area, which should be addressed for the project, and any conservation recommendations you may have. Please call me at (512) 342-3389 if you have any questions or need additional information.

Sincerely,

Lisa Vitale

Lisa Vitale, FP-C
Marine/Aquatic Biologist
LDV/lv

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PBS&J

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September 14, 2004

Ms. Jill Kelly
Louisiana Department of Wildlife and Fisheries
P.O. Box 98000
Baton Rouge, Louisiana 70898

Dear Ms. Kelly,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding state protected species within the study area. Your office (Mr. Gary Lester) initially responded to our data request in 2002 (attached), however, we are currently updating our agency contacts. Please provide written response since your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts. If there has been no change since your 2002 response, please let us know and we will utilize your earlier information.

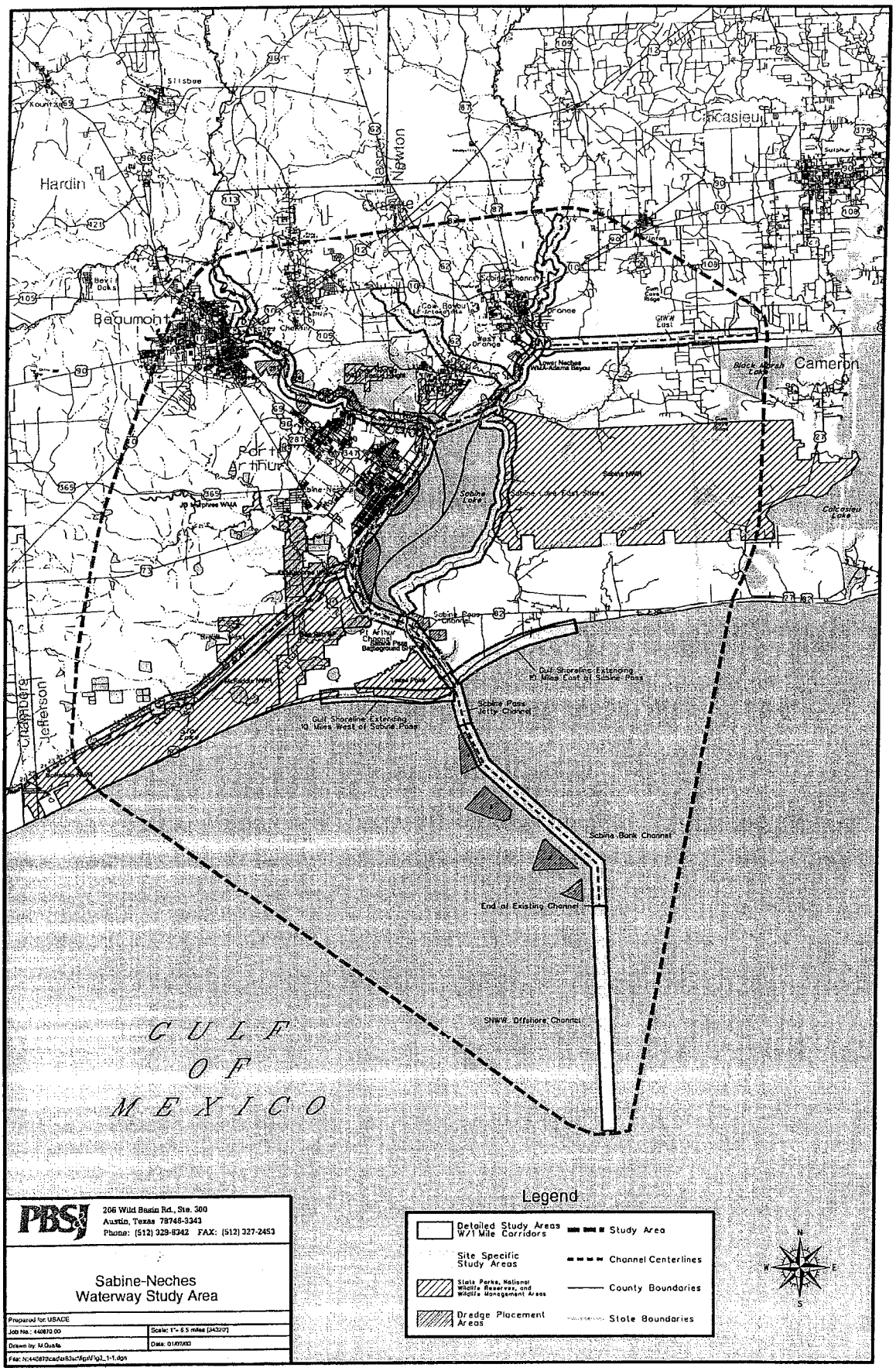
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachments

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com



PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453

Sabine-Neches
Waterway Study Area

Prepared for: USACE	
Job No.: 440870.00	Scale: 1"= 5.5 miles [343/0]
Drawn by: M.Quaife	Date: 01/07/00
File: N:\440870\cad\p83\c\fig\Fig3_1-1.dgn	

State of Louisiana

James H. Jenkins, Jr.
Secretary

Department of Wildlife & Fisheries
Post Office Box 98000
Baton Rouge, LA 70898-9000
(225) 765-2800

M.J. "Mike" Foster, Jr.
Governor

Name	Mr. Dave Munson
Company	PBS&J
Street Address	206 Wild Basin Road, Suite 300
City, State, Zip	Austin, Texas 78746
Project	Sabine-Neches Waterway Feasibility Study and EIS
Date	July 30, 2002
Invoice Number	02073001

Personnel of the Habitat Section of the Fur and Refuge Division have reviewed the preliminary data for the captioned project. In reviewing our database, many rare, threatened, or endangered species or critical habitats were found within the area of the captioned project that lies in Louisiana. I have attached tables containing the information for these element occurrence records, along with explanations of the data fields. Please refer to the LNHP data utilization agreement for restrictions regarding the use of these data. Element occurrence location information is given as point data and do not reflect the local extent of the occurrence. In addition, the precision of the location information may be limited. Please refer to the precision data field which defines the precision to which the element occurrence as described can be located on a topographic map. Due to the preliminary nature of the request, and the fact that no specific project details were given, the Louisiana Natural Heritage Program is unable to make specific comments concerning the project's impact on these species at this time. It will be necessary for you to contact us as your project progresses and specific project details are available, so that we may make the necessary comments in the future. In addition, please be aware that a manatee (Trichechus manatus) was observed in the Sabine River North of the I-10 Bridge in November of 1999. The manatee is listed as endangered on both the federal and state species lists. Your project area is in the Louisiana Department of Wildlife and Fisheries Sabine Island Wildlife Management Area (WMA). Please Contact the WMA Manager John Robinette at 318-491-2575 to coordinate activity. Your project area is in the USFWS Sabine National Wildlife Refuge. Please contact USFWS Wildlife Biologist Diane Borden-Billiot at 318-762-3816 to coordinate activity. Your project area is in the coastal zone. Contact the State of Louisiana Department of Natural Resources Coastal Management Division to determine if a coastal use permit is required. The Sabine Pass Lighthouse State Commemorative Area occurs in your project area. No other state or federal parks, wildlife refuges, scenic streams, or wildlife management areas are known at the specified site within Louisiana's boundaries.

The Louisiana Natural Heritage Program has compiled data on rare, endangered, or otherwise significant plant and animal species, plant communities, and other natural features throughout the state of Louisiana. Heritage reports summarize the existing information known at the time of the request regarding the

location in question. This report does not address the occurrence of wetlands at the site in question. Heritage reports should not be considered final statements on the biological elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The Louisiana Natural Heritage Program requires that this office be acknowledged in all reports as the source of all data provided here. If you have any questions or need additional information, please call Louisiana Natural Heritage Program Data Manger Jill Kelly at (225) 765-2643.

Sincerely,

Gary Lester, Coordinator
Natural Heritage Program

LOUISIANA NATURAL HERITAGE PROGRAM (LNHP)

DATA UTILIZATION AGREEMENT

We are pleased to provide you with information on the occurrence of threatened and endangered species. Do to the dynamic nature of the LNHP database and the sensitivity of some of the information however, some precautions are necessary in your use of the information.

Please sign and date below and return this document if you are in agreement with the conditions listed below for utilization of the LNHP database.

This agreement allows Dave Munson of PBS&J, 206 Wild Basin Road, Suite 300, Austin, Texas 78746 use of the LNHP records, at $20.00 per quad, for the Sabine-Neches Waterway Feasibility Study and EIS. The information supplied by the LNHP shall be used only for this project. As an employee of PBS&J, Dave Munson is authorized to sign this agreement.

PBS&J shall not use computer and hard copy files of LNHP data for any other projects, and PBS&J shall not release any copy of the LNHP data files to another party, without written consent of the LNHP Director.

All maps and graphs generated by PBS&J, using information provided by the LNHP shall reference in the legend the LNHP program as the source of the data. All text generated by PBS&J using information provided by the LNHP shall reference on the title or acknowledgement page the LNHP program as the source of the data, and the date the data were provided.

The quantity and quality of data collected by the LNHP are dependent on the research and observations of many individuals. In most cases, this information is not the result of comprehensive or site-specific field surveys; many natural areas in Louisiana have not been surveyed. The LNHP database represents a compilation of information extracted from published and unpublished literature, museums and herbaria, field surveys, personal communications, and other sources. Records for new occurrences of plants and animals are continuously being added to the database and other occurrence records may change as new information is gathered. For these reasons, PBS&J is authorized to use the data for a period of one year from the date the data are received. At that time, PBS&J shall delete all computerized files containing the LNHP data, or enter into another data utilization agreement with the LNHP.

The LNHP cannot provide a definitive statement on the presence, or absence, or condition of biological elements in any part of Louisiana. LNHP reports summarize the existing information known to the LNHP at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments.

The LNHP and the State of Louisiana shall not be liable for any damages or loss whatsoever, to any person or legal entity, or property resulting from the use of the data specified here. PBS&J and/or any person or legal entity which receives said information from PBS&J agrees to indemnify and hold harmless the LNHP and the State of Louisiana from and against any and all claims, demands and causes of action of any description in favor of any person for damage or loss whatsoever to persons, legal entities, or property arising from the use of the data specified herein and/or any person or legal entity which receives said information from PBS&J

Information provided by this database transfer may not be published without prior written approval of the LNHP, and the LNHP must be credited as an information source in these publications.

Gary Lester

Gary Lester
Director, Natural Heritage Program
Date: 7-31-02

Dave Munson

Dave Munson
PBS&J
Date: 8/7/02

Louisiana Natural Heritage Program
Biological Conservation Database Field Definitions

EOCODE – (Element Occurrence Code) Represents a unique code for each element in the database

LONG – Longitude of the centrum of the element occurrence. Element Occurrence data is given as point information for the centrum of the occurrence, at this time we can not supply information about the local extent of the occurrence.

LAT – Latitude of the centrum of the element occurrence. Element Occurrence data is given as point information for the centrum of the occurrence, at this time we can not supply information about the local extent of the occurrence.

PRECISION - Precision to which the element occurrence as described can be located on a topographic map.

S = Seconds (accuracy of locality mappable within a three-second radius)
M – Minute (within a one minute radius, approximately 2 km or 1.5 miles from centerpoint)
G = general (to quad or place name precision only, precision within about 8 km or 5 miles)

SNAME – (State Name) The appropriate element name recognized in the state using standard scientific binomial (or trinomial) nomenclature

SCOMNAME– (State Common Name) Common name of the element that is recognized at the state level

USESA – (United States Endangered Species Act) Appropriate standard abbreviation for the U.S. federal register category for the element as proposed or determined by the U.S. Fish and Wildlife Service or the National Oceanic and Atmospheric Administration (marine species)

GRANK– (Global Rank) The global element rank which best characterizes the relative rarity or endangerment of the element worldwide.

SRANK – (State Rank) The state element rank which best characterizes the relative rarity or endangerment of the element in the state.

LASTOBS – (Last Observation) Date the element occurrence was last observed extant at this site; not necessarily date site was last visited.

EXPLANATION OF RANKING CATEGORIES EMPLOYED BY NATURAL HERITAGE PROGRAMS NATIONWIDE

Each element is assigned a single global rank as well as a state rank for each state in which it occurs. Global ranking is done under the guidance of NatureServe, Arlington, VA. State ranks are assigned by each state's Natural Heritage Program, thus a rank for a particular element may vary considerably from state to state. Federal ranks are designated by the U.S. Fish & Wildlife Service under the provisions of the Endangered Species Act of 1973.

FEDERAL RANKS (USESA FIELD):

LE = Listed Endangered

LT = Listed Threatened

PE = Proposed endangered

PT = Proposed Threatened

C = Candidate

PDL = Proposed for delisting

E (S/A) or T (S/A) = Listed endangered or threatened because of similarity of appearance

XE = Essential experimental population

XN = Nonessential experimental population

No Rank = Usually indicates that the taxon does not have any federal status. However, because of potential lag time between publication in the Federal Register and entry in the central databases and state databases, some taxa may have a status which does not yet appear.

(Rank, Rank) = Combination values in parenthesis = The taxon itself is not named in the Federal Register as having U.S. ESA status; however, all of its infraspecific taxa (worldwide) do have official status. The statuses shown in parentheses indicate the statuses that apply to infraspecific taxa or populations within this taxon. *THE SPECIES IS CONSIDERED TO HAVE A COMBINATION STATUS IN LOUISIANA*

(PS) = partial status= Status in only a portion of the species' range. Typically indicated in a "full" species record where an infraspecific taxon or population has U.S. ESA status, but the entire species does not. *THE SPECIES DOES NOT HAVE A STATUS IN LOUISIANA*

(PS: Rank) = partial status= Status in only a portion of the species' range. The value of that status appears because the entity with status does not have an individual entry in Natureserve. *THE SPECIES MAY HAVE A STATUS IN LOUISIANA*

GLOBAL ELEMENT RANKS:

G1 = critically imperiled globally because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extinction

G2 = imperiled globally because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extinction throughout its range

G3 = either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range (21 to 100 known extant populations)

G4 = apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery (100 to 1000 known extant populations)

G5 = demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery (1000+ known extant populations)

GH = of historical occurrence throughout its range; i.e., formerly part of the established biota, with the possibility that it may be rediscovered (e.g., Bachman's Warbler)

GU = possibly in peril range-wide, but status uncertain; need more information

G? = rank uncertain. Or a range (e.g., G3G5) delineates the limits of uncertainty

GQ = uncertain taxonomic status

GX = believed to be extinct throughout its range (e.g., Passenger Pigeon) with virtually no likelihood that it will be rediscovered

T = subspecies or variety rank (e.g., G5T4 applies to a subspecies with a global species rank of G5, but with a subspecies rank of G4)

STATE ELEMENT RANKS:

S1 = critically imperiled in Louisiana because of extreme rarity (5 or fewer known extant populations) or because of some factor(s) making it especially vulnerable to extirpation

S2 = imperiled in Louisiana because of rarity (6 to 20 known extant populations) or because of some factor(s) making it very vulnerable to extirpation

S3 = rare and local throughout the state or found locally (even abundantly at some of its locations) in a restricted region of the state, or because of other factors making it vulnerable to extirpation (21 to 100 known extant populations)

S4 = apparently secure in Louisiana with many occurrences (100 to 1000 known extant populations)

S5 = demonstrably secure in Louisiana (1000+ known extant populations)

(B or N may be used as qualifier of numeric ranks and indicating whether the occurrence is breeding or nonbreeding)

SA = accidental in Louisiana, including species (usually birds or butterflies) recorded once or twice or only at great intervals hundreds or even thousands of miles outside their usual range

SH = of historical occurrence in Louisiana, but no recent records verified within the last 20 years; formerly part of the established biota, possibly still persisting

SR = reported from Louisiana, but without conclusive evidence to accept or reject the report

SU = possibly in peril in Louisiana, but status uncertain; need more information

SX = believed to be extirpated from Louisiana

SZ = transient species in which no specific consistent area of occurrence is identifiable

LNHP Element Occurrence Data in or surrounding your project area on the Echo 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
ABNKC10010*185*LA	0934142W	300743N	HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	(PS:LT,PDL)	G4	S2N,S3B	S	1999
AFCJC04010*014*LA	0934035W	301245N	CYCLEPTUS ELONGATUS	BLUE SUCKER		G3G4	S2S3	S	3/27/1996

LNHP Element Occurrence Data in or surrounding your project area on the Cameron Farms 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
CPC5000000*002*LA	0933350W	300415N	BOTTOMLAND HARDWOOD FOREST	BOTTOMLAND HARDWOOD FOREST			S4	S	-1977
PMCYP090Q0*001*LA	0933130W	300300N	ELEOCHARIS FALLAX	CREEPING SPIKE-RUSH		G4G5	S1?	M	4/6/1984

LNHP Element Occurrence Data in or surrounding your project area on the Black Lake 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
ABNGE05010*013*LA	0932333W	300255N	AJAIA AJAJA	ROSEATE SPOONBILL		G5	S3	M	5/1/1989
ORKER00000*224*LA	0932333W	300255N	WATERBIRD NESTING COLONY	WATERBIRD NESTING COLONY				M	5/1/1989

LNHP Element Occurrence Data in or surrounding your project area on the West of Greens Bayou 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
CEA2000000*010*LA	0934510W	295715N	BRACKISH MARSH	BRACKISH MARSH			S3S4	S	-1977

LNHP Element Occurrence Data in or surrounding your project area on the Greens Bayou 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
ABNGE05010*030*LA	0934436W	295707N	AJAIA AJAJA	ROSEATE SPOONBILL		G5	S3	S	5/28/1996
CTB2000000*004*LA	0934414W	295652N	COASTAL PRAIRIE	COASTAL PRAIRIE		G2Q	S1	S	-1986
CTB2000000*021*LA	0934234W	295702N	COASTAL PRAIRIE	COASTAL PRAIRIE		G2Q	S1	S	5/6/1997
ORKER00000*378*LA	0934436W	295707N	WATERBIRD NESTING COLONY	WATERBIRD NESTING COLONY				S	3/26/1996

LNHP Element Occurrence Data in or surrounding your project area on the F-R Ranch 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
ABNKD02020*002*LA	0933108W	295857N	CARACARA CHERIWAY	CRESTED CARACARA	(PS:LT)	G5	S1	M	4/2/1987
CPA1000000*015*LA	0933554W	295911N	FRESHWATER MARSH	FRESHWATER MARSH			S1S2	S	4/2/1987
ORKER00000*075*LA	0933300W	295900N	WATERBIRD NESTING COLONY	WATERBIRD NESTING COLONY				M	4/26/1990

LNHP Element Occurrence Data in or surrounding your project area on the Port Arthur South 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
PMPOA46010*001*LA	0935334W	294800N	MONANTHOCHLOE LITTORALIS	SALTFLAT-GRASS		G4G5	S1	M	7/14/1984

Element Occurrence Data in or surrounding your project area on the West of Johnsons Bayou 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
CEA2000000*011*LA	0934727W	294703N	BRACKISH MARSH	BRACKISH MARSH			S3S4	S	-1977
CTC1000000*001*LA	0933830W	294506N	COASTAL LIVE OAK-HACKBERRY FOREST	COASTAL LIVE OAK-HACKBERRY FOREST		G1G2Q	S1S2	S	1984-FALL

LNHP Element Occurrence Data in or surrounding your project area on the Johnsons Bayou 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
PDAST7Z020*001*LA	0933830W	294603N	RATIBIDA PEDUNCULARIS	MEXICAN HAT		G4G5	S2S3	S	9/7/1984
PDBOR0L070*001*LA	0933836W	294506N	LITHOSPERMUM INCISUM	NARROW-LEAVED PUCCOON		G5	S1	G	4/8/1966
PMPOA6B010*007*LA	0933907W	294503N	UNIOLA PANICULATA	SEA OATS		G5	S2	M	9/4/1974
CTC1000000*001*LA	0933830W	294506N	COASTAL LIVE OAK-HACKBERRY FOREST	COASTAL LIVE OAK-HACKBERRY FOREST		G1G2Q	S1S2	S	1984-FALL
PDFAB1A0C0*004*LA	0933907W	294502N	DALEA EMARGINATA	WEDGE-LEAF PRAIRIE-CLOVER		G5	S2	M	5/8/1982

Element Occurrence Data in or surrounding your project area on the Texas Point 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
ABNNB03070*011*LA	0934644W	294338N	CHARADRIUS MELODUS	PIPING PLOVER	(LE,LT)	G3	S2N	S	2/19/1988

Element Occurrence Data in or surrounding your project area on the Smith Bayou 7.5 minute Quadrangle Map

Eocode	Long	Lat	Sname	Scomname	Usesa	Grank	Srank	Precision	Lastobs
ABNNB03030*002*LA	0934024W	294452N	CHARADRIUS ALEXANDRINUS	SNOWY PLOVER	(PS:LT)	G4	S1B,S2N	S	2/9/1991
ABNNB03040*002*LA	0934442W	294405N	CHARADRIUS WILSONIA	WILSON'S PLOVER		G5	S1S3B,S3N	M	4/27/1986
ABNNB03070*002*LA	0934024W	294452N	CHARADRIUS MELODUS	PIPING PLOVER	(LE,LT)	G3	S2N	S	2/9/1991
CTB1000000*013*LA	0933959W	294450N	COASTAL DUNE GRASSLAND	COASTAL DUNE GRASSLAND			S1S2	S	5/2/1989
CTC1000000*001*LA	0933830W	294506N	COASTAL LIVE OAK-HACKBERRY FOREST	COASTAL LIVE OAK-HACKBERRY FOREST		G1G2Q	S1S2	S	1984-FALL
PDAMA040N0*002*LA	0933953W	294457N	AMARANTHUS GREGGII	GREGG'S AMARANTH		G4?	S2S3	M	6/30/1984
PDAST7Z020*006*LA	0933959W	294457N	RATIBIDA PEDUNCULARIS	MEXICAN HAT		G4G5	S2S3	S	5/12/1987
PDFAB0F630*008*LA	0934321W	294424N	ASTRAGALUS NUTTALLIANUS	A MILK-VETCH		G5	S2S3	S	5/2/1989
PDFAB1A0C0*004*LA	0933907W	294502N	DALEA EMARGINATA	WEDGE-LEAF PRAIRIE-CLOVER		G5	S2	M	5/8/1982
PDFAB1A0C0*006*LA	0933959W	294457N	DALEA EMARGINATA	WEDGE-LEAF PRAIRIE-CLOVER		G5	S2	S	5/12/1987
PDFAB1A0C0*007*LA	0934321W	294424N	DALEA EMARGINATA	WEDGE-LEAF PRAIRIE-CLOVER		G5	S2	S	5/2/1989
PDFAB5L0K0*007*LA	0934321W	294424N	PEDIOMELUM RHOMBIFOLIUM	ROUNDLEAF SCARF-PEA		G5	S2S3	S	5/2/1989

PBS&J

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September 14, 2004

Ms. Kathy Boydston
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Dear Ms. Boydston,

The U.S. Army Corps of Engineers, with the Jefferson County Navigation District (JCND) as the local sponsor, has proposed a project to widen and deepen the Sabine-Neches Waterway. The Sabine-Neches Waterway (SNWW) is located in Jefferson and Orange counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The project area includes the SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico. The Sabine Channel, that extends from Sabine Lake to the Port of Orange is not being considered for channel modification.

The study area is larger than the project area due to potential environmental affects and has been developed through consultation with the project Interagency Coordination Team (ICT). The study area is illustrated on the attached map.

PBS&J is currently developing the Biological Assessment (BA) for the proposed project and thereby is requesting your office provide any information regarding state protected species within the study area. Your comments will be an important consideration in the development of the BA and in the assessment of potential project impacts.

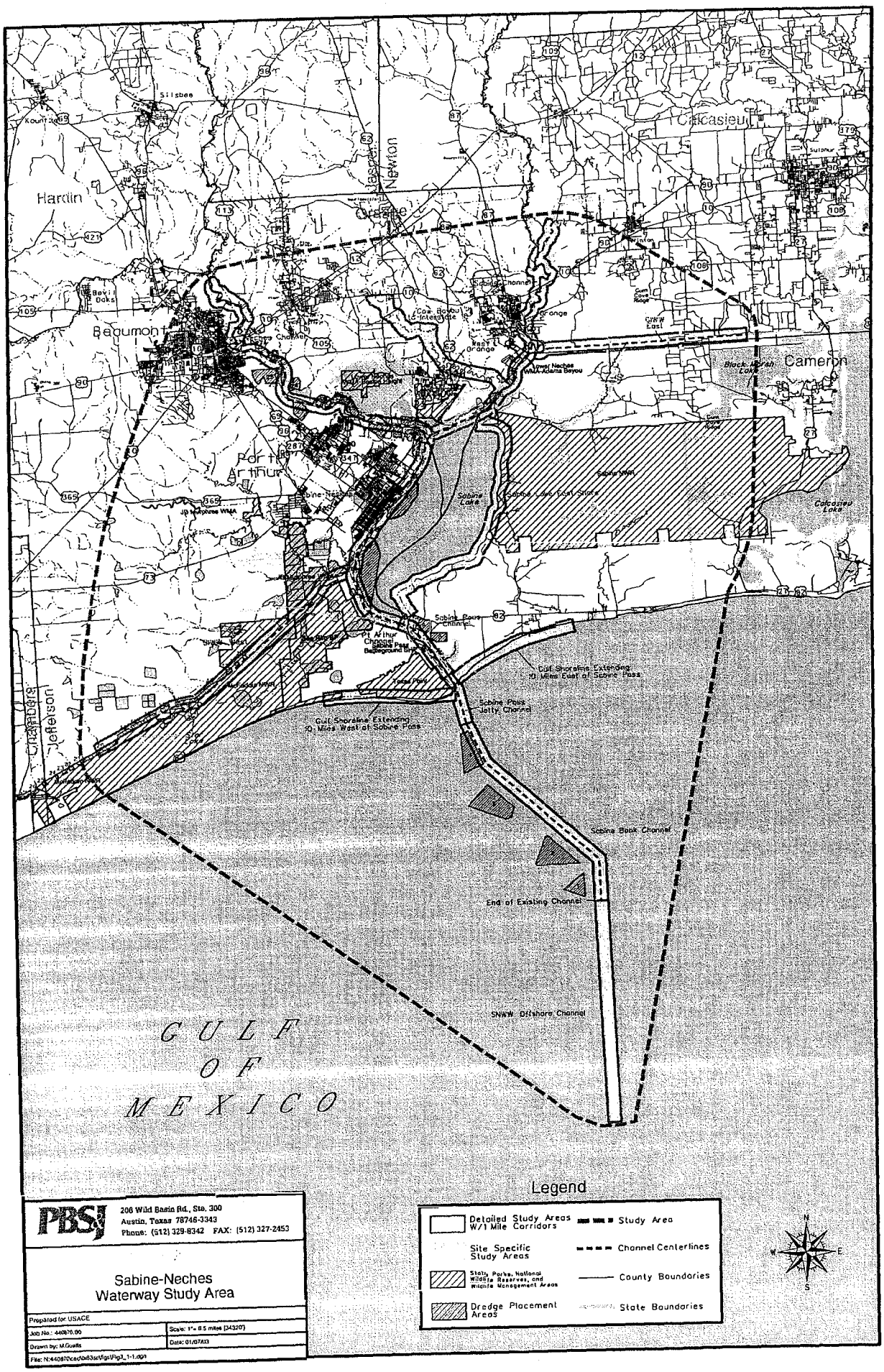
PBS&J looks forward to receiving information from your office and appreciates your time and effort required in responding to this request. Please contact Mike Horvath or me at 512 327-6840 if you have any questions or require additional study area information.

Sincerely,

Martin Arhelger
Project Manager
Vice President

attachment

6504 Bridge Point Parkway • Suite 200 • Austin, Texas 78730 • Telephone: 512.327.6840 • Fax: 512.327.2453 • www.pbsj.com



PBSJ
206 Wild Basin Rd., Ste. 300
Austin, Texas 78746-3343
Phone: (512) 329-8342 FAX: (512) 327-2453

Sabine-Neches
Waterway Study Area

Prepared for: USACE
Job No.: 440870.00
Scale: 1" = 8.5 miles (343207)
Drawn by: M.Guelis
Date: 01/07/03
File: N:\440870ce\0a83sc\figs\Fig3_1-1.dgn

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EXECUTIVE DIRECTOR

November 19, 2004

Martin Arhelger
Project Manager
PBS&J
6504 Bridge Point Parkway, Suite 200
Austin, Texas 78730

Re: Proposed project to widen and deepen the Sabine-Neches Waterway, Jefferson and Orange Counties.

Dear: Mr. Arhelger:

This letter is in response to your request for information concerning the state threatened and endangered fish, wildlife, and plant resources associated with the project referenced above. Texas Parks and Wildlife Department (TPWD) staff reviewed the project and provides the following comments.

The Jefferson County Navigation District proposes to widen and deepen the Sabine- Neches Waterway (SNWW). The SNWW is located in Jefferson and Orange Counties in Texas and borders Cameron and Calcasieu Parishes in southwest Louisiana. The proposed project area includes SNWW from the Gulf of Mexico through the jettied channel at Sabine Pass, through the Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel to the Port of Beaumont, including an additional 17 miles of new channel extending beyond the end of the existing channel into the Gulf of Mexico.

Please find attached the list of special species that occur in Jefferson and Orange Counties. If rare plant or animal species are found within or near the project area, precautions should be taken to avoid adverse impacts to them. If it is determined adverse impacts could occur with completion of your project, then mitigation in the form of planning to reduce adverse impacts and/or compensation for damages should occur. More site-specific information from a search of the BCD database and review of potential project impacts to endangered and threatened species can be obtained for a $50 fee. For more information about the BCD or threatened and endangered species in the project area please contact Celeste Brancel at (512) 912-7021.

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To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

We appreciate the opportunity to review and comment on your project. If you have any questions please contact me in Victoria at (361) 576-0022.

Sincerely,

Amy Hanna

Amy Hanna
Wildlife Habitat Assessment Program
Wildlife Division

/ajh

Attachment

JEFFERSON COUNTY

	Federal Status	State Status

******* DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*******
UNDER CONSTRUCTION ** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL**

*** AMPHIBIANS ***

Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt

*** BIRDS ***

	Federal Status	State Status
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Brown Pelican (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks	LE	E
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Piping Plover (*Charadrius melodus*) - wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Reddish Egret (*Egretta rufescens*) - resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Snowy Plover (*Charadrius alexandrinus*) – wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Sooty Tern (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

	Federal Status	State Status
***** BIRDS-RELATED *****		
Colonial waterbird nesting areas - many rookeries active annually		
Migratory songbird fallout areas - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds		
*****FISHES*****		
American Eel (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries		
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) **(extirpated)** - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Atlantic Hawksbill Sea Turtle (*Eretmochelys imbricata*) - Gulf and bay system	LE	E
Green Sea Turtle (*Chelonia mydas*) – Gulf and bay system	LT	T
Gulf Saltmarsh Snake (*Nerodia clarkii*) - saline flats, coastal bays, & brackish river mouths		
Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) - Gulf and bay system	LE	E
Leatherback Sea Turtle (*Dermochelys coriacea*) - Gulf and bay system	LE	E
Loggerhead Sea Turtle (*Caretta caretta*) - Gulf and bay system	LT	T

	Federal Status	State Status
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T
Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

*** VASCULAR PLANTS ***

Chapman's orchid (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August

Status Key:

LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
C1	- Federal Candidate for Listing, Category 1; information supports proposing to list as endangered/threatened
DL, PDL	- Federally Delisted/Proposed for Delisting
NL	- Not Federally Listed
E, T	- State Listed Endangered/Threatened
"blank"	- Rare, but with no regulatory listing status

Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

ORANGE COUNTY

	Federal Status	State Status
***** DRAFT ***** DRAFT ***** DRAFT***** DRAFT ***** DRAFT ***** DRAFT*****		
UNDER CONSTRUCTION **** SPECIES MIGHT BE ADDED/DELETED DURING QUALITY CONTROL		
*** **AMPHIBIANS** ***		
Pig Frog (*Rana grylio*) – prefers permanent bodies of open water with emergent vegetation; actively mainly at night; eats insects and crustaceans; mating and egg-laying March-September; male vocalization a pig-like grunt		
*** **BIRDS** ***		
American Peregrine Falcon (*Falco peregrinus anatum*) - potential migrant; nests in west Texas	DL	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant	DL	T
Bald Eagle (*Haliaeetus leucocephalus*) - found primarily near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	LT-PDL	T
Brown Pelican (*Pelecanus occidentalis*) - largely coastal and near shore areas, where it roosts on islands and spoil banks	LE	E
Henslow's Sparrow (*Ammodramus henslowii*) – wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking		
Interior Least Tern (*Sterna antillarum athalassos*) – this subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish & crustaceans, when breeding forages within a few hundred feet of colony	LE	E
Piping Plover (*Charadrius melodus*) - wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	LT	T
Reddish Egret (*Egretta rufescens*) - brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Snowy Plover (*Charadrius alexandrinus*) – wintering migrant along the Texas Gulf Coast beaches and bayside mud or salt flats		
Sooty Tern (*Sterna fuscata*) – predominately "on the wing"; does not dive, but snatches small fish and squid with bill as it flies or hovers over water; breeding April-July		T
Swallow-tailed Kite (*Elanoides forficatus*) - lowland forested regions, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes, and ponds; nests high in tall tree in clearing or on forest woodland edge, usually in pine, cypress, or various deciduous trees		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags, sometimes in association with other wading birds (i.e. active heronries); breeds in Mexico and birds move into Gulf States in search of mud flats and other wetlands, even those associated with forested areas; formerly nested in Texas, but no breeding records since 1960		T

	Federal Status	State Status
***** BIRDS-RELATED *****		
Colonial waterbird nesting areas - many rookeries active annually		
Migratory songbird fallout areas - oak mottes and other woods/thickets provide foraging/roosting sites for neotropical migratory songbirds		
*****FISH*****		
American Eel (*Anguilla rostrata*) - most aquatic habitats with access to ocean; spawns January-February in ocean, larva move to coastal waters, metamorphose, then females move into freshwater; muddy bottoms, still waters, large streams, lakes; can travel overland in wet areas; males in brackish estuaries		
Ironcolor Shiner (*Notropis chalybaeus*) - spawns April-September, eggs sink to bottom of pool; pools and slow runs of low gradient small acidic streams with sandy substrate and clear well vegetated water; feeds mainly on small insects, ingested plant material not digested		
Paddlefish (*Polyodon spathula*) - prefers large, free-flowing rivers, but will frequent impoundments with access to spawning sites; spawns in fast, shallow water over gravel bars; larvae may drift from reservoir to reservoir		T
***** MAMMALS *****		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas, Black Bear is federally listed threatened and inhabits bottomland hardwoods and large tracts of undeveloped forested areas; in remainder of Texas, Black Bear is not federally listed and inhabits desert lowlands and high elevation forests and woodlands; dens in tree hollows, rock piles, cliff overhangs, caves, or under brush piles	T/SA; NL	T
Louisiana Black Bear (*Ursus americanus luteolus*) - possible as transient; bottomland hardwoods and large tracts of inaccessible forested areas	LT	T
Plains Spotted Skunk (*Spilogale putorius interrupta*) – catholic; in habitat; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie		
Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		T
Red Wolf (*Canis rufus*) **(extirpated)** - formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	LE	E
Southeastern Myotis Bat (*Myotis austroriparius*) - roosts in cavity trees of bottomland hardwoods, concrete culverts, and abandoned man-made structures		
***** REPTILES *****		
Alligator Snapping Turtle (*Macrochelys temminckii*) - deep water of rivers, canals, lakes, and oxbows; also swamps, bayous, and ponds near deep running water; sometimes enters brackish coastal waters; usually in water with mud bottom and abundant aquatic vegetation; may migrate several miles along rivers; active March-October; breeds April-October		T
Gulf Saltmarsh Snake (*Nerodia clarkii*) - saline flats, coastal bays, & brackish river mouths		
Northern Scarlet Snake (*Cemophora coccinea copei*) - mixed hardwood scrub on sandy soils; feeds on reptile eggs; semi-fossorial; active April-September		T

	Federal Status	State Status
Sabine Map Turtle (*Graptemys quachitensis sabinensis*) – Sabine River system; rivers and related tributaries, ponds and reservoirs with abundant aquatic vegetation; basks on fallen logs and exposed roots; eats insects, crustaceans, mollusks, and aquatic plants; breeding and egg-laying March-May, with hatchlings appearing in early fall		
Texas Diamondback Terrapin (*Malaclemys terrapin littoralis*) - coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches; brackish and salt water; burrows into mud when inactive; may venture into lowlands at high tide		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T

*** VASCULAR PLANTS ***

Chapman's orchid (*Platanthera chapmanii*) - in Texas, restricted to wetland pine savannas, one of the states most endangered habitats; flowering July-August

Long-sepaled false dragon-head (*Physostegia longisepala*) – moist, acid loams in the fire-maintained transition zone between pine flatwoods and coastal prairies; also, wet, borrow ditches along roadsides and moist areas in manmade clearings in pine woodlands; flowering early May to late June

Status Key:

LE, LT	- Federally Listed Endangered/Threatened
PE, PT	- Federally Proposed Endangered/Threatened
E/SA, T/SA	- Federally Listed Endangered/Threatened by Similarity of Appearance
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Species appearing on these lists do not all share the same probability of occurrence. Some species are migrants or wintering residents only, or may be historic or considered extirpated.

Attachment B

PBS&J 2006 Piping Plover Habitat Survey at Texas and Louisiana Points

1.0 INTRODUCTION

On July 20, 2006, PBS&J performed a reconnaissance of coastal/beachfront habitat for the U.S. Army Corps of Engineers, Galveston District (USACE). The project area extends from 0.5 miles from the base of the Sabine Pass jetties to a distance of 3.5 miles west into Texas, and 3.5 miles east, into Louisiana. The purpose of the survey was to determine the presence or absence of piping plover (*Charadrius melodus*) habitat within the survey area.

2.0 METHODOLOGY

The habitat assessment was conducted via boat since the majority of the survey areas were inaccessible to vehicular traffic. PBS&J biologists traversed the survey area as close to beachfront habitat as water depth would allow (approximately 50-150 yards), coming ashore to further document habitat conditions when water conditions were acceptable recording habitat descriptions, and noting which bird species were present on the site.

3.0 RESULTS

3.1 TEXAS COASTLINE

Typical Texas coastal/beachfront habitat represented by Photos 1 and 2 consists of mud/clay beachfront, approximately 5 to 30 feet in width, with decaying vegetation throughout. An approximately 1 foot layer of decaying seaweed covered the majority of the Texas beachfront. Upland from the mud/clay beachfront was a 1 to 3 foot mud/clay shelf leading to narrow expanses of sand and shell. The majority of Texas beachfront did not contain any tidal flats or mud flats. The Texas coastline in the study area was typical of severely eroded beaches that lack sand replenishment.

Upland from the sand/shell areas was found dense vegetation, including saltwort (*Batis maritima*), annual glasswort (*Salicornia bigelovii)*, seashore salt grass (*Distichlis spicata*), and a variety of beach grasses. Typical birds occurring in the survey area included sanderling (*Calidris alba*), greater yellowlegs (*Tringa melanoleuca*), laughing gull (*Larus atricilla*), Herring gull (*Larus argentatus*), Least tern (*Sterna antillarum*), and common tern (*Sterna hirundo*).

Surveyed areas along the Texas coast provide little shorebird habitat, and no suitable piping plover habitat. Construction activities represented in Photo 3 are currently ongoing along the Texas shoreline. Construction activities are located approximately 2.40 miles from the western jetty extending to the western boundary of the survey area. Numerous vehicles, heavy equipment, and watercraft were traversing this area during the survey period.

3.2 LOUISIANA COASTLINE

The Louisiana coastline contained tidal sand/mudflats, sand bars, and sandy beaches with tidal flats. A tidal sand/mudflat (Photo 5) was located approximately 0.37 miles from base of the east jetty, approximately 500 yards off the beach, and varied from approximately 10 to 150 yards in width. The sand/mudflat extended for approximately 1.65 miles and ran parallel to the coastline, connecting to the beach approximately 2 miles from the eastern jetty. The sand/mudflat contained a variety of avian species, including great blue heron (*Ardea herodias*), great egret (*Ardea alba*), least

tern, common tern, laughing gull, and herring gull. This tidal sand/mudflat represented in Photo 5 contained suitable piping plover feeding habitat.

A sand bar (Photo 6) , resulting from beneficial use of dredged material by Cheniere Sabine Pass LNG Project, was located approximately 0.50 miles from the eastern jetty, beginning approximately 1,400 yards offshore, extended for approximately 1.00 miles, and ended approximately 400 yards offshore. The sandbar varied from approximately 10 to 150 feet in width, contained no vegetation, but was occupied by a variety of avian species. Bird species found on the sandbar included brown pelican (*Pelecanus occidentalis*), least tern, common tern, laughing gull, herring gull, and greater yellowlegs. The sandbar contains tidal flats that appeared to be suitable for piping plover feeding habitat.

Approximately 2 miles from the eastern jetty, sandy beaches began and extended to the eastern boundary of the survey area. The sandy beaches (Photos 7 and 8) varied in width from 50 to 300 feet in width and ended at an eroded shoreline. Located upland from the sandy beaches were sometimes dense stands of typical shoreline vegetation, including saltwort, annual glasswort, seashore salt grass, salt cedar (*Tamarix spp.*) and a variety of beach grasses. On other sections, the upland vegetation was scattered. Typical birds occurring in the survey area included sanderling, greater yellowlegs, laughing gull, Herring gull, least tern, common tern, and black skimmer (*Rynchops niger*). Sandy beaches found in the Louisiana coastline survey area contained tidal flats, with sparse vegetation, making this area suitable for wintering piping plovers.

4.0 DISCUSSION AND CONCLUSIONS

The habitat assessment of the Texas coastline identified no areas suitable for wintering piping plovers. The coastline consisted of a clay/mud shelf, varying in height from 1 to 3 feet and inhibiting tide waters from flowing over the narrow stretches of sand and shell. The likelihood of this area being utilized by piping plovers is remote.

The habitat assessment of the Louisiana coastline identified several areas suitable for wintering piping plovers. The large tidal sand/mudflats and sandbars located offshore appeared to provide piping plover feeding habitat. The sandy beaches found within the survey area contain tidal flats with sparse vegetation and appear to provide feeding and roosting habitat for wintering piping plovers.

Photo 1 - Typical view of Texas coastline, facing northeast.

Photo 2 - Typical view of Texas coastline, facing west.

Photo 3 - Texas coastline construction activities, facing northwest.

Photo 4 - View of Texas coastline, facing north.

Photo 5 - View of sand/mudflat along the Louisiana coastline, facing east.

Photo 6 - View of sandbar with avian species along the Louisiana coastline.

Photo 7 - View of Louisiana coastline, facing west.

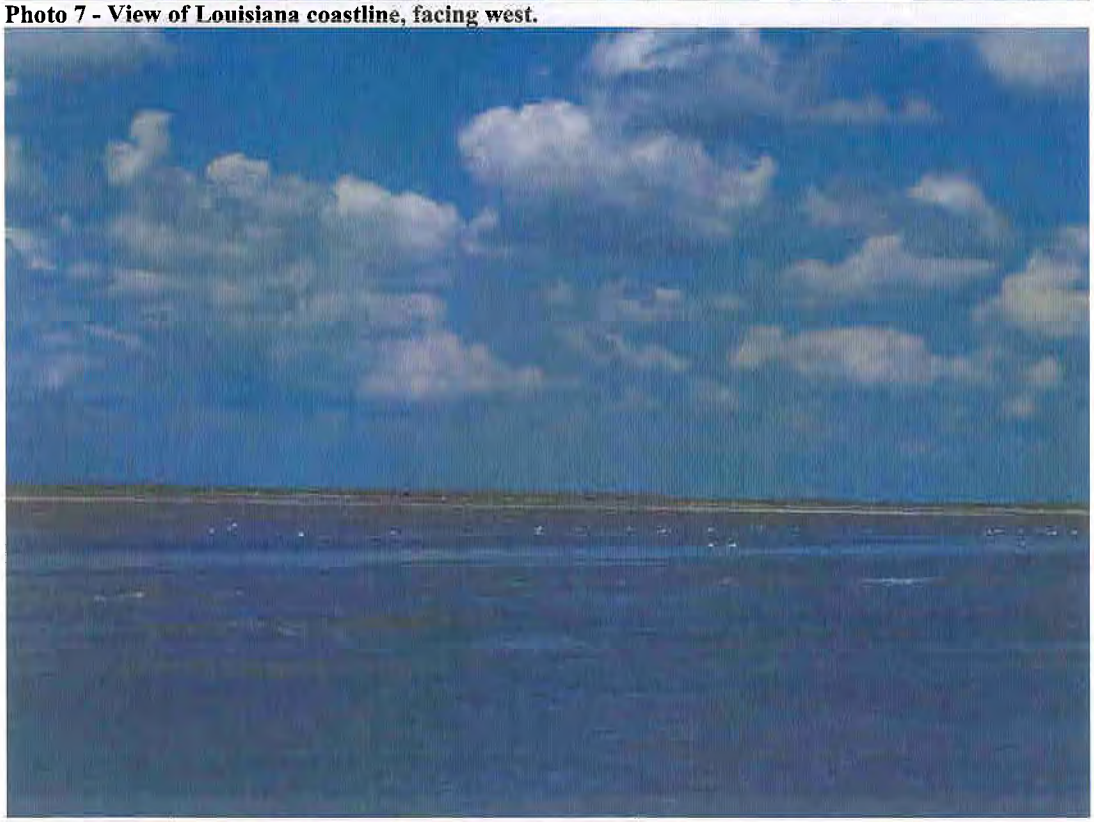

Photo 8 - View of Louisiana coastline, facing northeast.

Appendix G2

Biological Opinion

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701
(727) 824-5312; FAX (727) 824-5309
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AUG 13 2007

F/SER31:MCB

Ms. Carolyn Murphy
Galveston District, U.S. Army Corps of Engineers
P.O. Box 1229
Galveston, TX 77553

Dear Ms. Murphy:

This constitutes the National Marine Fisheries Service's biological opinion (opinion) based on our review of the U.S. Army Corps of Engineers' (COE) proposed action to widen and deepen the Sabine-Neches Waterway involving a combination of mechanical, pipeline, and hopper dredges. The opinion analyzes the project's effects on loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), and green *(Chelonia mydas)* sea turtles, in accordance with section 7 of the Endangered Species Act (ESA) of 1973. It is NMFS' biological opinion that the action, as proposed, is likely to adversely affect but is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, or green sea turtles.

This opinion is based on information provided in your February 21, 2007, letter and biological assessment, and a May 2, 2007, e-mail, as well as information from previous NMFS consultations conducted on the use of hopper dredges. A complete administrative record of this consultation is on file at NMFS' Southeast Regional Office.

We look forward to further cooperation with you on other COE projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Michael Barnette, fishery biologist, at the number listed above, or by e-mail at michael.barnette@noaa.gov.

Sincerely,

Thomas E. Weaver

For Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.F.1.TX
1514-22.F.1.LA
Ref: F/SER/2007/00954

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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Sincerely,

Thomas E. Weaver

For Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.F.1.TX
1514-22.F.1.LA
Ref: F/SER/2007/00954

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency: U.S. Army Corps of Engineers, Galveston District (GDCOE)

Activity: Sabine-Neches Waterway Widening and Deepening (Consultation Number F/SER/2007/00954)

Consulting Agency: National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida

Approved By: James E. Weaver

For Roy E. Crabtree, Ph.D., Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

Date Issued: AUG 13 2007

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Background

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 *et seq.*), requires that each federal agency shall ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species; section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. NMFS and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat or issues a biological opinion (opinion) that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures - RPMs) to reduce the effect of take, and recommends conservation measures to further conserve the species. Notably, no incidental destruction or adverse modification of critical habitat can be authorized, and thus there are no reasonable and prudent measures, only reasonable and prudent alternatives that must avoid destruction or adverse modification.

This document represents NMFS' opinion based on our review of impacts associated with the proposed widening and deepening of the Sabine-Neches Waterway (SNWW). The proposed widening and deepening will occur along a 65-mile long deep draft channel on the Louisiana-Texas border, from the Gulf of Mexico through a jettied channel at Sabine Pass, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont, Texas. Deepening of the entrance channels will be accomplished with hopper dredges, while the inshore channels will be modified with hydraulic pipeline dredges. Some of the dredged material will be utilized to restore several degraded marsh areas, while the remainder will be disposed of in upland placement areas or at Ocean Dredged Material Disposal Sites (ODMDS).

The GDCOE will perform the proposed action. This opinion analyzes project effects on loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles, in accordance with section 7 of the ESA, and is based on project information provided by GDCOE and other sources of information including the published literature cited herein.

BIOLOGICAL OPINION

1 CONSULTATION HISTORY

The GDCOE provided NMFS a biological assessment for the proposed project on February 21, 2007. This submission also requested ESA section 7 consultation for listed species. The biological assessment concluded the proposed action could potentially impact sea turtles.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

2.1 Proposed Action

The proposed widening and deepening of the SNWW will involve a combination of hydraulic pipeline and hopper dredges. Specific work includes:

1. Widening the Sabine Pass Jetty Channel, the Sabine Pass Channel, and the Port Arthur Canal to the junction of Taylors Bayou from 500 to 700 feet. Widening the entrance and connecting channels of Taylors Bayou Navigation Channel.
2. Deepening of the Sabine Pass Jetty Channel, the Sabine Pass Channel, the Port Arthur Canal, the Sabine-Neches Canal, and the Neches River Channel to the Port of Beaumont from 40 to 48 feet. Deepening the Taylors Bayou Navigation Channel and turning basins to 48 feet.
3. Deepening the existing SNWW Entrance Channel in the Gulf of Mexico from 42 to 50 feet, plus advance maintenance and allowable overdepth, and constructing an extension of the offshore entrance channel (50 x 700 feet for 13.1 miles).
4. Dredging two new anchorage basins, two new turning basins, and three turning and anchorage basins on the Neches River Channel, and reducing the existing Sabine Pass anchorage basin in size by approximately 50 percent.
5. Restoring three degraded marsh areas on the Neches River, six degraded marsh areas near Willow and Black Bayous, Louisiana, and nourish Gulf shorelines at Texas and Louisiana Points.
6. Establishing four new Ocean Dredged Material Disposal Sites (ODMDS) along the 13.1-mile extension of the offshore entrance channel.

Dredging the Sabine Pass Jetty and Entrance Channels will be conducted by hopper dredge, while hydraulic pipeline dredge will modify the remaining channels and basins. The proposed project new work would generate 110 million cubic yards of dredged material. Of that total, hopper dredges will remove approximately 44.69 million cubic yards; hydraulic pipeline dredges will remove the remainder. GDCOE informed NMFS that bed-leveling dredges will not be used in connection with the proposed action.

The dredging of the channels and basins is expected to require 4.75 years to complete, with several contracts running simultaneously. The GDCOE's Dredged Material Management Plan for the SNWW has a 50-year project life.

Future maintenance dredging of the SNWW will be covered under the revised regional biological opinion for Gulf of Mexico navigation channels (GMRBO; NMFS 2007). Because the widening and deepening of the SNWW is considered new work, the proposed action is not encompassed by the GMRBO. However, even though the dimensions of the SNWW would be expanded by the proposed action, the overall footprint (i.e., widening) of the SNWW would only have an insignificant increase in area. Therefore, since the total amount of future maintenance dredging of the SNWW would not be significantly increased, the effects of future maintenance dredging would be included in the existing GMRBO and any potential takes resulting from future maintenance dredging would be deducted from the ITS from that opinion. Subsequent placement of dredged material for shoreline restoration would occur every three years and alternate between Texas and Louisiana Points, so that placement of materials at each shoreline would occur every six years.

2.2 Action Area

50 CFR 404.02 defines action area as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." The action area for this activity includes the 65-mile long deep draft channel running through Jefferson and Orange Counties, Texas, Cameron Parish, Louisiana, as well as waters of the Gulf of Mexico, and includes the associated ODMDS, all of which is bounded by a one-mile buffer area.

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

The following endangered (E) and threatened (T) species under the jurisdiction of NMFS may occur in or near the action area:

Common Name	Scientific Name	Status
Sea Turtles		
Loggerhead sea turtle	*Caretta caretta*	T
Hawksbill sea turtle	*Eretmochelys imbricata*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Green sea turtle	*Chelonia mydas*[1]	E/T

There is no NMFS-designated critical habitat within the action area.

3.1 Species Likely to Be Affected

Pipeline and mechanical dredges (i.e., non-hopper dredges) are not known to introduce any direct impacts that may adversely affect sea turtles. While these dredges have the potential to impact habitat, which could adversely affect sea turtles, proposed dredging work will be confined to

[1] Green turtles in U.S. waters are listed as threatened except for the Florida breeding population, which is listed as endangered. 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.

existing channels devoid of preferred sea turtle foraging habitat, and, therefore, pipeline and mechanical dredges are not expected to introduce any indirect effects to sea turtles. However, loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles are all vulnerable to being taken as a result of the use of hopper dredges. NMFS believes these species may be incidentally captured in the course of the proposed action. Therefore, the remainder of the analysis in this biological opinion will focus on these species.

3.2 Status of Species

The sea turtle subsections focus primarily on the Atlantic Ocean populations of these species since these are the populations that may be directly affected by the proposed action; as sea turtles are highly migratory, potentially affected species in the action area may make migrations in other areas of the Gulf of Mexico, Atlantic Ocean, and Caribbean Sea. Therefore, the range-wide status of the species described below also best reflects each species' status within the action area. Furthermore, these species are listed as global populations (with the exception of Kemp's ridley and Florida green sea turtles, whose distribution is entirely in the Atlantic including the Gulf of Mexico), and the global status and trends of these species are included as well, in order to provide a basis for our final determination of the effects of the proposed action on the species as listed under the ESA.

3.2.1 Loggerhead Sea Turtle

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. It was listed because of direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat. Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. In the Atlantic, developmental habitat for small juveniles is the pelagic waters of the North Atlantic and the Mediterranean Sea (NMFS and USFWS 1991b). Within the continental United States, loggerhead sea turtles nest from Texas to New Jersey. Major nesting areas include coastal islands of Georgia, South Carolina, and North Carolina, and the Atlantic and Gulf of Mexico coasts of Florida, with the bulk of the nesting occurring on the Atlantic coast of Florida.

3.2.1.1 Pacific Ocean

In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. Within the Pacific Ocean, loggerhead sea turtles are represented by a northwestern nesting aggregation located in Japan and a smaller southwestern nesting aggregation, which occurs in eastern Australia (Great Barrier Reef and Queensland) and New Caledonia (NMFS 2001a). There are no reported loggerhead nesting sites in the eastern or central Pacific Ocean basin. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten et al. 1996). Recent genetic analyses on female loggerheads nesting in Japan suggest that this "subpopulation" is comprised of genetically distinct nesting colonies (Hatase et al. 2002) with precise natal homing of individual females. As a result, Hatase et al. (2002) indicate that loss of one of these colonies would decrease the genetic diversity of Japanese loggerheads; recolonization of the site would not be expected on an ecological time scale. In Australia, long-term census data has been collected at

some rookeries since the late 1960s and early 1970s, and nearly all the data show marked declines in nesting populations since the mid-1980s (Limpus and Limpus 2003). The nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

Pacific loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas; direct harvest and commercial fisheries off Baja California, Mexico; commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean; and California/Oregon drift gillnet fisheries. In addition, the abundance of loggerhead turtles on nesting colonies throughout the Pacific basin has declined dramatically over the past 10 to 20 years. Loggerhead turtle colonies in the western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (e.g., due to egg poaching).

3.2.1.2 Atlantic Ocean

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. There are at least five western Atlantic subpopulations, divided geographically as follows: (1) A northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29°N; (2) a south Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990; TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2001a). Additionally, there is evidence of at least several other genetically distinct stocks, including a Cay Sal Bank, Western Bahamas stock; a Quintana Roo, Mexico stock, including all loggerhead rookeries on Mexico's Yucatan Peninsula; a Brazilian stock; and a Cape Verde stock (SWOT Report, Volume II, The State of the World's Sea Turtles, 2007). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Fidelity for nesting beaches makes recolonization of nesting beaches with sea turtles from other subpopulations unlikely.

Life History and Distribution

Past literature gave an estimated age at maturity of 21-35 years (Frazer and Ehrhart 1985; Frazer et al. 1994), with the benthic immature stage lasting at least 10-25 years. However, based on data from tag returns, strandings, and nesting surveys (NMFS 2001a), NMFS estimates ages of maturity ranging from 20-38 years with the benthic immature stage lasting from 14-32 years.

Mating takes place in late March through early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs in the southeastern United States. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests/individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd 1988). Generally, loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years or more. Stranding records

indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length they begin to live in coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico, although some loggerheads may move back and forth between the pelagic and benthic environment (Witzell 2002). Benthic immature loggerheads (sea turtles that have come back to inshore and nearshore waters), the life stage following the pelagic immature stage, have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in Northeastern Mexico.

Tagging studies have shown loggerheads that have entered the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures. Loggerhead sea turtles occur year round in offshore waters off North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to immigrate to North Carolina inshore waters (e.g., Pamlico and Core Sounds) and also move up the coast (Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in mid-Atlantic and Northeast areas until late fall. By December loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore North Carolina, particularly off Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles ($\geq$ 11°C) (Epperly et al. 1995a; Epperly et al. 1995b; Epperly et al. 1995c). Loggerhead sea turtles are year-round residents of central and south Florida.

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

Population Dynamics and Status

A number of stock assessments (TEWG 1998; TEWG 2000; NMFS 2001a; Heppell et al. 2003) have examined the stock status of loggerheads in the waters of the United States, but have been unable to develop any reliable estimates of absolute population size. Based on nesting data of the five western Atlantic subpopulations, the south Florida-nesting and the northern-nesting subpopulations are the most abundant (TEWG 2000; NMFS 2001a). Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,014 to 92,182, annually with a mean of 73,751 (TEWG 2000). On average, 90.7 percent of these nests were of the south Florida subpopulation and 8.5 percent were from the northern subpopulation (TEWG 2000). The TEWG (2000) assessment of the status of these two better-studied populations concluded that the south Florida subpopulation was increasing at that time, while no trend was evident (may be stable but possibly declining) for the northern subpopulation. A more recent, yet-to-be-published analysis of nesting data from 1989-2005 by the Florida Wildlife Research Institute indicates there is a declining trend in nesting at beaches utilized by the south Florida nesting subpopulation (McRae letter to NMFS, October 25, 2006). Nesting data obtained for the 2006 nesting season is also consistent with the decline in loggerhead nests (Meylan pers. comm. 2006). It is unclear at this time whether the nesting decline reflects a decline in

population, or is indicative of a failure to nest by the reproductively mature females as a result of other factors (resource depletion, nesting beach problems, oceanographic conditions, etc.). NMFS has convened a new Turtle Expert Working Group for loggerhead sea turtles that will gather available data and examine the potential causes of the nesting decline and what the decline means in terms of population status. A final report by the loggerhead TEWG is expected by the end of summer 2007.

For the northern subpopulations, recent estimates of loggerhead nesting trends in Georgia from standardized daily beach surveys showed significant declines ranging from 1.5 to 1.9 percent annually (Mark Dodd, Georgia Department of Natural Resources, pers. comm., 2006). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.3 percent annual decline in nesting since 1980. Another consideration that may add to the importance and vulnerability of the northern subpopulation is the sex ratios of this subpopulation. NMFS scientists have estimated that the northern subpopulation produces 65 percent males (NMFS 2001a). However, new research conducted over a limited time frame has found opposing sex ratios (Wyneken et al. 2004) so further information is needed to clarify the issue. Since nesting female loggerhead sea turtles exhibit nest fidelity, the continued existence of the northern subpopulation is related to the number of female hatchlings that are produced. Producing fewer females will limit the number of subsequent offspring produced by the subpopulation.

The remaining three subpopulations – Dry Tortugas, Florida Panhandle, and Yucatán – are much smaller, but also relevant to the continued existence of the species. Nesting surveys for the Dry Tortugas subpopulation are conducted as part of Florida's statewide survey program. Survey effort has been relatively stable during the 9-year period from 1995-2003 (although the 2002 year was missed). Nest counts ranged from 168-270 but with no detectable trend during this period (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). Nest counts for the Florida Panhandle subpopulation are focused on index beaches rather than all beaches where nesting occurs. Currently, there is not enough information to detect a trend for the subpopulation (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Index Nesting Beach Survey Database). Similarly, nesting survey effort has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation. However, there is some optimistic news. Zurita et al. (2003) found a statistically significant increase in the number of nests on seven of the beaches on Quintana Roo, Mexico, from 1987-2001 where survey effort was consistent during the period.

Threats

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton et al. 1994). Also, many nests were destroyed during the 2004 hurricane season. Other sources of natural mortality include cold stunning and biotoxin exposure.

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, beach armoring and nourishment, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, beach driving, coastal construction and fishing piers, exotic dune and beach vegetation, and poaching. An increase in human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (e.g., raccoons, armadillos, and opossums) which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (e.g., Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density east Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Loggerhead sea turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation, marine pollution, underwater explosions, hopper dredging, offshore artificial lighting, power plant entrainment and/or impingement, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, poaching, and fishery interactions. Loggerheads in the pelagic environment are exposed to a series of longline fisheries, which include the Atlantic highly migratory species (HMS) pelagic longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various longline fleets in the Mediterranean Sea (Aguilar et al. 1995; Bolten et al. 1996). Loggerheads in the benthic environment in waters off the coastal United States are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gillnet, pound net, longline, and trap fisheries (see further discussion in Section 4.2, Environmental Baseline).

3.2.1.3 Summary of Status for Loggerhead Sea Turtles

The abundance of loggerhead turtles on nesting beaches throughout the Pacific basin has declined dramatically over the past 10 to 20 years. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten et al. 1996), but it has probably declined since 1995 and continues to decline (Tillman 2000). The nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

In the Atlantic Ocean, absolute population size is not known, but based on extrapolation of nesting information, loggerheads are likely much more numerous than in the Pacific Ocean. NMFS recognizes five subpopulations of loggerhead sea turtles in the western north Atlantic based on genetic studies. Cohorts from all of these are known to occur within the action area of this consultation. The South Florida subpopulation may be critical to the survival of the species in the Atlantic Ocean because of its size (over 90 percent of all U.S. loggerhead nests are from this subpopulation). In the past, this nesting aggregation was considered second in size only to the nesting aggregation on islands in the Arabian Sea off Oman (Ross 1979; Ehrhart 1989; NMFS and USFWS 1991b). However, the status of the Oman colony has not been evaluated recently and it is located in an area of the world where it is highly vulnerable to disruptive events such as political upheavals, wars, catastrophic oil spills, and lack of strong protections for sea

turtles (Meylan et al. 1995). Given the lack of updated information on this population, the status of loggerheads in the Indian Ocean basin overall is essentially unknown.

All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects that negatively influence the status of the species. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (i.e., fisheries in international waters).

3.2.2 Kemp's Ridley Sea Turtle

The Kemp's ridley was listed as endangered on December 2, 1970. Internationally, the Kemp's ridley has been considered the most endangered sea turtle (Zwinenberg 1977; Groombridge 1982; TEWG 2000). Kemp's ridleys nest primarily at Rancho Nuevo, a stretch of beach in Mexico, Tamaulipas State. This species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Occasional individuals reach European waters (Brongersma 1972). Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the United States.

3.2.2.1 Atlantic Ocean

Life History and Distribution
The TEWG (1998) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998). Nesting occurs from April into July and is essentially limited to the beaches of the western Gulf of Mexico, near Rancho Nuevo in southern Tamaulipas, Mexico. The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season.

Little is known of the movements of the post-hatchling stage (pelagic stage) within the Gulf of Mexico. Studies have shown the post-hatchling pelagic stage varies from 1-4 or more years, and the benthic immature stage lasts 7-9 years (Schmid and Witzell 1997). Benthic immature Kemp's ridleys have been found along the eastern seaboard of the United States and in the Gulf of Mexico. Atlantic benthic immature sea turtles travel northward as the water warms to feed in the productive, coastal waters off Georgia through New England, returning southward with the onset of winter (Lutcavage and Musick 1985; Henwood and Ogren 1987; Ogren 1989). Studies suggest that benthic immature Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud 1995).

Stomach contents of Kemp's ridleys along the lower Texas coast consisted of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fishery discards (Shaver 1991). Pelagic stage Kemp's ridleys presumably feed on the available *Sargassum* and associated infauna or other epipelagic species found in the Gulf of Mexico.

Population Dynamics and Status
Of the seven extant species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the Rancho Nuevo beaches (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in

1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s nest numbers were below 1,000 (with a low of 702 nests in 1985). However, observations of increased nesting with 6,277 nests recorded in 2000, 10,000 nests in 2005, and 12,143 nests recorded during the 2006 nesting season (Gladys Porter Zoo nesting database) show the decline in the ridley population has stopped and the population is now increasing.

A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an apparent increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets and Mexican beach protection efforts. As demonstrated by nesting increases at the main nesting sites in Mexico, adult ridley numbers have increased over the last decade. The population model used by TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015.

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath et al. 1987; Musick and Limpus 1997). The juvenile population of Kemp's ridley sea turtles in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997). These juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes spp.*, *Ovalipes spp.*, *Libinia sp.*, and *Cancer spp.* Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds, as well as smaller juveniles from New York and New England, to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly et al. 1995a; Epperly et al. 1995b).

Threats

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold stunning. Although cold stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999-2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green turtles were found on Cape Cod beaches (R. Prescott, pers. comm., 2001). Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stunning events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality.

Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, five Kemp's ridley

carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The five ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction because it is unlikely that all of the carcasses washed ashore.

3.2.2.2 Summary of Kemp's Ridley Status

The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). The number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 percent per year from 1985 to 1999. Current totals are 12,059 nests in Mexico in 2006 (August 8, 2006, e-mail from Luis Jaime Peña - Conservation Biologist, Gladys Porter Zoo). Kemp's ridleys mature at an earlier age (7-15 years) than other chelonids, thus "lag effects" as a result of unknown impacts to the non-breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (USFWS and NMFS 1992).

The largest contributors to the decline of Kemp's ridleys in the past were commercial and local exploitation, especially poaching of nests at the Rancho Nuevo site, as well as the Gulf of Mexico trawl fisheries. The advent of TED regulations for trawlers and protections for the nesting beaches has allowed the species to begin to rebound. Many threats to the future of the species remain, including interactions with fishery gear, marine pollution, foraging habitat destruction, illegal poaching of nests and potential threats to the nesting beaches from such sources as global climate change, development, and tourism pressures.

3.2.3 Hawksbill Sea Turtle

The hawksbill turtle was listed as endangered under the precursor of the ESA on June 2, 1970, and is considered Critically Endangered by the International Union for the Conservation of Nature (IUCN). The hawksbill is a medium-sized sea turtle, with adults in the Caribbean ranging in size from approximately 62.5 to 94.0 cm straight carapace length. The species occurs in all ocean basins, although it is relatively rare in the Eastern Atlantic and Eastern Pacific, and absent from the Mediterranean Sea. Hawksbills are the most tropical of the marine turtles, ranging from approximately 30°N to 30°S latitude. They are closely associated with coral reefs and other hard-bottom habitats, but they are also found in other habitats including inlets, bays and coastal lagoons (NMFS and USFWS 1993). There are five regional nesting populations with more than 1,000 females nesting annually. These populations are in the Seychelles, Mexico, Indonesia, and two in Australia (Meylan and Donnelly 1999). There has been a global population decline of over 80 percent during the last three generations (105 years) (Meylan and Donnelly 1999).

3.2.3.1 Pacific Ocean

Anecdotal reports throughout the Pacific indicate that the current Pacific hawksbill population is well below historical levels (NMFS 2004b). It is believed that this species is rapidly

approaching extinction in the Pacific because of harvesting for its meat, shell, and eggs as well as destruction of nesting habitat (NMFS 2001). Hawksbill sea turtles nest in the Hawaiian Islands as well as the islands and mainland of southeast Asia, from China to Japan, and throughout the Philippines, Malaysia, Indonesia, Papua New Guinea, the Solomon Islands, and Australia (NMFS 2004b). However, along the eastern Pacific Rim where nesting was common in the 1930s, hawksbills are now rare or absent (NMFS 2004b).

3.2.3.2 Atlantic Ocean

In the Western Atlantic, the largest hawksbill nesting population occurs in the Yucatán Peninsula of Mexico (Garduño-Andrade et al. 1999). With respect to the United States, nesting occurs in Puerto Rico, the USVI, and the southeast coast of Florida. Nesting also occurs outside of the United States and its territories in Antigua, Barbados, Costa Rica, Cuba, and Jamaica (Meylan 1999a). Outside of the nesting areas, hawksbills have been seen off of the U.S. Gulf of Mexico states and along the eastern seaboard as far north as Massachusetts, although sightings north of Florida are rare (NMFS and USFWS 1993).

The best estimate of age at sexual maturity for hawksbill sea turtles is about 20-40 years (NMFS 2004b). Reproductive females undertake periodic (usually non-annual) migrations to their natal beach to nest. Movements of reproductive males are less well known, but are presumed to involve migrations to their nesting beach or to courtship stations along the migratory corridor (Meylan 1999b). Females nest an average of 3-5 times per season (Meylan and Donnelly 1999). Clutch size is larger on average (up to 250 eggs) than that of other turtles (Hirth 1980). Reproductive females may exhibit a high degree of fidelity to their nest sites.

The life history of hawksbills consists of a pelagic stage that lasts from the time they leave the nesting beach as hatchlings until they are approximately 22-25 cm in straight carapace length (Meylan and Donnelly 1999), followed by residency in developmental habitats (foraging areas where juveniles reside and grow) in coastal waters. Adult foraging habitat, which may or may not overlap with developmental habitat, is typically coral reefs, although other hard-bottom communities and occasionally mangrove-fringed bays may be occupied. Hawksbills show fidelity to their foraging areas over several years (van Dam and Díez 1998).

The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan 1988). Other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (Leon and Díez 2000).

Estimates of the annual number of nests at hawksbill sea turtle nesting sites are of the order of hundreds to a few thousand. Nesting within the southeastern United States and U.S. Caribbean is restricted to Puerto Rico (>650 nests/yr), the USVI (~400 nests/yr), and, rarely, Florida (0-4 nests/yr) (Meylan 1999a; Florida Fish and Wildlife Conservation Commission; Florida Marine Research Institute's Statewide Nesting Beach Survey data 2002). At the two principal nesting beaches in the U.S. Caribbean where long-term monitoring has been carried out, populations appear to be increasing (Mona Island, Puerto Rico) or stable (Buck Island Reef National Monument, St. Croix, USVI) (Meylan 1999a).

As described for other sea turtle species, hawksbill sea turtles are affected by habitat loss, habitat degradation, fishery interactions, and poaching in some parts of their range. There continues to be a black market for hawksbill shell products ("tortoiseshell"), which likely contributes to the harvest of this species.

3.2.3.3 Summary of Status for Hawksbill Sea Turtles

Worldwide, hawksbill sea turtle populations are declining. They face many of the same threats affecting other sea turtle species. In addition, there continues to be a commercial market for hawksbill shell products, despite protections afforded to the species under U.S. law and international conventions.

3.2.4 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtle species. The large size of adult leatherbacks and their tolerance to relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS 1995). Adult leatherbacks forage in temperate and subpolar regions from 71°N to 47°S latitude in all oceans and undergo extensive migrations to and from their tropical nesting beaches. In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). That number, however, is probably an overestimation as it was based on a particularly good nesting year in 1980 (Pritchard 1996). By 1995, the global population of adult females had declined to 34,500 (Spotila et al. 1996). Pritchard (1996) also called into question the population estimates from Spotila et al. (1996), and felt they may be somewhat low, because it ended the modeling on data from a particularly bad nesting year (1994) while excluding nesting data from 1995, which was a good nesting year. However, Spotila et al. (1996) represents the best overall estimate of adult female leatherback population size.

3.2.4.1 Pacific Ocean

Based on published estimates of nesting female abundance, leatherback populations have collapsed or have been declining at all major Pacific basin nesting beaches for the last two decades (Spotila et al. 1996, NMFS and USFWS 1998, Sarti et al. 2000, Spotila et al. 2000). For example, the nesting assemblage on Terengganu, Malaysia – which was one of the most significant nesting sites in the western Pacific Ocean – has declined severely from an estimated 3,103 females in 1968 to two nesting females in 1994 (Chan and Liew 1996). Nesting assemblages of leatherback turtles are in decline along the coasts of the Solomon Islands, a historically important nesting area (D. Broderick, pers. comm., in Dutton et al. 1999). In Fiji, Thailand, Australia, and Papua New Guinea (East Papua), leatherback turtles have only been known to nest in low densities and scattered colonies.

Only an Indonesian nesting assemblage has remained relatively abundant in the Pacific basin. The largest extant leatherback nesting assemblage in the Indo-Pacific lies on the north Vogelkop

coast of Irian Jaya (West Papua), Indonesia, with over 3,000 nests recorded annually (Putrawidjaja 2000, Suarez et al. 2000). During the early-to-mid 1980s, the number of female leatherback turtles nesting on the two primary beaches of Irian Jaya appeared to be stable. More recently, this population has come under increasing threats that could cause this population to experience a collapse that is similar to what occurred at Terengganu, Malaysia. In 1999, for example, local Indonesian villagers started reporting dramatic declines in sea turtle populations near their villages (Suarez 1999). Unless hatchling and adult turtles on nesting beaches receive more protection, this population will continue to decline. Declines in nesting assemblages of leatherback turtles have been reported throughout the western Pacific region, with nesting assemblages well below abundance levels observed several decades ago (e.g., Suarez 1999).

In the western Pacific Ocean and South China Seas, leatherback turtles are captured, injured, or killed in numerous fisheries, including Japanese longline fisheries. The poaching of eggs, killing of nesting females, human encroachment on nesting beaches, beach erosion, and egg predation by animals also threaten leatherback turtles in the western Pacific.

In the eastern Pacific Ocean, nesting populations of leatherback turtles are declining along the Pacific coast of Mexico and Costa Rica. According to reports from the late 1970s and early 1980s, three beaches on the Pacific coast of Mexico supported as many as half of all leatherback turtle nests for the eastern Pacific. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 individuals during 1998-99 and 1999-2000 (Sarti et al. 2000). Spotila et al. (2000) reported the decline of the leatherback turtle population at Playa Grande, Costa Rica, which had been the fourth largest nesting colony in the world. Between 1988 and 1999, the nesting colony declined from 1,367 to 117 female leatherback turtles. Based on their models, Spotila et al. (2000) estimated that the colony could fall to less than 50 females by 2003-2004. Leatherback turtles in the eastern Pacific Ocean are captured, injured, or killed in commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru, and purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries. Because of the limited data, we cannot provide high-certainty estimates of the number of leatherback turtles captured, injured, or killed through interactions with these fisheries. However, between 8-17 leatherback turtles were estimated to have died annually between 1990 and 2000 in interactions with the California/Oregon drift gillnet fishery; 500 leatherback turtles are estimated to die annually in Chilean and Peruvian fisheries; 200 leatherback turtles are estimated to die in direct harvests in Indonesia; and before 1992, the North Pacific driftnet fisheries for squid, tuna, and billfish captured an estimated 1,000 leatherback turtles each year, killing about 111 of them each year.

Although all causes of the declines in leatherback turtle colonies in the eastern Pacific have not been documented, Sarti et al. (1998) suggest that the declines result from egg poaching, adult and sub-adult mortalities incidental to high seas fisheries, and natural fluctuations due to changing environmental conditions. Some published reports support this suggestion. Sarti et al. (2000) reported that female leatherback turtles have been killed for meat on nesting beaches like Píedra de Tiacoyunque, Guerrero, Mexico. Eckert (1997) reported that swordfish gillnet fisheries in Peru and Chile contributed to the decline of leatherback turtles in the eastern Pacific. The decline in the nesting population at Mexiquillo, Mexico, occurred at the same time that effort doubled in the Chilean driftnet fishery. In response to these effects, the eastern Pacific

population has continued to decline, leading some researchers to conclude that the leatherback is on the verge of extinction in the Pacific Ocean (e.g., Spotila et al. 1996, Spotila et al. 2000). The NMFS assessment of three nesting aggregations in its February 23, 2004, opinion supports this conclusion: If no action is taken to reverse their decline, leatherback sea turtles nesting in the Pacific Ocean either have high risks of extinction in a single human generation (for example, nesting aggregations at Terrenganu and Costa Rica) or they have a high risk of declining to levels where more precipitous declines become almost certain (e.g., Irian Jaya) (NMFS 2004a).

3.2.4.2 Atlantic Ocean

In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS SEFSC 2001). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (NMFS SEFSC 2001). Genetic analyses of leatherbacks to date indicate that within the Atlantic basin there are genetically different nesting populations; the St. Croix nesting population (U.S. Virgin Islands), the mainland nesting Caribbean population (Florida, Costa Rica, Suriname/French Guiana), and the Trinidad nesting population (Dutton et al. 1999). When the hatchlings leave the nesting beaches, they move offshore but eventually utilize both coastal and pelagic waters. Very little is known about the pelagic habits of the hatchlings and juveniles, and they have not been documented to be associated with the *Sargassum* areas as are other species. Leatherbacks are deep divers, with recorded dives to depths in excess of 1,000 m (Eckert et al. 1999, Hayes et al. 2004).

Life History and Distribution

Leatherbacks are a long-lived species, living for over 30 years. They reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin 1985) to 13-14 years (Zug and Parham 1996). They nest frequently (up to 10 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30 percent) of the eggs can be infertile. Thus, the actual proportion of eggs that can result in hatchlings is less than this seasonal estimate. The eggs incubate for 55-75 days before hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26~C until they exceed 100 cm ccl.

Although leatherbacks are the most pelagic of the sea turtles, they enter coastal waters on a seasonal basis to feed in areas where jellyfish are concentrated. Leatherback sea turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates.

Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate, and tropical waters (NMFS and USFWS 1992). A 1979 aerial survey of the outer continental shelf from Cape Hatteras, North Carolina, to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the

area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in waters where depths ranged from 1-4,151 m, but 84.4 percent of sightings were in areas where the water was less than 180 m deep (Shoop and Kenney 1992). Leatherbacks were sighted in waters of a similar sea surface temperature as loggerheads; from 7-27.2°C (Shoop and Kenney 1992). However, this species appears to have a greater tolerance for colder waters because more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). This aerial survey estimated the in-water leatherback population from near Nova Scotia, Canada to Cape Hatteras, North Carolina at approximately 300-600 animals.

Population Dynamics and Status

The status of the Atlantic leatherback population is less clear than the Pacific population. The total Atlantic population size is undoubtedly larger than in the Pacific, but overall population trends are unclear. In 1996, the entire western Atlantic population was characterized as stable at best (Spotila et al. 1996), with numbers of nesting females reported to be on the order of 18,800. A subsequent analysis by Spotila (pers. comm.) indicated that by 2000, the western Atlantic nesting population had decreased to about 15,000 nesting females. The nesting aggregation in French Guiana has been declining at about 15 percent per year since 1987 (NMFS SEFSC 2001). However, from 1979-1986, the number of nests was increasing at about 15 percent annually which could mean that the current 15 percent decline could be part of a nesting cycle which coincides with the erosion cycle of Guiana beaches described by Schultz (1975). In Suriname, leatherback nest numbers have shown large recent increases (with more than 10,000 nests per year since 1999 and a peak of 30,000 nests in 2001), and the long-term trend for the overall Suriname and French Guiana population may show an increase (Girondot 2002 in Hilterman and Goverse 2003). The number of nests in Florida and the U.S. Caribbean has been increasing at about 10.3 percent and 7.5 percent, respectively, per year since the early 1980s, but the magnitude of nesting is much smaller than that along the French Guiana coast (NMFS SEFSC 2001). Also, because leatherback females can lay 10 nests per season, the recent increases to 400 nests per year in Florida may represent as few as 40 individual female nesters per year.

In summary, the conflicting information regarding the status of Atlantic leatherbacks makes it difficult to characterize the current status. Numbers at some nesting sites are increasing, but are decreasing at other sites. Tag return data emphasize the wide-ranging nature of the leatherback and the link between South American nesters and animals found in U.S. waters. For example, a nesting female tagged May 29, 1990, in French Guiana was later recovered and released alive from the York River, Virginia. Another nester tagged in French Guiana on June 21, 1990, was later found dead in Palm Beach, Florida (STSSN database). Genetic studies performed within the Northeast Distant Fishery Experiment indicate that the leatherbacks captured in the Atlantic highly migratory species pelagic longline fishery were primarily from the French Guiana and Trinidad nesting stocks (over 95 percent). Individuals from West African stocks were surprisingly absent (Roden et al. In press).

There are a number of problems contributing to the uncertainty of the leatherback nest counts and population assessments. The nesting beaches of the Guianas (Guyana, French Guiana, and Suriname) and Trinidad are by far the most important in the western Atlantic. However, beaches in this region undergo cycles of erosion and reformation, so that the nesting beaches are not consistent over time. Additionally, leatherback sea turtles do not exhibit the same degree of

nest-site fidelity demonstrated by loggerhead and other hardshell sea turtles, further confounding analysis of population trends using nesting data. Reported declines in one country and reported increases in another may be the result of migration and beach changes, not true population changes. Nesting surveys, as well as being hampered by the inconsistency of the nesting beaches, are themselves inconsistent throughout the region. Survey effort varies widely in the seasonal coverage, aerial coverage, and actual surveyed sites. Surveys have not been conducted consistently throughout time, or have even been dropped entirely as the result of wars, political turmoil, funding vagaries, etc. The methods vary in assessing total numbers of nests and total numbers of females. Many sea turtle scientists agree that the Guianas (and some would include Trinidad) should be viewed as one population and that a synoptic evaluation of nesting at all beaches in the region is necessary to develop a true picture of population status (Reichart et al. 2001). No such region-wide assessment has been conducted recently.

The most recent, complete estimates of regional leatherback populations are in Spotila et al. (1996). As discussed above, nesting in the Guianas may have been declining in the late 1990s but may have increased again in the early 2000s. Spotila et al. estimated that the leatherback population for the Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. We believe that the current population probably still lies within this range, taking into account the reported nesting declines and increases and the uncertainty surrounding them. We therefore choose to rely on Spotila et al.'s (1996) published total Atlantic population estimates, rather than attempt to construct a new population estimate here, based on our interpretation of the various, confusing nesting reports from areas within the region.

Threats

Zug and Parham (1996) pointed out that the main threat to leatherback populations in the Atlantic is the combination of fishery-related mortality (especially entanglement in gear and drowning in trawls) and the intense egg harvesting on the main nesting beaches. Other important ongoing threats to the population include pollution, loss of nesting habitat, and boat strikes.

Of sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, possibly their method of locomotion, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets and pot/trap lines (used in various fisheries) and capture in trawl gear (e.g., shrimp trawls).

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. Unlike loggerhead turtle interactions with longline gear, leatherback turtles do not usually ingest longline bait. Instead, leatherbacks are foul hooked by longline gear (e.g., on the flipper or shoulder area) rather than getting mouth hooked or swallowing the hook (NMFS SEFSC 2001). According to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NMFS SEFSC 2001). The U.S. fleet accounts for only 5 to 8 percent of the hooks fished in the Atlantic Ocean, and adding up the under-represented observed takes of the

other 23 countries that actively fish in the area would lead to annual take estimates of thousands of leatherbacks over different life stages. Basin-wide, Lewison et al. (2004) estimated that 30,000-60,000 leatherback sea turtle captures occurred in Atlantic pelagic longline fisheries in the year 2000 alone (note that multiple captures of the same individual are known to occur, so the actual number of individuals captured may not be as high).

Leatherbacks are also susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer et al. 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer et al. 2002). Fixed gear fisheries in the mid-Atlantic have also contributed to leatherback entanglements. In North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (D. Fletcher, pers. comm. to S. Epperly in NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico Sound near Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (D. Fletcher, pers. comm. to S. Epperly in NMFS SEFSC 2001). In the Southeast, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 was due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to J. Braun-McNeill in NMFS SEFSC 2001). Because many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much higher.

Leatherback interactions with the southeast Atlantic shrimp fishery, which operates predominately from North Carolina through southeast Florida (NMFS 2002), have also been a common occurrence. Leatherbacks, which migrate north annually, are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast from Cape Canaveral, Florida, to the Virginia/North Carolina border. Leatherbacks also interact with the Gulf of Mexico shrimp fishery. For many years, TEDs required for use in these fisheries were less effective at excluding leatherbacks than the smaller, hard-shelled turtle species. To address this problem, on February 21, 2003, the NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks and large and sexually mature loggerhead and green turtles.

Other trawl fisheries are also known to interact with leatherback sea turtles. In October 2001, a Northeast Fisheries Science Center observer documented the take of a leatherback in a bottom otter trawl fishing for Loligo squid off of Delaware; TEDs are not required in this fishery. The winter trawl flounder fishery, which did not come under the revised TED regulations, may also interact with leatherback sea turtles.

Gillnet fisheries operating in the nearshore waters of the mid-Atlantic states are also suspected of capturing, injuring, and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92 percent.

Poaching is not known to be a problem for nesting populations in the continental U.S. However, in 2001 the NMFS Southeast Fishery Science Center (SEFSC) noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands and the Guianas. In all, four of the five strandings in St. Croix were the result of poaching (Boulon 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is on eggs.

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage et al. 1997, Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained plastic (Mrosovsky 1981). Along the coast of Peru, intestinal contents of 19 of 140 (13 percent) leatherback carcasses were found to contain plastic bags and film (Fritts 1982). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks.

It is important to note that, like marine debris, fishing gear interactions and poaching are problems for leatherbacks throughout their range. Entanglements are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are reported taken by many other nations that participate in Atlantic pelagic longline fisheries, including Taipei, Brazil, Trinidad, Morocco, Cyprus, Venezuela, Korea, Mexico, Cuba, U.K., Bermuda, People's Republic of China, Grenada, Canada, Belize, France, and Ireland (see NMFS SEFSC 2001, for a description of take records). Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo et al. 1994, Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback sea turtle population in French Guiana (Chevalier et al. 1999), and gillnets targeting green and hawksbill turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux et al. 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio-M 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50 to 95 percent (Eckert and Lien 1999). However, many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS SEFSC 2001).

3.2.4.3 Summary of Leatherback Status

In the Pacific Ocean, the abundance of leatherback turtle nesting individuals and colonies has declined dramatically over the past 10 to 20 years. Nesting colonies throughout the eastern and western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females. In addition, egg poaching has reduced the reproductive success of the remaining nesting females. At current rates of decline, leatherback turtles in the Pacific basin are a critically endangered species with a low probability of surviving and recovering in the wild.

In the Atlantic Ocean, our understanding of the status and trends of leatherback turtles is much more confounded, although the picture does not appear nearly as bleak as in the Pacific. The number of female leatherbacks reported at some nesting sites in the Atlantic Ocean has increased, while at others they have decreased. Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic: leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in state, federal, and international waters. Poaching is a problem and affects leatherbacks that occur in U.S. waters. Leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species.

3.2.5 Green Sea Turtle

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered. The nesting range of the green sea turtles in the southeastern United States includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina, the U.S. Virgin Islands (USVI) and Puerto Rico (NMFS and USFWS 1991a). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties (Ehrhart and Witherington 1992). Green sea turtle nesting also occurs regularly on St. Croix, USVI, and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Mackay and Rebholz 1996).

3.2.5.1 Pacific Ocean

Green turtles are thought to be declining throughout the Pacific Ocean, with the exception of Hawaii, from a combination of overexploitation and habitat loss (Seminoff 2002). In the western Pacific, the only major (>2,000 nesting females) populations of green turtles occur in Australia and Malaysia, with smaller colonies throughout the area. Indonesia has a widespread distribution of green turtles, but has experienced large declines over the past 50 years. Hawaii green turtles are genetically distinct and geographically isolated, and the population appears to be increasing in size despite the prevalence of fibropapilloma and spirochidiasis (Aguirre et al. 1998 in Balazs and Chaloupka 2003). In the eastern Pacific, mitochondrial DNA analysis has indicated that there are three key nesting populations: Michoacan, Mexico; Galapagos Islands, Ecuador; and Islas Revillagigedos, Mexico (Dutton 2003). There is also sporadic green turtle nesting along the Pacific coast of Costa Rica.

3.2.5.2 Atlantic Ocean

Life History and Distribution
The estimated age at sexual maturity for green sea turtles is between 20-50 years (Balazs 1982; Frazer and Ehrhart 1985). Green sea turtle mating occurs in the waters off the nesting beaches. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs 1983). After hatching, green sea turtles go through a post-hatchling pelagic stage where they are associated with drift lines of algae and other debris. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal 1997).

Green sea turtles are primarily herbivorous, feeding on algae and sea grasses, but also occasionally consume jellyfish and sponges. The post-hatchling, pelagic-stage individuals are assumed to be omnivorous, but little data are available.

Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or sea grasses. This includes areas near mainland coastlines, islands, reefs, or shelves, and any open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth 1997; NMFS and USFWS 1991a). Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty 1984; Hildebrand 1982; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon System, Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven 1992; Guseman and Ehrhart 1992). Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs.

Population Dynamics and Status
The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Meylan et al. 1995; Johnson and Ehrhart 1994). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index Nesting Beach Survey Database). Current nesting levels in Florida are reduced compared to historical levels, reported by Dodd (1981). However, total nest counts and trends at index beach sites during the past 17 years suggest the numbers of green sea turtles that nest within the southeastern United States are increasing.

Although nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging and developmental grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the

Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1997). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997).

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas (where they come to forage) of the southeastern United States. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant (they have averaged 215 green sea turtle captures per year since 1977) in St. Lucie County, Florida (on the Atlantic coast of Florida) show that the annual number of immature green sea turtles captured has increased significantly in the past 26 years (FPL 2002).

It is likely that immature green sea turtles foraging in the southeastern United States come from multiple genetic stocks; therefore, the status of immature green sea turtles in the southeastern United States might also be assessed from trends at all of the main regional nesting beaches, principally Florida, Yucatán, and Tortuguero. Trends at Florida beaches were previously discussed. Trends in nesting at Yucatán beaches cannot be assessed because of a lack of consistent beach surveys over time. Trends at Tortuguero (ca. 20,000-50,000 nests/year) showed a significant increase in nesting during the period 1971-1996 (Bjorndal et al. 1999), and more recent information continues to show increasing nest counts (Troëng and Rankin 2004). Therefore, it seems reasonable that there is an increase in immature green sea turtles inhabiting coastal areas of the southeastern United States; however, the magnitude of this increase is unknown.

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the over-exploitation of green sea turtles for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. However, there are still significant and ongoing threats to green sea turtles from human-related causes in the United States. These threats include beach armoring, erosion control, artificial lighting, beach disturbance (e.g., driving on the beach), pollution, foraging habitat loss as a result of direct destruction by dredging, siltation, boat damage, other human activities, and interactions with fishing gear. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. There is also the increasing threat from green sea turtle fibropapillomatosis disease. Presently, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Herbst 1994; Jacobson, 1990; Jacobson et al. 1991).

3.2.5.3 Summary of Status for Atlantic Green Sea Turtles

Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare in benthic areas north of Cape Hatteras (Wynne and Schwartz 1999). Green turtles face many of the same natural and anthropogenic threats as for loggerhead sea turtles described above. In addition, green turtles are also

susceptible to fibropapillomatosis, which can result in death. In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Recent population estimates for the western Atlantic area are not available. Between 1989 and 2006, the annual number of green turtle nests at core index beaches ranged from 267 to 7,158 (Florida Marine Research Institute Statewide Nesting Database). While the pattern of green turtle nesting shows biennial peaks in abundance, there is a generally positive trend since establishment of index beaches in Florida in 1989.

4 ENVIRONMENTAL BASELINE

This section contains a description of the effects of past and ongoing human activities leading to the current status of the species, their habitat, and the ecosystem, within the action area. The environmental baseline is a snapshot of the factors affecting the species and includes federal, state, tribal, local, and private actions already affecting the species, or that will occur contemporaneously with the consultation in progress. Unrelated, future federal actions affecting the same species that have completed formal or informal consultation are also part of the environmental baseline, as are implemented and ongoing federal and other actions within the action area that may benefit listed species.

4.1 Status of Sea Turtles in the Action Area

Sea turtles found in the immediate project area may travel widely throughout the Atlantic, Gulf of Mexico, and Caribbean Sea, and individuals found in the action area can potentially be affected by activities anywhere within this wide range. Thus, the status of the species in the action area is the same as the species' range-wide status discussed in section 3 above.

4.1.2 Federal Actions

In recent years, NMFS has undertaken numerous ESA section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered sea turtle species. Each of those consultations sought to develop ways of reducing the probability of adverse effects of the action on sea turtles. Similarly, recovery actions NMFS has undertaken under the ESA are addressing the problem of take of sea turtles in the fishing and shipping industries and other activities such as COE dredging operations. The summary below of anticipated sources of incidental take of sea turtles from federal actions includes only those actions which have already concluded or are currently undergoing formal section 7 consultation.

Fisheries

Adverse effects on threatened and endangered sea turtles from several types of fishing gear occur in the action area. These gears, including gillnet, hook-and-line (i.e., vertical line), and trawl gear; have all been documented as interacting with sea turtles. For all fisheries for which there is a fishery management plan (FMP) or for which any federal action is taken to manage that fishery, the impacts have been evaluated via section 7 consultation. Formal section 7 consultations have been conducted on the southeast shrimp trawl fishery, which is the only federally-managed fishery operating in the action area.

The southeast shrimp trawl fishery affects more sea turtles than all other activities combined (NRC 1990). On December 2, 2002, NMFS completed the opinion for shrimp trawling in the southeastern United States under proposed revisions to the TED regulations (68 FR 8456, February 21, 2003). This opinion determined that the shrimp trawl fishery under the revised TED regulations would not jeopardize the continued existence of any sea turtle species. This determination was based, in part, on the opinion's analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94 percent for loggerheads and 97 percent for leatherbacks. An incidental take statement (ITS) has been issued for the take of sea turtles in this fishery. More detailed information can be found in the opinion (NMFS 2002).

Formal section 7 consultations have also been conducted for the issuance of several exempted fishing permits (EFP). These opinions have concluded the proposed activities may adversely affect but were not likely to jeopardize the continued existence of any sea turtles. ITSs for each EFP issued were provided.

Vessel and Military Operations

Potential sources of adverse effects from federal vessel operations in the action area include operations of the U.S. Department of Defense (DOD), Navy (USN), Air Force and Coast Guard (USCG), the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and the COE. NMFS has conducted formal consultations with the USCG, the USN, and NOAA on some of their vessel operations. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. At the present time, however, they present the potential for some level of interaction. Refer to the Biological Opinions for the USCG (NMFS 1995; NMFS 1996; NMFS 1998) and the USN (NMFS 1997a) for details on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

Since the USN consultation only covered operations out of Mayport, Florida, potential still remains for USN vessels to adversely affect sea turtles within the action area. Similarly, operations of vessels by other federal agencies within the action area (NOAA, EPA, COE) may adversely affect sea turtles. However, the in-water activities of those agencies are limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

Dredging

The construction and maintenance of federal navigation channels and sand mining ("borrow") areas has also been identified as a source of sea turtle mortality. Hopper dredges move relatively rapidly (compared to sea turtle swimming speeds) and can entrain and kill sea turtles as the drag arm of the moving dredge overtakes the slower moving sea turtle. On September 22, 1995, NMFS completed the Regional Biological Opinion (RBO) issued to the COE, New Orleans and Galveston Districts, on hopper dredging of channels in Texas and Louisiana. NMFS reinitiated consultation with all Gulf of Mexico COE districts (i.e., Galveston, New Orleans, Mobile, and Jacksonville) on November 19, 2003, and issued an ITS for the entire Gulf of Mexico from the U.S.-Mexico border to Key West. This opinion determined that all channel dredging (i.e.,

maintenance dredging) and sand mining by hopper dredges in the Gulf of Mexico under the purview of the COE's Gulf districts would not jeopardize the continued existence of any sea turtle species. NMFS amended the GRBO on June 24, 2005 (Revision 1), and subsequently amended it a second time on January 9, 2007 (Revision 2).

ESA Permits
The ESA allows the issuance of permits to take ESA-listed species for the purposes of scientific research (section 10(a)(1)(a)). In addition, the ESA allows for the NMFS to enter into cooperative agreements with states developed under section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with section 7 of the ESA.

Sea turtles are the focus of research activities authorized by a section 10 permit under the ESA. There are currently 31 active scientific research permits (NMFS unpublished data) directed toward sea turtles that are applicable to the action area of this opinion. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, blood sampling, tissue sampling (biopsy), and performing laparoscopy on intentionally captured turtles. The number of authorized takes varies widely depending on the research and species involved but may involve the taking of hundreds of turtles annually. Most takes authorized under these permits are expected to be non-lethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, issuance of the permit by the NMFS must also be reviewed for compliance with section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species.

4.1.3 State or Private Actions

Vessel Traffic
Commercial traffic and recreational pursuits can have an adverse effect on sea turtles through propeller and boat strike damage. Private vessels participate in high-speed marine events concentrated in the southeastern United States and are a particular threat to sea turtles, and occasionally to marine mammals as well. The magnitude of these marine events is not currently known. NMFS and the USCG (who permit these events) have consulted on some of these events, but a complete analysis has not been completed. NMFS has also consulted with other agencies, such as MMS and FERC, on vessel transit interactions with listed species.

State Fisheries
Several coastal state fisheries are known to incidentally take listed species, but information on these fisheries is sparse (NMFS 2001a). Various fishing methods used in these commercial and recreational fisheries, including trawling, pot fisheries, gillnets, and vertical line are all known to incidentally take sea turtles, but information on these fisheries is sparse (NMFS 2001a). Most state data are based on extremely low observer coverage or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem. The 2001 HMS Biological Opinion (NMFS 2001b) has an excellent summary of turtles taken in state fisheries throughout the action area.

To address data gaps, several state agencies have initiated observer programs to collect information on interactions between listed species and certain gear types. Other states have closed nearshore waters to gear-types known to have high encounter rates with listed species. Depending on the fishery in question, many state permit holders also hold federal permits; therefore, existing section 7 consultations on federal fisheries may address some of the state fishery impacts.

Additional information on impact of take (i.e., associated mortality) is also needed for analysis of impacts to sea turtles from these fisheries. Certain gear types may have high levels of sea turtle takes, but very low rates of serious injury or mortality. For example, hook-and-line takes rarely are dead upon retrieval of gear, but trawls and gillnets frequently result in immediate mortality. Leatherbacks seem to be susceptible to a more restricted list of fisheries, while hardshell turtles, particularly loggerheads, seem to appear in data from almost all state fisheries. The HMS opinion also summarizes sea turtle interactions with flynets and various trawl techniques that occur within the action area.

Texas, Louisiana, Mississippi, and Florida have placed restrictions on gillnet fisheries within state waters such that very little commercial gillnetting takes place in southeastern waters.

Observations of state recreational fisheries have shown that loggerhead, leatherback, and green sea turtles are known to bite baited hooks, and loggerheads frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, and beach, banks, and jetties and from commercial fishermen fishing for reef fish and for sharks with both single rigs and bottom longlines (NMFS 2001b). A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead sea turtles can be found in the TEWG reports (1998; 2000).

4.1.4 Other Potential Sources of Impacts in the Environmental Baseline

A number of activities that may indirectly affect listed species in the action area of this consultation include ocean dumping and disposal, aquaculture, and anthropogenic marine debris. The impacts from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study impacts from these sources. Close coordination is occurring through the section 7 process on both dredging and disposal sites to develop monitoring programs and ensure that vessel operators do not contribute to vessel-related impacts.

Marine Pollution

Sources of pollutants in the Gulf of Mexico coastal regions include atmospheric loading of pollutants such as PCBs, stormwater runoff from coastal towns, cities and villages, runoff into rivers emptying into the bays, groundwater and other discharges, and river input and runoff. Nutrient loading from land-based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo et al. 1986), the impacts of many other anthropogenic toxins have not been investigated.

Acoustic Impacts
Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. Although focused on marine mammals, sea turtles may benefit from increased research on acoustics and reduction in noise levels.

4.1.5 Conservation and Recovery Actions Shaping the Environmental Baseline

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial fisheries. In particular, NMFS has required the use of TEDs in southeast U.S. shrimp trawls since 1989. It has been estimated that TEDs exclude 97 percent of the sea turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), floatation, and more widespread use. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimensions in TEDs in use at that time were too small, and that as many as 47 percent of the loggerheads stranding annually along the Atlantic Seaboard and Gulf of Mexico were too large to fit through existing openings. On February 21, 2003, NMFS published a final rule to require larger escape openings in TEDs used in the Southeast shrimp trawl fishery (68 FR 8456, February 21, 2003). Based upon the analyses in Epperly et al. (2002), leatherback and loggerhead sea turtles will greatly benefit from the new regulations, with expected reductions of 97 percent and 94 percent, respectively, in mortality from shrimp trawling. Several states (e.g., Florida, Georgia, South Carolina, Texas) have regulations requiring the use of TEDs in state-regulated shrimp trawl fisheries, and the federal regulations also apply in state waters.

NMFS has also been active in public outreach efforts to educate fishermen regarding sea turtle handling and resuscitation techniques. There is also an extensive network of Sea Turtle Stranding and Salvage Network (STSSN) participants along the Atlantic and Gulf of Mexico coasts who not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

Loggerheads, leatherbacks, greens, and Kemp's ridleys are known to bite a baited hook, frequently ingesting the hook. Hooked turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties. Necropsies have revealed hooks internally, which often were the cause of death. In 2006, the Marine Recreational Fishery Statistics Survey (MRFSS) added a survey question regarding sea turtle interactions within recreational fisheries; NMFS is exploring potential revisions to MRFSS to quantify recreational encounters with sea turtles on a permanent basis. Detailed summaries of the impact of hook-and-line incidental captures on loggerhead sea turtles can be found in the TEWG reports (1998; 2000).

The Recovery Plans for loggerhead and Kemp's ridley sea turtles are in the process of being updated. Recovery teams comprised of sea turtle experts have been convened and are currently working towards revising these plans based upon the latest and best available information.

5 EFFECTS OF THE ACTION

In this section of the opinion, we assess the probable effects of the proposed action on listed species within the action area. The analysis in this section forms the foundation for our jeopardy analysis in Section 7. A jeopardy determination is reached if we would reasonably expect a proposed action to cause reductions in numbers, reproduction, or distribution that would appreciably reduce a listed species' likelihood of surviving and recovering in the wild. The status of each listed sea turtle species likely to be adversely affected by the proposed action is reviewed in Section 3. Sea turtle species are listed because of their global status; a jeopardy determination must therefore find the proposed action will appreciably reduce the likelihood of survival and recovery of each species globally.

The quantitative and qualitative analyses in this section are based upon the best scientific and commercial data available on sea turtle biology and the effects of the proposed action. When analyzing the effects of any action, it is important to consider indirect effects as well as the direct effects. Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects include aspects such as habitat degradation, reduction of prey/foraging base, etc.

Previous biological opinions have documented that hopper dredging occasionally results in sea turtle entrainment and death, even with seasonal dredging windows, turtle deflector dragheads in place, and concurrent relocation trawling. For example, in the western Gulf of Mexico from February 1995 through March 2007, a total of 66 lethal takes (13 Kemp's ridleys, 27 loggerheads, and 26 greens) by Galveston District hopper dredging activities were documented during the dredging of 90.49 million cubic yards of material (U.S. Army Corps of Engineers Sea Turtle Data Warehouse, http://el.erdc.usace.army.mil/seaturtles/index.cfm). Of that total, two Kemp's and one loggerhead sea turtle takes occurred during maintenance dredging specifically in the SNWW area (Ibid).

Satellite telemetry work funded by COE and conducted by the NMFS Galveston Laboratory, demonstrates the nearshore occurrence of Kemp's ridleys near northern Gulf channels. Kemp's ridleys remained within 10 nm of shore for greater than 95 percent of the observed time, with 90 percent of the observed locations within 5 nm (M. Renaud, NMFS Galveston Laboratory, pers. comm.). Movements out of northern Gulf waters in response to cooling temperatures occurred during December, and Kemp's ridleys returned with warming waters in March.

Seasonal abundance of sea turtles utilizing nearshore waters of the northwest Gulf of Mexico varies with species and location. Green turtles within subtropical habitats of the Laguna Madre are the region's only year-round, inshore occupants. Other species, especially the Kemp's ridley, are transient users of the coastal zone that venture toward tidal passes and into bays during May-August when food sources and other environmental factors are favorable. The May-August period has yielded over 80 percent of the sea turtles captures (n=516) recorded by Texas A&M researchers (Landry et al. 1994). Based on strandings, reported incidental captures, observer data, aerial surveys, and telemetry tracks, loggerheads are distributed ubiquitously in the Gulf, generally occurring in all areas, both inshore and offshore.

Habitat Effects of Hopper Dredging
Hopper dredges widening and deepening the SNWW will directly alter the benthos through the removal of sediments. During dredging, water quality may be negatively impacted (i.e., increased turbidity) for short durations, although the area normally is extremely turbid. The widening of the SNWW will permanently and directly alter sediment quality in the portion of the SNWW to be widened. However, while sea turtles may be encountered in and near shipping channels, these areas do not provide preferred foraging opportunities. Therefore, any direct or indirect habitat impacts by dredging are expected to be insignificant in regard to ESA-listed sea turtle species.

Estimated Turtle Takes by Dredges
The proposed project would generate 110 million cubic yards of dredged material. However, hopper dredges will generate only 44.69 million cubic yards of material; hydraulic pipeline dredges will remove the remainder. Hopper dredging the SNWW has generated 32.57 million cubic yards of material from 1995-2007, which resulted in 3 turtle takes (2 Kemp's and 1 loggerhead). Therefore, on average, in the project area one turtle take is associated with every 10.86 million cubic yards of dredged material (32,565,321 cubic yards/3 turtles). This average would translate into an expected take of four turtles (three Kemp's ridley and one loggerhead or green sea turtle based on estimated catch rates by species for the western Gulf in Epperly et al. 2002, which is also consistent with species composition of reported takes in Galveston District dredging projects) during the course of the proposed project's hopper dredging; hydraulic pipeline dredges are not known to take turtles (NMFS 2007). This estimate is based on the implementation of relocation trawling to prevent additional lethal takes by hopper dredges; in the complete absence of relocation trawling, takes by hopper dredges could be higher.

Disorientation Effects of Hopper Dredge and Pumpout Barge Deck Lighting
NMFS believes that female sea turtles approaching nesting beaches, and neonates (i.e., hatchlings) emerging from nests and exiting their natal beaches, may be adversely affected by bright offshore lights from hopper dredges or hopper dredge pumpout barges operating in the nearshore (0-3 nm) environment. Females approaching the beach to nest could be deterred from nesting by bright lights in the nearshore environment. Hatchlings emerging from their nests could be attracted away from the shortest path to the water and instead crawl or swim toward the bright lights of a nearshore hopper dredge or anchored pumpout barge (instead of crawling or swimming seaward toward the open horizon), thus increasing their exposure time to predation. NMFS recently received a report from a National Park Service biologist at Gulf Islands National Seashore (M. Nicholas, pers. comm. to E. Hawk, September 29, 2003) who relocated a clutch of 97 Perdido Key hatchlings on September 28, 2003. The biologist felt that the hatchlings were in danger of being attracted to a nearby operating, brightly lit hopper dredge which was dredging one-half to one mile offshore in Pensacola Entrance Channel. NMFS considers it prudent that hopper dredges and hopper dredge pumpout barges operating within 3 nm of sea turtle nesting beaches during sea turtle nesting and sea turtle hatchling emergence season (May 1-October 31, annually), should shield essential deck lighting and reduce or extinguish non-essential deck lighting to the maximum extent possible consistent with vessel personnel safety and U.S. Coast Guard navigation requirements, to reduce potential disorientation effects, potential reduced or aborted nesting, and potential increased hatchling mortality from increased exposure to predators. This is consistent with U.S. Fish and Wildlife Service biological opinion requirements

and Florida Wildlife Commission requirements for beach nourishment projects where nesting sea turtles may be present, and was jointly developed by these agencies, the Florida Department of Environmental Protection, and the U.S. Army Corps of Engineers, Jacksonville District (R. Trindell, pers. comm. to E. Hawk, September 30, 2003). Due to the small footprint of a hopper dredge and pumpout barge, NMFS does not expect the equipment/vessels will introduce a mechanical obstacle to nesting sea turtles or hatchlings, to the extent they may be in the immediate vicinity of the SNWW.

Effects of Relocation Trawling Activities in Association with Hopper Dredging
Relocation trawling has been successful at temporarily displacing Kemp's ridley, loggerhead, leatherback, and green sea turtles from channels in the Atlantic and Gulf of Mexico during periods when hopper dredging was imminent or ongoing. Some turtles captured during relocation trawling operations return to the dredge site and are subsequently recaptured. Sea turtle relocation studies by Standora et al. (1993) at Canaveral Channel relocated 34 turtles to 6 release sites of varying distances north and south of the channel. Ten turtles returned from southern release sites, and seven from northern sites, suggesting that there was no significant difference between directions. Return times observed suggested that there was a direct correlation between relocation distance and likelihood of return or length of return time to the channel when sea turtles were relocated to the south. No correlation was observed between the northern release sites and the time or likelihood of return. The study found that relocation of turtles to the site 70 km (43 miles) south of the channel would result in a return time of over 30 days.

REMSA, a private company contracted to conduct relocation trawling, captured, tagged, and relocated 69 turtles in a 7-day period at Canaveral Channel in October 2002, with no recaptures; turtles were relocated a minimum of 3-4 miles away (T. Bargo, REMSA, pers. comm. to Eric Hawk, June 2, 2003). Twenty-four hour per day relocation trawling conducted by REMSA at Aransas Pass Entrance Channel (Corpus Christi Ship Channel) from April 15, 2003, to July 7, 2003, relocated 71 turtles from 1.5-5 miles from the dredge site, with 3 recaptures (T. Bargo, REMSA, pers. comm. to Eric Hawk, July 24, 2003). One turtle released on June 14, 2003, approximately 1.5 miles from the dredge site, was recaptured four days later; another turtle captured June 9, 2003, and released about three miles from the dredge site was recaptured nine days later. Subsequent releases occurred five miles away. Of these 68 subsequent capture/releases, 1 turtle released on June 22, 2003, was recaptured 13 days later (REMSA Final Report, Sea Turtle Relocation Trawling, Aransas Pass, Texas, April-July 2003).

Relocation trawling activities initiated by GDCOE in 2007 have resulted in the capture, tagging, and relocation of 65 green, 19 Kemp's ridley, and 9 loggerhead sea turtles as of April 20. Relocation trawling within the immediate project area (i.e., SNWW) has resulted in 7 Kemp's ridley and 11 loggerhead sea turtle captures since 2003.

Prior to 1997, most relocation trawling in association with hopper dredging was performed by the COE under an ESA section 10 incidental take/research permit. Since then, however, relocation trawling has primarily been conducted by private companies. Since approximately October 1999, Coastwise Consulting, Inc., has conducted over 1,600 days of relocation trawling at Wilmington, North Carolina; Kings Bay and Savannah, Georgia; Pensacola, Florida; and

Sabine Pass, Galveston, Freeport, Matagorda Pass, and Corpus Christi, Texas (C. Slay, e-mail to E. Hawk, January 25, 2007). During the course of that work, over 770 loggerhead, Kemp's ridley, green, and hawksbill, and leatherback sea turtles were successfully captured, tagged, and released; only one leatherback mortality has been documented, which was attributed to illegal artificial reef material deployed within a designated borrow area. On the Atlantic coast, REMSA has also successfully tagged and relocated over 140 turtles in the last several years, most notably, 69 turtles (55 loggerheads and 14 greens) in a 7-day period at Canaveral Channel in October 2002, with no significant injuries. Other sea turtle relocation contractors (R. Metzger in 2001; C. Oravetz in 2002) have also successfully and non-injuriously trawl-captured and released sea turtles out of the path of oncoming hopper dredges. More recently in the Gulf of Mexico, REMSA captured, tagged, and relocated 71 turtles at Aransas Pass with no apparent long-term ill effects to the turtles. Three injured turtles captured were subsequently transported to University of Texas Marine Science Institute rehabilitation facilities for treatment (two had old, non-trawl related injuries or wounds; the third turtle may have sustained an injury to its flipper, apparently from the door chain of the trawl, during capture). Three of the 71 captures were recaptures and were released around 1.5, 3, and 5 miles, respectively, from the dredge site; none exhibited any evidence their capture, tag, release, and subsequent recapture, was in any way detrimental.

The effects of this harassment of the turtles during capture and handling can result in raised levels of stressor hormones, and can cause some discomfort during tagging procedures. Based on past observations obtained during similar research trawling for turtles, these effects are expected to dissipate within a day (Stabenau and Vietti 1999). Since turtle recaptures are rare, and recaptures that do occur typically happen several days to weeks after initial capture, cumulative adverse effects of recapture are not expected.

The Gulf and South Atlantic Fisheries Development Foundation's August 31, 1998, "Alternatives to TEDs: Final Report," presents data on 641 South Atlantic shallow tows (only one tow was in water over 27.4 m), all conducted under restricted tow times (55 minutes during April through October and 75 minutes from November through March), and 584 Gulf of Mexico nearshore tows conducted under the same tow time restrictions. Offshore effort in the Gulf of Mexico consisted of 581 non-time restricted tows, which averaged 7.8 hours per tow. All totaled, 323 turtle observations were documented: 293 in the nearshore South Atlantic efforts, and 30 in the Gulf efforts (24 nearshore and 6 offshore). Of the 293 South Atlantic turtles (219 loggerhead, 68 Kemp' ridley, 5 green, and 1 leatherback), only 274 were used in the analyses (201 loggerhead, 67 Kemp's ridley, 5 green, and 1 leatherback) because 12 escaped from the nets after being seen and 7 were caught in try nets. Of the 274 South Atlantic turtles captured using restricted tow times, only 5 loggerheads and 1 Kemp's ridley died because of the interaction. For the Gulf efforts, 26 turtles (8 loggerhead, 16 Kemp's ridley, and 2 green) were captured, resulting in three mortalities (1 loggerhead inshore, 1 loggerhead, and 1 green offshore). Excluding all six offshore tows and both offshore mortalities (because of the prolonged, non-restricted tow times), we are left with 1,225 time-restricted tows (584 + 641) resulting in 298 trawl-captured turtles (274 + 24) resulting in seven mortalities, i.e., 2.3 percent of the interactions resulted in death.

Rarely, even properly conducted relocation trawling can result in accidental sea turtle deaths. Henwood (T. Henwood, pers. comm. to E. Hawk, December 6, 2002) noted that trawl-captured

loggerhead sea turtles died on several occasions during handling on deck during winter trawling in Canaveral Channel in the early 1980s, after short (approximately 30 minutes) tow times. However, Henwood also noted that a significant number of the loggerheads captured at Canaveral during winter months appeared to be physically stressed and in "bad shape" compared to loggerheads captured in the summer months from the same site, which appeared much healthier and robust. Stressed turtles or unhealthy turtles or turtles exposed to repeated forced submergences are more likely to be injured or killed during relocation trawling than healthy turtles.

In November 2002, during relocation trawling conducted in York Spit, Virginia, a Kemp's ridley sea turtle was likely struck by one of the heavy trawl doors or it may have been struck and killed by another vessel shortly before trawl net capture. The hopper dredge was not working in the area at the time (T. Bargo, pers. comms. and e-mails to E. Hawk, December 6 and 9, 2002). Additionally, during relocation trawling conducted off Destin, Florida, on December 2, 2006, a leatherback turtle was captured and killed. However, this mortality occurred after the trawler encountered a large section of debris, potentially illegally dumped artificial reef material, which likely impacted the sea turtle (C. Slay, pers. comms. and e-mails to E. Hawk, December 4, 2006).

NMFS typically limits tow times for relocation trawling to 42 minutes or less measured from the time the trawl doors enter the water when setting the net to the time the trawl doors exit the water during haulback ("doors in - doors out"). The National Research Council (NRC) report "Decline of the Sea Turtles: Causes and Prevention" (NRC 1990) suggested that limiting tow durations to 40 minutes in summer and 60 minutes in winter would yield sea turtle survival rates that approximate those required for the approval of new TED designs, i.e., 97 percent. The NRC report also concluded that mortality of turtles caught in shrimp trawls increases markedly for tow times greater than 60 minutes. Current NMFS TED regulations allow, under very specific circumstances, for shrimpers with no mechanical-advantage trawl retrieval devices on board, to be exempt from TED requirements if they limit tow times to 55 minutes during April through October and 75 minutes from November through March. The presumption is that these tow time limits will result in turtle survivability comparable to having TEDs installed.

In summary, NMFS believes that properly conducted and supervised relocation trawling (i.e., observing NMFS-recommended trawl speed and tow-time limits, and taking adequate precautions to release captured animals) and tagging is unlikely to result in adverse effects to sea turtles. NMFS estimates that, overall, sea turtle trawling and relocation efforts will result in considerably less than 0.5 percent mortality of captured turtles, primarily due to their being previously stressed or diseased or if struck by trawl doors or accidents on deck. On the other hand, hopper dredge entrainments invariably result in injury, and are almost always fatal. In the regional biological opinions on hopper dredging, NMFS requires relocation trawling and tagging as methods of reducing sea turtle entrainment in hopper dredges and to document the effects of relocation trawling, according to criteria defined in the ITS.

Effects and Desirability of Tagging and Taking Genetic Samples From Relocated Animals
Tagging prior to release will help NMFS learn more about the habits and identity of trawl-captured animals after they are released, and if they are recaptured they will enable improvements in relocation trawling design to further reduce the effect of the take. External and

internal flipper tagging (e.g., with Inconel and PIT tags) is not considered a dangerous procedure by the sea turtle research community, is routinely done by thousands of volunteers in the United States and abroad; and can be safely accomplished with minimal training. NMFS knows of no instance where flipper tagging has resulted in mortality or serious injury to a trawl-captured sea turtle. Such an occurrence would be extremely unlikely because the technique of applying a flipper tag is minimally traumatic and relatively non-invasive; in addition, these tags are attached using sterile techniques. Important growth, life history, and migratory behavior data may be obtained from turtles captured and subsequently relocated. Therefore, these turtles should not be released without tagging (and scanning for pre-existing tags).

Tissue sampling is performed to determine the genetic origins of captured sea turtles, and learn more about species' life history, nesting beach identification, and distribution/stock overlap. This is important information because some populations, e.g., the northern subpopulation of loggerheads nesting in the Southeast Region, may be declining. For all tissue sample collections, a sterile 4- to 6-mm punch sampler is used. Researchers who examined turtles caught two to three weeks after sample collection noted that the sample collection site was almost completely healed (Witzell, pers. comm.). NMFS does not expect that the collection of a tissue sample from each captured turtle will cause any additional stress or discomfort to the turtle beyond that experienced during capture, collection of measurements, and tagging. Tissue sampling procedures are specified in the terms and conditions of this opinion.

Estimated Turtle Takes by Relocation Trawler

This opinion will require the use of relocation trawling as a RPM to reduce the effect of take of turtles by hopper dredges. Even though relocation trawling involves directed take of turtles, it constitutes a legitimate RPM because it reduces the level of almost certain lethal and injurious take of sea turtles by hopper dredges, and allows the turtles captured non-injuriously by trawl to be relocated out of the path of the dredges. Without relocation trawling, the number of lethal takes of sea turtles by hopper dredging would likely be significantly greater than the estimated number discussed above and specified in the ITS. The Consultation Handbook (for Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act, U.S. Fish and Wildlife Service and National Marine Fisheries Service, March 1998) expressly authorizes such directed take as an RPM at page 4-54. Therefore, NMFS will in this section evaluate the expected level of turtle take through required relocation trawling, so that these levels can be included in the evaluation of whether the proposed action will jeopardize the continued existence of the species.

The number of turtles relocated by trawlers in association with Gulf of Mexico hopper dredging projects varies considerably by project area, amount of effort, and time of year. For example, in 2006 the dredging of the Houston-Galveston Navigation Channels, which produced 3.7 million cubic yards of material (i.e., similar to what is expected in the proposed action), resulted in 7 loggerheads relocated in 60 days of trawling. However, in 2006 over approximately 15 days, 34 green sea turtles were relocated during the dredging of the Brownsville Entrance Channel. Furthermore, sea turtle distribution can be very patchy, resulting in significant differences in number of turtle takes by relocation trawler. For example, in 2003, Aransas Pass relocation trawling associated with hopper dredging resulted in 71 turtles captured and released in 3 months

of relocation trawling, while the aforementioned Houston-Galveston project in 2006 only experienced 7 turtles in 2 months.

NMFS estimates that relocation trawling associated with the proposed action will take no more than 32 sea turtles (7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles based on frequency data in Epperly et al. 2002). This number is based on past recent history of relocation trawler takes in the Gulf of Mexico, the possibility that a significant pulse of turtles could be encountered by relocation trawlers (e.g., 2003 event at Aransas Pass), and increased presence of sea turtles in coastal waters as turtle populations recover and new TED regulations take effect leading to increased trawl capture rates. As stated in the RPMs and Terms and Conditions of this opinion's ITS, relocation trawling is required under specific circumstances. This relocation trawling may result in sea turtle takes, but these takes are not expected to be injurious or lethal due to the short duration of the tow times (15 to 30 minutes per tow; not more than 42 minutes, as per Term and Condition No. 13) and required safe-handling procedures.

The number of non-lethal sea turtles takes expected by relocation trawlers does not directly translate into potential lethal takes by hopper dredges in the absence of relocation trawling, due to the differences in footprint between the two gears. The spread of a relocation trawler is much greater than the intake of a hopper dredge, therefore, the trawler will encounter a significantly greater number of sea turtles. However, it is reasonable to assume that in the absence of relocation trawling the number of lethal takes would increase, but predicting a precise number (i.e., lethal take by hopper dredging in the absence of relocation trawling) would be problematic due to the fact that the COE has consistently used relocation trawling as a standard practice for the majority of its projects in the Gulf of Mexico in recent years.

Effects of Dredged Material Disposal and Establishing Four New ODMDS

Typically, dredged materials from channel maintenance dredging activities are disposed of down current of the navigation channels being maintained (by agitation dredging and sidecasting), or in designated disposal areas which are adjacent to and run approximately parallel to the navigation channels, or in nearby designated offshore disposal areas (to minimize transit time of the hopper dredge to and from the dredging site). Alternatively, they are used beneficially for barrier island restoration and creation of island, wetland, marsh, and shallow-water habitats, or to renourish eroded mainland beaches. NMFS believes that proposed disposal activities are unlikely to adversely affect sea turtles. These species are highly mobile and should be able to easily avoid a descending sediment plume discharged at the surface by a hopper dredge opening its hopper doors, or pumping its sediment load over the side. Furthermore, the disposal of dredged material will occur in areas that are not preferred sea turtle foraging habitat. Regardless, NMFS believes that foraging habitat for sea turtles is not likely a limiting factor in the Gulf of Mexico, and thus the potential temporary removal of relatively small areas (compared to remaining foraging habitat) of potential foraging habitat by burial with dredged material sediment will not measurably adversely affect sea turtles. Turtles will typically forage further offshore where non-ephemeral limestone ledges supporting algal/sponge growth are located. These ledges are not routinely covered by shifting sands, as they are prone to in the high wave-energy nearshore environment.

While the proposed project plans to dispose of dredged material in four existing ODMDS, it also proposes to dispose of material in four new ODMDS. The four new ODMDS each average approximately 3,392 acres in size, and will accommodate a total of 18.7 million cubic yards of material. They are located between 21 and 30 miles from shore in water depths ranging from 44 to 46 feet.

NMFS believes the disposal of material at four new ODMDS is unlikely to adversely affect sea turtles. These species are highly mobile and should be able to easily avoid a descending sediment plume discharged at the surface by a hopper dredge opening its hopper doors, or pumping its sediment load over the side. NMFS also believes that foraging habitat for sea turtles is not likely a limiting factor in this area of the Gulf of Mexico; thus, the temporary removal of relatively small areas (compared to remaining foraging habitat) of potential foraging habitat by burial with dredged material sediment will not significantly affect sea turtles. Turtles will typically forage further offshore where non-ephemeral limestone ledges supporting algal/sponge growth are located. There are no known limestone ledges or other associated habitat in the proposed ODMDS.

Sediment composition is a cardinal factor in controlling the settlement and viability of many marine invertebrates. In addition, benthic recovery is dependent on time of year. Placement of materials similar to ambient sediments (e.g., sand on sand or mud on mud) has been shown to produce less severe impacts in contrast to placement of dissimilar sediments, which generally results in more severe, long-term impact (Maurer et al. 1978; Maurer et al. 1986). Deposition of relatively thin layers of dredged material (<10 cm; 4 in) can minimize impacts by allowing many populations of small, shallow-burrowing infauna with characteristically high reproductive rates and wide dispersal capabilities to recover quickly. Deposits greater than 20-30 cm (8-12 in) generally eliminate all but the largest and most vigorous burrowers (Maurer et al. 1978).

Observed rates of benthic community recovery after dredged material placement range from a few months to several years. The relatively species-poor benthic assemblages associated with low salinity estuarine sediments can recover in periods of time ranging from a few months to approximately one year (Van Dolah et al. 1979; Van Dolah et al. 1984; Clarke and Miller-Way 1992), while the more diverse communities of high salinity estuarine sediments may require a year or longer (e.g., Ray and Clarke 1999). Recovery rates for sandy inshore marine sites should be similar to those reported for high salinity estuarine sites (Richardson et al. 1977; Van Dolah et al. 1984) if the overburden is comprised of similar sediments.

Most of what is known about the species-specific recovery/recolonization of benthic communities following dredge material placement in the Gulf of Mexico is the result of work by Rakocinski et al. (1991; 1996); others (e.g., Nelson 1993) have focused on benthic recovery following beach restoration. Generally, recovery/recolonization is dependent upon sediment-type, time, depth of overburden, depth, and proximity to shore. One long-term (i.e., two year) study monitored recovery and concluded recolonization occurred, although the macrobenthic community structure was different and wide fluctuations between stations were present two years post-event (Rakocinski et al. 1996). NMFS concludes that the effects of dredged material disposal on benthic communities is unlikely to adversely affect listed sea turtles because they

will avoid the sediment plumes and their foraging success is likely to be insignificantly affected by dredged material deposition.

Effects of Marsh Restoration
An inshore portion of the proposed project would beneficially use dredged material to restore several degraded marsh areas in Texas and Louisiana. The restoration work will convert approximately 716 acres of tidal marsh to open water, as well as produce 7,475 acres of fresh, intermediate, and brackish marsh.

NMFS believes that deposition of dredged materials in the littoral nearshore environment for creation/restoration of wetland, marsh, and shallow-water habitats in the Gulf of Mexico will not adversely affect sea turtles, and may ultimately be beneficial if restoration efforts are successful. Sea turtles are highly mobile and should be able to easily avoid marsh restoration work (i.e., placement of dredged material, marsh plantings). Nearshore habitats for foraging sea turtles are present in sufficient quantities such that removal of relatively small portions of potential foraging habitat will not cause measurable adverse effects on sea turtles.

The conversion of tidal marsh to open water and marsh restoration activities will potentially produce an increase in salinity of 0.5-3.0 parts per thousand in portions of the Sabine River, the marshes at Sabine Pass, and portions of Sabine Lake. NMFS believes the expected salinity increases in specific areas will not adversely affect sea turtles, and the restoration of 7,475 acres of fresh, intermediate, and brackish marsh will have a beneficial impact on the local ecosystem.

6 CUMULATIVE EFFECTS

Cumulative effects are the effects of future state, local, or private activities that are reasonably certain to occur within the action area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Within the action area, the major future change in human activities that is anticipated is associated with eastward expansion of oil and gas exploration and extraction in the Gulf of Mexico and would involve a federal action. The action area's present use for commercial and recreational fishing is expected to continue at the present levels of intensity in the near future. Residential development in coastal Texas and Louisiana is likely to increase as part of the nationwide trend of human migration to the coasts. This trend likely will not have a major effect on the action area's ability to function as a foraging habitat for turtles. As discussed in the Environmental Baseline Section, however, listed species of turtles migrate throughout the Gulf of Mexico and may be affected during their life cycles by non-federal activities outside the action area.

Throughout the coastal Gulf of Mexico, and particularly in Louisiana, the loss of thousands of acres of wetlands is occurring due to natural subsidence and erosion, as well as reduced sediment input from the Mississippi River. Impacts caused by residential, commercial, and agricultural developments appear to be the primary causes of wetland loss in Texas.

Oil spills from tankers transporting foreign oil, as well as the illegal discharge of oil and tar from vessels discharging bilge water will continue to affect water quality in the Gulf of Mexico.

Cumulatively, these sources and natural oil seepage contribute most of the oil discharged into the Gulf of Mexico. Floating tar sampled during the 1970s, when bilge discharge was still legal, concluded that up to 60 percent of the pelagic tars sampled did not originate from the northern Gulf of Mexico coast.

Marine debris will likely persist in the action area in spite of marine pollution prohibitions. In Texas and Florida, approximately half of the stranded turtles examined have ingested marine debris (Plotkin and Amos 1990; Bolten and Bjorndal 1991). Although entanglements affect fewer individuals than ingestion of debris, entanglement in marine debris may contribute more frequently to the death of sea turtles.

Coastal runoff and river discharges carry large volumes of petrochemical and other contaminants from agricultural activities, cities and industries into the Gulf of Mexico. The coastal waters of the Gulf of Mexico have more sites with high contaminant concentrations than other areas of the coastal United States, due to the large number of waste discharge point sources. Sea turtles may be exposed to and accumulate these contaminants during their life cycles, with unknown effects.

State regulated commercial and recreational fishing activities in Gulf of Mexico waters probably take endangered species. These takes are not reported and are unauthorized. It is expected that states will continue to license/permit large vessel and thrill-craft operations, which do not fall under the purview of a federal agency and will issue regulations that will affect fishery activities. NMFS will continue to work with states to develop ESA section 6 agreements and section 10 permits to enhance programs to quantify and mitigate these takes. Increased recreational vessel activity in inshore waters of the Gulf of Mexico will likely increase the number of turtles taken by injury or mortality in vessel collisions. Recreational hook-and-line fisheries have been known to lethally take sea turtles, including Kemp's ridleys. In a study conducted by the NMFS Galveston Laboratory between 1993 through 1995, 170 ridleys were reported associated with recreational hook-and-line gear; including 18 dead stranded turtles, 51 rehabilitated turtles, 5 that died during rehabilitation, and 96 that were released by fishermen (Cannon and Flanagan 1996). The STSSN also receives stranding reports that identify carcass anomalies that may be associated with the recreational fishery (entangled in line or net, fish line protruding, fish hook in mouth or digestive tract, fish line in digestive tract. The reports do not distinguish between commercial or recreational sources of gear, such as hook, net, and line, which may be used in both sectors. Cumulatively, fishery entanglement anomalies are noted in fewer than 4 percent of the stranded sea turtle carcasses reported between 1990 and 1996, and some carcasses carry more than one anomaly (e.g., fishing line in digestive tract/fishing line protruding from mouth or cloaca); therefore, summing these reports may result in some double counting.

7 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of any ESA-listed sea turtles. In Section 5, we have outlined how the proposed dredging and sediment disposal can affect sea turtles, and the extent of those effects in terms of estimates of the numbers of sea turtles caught and/or injured/killed. Now we turn to an assessment of each species' response to this impact, in terms of overall population effects from the estimated take,

and whether those effects of the proposed action, when considered in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of the affected species.

"To jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). Thus, in making this determination for each species, we must look at whether there will be a reduction in the reproduction, numbers, or distribution. Then, if there is a reduction in one or more of these elements, we evaluate whether it will cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

7.1 Effects of the Action on the Likelihood of Survival in the Wild

This section analyzes the effects of the action on the likelihood of survival of each species in the wild. In this context, the survival of the species refers to the continued existence of the species in the wild, and whether or not any anticipated take of that species will result in any reduction in reproduction, numbers, or distribution of that species that may appreciably increase a species' risk of extinction in the wild.

In the following analysis, we demonstrate that although some short-term reduction in numbers and reproduction is expected, the anticipated take of Kemp's ridley, loggerhead, and green sea turtles will not appreciably increase the risk of extinction of these species in the wild.

The lethal take of four sea turtles (three Kemp's ridley, and either one loggerhead or one green sea turtle based on estimated catch rates by species for the western Gulf in Epperly at al. 2002, which is also consistent with species composition of reported takes in Galveston District dredging projects) by hopper dredges over the duration of the proposed project could potentially result in short-term effects on individuals. Changes in distribution, even short-term, are not expected from non-lethal takes (interactions/releases from relocation trawling, vessel strikes, etc.) during the widening and deepening of the SNWW. Interactions with vessels and/or relocation trawlers may elicit startle or avoidance responses and the effects of the proposed action may result in temporary changes in behavior of sea turtles (minutes to hours) over small areas, but are not expected to reduce the distribution of any sea turtles in the action area. The removal of four sea turtles is anticipated during the proposed project. Because all the potential takes are expected to occur anywhere in the action area and sea turtles generally have large ranges in which they disperse, no reduction in the distribution of Kemp's ridley, loggerhead, and/or green sea turtles is expected from the take of these individuals.

The non-lethal take of 32 sea turtles by relocation trawlers (7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles based on frequency data in Epperly et al. 2002) is not expected to have any measurable impact on the reproduction or numbers of sea turtles. Any negative effects experienced by sea turtles captured and released by relocation trawlers are expected to be minimal and temporary in nature. Although the range of impacts of non-lethal takes are variable, all are expected to be fully recoverable such that no reductions in reproduction or numbers of Kemp's ridley, loggerhead, and/or green sea turtles are anticipated.

The removal of four sea turtles by hopper dredges would result in an instantaneous, but temporary reduction in total population numbers. Thus, the action will result in a reduction of sea turtle numbers. Sea turtle mortality resulting from hopper dredges could result in the loss of reproductive value of an adult turtle. For example, an adult loggerhead sea turtle can lay 3 or 4 clutches of eggs every 2 to 4 years, with 100 to 130 eggs per clutch. The annual loss of one adult female sea turtle, on average, could preclude the production of thousands of eggs and hatchlings, of which a small percentage are expected to survive to sexual maturity. Thus, the death of a female eliminates an individual's contribution to future generations, and the action will result in a reduction in sea turtle reproduction.

All life stages are important to the survival of the species; however, it is important to note that individuals of one life stage are not equivalent to those of other life stages. For example, loggerhead sea turtles have very long developmental times before reaching maturity (up to 38 years). Individuals in earlier life stages are subject to many potential sources of mortality, both natural and human-induced, prior to reaching sexual maturity. Only a fraction of pelagic juveniles are ever expected to contribute to the population through reproduction, and thus are not as valuable to the population as a breeding age adult. The loss of a certain number of pelagic juveniles, therefore, is less of a threat to the species' survival compared to an equal loss of sexually-mature adults.

The low number of expected sea turtle mortalities (four over the course of the project's approximately 5-year duration) is not detectable. Considering their population sizes in the Western North Atlantic, we believe the Kemp's ridley, loggerhead, and green sea turtle populations are sufficiently large enough to persist and recruit new individuals to replace those expected to be taken. For example, the TEWG (1998) estimated the total loggerhead population of benthic individuals in U.S. waters – a subset of the whole Western Atlantic population – at over 200,000. Based on this estimate, the potential mortality of 1 loggerhead over the duration of the proposed action would be less than 0.000005 percent of the current total eastern U.S. population.

The total population of Kemp's ridleys is not known, but nesting has been increasing significantly in the past several years (9 to 13 percent per year) with a trajectory that should meet or exceed recovery goals. Kemps' ridleys mature and nest at an age of 7-15 years, which is earlier than other chelonids. A younger age at maturity may be a factor in the response of this species to recovery actions. A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an apparent increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of turtle excluder devices (TEDs) in the United States and Mexican shrimping fleets and Mexican beach protection efforts. The TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015. Based on the above analysis, and similar to the conclusion reached for loggerhead sea turtles, the anticipated lethal take of three Kemp's ridley sea turtles on the population would not be expected to be detectable.

Although the anticipated mortalites would result in an instantaneous reduction in absolute population numbers, it is likely that the U.S. populations of sea turtles would not be appreciably affected considering the following. For a population to remain stable, sea turtles must replace themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. If the hatchling survival rate to maturity is greater than the mortality rate of the population, the loss of breeding individuals would be replaced through recruitment of new breeding individuals from successful reproduction of non-taken sea turtles. Even given a declining trend of a major nesting subpopulation (e.g., loggerhead sea turtles), the present population sizes of Kemp's ridley, loggerhead, and green sea are sufficiently large for their persistence. Although the declining numbers of major loggerhead sea turtle nesting subpopulations requires further study and analysis to determine the causes and long-term effects on population dynamics, the likelihood of survival in the wild of loggerhead, as well as Kemp's ridley and green sea turtles, will not be appreciably reduced as a result of this action.

Based on the above analysis, we believe that the lethal and non-lethal takes of Kemp's ridley, loggerhead, green, hawksbill, and leatherback sea turtles associated with the proposed action are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of these species of sea turtles in the wild.

7.2 Effects of the Action on the Likelihood of Recovery in the Wild

The above analysis on the effects of the action on the likelihood of each species' survival in the wild considered the current status of each species and effects of the numbers of lethal and/or non-lethal takes anticipated for each species. Although no appreciable change in distribution was concluded for any species, we concluded lethal takes would result in an instantaneous reduction in absolute population numbers that may also reduce reproduction, but the short-term reductions are not expected to appreciably reduce the likelihood of survival of any species in the wild. The following analysis considers the effects of the take on the likelihood of recovery in the wild. We consider the recovery objectives in the recovery plans prepared for each species that relate to population numbers or reproduction that may be affected by the predicted reductions in the numbers or reproduction of sea turtles resulting from the proposed action.

The Atlantic recovery plan for the United States population of the loggerhead sea turtles (NMFS and USFWS 1991a), herein incorporated by reference, lists the following relevant recovery objective over a period of 25 continuous years:

- The adult female population in Florida is increasing and in North Carolina, South Carolina, and Georgia, it has returned to pre-listing nesting levels (NC = 800 nests/season; SC = 10,000 nests/season; GA = 2,000 nests/season).

The recovery plan for Kemp's ridley sea turtles (USFWS and NMFS 1992), herein incorporated by reference, lists the following relevant recovery objective:

- Attain a population of at least 10,000 females nesting in a season.

The Atlantic recovery plan for the population of green sea turtles (NMFS and USFWS 1991b), herein incorporated by reference, lists the following relevant recovery objectives over a period of 25 continuous years:

- The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years; and
- A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

The recovery plan for the population of the hawksbill sea turtles (NMFS and USFWS 1993), herein incorporated by reference, lists the following relevant recovery objectives over a period of 25 continuous years:

- The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests at five index beaches, including Mona Island and BIRNM; and
- The numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, USVI, and Florida.

The Atlantic recovery plan for the United States population of the leatherback sea turtles (NMFS and USFWS 1992), herein incorporated by reference, lists the following relevant recovery objective:

- The adult female population increases over the next 25 years, as evidenced by as statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, USVI, and along the east coast of Florida.

The potential lethal take of three Kemp's ridley, and either one loggerhead or one green sea turtle will result in a reduction in overall population numbers in any given year. We have already determined this take is not likely to reduce population numbers over time due to current population sizes and expected recruitment. Non-lethal takes of sea turtles by relocation trawlers will not affect the adult female nesting population or number of nests per nesting season. Thus, the effects of the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley, loggerhead, green, hawksbill, and/or leatherback sea turtles recovery in the wild.

7.3 Summary

The proposed widening and deepening of the SNWW will not appreciably reduce the likelihood of the survival and recovery in the wild of any of the five species of sea turtles considered in this biological opinion. We conclude that the anticipated reduction in numbers by take of sea turtles by hopper dredges associated with the proposed action, combined with the non-lethal takes resulting from relocation trawling, when evaluated in the context of each species' status, the environmental baseline, and the cumulative effects, are not expected jeopardize the continued existence of Kemp's ridley, loggerhead, green, hawksbill, and/or leatherback sea turtles.

8 CONCLUSION

We have analyzed the best available data, the current status of the species, environmental baseline, effects of the proposed action, and cumulative effects to determine whether the proposed action is likely to jeopardize the continued existence of any sea turtle species.

Our sea turtle analyses focused on the impacts and population response of Kemp's ridley, loggerhead, green, hawksbill, and leatherback sea turtles in the Gulf of Mexico (i.e., Atlantic basin). However, the impact of the effects of the proposed action on the Atlantic populations must be directly linked to the global populations of the species, and the final jeopardy analysis is for the global populations as listed in the ESA. Because the proposed action will not reduce the likelihood of survival and recovery of any Atlantic populations of sea turtles, it is our opinion that the proposed action is also not likely to jeopardize the continued existence of Kemp's ridley, loggerhead, green, hawksbill, or leatherback sea turtles.

9 INCIDENTAL TAKE STATEMENT (ITS)

Section 9 of the ESA and protective regulations issued pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the RPMs and terms and conditions of the ITS.

Section 7(b)(4)(c) of the ESA specifies that in order to provide an incidental take statement for an endangered or threatened species of marine mammal, the taking must be authorized under section 101(a)(5) of the MMPA. Since no incidental take of listed marine mammals is expected or has been authorized under section 101(a)(5) of the MMPA, no statement on incidental take of endangered whales is provided and no take is authorized. Nevertheless, GDCOE must immediately notify (within 24 hours, if communication is possible) the NMFS' Office of Protected Resources should a take of a listed marine mammal occur.

9.1 Anticipated Amount or Extent of Incidental Take

Based on historical distribution data and observations from past COE projects, loggerhead, Kemp's ridley, and green sea turtles may occur in the action area and may be taken by hopper dredges and relocation trawlers used in the proposed action. Incidental take is anticipated; therefore, terms and conditions necessary to minimize and monitor takes are established. NMFS anticipates incidental lethal take will consist of 4 sea turtles (3 Kemp's ridley and 1 loggerhead or green sea turtle); and 32 non-injurious takes of sea turtles (7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles, based on frequency data in Epperly et al. 2002) by relocation trawling.

9.2 Effect of the Take

NMFS has determined the anticipated level of incidental take specified in Section 9.1 is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, hawksbill, leatherback, and green sea turtles.

9.3 Reasonable and Prudent Measures

NMFS has determined that the following RPMs are necessary and appropriate to minimize impacts of the incidental take of sea turtles during the proposed action. The RPMs that NMFS believes are necessary to minimize the impacts of the proposed hopper dredging have been discussed with the COE in the past and are standard operating procedures, and include the use of temporal dredging windows, intake and overflow screening, use of sea turtle deflector dragheads, observer and reporting requirements, and sea turtle relocation trawling. The following RPMS and associated terms and conditions are established to implement these measures, and to document incidental takes. Only incidental takes that occur while these measures are in full implementation are authorized. These restrictions remain valid until reinitiation and conclusion of any subsequent section 7 consultation.

Seasonal Dredging Windows, Observer Requirements, Deflector Dragheads, and Relocation Trawling[2]

Experience has shown that injuries sustained by sea turtles entrained in the hopper dredge dragheads are usually fatal. Current regional opinions for hopper dredging require seasonal dredging windows and observer monitoring requirements, deflector dragheads, and conditions and guidelines for relocation trawling, which NMFS believes are necessary to minimize effects of these removals on listed sea turtle species that occur in inshore and nearshore Gulf waters.

1. Temperature- and date-based dredging windows

Sea turtles generally move inshore with warming waters and offshore with cooling waters. In east coast channels, Dickerson et al. (1995) found reduced sea turtle abundance with water temperatures less than 16°C. They found that 1,008 trawls conducted at or below 16°C captured 22 turtles (4.4 percent), while 1,791 trawls conducted above 16°C resulted in 473 (95.6 percent) captures. Dickerson et al. also found that sea turtles tend to avoid water temperatures less than 15°C; however, hopper dredging Kings Bay, Georgia, between March 1-12, 1997, with surface water temperatures of 57-58°F (13.9-14.4°C) resulted in 11 turtle takes in nine days (NMFS 1997b).

[2] The COE sidecast dredges FRY, MERRITT, and SCHWEIZER, and split-hull hopper dredge CURRITUCK, are exempt from the above hopper dredging requirements (operating windows, deflectors, screening, observers, reporting requirements, etc.). Their small size and operating characteristics including small draghead sizes [2-ft by 2-ft, to 2-ft by 3-ft], small draghead openings [5-in by 5-in to 5 in by 8 in], small suction intake pipe diameters [10-14 in], and limited draghead suction [350-400 hp]) have been previously determined by NMFS to not adversely affect listed species (March 9, 1999, ESA consultation with COE Wilmington District, incorporated herein by reference). The aforementioned vessels and commercial hopper and sidecast dredges of the same or lesser sizes and operating characteristics working in the Gulf of Mexico would be considered similarly exempt by NMFS SERO after consultation with SERO.

Recognizing the relationship between water temperature and sea turtle presence and based on work by the NMFS Galveston Laboratory (Renaud et al. 1994, 1995) funded by the COE, NMFS wrote in its September 22, 1995, Regional Biological Opinion (RBO) to the Galveston and New Orleans Districts that sea turtles might be taken by hopper dredges "in all ship channels in the northern Gulf when temperatures exceed 12°C," and that "Lacking seasonal water temperature data, NMFS believes takes may occur from April through November northeast of Corpus Christi, Texas." Consequently, Term and Condition No. 3 of the 1995 RBO required that observers be aboard hopper dredges year-round from Corpus Christi southwest to the Mexican border, but "If no turtle take is observed in December, then observer coverage can be terminated during January and February or until water temperatures again reach 12°." It also required that "In channels northeast of Corpus Christi (except for Mississippi River – Southwest Pass), observers shall be aboard whenever surface water temperatures are 12°C or greater, and/or between April 1 and November 30."

NMFS published a final rule (67 FR 71895, December 3, 2002) effective January 2, 2003, to reduce the impact of large-mesh gillnet fisheries on the Atlantic Coast on sea turtles. This rule was directed primarily at the monkfish fishery, which uses large-mesh gillnets and operates in the area when sea turtles are present. The rule reduces impacts on endangered and threatened species of sea turtles by closing portions of the Mid-Atlantic Exclusive Economic Zone (EEZ) waters to fishing with gillnets with a mesh size larger than 8-inch (20.3-cm) stretched mesh. The timing of the restrictions was based upon an analysis of sea surface temperatures for the above areas. Sea turtles are known to migrate into and through these waters when the sea surface temperature is 11°C or greater (Epperly and Braun-McNeill 2002). The January 15 date for the re-opening of the areas north of Oregon Inlet, North Carolina, to the large-mesh gillnet fisheries was also based upon the 11°C threshold and is consistent with the seasonal boundary established for the summer flounder fishery-sea turtle protection area (50 CFR 223.206(d)(2) (iii)(A)). In summary, NMFS believes that the 11°C threshold established to protect East Coast sea turtles is reasonable and prudent to protect sea turtles in the Gulf of Mexico from hopper dredging operations.

A 1991 jeopardy Opinion to the COE's South Atlantic District on hopper dredging of southeastern U.S. channels first identified a December 1 and March 31 "hopper dredging window" as necessary to minimize sea turtle interactions. Subsequent studies by the COE (Dickerson et al. 1995) in six southeastern channels suggested that the existing windows were accurate. Sea turtles are generally less abundant in coastal waters of both the Southeast and the Gulf of Mexico during this time period compared to other times of the year since water temperatures are coolest.

Temperature- and date-based dredging windows appear to have been very effective in reducing sea turtle entrainments. Observer requirements and monitoring including assessment and relocation trawling have provided valuable real-time estimates of sea turtle abundance, takes, and distribution which have been helpful to COE project planning efforts. Evidence that the windows and observer requirements are effective and valuable is that, throughout its 8-year lifetime (the 1995 RBO was superseded by the GMRBO in 2003), neither the Galveston or New Orleans District's hopper dredging projects ever exceeded their anticipated incidental takes authorized by the 1995 RBO.

2. Observer Requirements

NMFS-approved observers monitor dredged material inflow and overflow screening baskets on many projects; however, screening is only partially effective and observed, documented takes provide only partial estimates of total sea turtle mortality. NMFS believes that some listed species taken by hopper dredges go undetected because body parts are forced through the sampling screens by the water pressure and are buried in the dredged material, or animals are crushed or killed but not entrained by the suction and so the takes may go unnoticed. The only mortalities that are documented are those where body parts either float, are large enough to be caught in the screens, and can be identified as from sea turtle species. However, this opinion estimates that with 4-inch inflow screening in place, the observers probably detect and record at least 50 percent of total mortality.

3. Deflector Dragheads

V-shaped, sea turtle deflector dragheads prevent an unquantifiable yet significant number of sea turtles from being entrained and killed in hopper dredges each year. Without them, turtle takes during hopper dredging operations would unquestionably be higher. Draghead tests conducted in May-June 1993 by the COE's Waterways Experimental Station (WES), now known as the Engineering Research and Development Center (ERDC), in clear water conditions on the sea floor off Fort Pierce, Florida, with 300 mock turtles placed in rows, showed convincingly that the newly-developed WES deflector draghead "performed exceedingly well at deflecting the mock turtles." Thirty-seven of 39 mock turtles encountered were deflected, 2 turtles were not deflected, and none were damaged. Also, "the deflector draghead provided better production rates than the unmodified California draghead, and the deflector draghead was easier to operate and maneuver than the unmodified California flat-front draghead." The V-shape reduced forces encountered by the draghead, and resulted in smoother operation. V-shaped deflecting dragheads are now a widely accepted conservation tool, the dredging industry is familiar with them and their operation, and they are used by all COE Districts conducting hopper dredge operations where turtles may be present.

4. Relocation Trawling

Relocation trawling has proved to be a useful conservation tool in most dredging projects where it has been implemented. The September 22, 1995, RBO included a conservation recommendation for relocation trawling which stated that "Relocation trawling in advance of an operating dredge in Texas and Louisiana channels should be considered if takes are documented early in a project that requires use of a hopper dredge during a period in which large number of sea turtles may occur." That RBO was amended by NMFS (Amendment No. 1, June 13, 2002) to change the conservation recommendation to a term and condition of the RBO. Overall, it is NMFS' opinion that the COE Districts choosing to implement relocation trawling have benefited from their decisions. For example, in the Galveston District, Freeport Harbor Project (July 13-September 24, 2002), assessment and relocation trawling resulted in one loggerhead capture. In Sabine Pass (Sabine-Neches Waterway), assessment and relocation trawling in July-August 2002 resulted in five loggerhead and three Kemp's ridley captures. One turtle was killed by the

dredge; this occurred while the relocation trawler was in port repairing its trawl net (P. Bargo, pers. comm. 2002). In the Jacksonville District, sea turtles have been relocated out of the path of hoppers dredges operating in Tampa Bay and Charlotte Harbor or their entrance channels. During St. Petersburg Harbor and Entrance Channel dredging in the fall of 2000, a pre-dredging risk assessment trawl survey resulted in capture, tagging, and relocation of two adult loggerheads and one subadult green turtle. In February 2002 during the Jacksonville District's Canaveral Channel emergency hopper dredging project for the Navy, two trawlers working around the clock captured and relocated 69 loggerhead and green turtles in seven days, and no turtles were entrained by the hopper dredge. In the Wilmington District's Bogue Banks Project in North Carolina, two trawlers successfully relocated five turtles in 15 days between March 13 and 27, 2003; one turtle was taken by the dredge. In 2003, Aransas Pass relocation trawling associated with hopper dredging resulted in 71 turtles captured and released (with three recaptures) in three months of dredging and relocation trawling. Five turtles were killed by the dredge. No turtles were killed after relocation trawling was increased from 12 to 24 hours per day (T. Bargo, pers. comm. to E. Hawk, October 27, 2003). In 2006, trawling associated with the dredging of the Houston-Galveston Navigation Channels resulted in 7 loggerheads relocated in 60 days of trawling (U.S. Army Corps of Engineers Sea Turtle Data Warehouse, http://el.erdc.usace.army.mil/seaturtles/index.cfm). From January through April 2007, relocation trawling activities in GDCOE channel projects have resulted in the capture and relocation of 65 green, 19 Kemp's ridley, and 9 loggerhead sea turtles as of April 20. (Ibid).

This opinion authorizes the per-fiscal-year non-lethal non-injurious take (minor skin abrasions resulting from trawl capture are considered non-injurious), external flipper-tagging, and taking of tissue samples of 30 sea turtles in any combination, though 7 loggerhead, 21 Kemp's ridley, and 2 green sea turtles would be expected based on frequency data in Epperly et al. 2002) in association with any relocation trawling conducted during the course of the proposed project. This take is limited to relocation trawling conducted during actual hopper dredging. Relocation trawling performed to reduce endangered species/hopper dredge interactions is subject to the requirements detailed in the terms and conditions of this opinion.

NMFS estimates that no turtles will be killed or injured pursuant to relocation trawling associated with the proposed project. NMFS shall be immediately notified of any injuries sustained by protected species during relocation/assessment trawling.

Summary

NMFS believes that seasonal dredging windows, deflector dragheads, observer and screening requirements, and relocation trawling have proved convincingly over the last decade to be an excellent combination of reasonable and prudent measures for minimizing the number and impact of sea turtle takes, enabling NMFS to assess the quantity of turtles being taken, and allowing the COE to meet its essential dredging requirements to keep federal navigation channels open.

There are increased costs associated with observers and relocation trawling (recent estimates are $3,500-$5,000/day for 24 hours of relocation trawling and $150-$200/day for a hopper dredge endangered species observer); delays sometimes occur, particularly when two turtles are taken in 24 hours, or when clay-like materials clog the inflow screening boxes; and dredging projects

may take longer to complete. However, overall, NMFS believes that loss of production associated with the deflector draghead is insignificant, while saving significant numbers of sea turtles from almost-certain death by dismemberment in suction dragheads; increased production costs, including costs of observers and relocation trawlers, pale in comparison to overall project costs; and NMFS' experience over the past decade with the COE's South Atlantic districts (SAD) and Gulf of Mexico's districts has shown that federal hopper dredging projects get completed in a timely fashion. Also, allowable overdredging by the COE reduces to some degree the need for frequent maintenance dredging, and the conservation measures required by the biological opinions in place result in significantly reduced dredge interactions with sea turtles–interactions which usually prove fatal.

NMFS considers that PIT tagging, external flipper tagging, and tissue sampling of turtles captured pursuant to relocation trawling, including genetic analysis of tissue samples taken from dredge- and trawl-captured turtles, will provide benefits to the species by providing data which will enable NMFS to make determinations on what sea turtle stocks are being impacted, and how that may change over time as the population growth rates change among the different stocks (S. Epperly, pers. comm. to E. Hawk).

9.4 Terms and Conditions

In order to be exempt from liability for take prohibited by section 9 of the ESA, the GDCOE must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

1. Hopper Dredging (RPM 1): Hopper dredging activities shall be completed, whenever possible, between December 1 and March 31, when sea turtle abundance is lowest throughout Gulf coastal waters.

2. Non-hopper Type Dredging (RPM 1): Pipeline or hydraulic dredges, because they are not known to take turtles, must be used whenever possible between April 1 and November 30.

3. Observers (RPM 2): The GDCOE shall arrange for NMFS-approved protected species observers to be aboard the hopper dredges to monitor the hopper bin, screening, and dragheads for sea turtles and their remains. Observer coverage sufficient for 100 percent monitoring (i.e., two observers) of hopper dredging operations is required aboard the hopper dredges year-round between April 1 and November 30, and whenever surface water temperatures are 11°C or greater.

4. Operational Procedures: During periods in which hopper dredges are operating and NMFS-approved protected species observers are *not* required, (as delineated in No. 3 above), the GDCOE must:

   a. Advise inspectors, operators, and vessel captains about the prohibitions on taking, harming, or harassing sea turtles.

b. Instruct the captain of the hopper dredge to avoid any turtles and whales encountered while traveling between the dredge site and offshore disposal area, and to immediately contact the GDCOE if sea turtles or whales are seen in the vicinity.

c. Notify NMFS if sea turtles are observed in the dredging area, to coordinate further precautions to avoid impacts to turtles.

d. Notify NMFS immediately by phone (727/824-5312), fax (727/824-5309), or e-mail (**takereport.nmfsser@noaa.gov**) if a sea turtle or other threatened or endangered species is taken by the dredge.

5. Screening (RPM 2): When sea turtle observers are required on hopper dredges, 100 percent inflow screening of dredged material is required and 100 percent overflow screening is recommended. If conditions prevent 100 percent inflow screening, inflow screening may be reduced gradually, as further detailed in the following paragraph, but 100 percent overflow screening is then required.

   a. Screen Size: The hopper's inflow screens should have 4-inch by 4-inch screening. If the GDCOE, in consultation with observers and the draghead operator, determines that the draghead is clogging and reducing production substantially, the screens may be modified sequentially: mesh size may be increased to 6-inch by 6-inch, then 9-inch by 9-inch, then 12-inch by 12-inch openings. Clogging should be greatly reduced with these flexible options; however, further clogging may compel removal of the screening altogether, in which case effective 100 percent overflow screening is mandatory. The GDCOE shall notify NMFS beforehand if inflow screening is going to be reduced or eliminated, and provide details of how effective overflow screening will be achieved.

   b. Need for Flexible, Graduated Screens: NMFS believes that this flexible, graduated-screen option is necessary, since the need to constantly clear the inflow screens will increase the time it takes to complete the project and therefore increase the exposure of sea turtles to the risk of impingement or entrainment. Additionally, there are increased risks to sea turtles in the water column when the inflow is halted to clear screens, since this results in clogged intake pipes, which may have to be lifted from the bottom to discharge the clay by applying suction.

6. Dredging Pumps: Standard operating procedure shall be that dredging pumps shall be disengaged by the operator when the dragheads are not firmly on the bottom, to prevent impingement or entrainment of sea turtles within the water column. This precaution is especially important during the cleanup phase of dredging operations when the draghead frequently comes off the bottom and can suck in turtles resting in the shallow depressions between the high spots the draghead is trimming off.

7. Sea Turtle Deflecting Draghead (RPM 3): A state-of-the-art rigid deflector draghead must be used on all hopper dredges at all times.

8. Dredge Take Reporting and Final Report: Observer reports of incidental take by hopper dredges must be faxed to NMFS' Southeast Regional Office (phone: 727/824-5312, fax: 727/824-5309, or electronic mail: **takereport.nmfsser@noaa.gov**) by onboard NMFS-approved protected species observers, the dredging company, or the GDCOE within 24 hours of any sea turtle or other listed species take observed.

   A final report summarizing the results of the hopper dredging and any documented sea turtle or other listed species takes must be submitted to NMFS within 30 working days of completion of the dredging project. Reports shall contain information on project location (specific channel/area dredged), start-up and completion dates, cubic yards of material dredged, problems encountered, incidental takes and sightings of protected species, mitigative actions taken (if relocation trawling, the number and species of turtles relocated), screening type (inflow, overflow) utilized, daily water temperatures, name of dredge, names of endangered species observers, percent observer coverage, and any other information the GDCOE deems relevant.

9. Sea Turtle Strandings: The GDCOE Project Manager or designated representative shall notify the Sea Turtle Stranding and Salvage Network (STSSN) state representative (contact information available at: http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp) of the start-up and completion of hopper dredging operations and bed-leveler dredging operations and ask to be notified of any sea turtle strandings in the project area that, in the estimation of STSSN personnel, bear signs of potential draghead impingement or entrainment, or interaction with a bed-leveling type dredge.

   Information on any such strandings shall be reported in writing within 30 days of project end to NMFS' Southeast Regional Office. Because the deaths of these turtles, if hopper dredge or bed-leveler dredge related, have already been accounted for in NMFS' jeopardy analysis, these strandings will not be counted against the GDCOE's take limit.

10. Reporting - Strandings: The GDCOE shall provide NMFS' Southeast Regional Office with a report detailing incidents, with photographs when available, of stranded sea turtles that bear indications of draghead impingement or entrainment.

11. Relocation Trawling Report (RPM 4): The GDCOE shall provide NMFS' Southeast Regional Office with an end-of-project report within 30 days of completion of any relocation trawling. This report may be incorporated into the final report summarizing the results of the hopper dredging project.

12. Conditions Requiring Relocation Trawling (RPM 4): Handling of sea turtles captured during relocation trawling in association with the dredging project shall be conducted by NMFS-approved protected species observers. Because the authorized ITS permits the lethal take of only two sea turtles, relocation trawling shall be undertaken by the GDCOE after the take of one sea turtle during the project.

13. Relocation Trawling (RPM 4): Any relocation trawling conducted or contracted by the GDCOE to temporarily reduce or assess the abundance of these listed species during a

hopper dredging project in order to reduce the possibility of lethal hopper dredge interactions, is subject to the following conditions:

a. Trawl Time: Trawl tow-time duration shall not exceed 42 minutes (doors in - doors out) and trawl speeds shall not exceed 3.5 knots.

b. Handling During Trawling: Sea turtles captured pursuant to relocation trawling shall be handled in a manner designed to ensure their safety and viability, and shall be released over the side of the vessel, away from the propeller, and only after ensuring that the vessel's propeller is in the neutral, or disengaged, position (i.e., not rotating). Resuscitation guidelines are attached (Appendix I).

c. Captured Sea Turtle Holding Conditions: Sea turtles may be held briefly for the collection of important scientific measurements, prior to their release. Captured sea turtles shall be kept moist, and shaded whenever possible, until they are released, according to the requirements of Term and Condition No. 13-e, below.

d. Scientific Measurements: When safely possible, all turtles shall be measured (standard carapace measurements including body depth), tagged, weighed, and a tissue sample taken prior to release. Any external tags shall be noted and data recorded into the observers log. Only NMFS-approved protected species observers or observer candidates in training under the direct supervision of a NMFS-approved protected species observer shall conduct the tagging/measuring/weighing/tissues sampling operations.

NMFS-approved protected species observers may conduct more invasive scientific procedures (e.g., blood letting, laparoscopies, external tumor removals, anal and gastric lavages, mounting satellite or radio transmitters, etc.) and partake in or assist in "piggy back" research projects but only if the observer holds a valid federal sea turtle research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder, and has first notified NMFS' Southeast Regional Office, Protected Resources Division.

e. Take and Release Time During Trawling - Turtles: Turtles shall be kept no longer than 12 hours prior to release and shall be released not less than 3 nm from the dredge site. If two or more released turtles are later recaptured, subsequent turtle captures shall be released not less than 5 nm away. If it can be done safely, turtles may be transferred onto another vessel for transport to the release area to enable the relocation trawler to keep sweeping the dredge site without interruption.

f. Injuries: Injured sea turtles shall be immediately transported to the nearest sea turtle rehabilitation facility. Minor skin abrasions resulting from trawl capture are considered non-injurious. The GDCOE shall ensure that logistical arrangements and support to accomplish this are pre-planned and ready. The GDCOE shall bear the financial cost of sea turtle transport, treatment, and rehabilitation.

g. Flipper Tagging: All sea turtles captured by relocation trawling shall be flipper-tagged prior to release with external tags which shall be obtained prior to the project from the University of Florida's Archie Carr Center for Sea Turtle Research. This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard these relocation trawlers to flipper-tag with external tags (e.g., Inconel tags) captured sea turtles. Columbus crabs or other organisms living on external sea turtle surfaces may also be sampled and removed under this authority.

h. PIT-Tag Scanning: This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard a relocation trawler to PIT-tag captured sea turtles. PIT tagging of sea turtles is not required to be done if the NMFS-approved protected species observer does not have prior training or experience in said activity; however, if the observer has received prior training in PIT tagging procedures, then the observer shall PIT tag the animal prior to release (in addition to the standard external tagging):

Sea turtle PIT tagging must then be performed in accordance with the protocol detailed at NMFS' Southeast Fisheries Science Center's Web page: http://www.sefsc.noaa.gov/seaturtlefisheriesobservers.jsp. (See Appendix C on SEFSC's "Fisheries Observers" Web page);

PIT tags used must be sterile, individually-wrapped tags to prevent disease transmission. PIT tags should be 125-kHz, glass-encapsulated tags–the smallest ones made. Note: If scanning reveals a PIT tag and it was not difficult to find, then do not insert another PIT tag; simply record the tag number and location, and frequency, if known. If for some reason the tag is difficult to detect (e.g., tag is embedded deep in muscle, or is a 400-kHz tag), then insert one in the other shoulder.

i. Other Sampling Procedures: All other tagging and external or internal sampling procedures (e.g., blood letting, laparoscopies, external tumor removals, anal and gastric lavages, mounting satellite or radio transmitters, etc.) performed on live sea turtles are not permitted under this opinion unless the observer holds a valid sea turtle research permit authorizing the activity, either as the permit holder or a designated agent of the permit holder.

j. PIT-Tag Scanning and Data Submission Requirements: All sea turtles captured by relocation trawling or dredges shall be thoroughly scanned for the presence of PIT tags prior to release using a multi-frequency scanner powerful enough to read multiple frequencies (including 125-, 128-, 134-, and 400-kHz tags) and read tags deeply embedded in muscle tissue (e.g., manufactured by Trovan, Biomark, or Avid). Turtles whose scans show they have been previously PIT tagged shall nevertheless be externally flipper tagged. Sea turtle data collected (PIT tag scan data and external tagging data) shall be submitted to NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149. All sea turtle data collected shall be submitted in electronic format within 60 days of project completion to Lisa.Belskis@noaa.gov and Sheryan.Epperly@noaa.gov. Sea turtle

external flipper tag and PIT tag data generated and collected by relocation trawlers shall also be submitted to the Cooperative Marine Turtle Tagging Program (CMTTP), on the appropriate CMTTP form, at the University of Florida's Archie Carr Center for Sea Turtle Research.

k. Handling Fibropapillomatose Turtles: NMFS-approved protected species observers are not required to handle viral fibropapilloma tumors if they believe there is a health hazard to themselves and choose not to. When handling sea turtles infected with fibropapilloma tumors, observers must maintain a separate set of sampling equipment for handling animals displaying fibropapilloma tumors or lesions.

14. Requirement and Authority to Conduct Tissue Sampling for Genetic Analyses (RPM 2): This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard a relocation trawler or hopper dredge to tissue-sample live- or dead-captured sea turtles without the need for an ESA section 10 permit.

All live or dead sea turtles captured by relocation trawling and hopper dredging (for both GDCOE-conducted and GDCOE-permitted activities) shall be tissue-sampled prior to release. Sampling shall continue uninterrupted until such time as NMFS determines and notifies the GDCOE in writing.

Sea turtle tissue samples shall be taken in accordance with NMFS' SEFSC procedures for sea turtle genetic analyses (Appendix II of this opinion). The GDCOE shall ensure that tissue samples taken during the dredging project are collected and stored properly and mailed every three months until completion of the dredging project to: NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149.

15. Training - Personnel on Hopper Dredges: The GDCOE must ensure that all contracted personnel involved in operating hopper dredges (whether privately-funded or federally-funded projects) receive thorough training on measures of dredge operation that will minimize takes of sea turtles. It shall be the goal of the hopper dredging operation to establish operating procedures that are consistent with those that have been used successfully during hopper dredging in other regions of the coastal United States, and which have proven effective in reducing turtle/dredge interactions. Therefore, COE Engineering Research and Development Center experts or other persons with expertise in this matter shall be involved both in dredge operation training, and installation, adjustment, and monitoring of the rigid deflector draghead assembly.

16. Dredge Lighting (RPM 1): From May 1 through October 31, sea turtle nesting and emergence season, all lighting aboard hopper dredges and hopper dredge pumpout barges operating within 3 nm of sea turtle nesting beaches shall be limited to the minimal lighting necessary to comply with U.S. Coast Guard and/or OSHA requirements. All non-essential lighting on the dredge and pumpout barge shall be minimized through reduction, shielding, lowering, and appropriate placement of lights to minimize illumination of the water to reduce potential disorientation effects on female sea turtles

approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches.

10 CONSERVATION RECOMMENDATIONS

Pursuant to section 7(a)(1) of the ESA, the following conservation recommendations are made to assist the GDCOE in contributing to the conservation of sea turtles by further reducing or eliminating adverse impacts that result from hopper dredging.

1. Channel Conditions and Seasonal Abundance Studies: Channel-specific studies should be undertaken to identify seasonal relative abundance of sea turtles within Gulf of Mexico channels. The December 1 through March 31 dredging window and associated observer requirements listed above may be adjusted (after consultation and authorization by NMFS) on a channel-specific basis, if (a) the GDCOE can provide sufficient scientific evidence that sea turtles are not present or that levels of abundance are extremely low during other months of the year, or (b) the GDCOE can identify seawater temperature regimes that ensure extremely low abundance of sea turtles in coastal waters, and can monitor water temperatures in a real-time manner. Surveys may indicate that some channels do not support significant turtle populations, and hopper dredging in these channels may be unrestricted on a year-round basis. To date, sea turtle deflector draghead efficiency has not reached the point where seasonal restrictions can be lifted.

2. Draghead Modifications and Bed-Leveling Studies: The GDCOE should supplement other efforts to develop modifications to existing dredges to reduce or eliminate take of sea turtles, and develop methods to minimize sea turtle take during "cleanup" operations when the draghead maintains only intermittent contact with the bottom. Some method to level the "peaks and valleys" created by dredging would reduce the amount of time dragheads are off the bottom. NMFS is ready to assist the GDCOE in conducting studies to evaluate bed- leveling devices and their potential for interaction with sea turtles, and develop modifications if needed.

3. Draghead Evaluation Studies and Protocol: Additional research, development, and improved performance is needed before the V-shaped rigid deflector draghead can replace seasonal restrictions as a method of reducing sea turtle captures during hopper dredging activities. Development of a more effective deflector draghead or other entrainment-deterring device (or combination of devices, including use of acoustic deterrents) could potentially reduce the need for sea turtle relocation or result in expansion of the winter dredging window. NMFS should be consulted regarding the development of a protocol for draghead evaluation tests. NMFS recommends that GDCOE coordinate with ERDC, SAD, the Association of Dredge Contractors of America, and dredge operators (Manson, Bean-Stuyvesant, Great Lakes, Natco, etc.) regarding additional reasonable measures they may take to further reduce the likelihood of sea turtle takes.

4. Continuous Improvements in Monitoring and Detecting Takes: The GDCOE should seek continuous improvements in detecting takes and should determine, through research and

development, a better method for monitoring and estimating sea turtle takes by hopper dredge. Observation of overflow and inflow screening is only partially effective and provides only partial estimates of total sea turtle mortality.

Overflow Screening: The GDCOE should encourage dredging companies to develop or modify existing overflow screening methods on their company's dredge vessels for maximum effectiveness of screening and monitoring. Horizontal overflow screening is preferable to vertical overflow screening because NMFS considers that horizontal overflow screening is significantly more effective at detecting evidence of protected species entrainment than vertical overflow screening.

Preferential Consideration for Horizontal Overflow Screening: The GDCOE should give preferential consideration to hopper dredges with horizontal overflow screening when awarding hopper dredging contracts for areas where new materials, large amounts of debris, or clay may be encountered, or have historically been encountered. Excessive inflow screen clogging may in some instances necessitate removal of inflow screening, at which point effective overflow screening becomes more important.

5. Section 10 Research Permits, Relocation Trawling, Piggy-Back Research, and 50 CFR Part 223 Authority to Conduct Research on Salvaged, Dead Specimens: NMFS recommends that GDCOE, either singly or combined with other COE Districts, apply to NMFS for an ESA section 10 research permit to conduct endangered species research on species incidentally captured during relocation trawling. For example, satellite tagging of captured turtles could enable the GDCOE to gain important knowledge on sea turtle seasonal distribution and presence in navigation channels and also, as mandated by section 7(a)(1) of the ESA, to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of listed species. SERO shall assist the GDCOE with the permit application process.

NMFS also encourages the GDCOE to cooperate with NMFS' scientists, other federal agencies' scientists, and university scientists holding appropriate research permits to make fuller use of turtles taken or captured by hopper dredges and relocation trawlers pursuant to the authority conferred by this opinion. NMFS encourages "piggy-back" research projects by duly-permitted individuals or their authorized designees. Section 10-permitted piggy-back projects could include *non-lethal* research of many types, including blood letting, laparoscopies, anal and gastric lavages, mounting satellite or radio transmitters, etc.

Important research can be conducted without a section 10 permit on salvaged dead specimens. Under current federal regulations (see 50 CFR 223.206 (b): Exception for injured, dead, or stranded [threatened sea turtle] specimens), "Agents. . . of a Federal land or water management agency may. . . salvage a dead specimen which may be useful for scientific study." Similar regulations at 50 CFR 222.310 provide "salvaging" authority for endangered sea turtles.

6. Draghead Improvements - Water Ports: NMFS recommends that the GDCOE require or at least recommend to dredge operators that all dragheads on hopper dredges contracted by the GDCOE for dredging projects be eventually outfitted with water ports located in the *top* of the dragheads to help prevent the dragheads from becoming plugged with sediments. When the dragheads become plugged with sediments, the dragheads are often raised off the bottom (by the dredge operator) with the suction pumps on in order to take in enough water to help clear clogs in the dragarm pipeline, which increases the likelihood that sea turtles in the vicinity of the draghead will be taken by the dredge. Water ports located in the top of the dragheads would relieve the necessity of raising the draghead off the bottom to perform such an action, and reduce the chance of incidental take of sea turtles.

   NMFS supports and recommends the implementation of proposals by ERDC and SAD personnel for various draghead modifications to address scenarios where turtles may be entrained during hopper dredging (Dickerson and Clausner 2003). These include: 1) An adjustable visor, 2) water jets for flaps to prevent plugging and thus reduce the requirement to lift the draghead off the bottom, and 3) a valve arrangement (which mimics the function of a "Hoffer" valve used on cutterhead type dredges to allow additional water to be brought in when the suction line is plugging) that will provide a very large amount of water into the suction pipe thereby significantly reducing flow through the visor when the draghead is lifted off the bottom, reducing the potential to take a turtle.

7. Economic Incentives for No Turtle Takes: The GDCOE should consider devising and implementing some method of significant economic incentives to hopper dredge operators such as financial reimbursement based on their satisfactory completion of dredging operations, or *X* number of cubic yards of material moved, or hours of dredging performed, *without taking turtles*. This may encourage dredging companies to research and develop "turtle friendly" dredging methods; more effective, deflector dragheads; pre-deflectors; top-located water ports on dragarms; etc.

8. Sedimentation Limits to Protect Resources (Hardbottoms/Reefs): NMFS recommends water column sediment load deposition rates of no more than 200 mg/cm^2/day, averaged over a 7-day period, to protect coral reefs and hardbottom communities from dredging-associated turbidity impacts to listed species foraging habitat.

9. Sodium Vapor Lights on Offshore Equipment: On offshore equipment (i.e., hopper dredges, pumpout barges) shielded low-pressure sodium vapor lights are highly recommended for lights that cannot be eliminated.

11 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed widening and deepening of the SNWW involving a combination of mechanical, pipeline, and hopper dredges. As provided in 50 CFR 402.16, 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 taking specified in the incidental take statement is exceeded; (2) new

information reveals effects of the action may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

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APPENDIX I

SEA TURTLE HANDLING AND RESUSCITATION GUIDELINES

Any sea turtles taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures:

A) Sea turtles that are actively moving or determined to be dead (as described in paragraph (B)(4) below) must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

B) Resuscitation must be attempted on sea turtles that are comatose or inactive by:

1) Placing the turtle on its bottom shell (plastron) so that the turtle is right side up and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 to 24 hours. The amount of elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side. Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

2) Sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, carapace, and flippers is the most effective method in keeping a turtle moist.

3) Sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.

4) A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise, the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

Any sea turtle so taken must not be consumed, sold, landed, offloaded, transshipped, or kept below deck.

These requirements are excerpted from 50 CFR 223.206(d)(1). Failure to follow these procedures is therefore a punishable offense under the Endangered Species Act.

APPENDIX II

PROTOCOL FOR COLLECTING TISSUE FROM SEA TURTLES FOR GENETIC ANALYSIS

Method for Dead Turtles

<<<IT IS CRITICAL TO USE A NEW SCALPEL BLADE AND GLOVES FOR EACH TURTLE TO AVOID CROSS-CONTAMINATION OF SAMPLES>>>

1) Put on a new pair of latex gloves.
2) Use a new disposable scalpel to cut out an approx. 1 cm (½ in) cube (bigger is NOT better) piece of muscle. Easy access to muscle tissue is in the neck region or on the ventral side where the front flippers "insert" near the plastron. It does not matter what stage of decomposition the carcass is in.
3) Place the muscle sample on a hard uncontaminated surface (plastron will do) and make slices through the sample so the buffer solution will penetrate the tissue.
4) Put the sample into the plastic vial containing saturated NaCl with 20 percent DMSO.*
5) Use the pencil to write the stranding ID number (observer initials, year, month, day, turtle number by day), species, state and carapace length on the waterproof paper label and place it in the vial with the sample. EXAMPLE: For a 35.8 cm curved carapace length green turtle documented by Jane M. Doe on July 15, 2001 in Georgia, the label should read "JMD20010715-01, C. mydas, Georgia, CCL=35.8 cm". If this had been the third turtle Jane Doe responded to on July 15, 2001, it would be JMD20010715-03.
6) Label the outside of the vial with the same information (stranding ID number, species, state and carapace length) using the permanent marker.
7) Place clear scotch tape over the writing on the vial to protect it from being smeared or erased.
8) Wrap parafilm around the cap of the vial by stretching it as you wrap.
9) Place vial within whirl-pak and close.
10) Dispose of the scalpel.
11) Note on the stranding form that a part was salvaged, indicating that a genetic sample was taken and specify the location on the turtle where the sample was obtained.
12) Submit the vial with the stranding report to your state coordinator. State coordinators will forward the reports and vials to NMFS for processing and archiving.

Method for Live Turtles

<<< IT IS CRITICAL TO USE A NEW BIOPSY PUNCH AND GLOVES FOR EACH TURTLE TO AVOID CROSS-CONTAMINATION OF SAMPLES >>>

1) Turn the turtle over on its back.
2) Put on a new pair of latex gloves.
3) Swab the entire cap of the sample vial with alcohol.
4) Wipe the ventral and dorsal surfaces of the rear flipper 5-10 cm from the posterior edge with the Betadine/iodine swab.
5) Place the vial under the flipper edge to use the cleaned cap as a hard surface for the punch.
6) Press a new biopsy punch firmly into the flesh as close to the posterior edge as possible and rotate one complete turn. Cut all the way through the flipper to the cap of the vial.
7) Wipe the punched area with Betadine/iodine swab; rarely you may need to apply pressure to stop bleeding.
8) Use a wooden skewer to transfer the sample from the biopsy punch into the plastic vial containing saturated NaCl with 20 percent DMSO.*

9) Use the pencil to write the stranding ID number (observer initials, year, month, day, turtle number by day), species, state and carapace length on the waterproof paper label and place it in the vial with the sample. EXAMPLE: For a 35.8 cm curved carapace length green turtle documented by Jane M. Doe on July 15, 2001 in Georgia, the label should read "JMD20010715-01, C. mydas, Georgia, CCL=35.8 cm". If this had been the third turtle Jane Doe responded to on July 15, 2001, it would be JMD20010715-03.

10) Label the outside of the vial with the same information (stranding ID number, species, state and carapace length) using the permanent marker.

11) Place clear scotch tape over the writing on the vial to protect it from being smeared or erased.

12) Wrap parafilm around the cap of the vial by stretching it as you wrap.

13) Place vial within whirl-pak and close.

14) Dispose of the biopsy punch.

15) Note on the stranding form that a part was salvaged, indicating that a genetic sample was taken and specify the location on the turtle where the sample was obtained.

16) Submit the vial with the stranding report to your state coordinator. State coordinators will forward the reports and vials to NMFS for processing and archiving.

***The 20 percent DMSO buffer in the plastic vials is nontoxic and nonflammable. Handling the buffer without gloves may result in exposure to DMSO. This substance soaks into skin very rapidly and is commonly used to alleviate muscle aches. DMSO will produce a garlic/oyster taste in the mouth along with breath odor. The protocol requires that you WEAR gloves each time you collect a sample and handle the buffer vials.**

The vials (both before and after samples are taken) should be stored at room temperature or cooler. If you don't mind the vials in the refrigerator, this will prolong the life of the sample. DO NOT store the vials where they will experience extreme heat (like in your car!) as this could cause the buffer to break down and not preserve the sample properly.

Questions:
Sea Turtle Program
NOAA/NMFS/SEFSC
75 Virginia Beach Drive
Miami, FL 33149
305-361-4207

THANK YOU FOR COLLECTING SAMPLES FOR SEA TURTLE GENETIC RESEARCH!!

Genetic Sample Kit Materials

- latex gloves
- alcohol swabs
- Betadine/iodine swabs
- 4-6 mm biopsy punch – sterile, disposable (Moore Medical Supply 1-800-678-8678, part #0052442)
- wooden skewer
- single-use scalpel blades (Fisher Scientific 1-800-766-7000, cat. # 08-927-5A)
- plastic screw-cap vial containing saturated NaCl with 20 percent DMSO, wrapped in parafilm
- waterproof paper label, ¼" x 4"
- pencil to write on waterproof paper label
- permanent marker to label the plastic vials
- scotch tape to protect writing on the vials

- piece of parafilm to wrap the cap of the vial
- whirl-pak to return/store sample vial

Stokes, Janelle S SWG

From: Michael Barnette [Michael.Barnette@noaa.gov]
Sent: Wednesday, May 14, 2008 9:58 AM
To: Stokes, Janelle S SWG
Cc: Hauch, Robert G SWG; Murphy, Carolyn E SWG; Michael Barnette
Subject: Re: SNWW Biological Opinion - discrepancy in relocation trawling take number

Attachments: Michael.Barnette.vcf

Michael.Barnette.vcf (410 B)

Hi Jan-
Yes, after review it was determined the RPM language was in error, and it should read as:

This opinion authorizes the per-fiscal-year non-lethal non-injurious take (minor skin abrasions resulting from trawl capture are considered non-injurious), external flipper-tagging, and taking of tissue samples of 32 sea turtles in any combination, though 7 loggerhead, 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea turtles would be expected based on frequency data in Epperly et al. (2002), in association with any relocation trawling conducted during the course of the proposed project.

Mike

Stokes, Janelle S SWG wrote:
>
> Good morning, Michael,
>
> We are getting ready to finalize the draft EIS for the SNWW navigation
> project and have noticed a discrepancy in the relocation trawling take
> number cited in the NMFS Biological Opinion dated Aug 13, 2007. A
> scanned copy of the document is attached.
>
> The Incidental Take statement in section 9.1 (page 43) states "NMFS
> anticipates ..... 32 non-injurious takes of sea turtles (7 loggerhead,
> 21 Kemp's ridley, 1 hawksbill, 1 leatherback, and 2 green sea
> turtles), based on frequency data in Epperly et al. 2002) by
> relocation trawling."
>
> The Reasonable and Prudent Measures, in section 9.3.4 (page 47) states
> "This opinion authorizes the per-fiscal-year non-lethal take
> non-injurious take (minor skin abrasions resulting from trawl capture
> are considered non-injurious), external flipper tagging, and taking of
> tissue samples of 30 sea turtles in any combination, though 7
> loggerhead, 21 Kemp's ridley, and 2 green sea turtles would be
> expected based on frequency data in Epperly et al. 2002) in
> association with any relocation trawling conducted during the course
> of the proposed project."
>
> In our phone conversation this morning, you indicated that you might
> be able resolve the discrepancy with an email response and with
> replacement page (or pages as needed) after review of the document.
> Specifically, we need to know if we are authorized 30 or 32
> non-injurious takes and whether the aurthorized takes are by species
> or are "in any combination" as stated on page 47.
>
> Thanks for your help with this.
>
> Jan
>

Appendix H

Historic Properties Programmatic Agreement

PROGRAMMATIC AGREEMENT
REGARDING COMPLIANCE WITH SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT FOR THE CONSTRUCTION AND MAINTENANCE MEASURES FOR THE SABINE – NECHES WATERWAY, SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA
AMONG
THE U.S. ARMY CORPS OF ENGINEERS GALVESTON DISTRICT
THE TEXAS STATE HISTORIC PRESERVATION OFFICER
THE LOUISIANA STATE HISTORIC PRESERVATION OFFICER
AND
THE SABINE NECHES NAVIGATION DISTRICT

WHEREAS, the U.S. Army Corps of Engineers, Galveston District (USACE) has determined that the proposed construction and ongoing maintenance of the Sabine-Neches Waterway (hereinafter, "undertaking") may have an effect on properties eligible for inclusion in the National Register of Historic Places (NRHP) (hereinafter, "historic properties) pursuant to Section 106 of the National Historic Preservation Act (16.U.S.C § 470) (hereinafter NHPA) and its implementing regulation, "Protection of Historic Properties," (36 CFR 800); and

WHEREAS, the existing Sabine-Neches Waterway Project (SNWW) is administered by the USACE under the authority of the Rivers and Harbors Act of 1962 and improvements are being studied under authorization contained in the Senate Committee on Environment and Public Works Resolution adopted on 5 June 1997; and

WHEREAS, the Sabine Neches Navigation District (SNND) is the non-federal partner with the USACE for this undertaking and is providing all lands, easements, rights-of-way, relocations, removals, and upland placement areas necessary for the project construction and operation; and

WHEREAS, the size of the project area and the number of alternatives being studied for proposed channel improvements make it necessary to defer final identification and evaluation of historic properties until authorization of proposed improvements is obtained; and

WHEREAS, the USACE, the Texas and Louisiana State Historic Preservation Officers (SHPOs), and the SNND agree that it is advisable to accomplish compliance with Section 106 through the development and execution of this Programmatic Agreement (PA) in accordance with § 800.6 and § 800.14(b)(3); and

WHEREAS, the USACE has invited the Advisory Council on Historic Preservation (Council) to determine whether the Council wishes to enter into the Section 106 process; and

NOW, THEREFORE, the USACE, the SHPOs and the SNND, agree that the proposed undertaking shall be implemented in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties and to satisfy the USACE Section 106 responsibilities for all individual aspects of the undertaking.

Stipulation I

Identification, Evaluation, Effect Determination and Resolution

A. *Scope of Undertaking.* This PA shall be applicable to all new construction activities related to the proposed SNWW channel improvement project and activities related to maintenance dredging. The Area of Potential Effects (APE) shall be established by the USACE in consultation with the appropriate SHPO and shall include all areas to be directly affected by new dredging and channel construction, construction staging and access areas, new or extensions of existing placement areas, ecological mitigation features, areas affected by the beneficial uses of dredged material, and ongoing maintenance dredging activities related to the SNWW project.

B. *Qualifications and Standards.* The USACE shall ensure that all work conducted in conjunction with this PA is performed in a manner consistent with the Secretary of Interior's "Standards and Guidelines for Archeology and Historic Preservation (48 Federal Register 44716-44740; September 23, 1983), as amended, or the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR 68), as appropriate.

C. *Definitions.* The definitions set forth in § 800.16 are incorporated herein by reference and apply throughout this PA.

D. *Identification of Historic Properties.* Prior to the initiation of construction or maintenance activities, the USACE shall make a reasonable and good faith effort to identify historic properties located in the APE. These steps may include, but are not limited to, background research, consultation, oral history interviews, sample field investigation and field survey. The level of effort for these activities shall be determined in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party. If no historic properties are identified in APE, the USACE shall document this finding pursuant to § 800.11(d) and retain this documentation in USACE files for at least seven (7) years.

E. *Evaluation of National Register Eligibility.* If cultural resources are identified within the APE, the USACE shall determine their eligibility for the National Register of Historic Places in accordance with the process described in § 800.4(c) and criteria established in 36 CFR 60. The determination of cultural significance shall be conducted in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party. Should the USACE and the appropriate SHPO agree that a property is

or is not eligible, such consensus shall be deemed conclusive for the purpose of the PA. Should the USACE and appropriate SHPO not agree regarding the eligibility of a property, the USACE shall obtain a determination of eligibility from the Keeper of the National Register pursuant to 36 CFR 63.

F. *Assessment of Adverse Effects.*

1. *No Historic Properties Affected.* The USACE shall make a reasonable and good faith effort to evaluate the effect of each undertaking on historic properties in the APE. The USACE may conclude that no historic properties are affected by an undertaking if no historic properties are present in the APE, or the undertaking will have no effect as defined in §800.16(i). This finding shall be documented in compliance with § 800.11(d) and the documentation shall be retained by the USACE for at least seven (7) years. The USACE shall provide information on the finding to the public upon request, consistent with the confidentiality requirements of § 800.11(c).

2. *Finding of No Adverse Effect.* The USACE, in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party, shall apply the criteria of adverse effect to historic properties within the APE in accordance with § 800.5. The USACE may propose a finding of no adverse effect if the undertaking's effects do not meet the criteria of § 800.5(a)(1) or the undertaking is modified to avoid adverse effects in accordance with 36 CFR 68. The USACE shall provide to the appropriate SHPO documentation of this finding meeting the requirements of § 800.11(e). The SHPO shall have 30 calendar days in which to review the findings and provide a written response to the USACE. The USACE may proceed upon receipt of written concurrence from the SHPO. Failure of the SHPO to respond within 30 days of receipt of the finding shall be considered agreement with the finding. The USACE shall maintain a record of the finding and provide information on the finding to the public upon request, consistent with the confidentiality requirements of § 800.11(c).

3. *Resolution of Adverse Effect.* If the USACE determines that the undertaking will have an adverse effect on historic properties as measured by criteria in § 800.5.(a)(1), the agency shall consult with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party to resolve adverse effects in accordance with § 800.6.

a. For historic properties that the USACE and the appropriate SHPO agree will be adversely affected, the USACE shall:

1) Consult with the appropriate SHPO to identify other individuals or organizations to be invited to become consulting parties. If additional consulting parties are identified, the USACE shall provide them copies of documentation specified in § 800.11(e) subject to confidentiality provisions of § 800.11(c).

2) Afford the public an opportunity to express their views on resolving adverse effects in a manner appropriate to the magnitude of the project and its likely effects on historic properties.

3) Consult with the appropriate SHPO, the SNND and Native American tribes which have indicated an interest in the undertaking, and consulting parties to seek ways to avoid, minimize or mitigate adverse effects.

4) Prepare an historic property treatment plan which describes mitigation measures the USACE proposes to resolve the undertaking's adverse effects and provide this plan for review and comment to the appropriate SHPO, consulting parties and Native American tribes that have indicated an interest in the undertaking. All parties shall have 30 calendar days in which to provide a written response to the USACE.

b. If the USACE and appropriate SHPO fail to agree on how adverse effects will be resolved, the USACE shall request that the Council join the consultation and provide the Council with documentation pursuant to § 800.11(g).

1) If the Council agrees to join the consultation, the USACE shall proceed in accordance with § 800.9.

2) If, after consulting to resolve adverse effects pursuant to Stipulations I, II or IV of this PA, the Council, USACE or SHPOs determines that further consultation will not be productive, then any party may terminate consultation in accordance with the notification requirement and process prescribed by § 800.7.

Stipulation II

Post Review Changes and Discoveries

A. *Changes in the Undertaking.* If construction on the undertaking has not commenced and the USACE determines that it will not conduct the undertaking as originally coordinated, the USACE shall reopen consultation pursuant to Stipulation I E – F.

B. *Unanticipated Discoveries or Effects.* Pursuant to § 800.13(a)(2), if historic properties are discovered or unanticipated effects on historic properties are found after construction on an undertaking has commenced, the USACE shall develop a treatment plan to resolve adverse effects and notify the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party within two working days of the discovery. The notification shall include the USACE assessment of National Register eligibility of

affected properties and proposed actions to resolve the adverse effects. Comments received from the SHPO, the Native American tribes or other consulting party within two working days of the notification shall be taken into account by the USACE in carrying out the proposed treatment plan. The USACE may assume SHPO concurrence in its eligibility assessment unless otherwise notified by the SHPO. The USACE shall provide the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party which have expressed an interest in the undertaking a report of the USACE actions when they are completed.

Stipulation III

Curation and Disposition of Recovered Materials and Records

The USACE shall ensure that all archeological materials and associated records owned by the State of Texas or Sponsor, which result from identification, evaluation, and treatment efforts conducted under this PA, are accessioned into a curational facility that has been certified or granted provisional status by the Texas SHPO in accordance with the Texas Administrative Code, Title 13, Part 2, Chapter 29.6 and meets the standards of 36 CFR 79, except as specified in Stipulation IV for human remains. Management and care of artifacts and collections shall follow the Texas Administrative Code, Title 13, Part 2, Chapter 29. Archeological items and materials from privately-owned lands in Texas shall be returned to their owners upon completion of analyses required for Section 106 compliance under this PA. Archeological collections generated from Louisiana lands shall be prepared for curation according to the collections standards of the Louisiana Division of Archeology and curated with the Louisiana Division of Archeology. Archeological items and materials from privately-owned lands may be returned to owners if requested. Private property owners in Louisiana shall be encouraged to curate with the state of Louisiana to ensure long-term preservation and future research potential of non-state owned collections. All associated records from archeological sites in Louisiana shall be curated with the Louisiana Division of Archeology.

Stipulation IV

Treatment of Human Remains

A. *Prior Consultation of Native American Burials*: If the USACE investigations conducted pursuant to Stipulation I of this PA indicate a high likelihood that Native American Indian human remains may be encountered, the USACE shall develop a treatment plan for these remains in consultation with the appropriate SHPO, the SNND, Native American Indian tribes that attach religious and cultural significance to identified historic properties and any other consulting party. The USACE shall ensure that tribes indicating an interest in the undertaking are afforded a reasonable opportunity to identify concerns, advise on identification and evaluation, and participate in the resolution of adverse effects in compliance with the terms of this PA.

B. *Inadvertent Discovery in Texas*. Immediately upon the inadvertent discovery of human remains during historic properties investigations or construction activities

conducted pursuant to this PA, the USACE shall ensure that all ground disturbing activities cease in the vicinity of the human remains and any associated grave goods. Within two working days of the discovery, the USACE shall initiate consultation with the appropriate SHPO, Native American Indian tribes and any other consulting party that might attach religious and cultural significance to identified historic properties. The USACE shall consult with the appropriate SHPO, Native American Indian tribes and other consulting party which have expressed an interest in the undertaking in an effort to develop a plan for resolving the adverse effects.

C. *Inadvertent Discovery in Louisiana*: If an unmarked burial site or human skeletal remains are discovered, the USACE shall notify the local law enforcement office within 24 hours and the Louisiana SHPO within 72 hours. Upon discovery, all disturbing activity shall cease and shall not resume until the USACE has consulted with the Louisiana SHPO and the Louisiana Division of Archeology regarding a plan for the disposition of the remains. This shall be done within 30 days. The USACE, in consultation with the Louisiana SHPO and the Louisiana Division of Archeology, shall take every reasonable action to restore the burial site and avoid disturbing the remains. All burial artifacts found in an unmarked burial site shall become the property of the State of Louisiana and the Louisiana Division of Archeology shall have control over their disposition pursuant to the Louisiana Revised Stat. Ann. Title 8, §671 – 681, "Louisiana Unmarked Human Burial Sites Preservation Act."

D. *Advisory Council on Historic Preservation Policy Statement regarding Treatment of Burial Sites, Human Remains and Funerary Objects effective 23 February 2007:* This policy applies to all Federal Agencies with Undertakings that are subject to review under Section 106 of the NHPA. To be considered under Section 106, the burial site must be or be a part of an historic property, meaning that it is listed or eligible for listing in the National Register of Historic Places. This policy shall be applied if the burial meets this criterion.

E. *Dispute Resolution*. If, during consultations conducted under paragraphs A, B and C of this stipulation, all consulting parties cannot agree upon an consensus plan for resolving adverse effects, the matter shall be referred to the Council for resolution in accordance with the procedures outlined in § 800.9.

Stipulation V

PA Amendments, Disputes and Termination

A. *Amendments*. Any party to this PA may propose to the other parties that it be amended, whereupon the parties shall consult in accordance with § 800.6(c)(7) to consider such an amendment.

B. *Disputes*. Disputes regarding the completion of the terms of this agreement shall be resolved by the signatories. If the signatories cannot agree regarding a dispute, any one of the signatories may request the participation of the Council in resolving the dispute in accordance with the procedures outlined in § 800.9.

C. *Termination of PA.* Any party to this PA may terminate it by providing sixty (60) days notice to the other parties, provided that the parties shall consult during the period prior to the termination to seek agreement on amendments or other actions that will avoid termination. In the event of termination of this PA by the appropriate SHPO, the USACE shall comply with the provisions of § 800 Subpart B.

Stipulation VI
Termination of Consultation

If, after consulting to resolve adverse effects pursuant to Stipulation I, II or IV of this PA, the USACE or appropriate SHPO determines that further consultation will not be productive, then either party may terminate consultation in accordance with the notification requirements and process prescribed by § 800.7.

Stipulation VII
Term of this Agreement

This PA remains in force for a period of ten (10) years from the date of its execution by all signatories. Sixty (60) days prior to the conclusion of the ten (10) year period, the USACE shall notify all parties in writing of the end of the ten year period to determine if they have any objections. If there are no objections received prior to expiration, the PA shall continue to remain in force for a new ten (10) year period.

DISTRICT ENGINEER, U.S. ARMY CORPS OF ENGINEERS, GALVESTON

11/13/2007

Colonel David C. Weston, District Engineer **Date**

TEXAS STATE HISTORIC PRESERVATION OFFICER

1/31/08

F. Lawerence Oaks, Texas State Historic Preservation Officer **Date**

LOUISIANA STATE HISTORIC PRESERVATION OFFICER

1-29-08

Pam Breaux, Louisiana State Historic Preservation Officer **Date**

SABINE-NECHES NAVIGATION DISTRICT

12/11/07

Paul Beard, Chairman of the Board of Commissioners **Date**

Appendix I

Compliance with the Texas and Louisiana Coastal Management Programs

Appendix I1

Compliance with Texas Coastal Management Program

Appendix I1

Compliance with Goals and Policies – Section 501.25(a)–(f)
Dredging and Dredged Material Disposal and Placement
Sabine-Neches Waterway Channel Improvement Project
Environmental Impact Statement
Texas Coastal Zone Management Program
Consistency Determination

INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Galveston District proposes to modify the navigation channels servicing the Ports of Beaumont, Port Neches, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively referred to as the Sabine-Neches Waterway (SNWW), and the project to modify the SNWW is referred to as the Channel Improvement Project (CIP). The purpose of the CIP is to improve the transportation efficiency of the SNWW's deep-draft navigation system, while protecting the quality of the area's coastal and estuarine resources.

The existing 40-foot inshore SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. The existing SNWW consists of the following channel reaches, as listed from offshore to inshore: (1) Sabine Bank Channel; (2) Sabine Pass Outer Bar Channel; (3) Sabine Pass Jetty Channel; (4) Sabine Pass Channel; (5) Port Arthur Channel; (6) Sabine-Neches Channel; and (7) Neches River Channel.

The authorized depth of the channel in the Preferred Alternative would be deepened by 8 feet along the entire existing channel and the offshore Entrance Channel would extend 13.2 miles farther into the Gulf of Mexico (Gulf). The Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel would be deepened from 40 feet to 48 feet. The authorized depth of the existing offshore Entrance Channel (Sabine Pass Outer Bar Channel and Sabine Bank Channel) is currently 42 feet; the additional depth is needed to accommodate fluctuations in offshore surface water elevation. These channels and the proposed Sabine Bank Extension Channel would be deepened from 42 to 50 feet. This would increase the SNWW from 64 miles to approximately 77 miles in length. No modifications to the existing Sabine Pass Jetties would be required as part of the Preferred Alternative.

The Sabine Pass Jetty Channel and the majority of the inshore channels (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel) would remain at their existing widths. With the exception of wider sections at anchorages or channel intersections, these channels transition from 500 feet wide between the jetties to 400 feet wide upstream of the Martin Luther King Bridge on the Sabine-Neches Canal and Neches River Channel. The Taylor Bayou Channels and Basins would also be widened and deepened to 48 foot. Although the Sabine-Neches Canal and Neches River Channel would

not be widened, navigation efficiency would be improved with short stretches of selective widening and bend easings in both reaches, and the addition or enlargement of one anchorage and two turning/anchorage basins on the Neches River Channel. Up to five additional anchorage/turning basins could also be added on the Neches River.

Environmental affects addressed in the SNWW CIP Final Environmental Impact Statement (FEIS), particularly pertaining to coastal resources, have been analyzed in a large surrounding area that includes Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW) west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and offshore in the Gulf to 13.2 miles beyond the end of the current navigation channel.

The SNWW study area contains a high concentration of significant coastal wetlands. The USACE, in coordination with an Interagency Coordination Team (ICT) comprised of numerous State and Federal agencies, including the Texas General Land Office, developed a dredged material management plan (DMMP) that uses dredged material from the proposed SNWW CIP in an environmentally acceptable and economically practical manner. The ICT identified, within the proposed study area, 109,175 acres (171 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats.

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. Several components of the DMMP and mitigation plan involve restoration, protection, and enhancement of coastal wetlands. Beneficial Use (BU) features of the DMMP that would offset project-induced impacts within Texas, as well as mitigation features that would offset project-induced impacts in Louisiana, are described further below.

Neches River BU Feature – Rose City would restore 345 acres of fresh marsh, 72 acres of shallow water, and nourish 151 acres of existing marsh. New Work material (approximately 2.1 million cubic yards) would be used to restore a 225-acre marsh, including the construction of hydraulic containment levees and higher-elevation features. Maintenance material (approximately 540,000 cubic yards) from the first maintenance cycle would be used to restore an additional 120 acres of marsh. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

Neches River BU Feature – Bessie Heights East would restore 679 of brackish and 1,190 acres of intermediate marsh, 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. The Bessie Heights East site is located within the much larger Bessie Heights Marsh. This was a natural emergent marsh that over time has seen the majority of its marsh acreage convert to open water. The site is located on Texas Parks and Wildlife Department (TPWD) property and privately owned land. Bessie

Heights East totals 3,180 acres. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled.

Neches River BU Feature – Old River Cove is located north of the Neches River on property owned by TPWD and would involve and restoration of 639 acres of brackish marsh, enhancement of 139 acres of shallow water habitat, and nourishment of 432 acres of existing marsh, as suspended fine-grained sediments disperse beyond restored emergent marsh areas. Topographic relief would be created by varying the final elevation of material placement, and each elevation would subsequently be planted with appropriate native flora.

Gulf Shore BU Feature (Texas and Louisiana Points – TX 8-11 and LA 5-2/6-2) are located on the east and west sides of the Sabine Pass jetties. Each area begins approximately 0.5 mile from the respective jetty and extends about 3.5 miles away. The land on the Texas side is part of the Texas Point National Wildlife Refuge (NWR), while the land on the Louisiana side is privately owned. The conceptual plan calls for placing maintenance material at the shoreline in an unconfined manner. Placement would alternate between the Louisiana and Texas shorelines with each complete maintenance cycle, so that each side receives material every 6 years for the 50-year period of analysis, or eight placement episodes. The plan anticipates that much of the material would be redistributed into the littoral system.

All CIP impacts in Texas would be minimized and offset by beneficially using dredged material as described in the DMMP and therefore no mitigation is required; unavoidable impacts of the SNWW CIP remain only in Louisiana. Therefore, all of the mitigation measures would be located in Louisiana. The mitigation plan for Louisiana consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. The mitigation efforts would compensate for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone.

IMPACTS ON COASTAL NATURAL RESOURCE AREAS

Several of the Coastal Natural Resource Areas (CNRAs) listed in 31 TAC §501.3 are found reasonably close to the areas discussed in the FEIS. A short description of each CNRA near the project and of attempts to minimize or avoid potential impacts is provided below.

Waters of the Open Gulf of Mexico

New work and future dredged material generated from within the Sabine Bank Channel, Sabine Pass Outer Bar Channel, and the Sabine Pass Jetty Channel would be placed in four open Gulf existing Ocean,

Dredged Material Disposal Sites (ODMDSs), where only two occur in Texas waters (i.e., portion of Placement Area [PA] 3 and all of PA 4) and were designated in 1987 (52 FR 34218). All other project ODMDSs occur beyond Texas waters. The areas within the existing maintenance ODMDSs' footprint (i.e., portion of PA 3 and all of PA 4) would be disturbed during construction and intermittently for the life of the project, as it has since designation in 1987. Impacts to these areas are minimized by placement of dredged material into either historically used and/or dispersive offshore PAs. The overall footprint of these offshore PAs would be minimized by mounding the dredged material vertically to the maximum extent practical. These offshore PAs are dispersive by nature and would likely revert to the in situ topography prior to the next maintenance dredged material disposal sequence.

Waters Under Tidal Influence

The entire project is located in a tidally influenced region. Dredging and placement activities represent a minimal impact because the localized and temporary release of suspended solids is minimized by refraining from open-bay placement and using existing, confined upland PAs. Additionally, beneficial use of dredged material would restore subsided, tidal wetlands.

Submerged Lands

The areas within the channel alignment and Neches River BU Feature (restoration areas located at Rose City East [TX 3-1E], Bessie Heights East [TX 5-2], and Old River Cove [TX 6-1A]) are characterized as submerged lands. These submerged lands are PAs for dredged material generated from the Neches River reach. Dredged material placement within the Neches River BU Feature would result in a net increase in several CNRAs from restoration and enhancement efforts, as noted below. The DMMP (Appendix D) and Chapter 5 of the FEIS provide more information regarding project impacts and coastal wetlands.

Coastal Wetlands

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. Several components of the DMMP and mitigation plan for Louisiana involve restoration, protection, and enhancement of coastal wetlands. All impacts within Texas are offset by the DMMP and BU features. The Neches River BU Feature would restore 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. Impacts within Louisiana would be mitigated by restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing, adjacent marsh.

Submerged Aquatic Vegetation

The Preferred Alternative is located near areas not characterized as having large expanses of seagrasses. There would be negligible, if any, direct or indirect adverse impacts to seagrass beds as result of the Preferred Alternative.

Tidal Sand and Mudflats

The only potential impacts to tidal sand would be from the nourishment of the shoreline at both Texas and Louisiana Points to provide shoreline protection; this effort would be considered a long-term positive effect as these areas are eroding. Similarly, mudflats may occur within subsided marshes receiving material. Several subsided marshes would receive material for restoration and enhancement, as outlined in the DMMP (Appendix D) and Chapter 5 of the FEIS.

Oyster Reefs

The majority of oyster reefs in the study area are located in the southern part of Sabine lake near Blue Buck Point, in Sabine Pass, and in Keith Lake. Oysters are not commercially harvested from Sabine Lake. Sabine Lake has not been classified or delineated by Texas and, therefore, the Texas Department of State Health Services (TDSHS) has prohibited the harvesting of molluscan shellfish from this system since the late 1970s. Louisiana has designated Sabine Lake as a “Public Oyster Area.” Commercial harvesting is prohibited and public harvesting methods are restricted to tonging; however, no harvesting is currently allowed due to water quality issues. There are no oyster reefs identified within the Preferred Alternative footprint. While no impacts to extant live oyster reefs are likely because salinities are too fresh for oyster development, prior to construction of the access channel and borrow trench, a full water-bottom assessment would be conducted by the USACE within Louisiana in accordance with Louisiana Department of Wildlife and Fisheries (LDWF) survey standards. This survey would be necessary in order for LDWF to consider a waiver of compensation for impacts to the water bottoms of the Sabine Lake public oyster area.

Hard-substrate Reefs

There are no naturally occurring hard-substrate formations in the vicinity of the project. The closest serpulid worm reefs within Texas waters are located several hundred miles south in the Laguna Madre and Baffin Bay.

Coastal Barriers

The coastal barrier downdrift of Sabine Pass primarily consists of state parks and NWR areas, which are undeveloped with marshes in the backshore and with narrow beaches and overwash terrace on the foreshore. The DMMP includes the placement of dredged material for beneficial use (Gulf Shoreline BU Feature) immediately downdrift of Sabine Pass on Texas and Louisiana Points to provide for shore

protection and marsh creation. Placement and placement operations are not expected to have any adverse impacts to the coastal barriers. Shoreline nourishment would yield ecological benefits to coastal barriers.

Coastal Shore Areas

These resource areas function as buffers, protecting upland habitats from erosion and storm damage and adjacent marshes and waterways from water quality degradation. This type of area is located west of Sabine Pass, and protect against wetlands located behind these shores from McFaddin NWR, Texas Point NWR, and Sea Rim State Park. The Texas Point NWR coastal shore would be improved by shore nourishment; therefore, the Preferred Alternative would have a beneficial effect on the Texas Point coastal shore, and would not have adverse impacts to other coastal shore areas as a result of dredging and dredged material operations.

Gulf Beaches

Sabine Pass forms the southern entrance of the Sabine-Neches Ship Channel from the Gulf into the area studied. In this area, on the Texas side (or west side) of Sabine Pass, is the Texas Point NWR. Farther west along the Gulf of Mexico coastline is Sea Rim State Park and McFadden NWR. This area is characterized by (mostly) undeveloped marshland and beaches, with numerous small lakes and wetland areas. It is predicted approximately 3,100 acres of shoreline west of Sabine Pass would erode over the next 50 years, under future conditions. However, a DMMP feature of the Preferred Alternative would use maintenance dredged material generated from the Sabine Pass Channel to nourish Texas and Louisiana Points.

Critical Dune Areas

The Gulf beaches on the Texas side of the study area include dune systems at McFaddin NWR and Sea Rim State Park. Adverse impacts to the dune complexes are not expected to occur as a result of dredging and dredged material placement operations. Gulf Shoreline BU Features would not result in placement of material on critical dune areas.

Special Hazard Areas

Special hazard areas are areas designated by the administrator of the Federal Insurance Administration under the National Flood Insurance Act as having special flood, mudslide, and/or flood-related erosion hazards. The SNWW and Sabine Lake area are covered under the Flood Insurance Studies for Jefferson and Orange counties in Texas and Cameron and Calcasieu parishes in Louisiana. The land along the SNWW within the area studied is predominantly located in, or adjacent to, the 100-year floodplain. Except from improvements caused by shore nourishment and shoreline protection measures in the DMMP, project dredging and placement activities do not affect these low-lying areas because dredging is within and adjacent to the existing channel and disposal is within contained PAs and sites in open waters.

Critical Erosion Areas

These areas are those Gulf and bay shorelines that are undergoing erosion and are designated by the Commissioner of the General Land Office under Texas Natural Resources Code, §33.601(b). The shoreline from downdrift of Sabine Pass, including the Texas Point NWR and Sea Rim State Park, are classified as critical erosion areas. Erosion in these areas threatens wetlands at McFaddin NWR, Texas Point NWR, and Sea Rim State Park. The Texas Point NWR shoreline would be nourished by the Gulf Shoreline BU Feature; therefore, the Preferred Alternative would have a beneficial effect for critical erosion areas on Texas Point.

Coastal Historic Areas

Sites listed or eligible for listing in the National Register of Historic Places or for designation as State Archeological Landmarks are present in the project area. Compliance with the Texas Coastal Management Program (TCMP) regarding coastal historic areas is accomplished through procedures established by Section 106 of the National Historic Preservation Act of 1965, as amended. These coastal historic sites, as well as noncoastal historic sites, are discussed in Section 4.14 of the FEIS. Coordination with the Texas Historic Commission is ongoing, but it is expected that impacts to significant sites would be avoided.

While no specific impacts to historic resources have been identified at this time, the Preferred Alternative has the potential to adversely affect significant historic properties because numerous prehistoric and historic sites, structures, and shipwrecks are present in the project vicinity. A Historic Properties Programmatic Agreement has been negotiated and executed with the Texas and Louisiana State Historic Preservation Officers to ensure that significant historic properties are identified and mitigation, if necessary, is completed prior to construction. It is attached to the FEIS as Appendix H.

Coastal Preserves

This CNRA includes state parks and NWRs. There are several preserves within the vicinity of the coastal shoreline that include the Texas Point NWR, Sea Rim State Park, McFadden NWR, J.D. Murphree WMA, Sabine Pass Battleground State Park and Historic Site, Lower Neches WMA (Nelda Stark Unit), and Lower Neches WMA (Old River Unit). Direct placement of dredged material would occur within Texas Point NWR, Sabine NWR, and the Lower Neches WMA (Nelda Stark and Old River units) for restoration, enhancement, and creation of coastal wetlands in specific BU features and mitigation areas. Appendix D and Chapter 5 of the FEIS provides more information about project impacts and coastal preserves.

COMPLIANCE WITH GOALS AND POLICIES

The following goals and policies of the TCMP were reviewed for compliance.

- §501.25 – Dredging and Dredged Material Disposal and Placement
- §501.15 – Policy for Major Actions

Compliance with §501.15 – Policy for Major Actions

This project involves action subject to §506.12 and constitutes a major action. Therefore, a Federal Environmental Impact Statement (EIS) is required under the National Environmental Policy Act (NEPA), 42 USC, §4321, et seq. Both State and Federal agencies involved with the SNWW CIP have met and coordinated on the identification and mitigation of project impacts and beneficial uses of dredged material. The purpose of this appendix to the FEIS is to demonstrate that the Preferred Alternative is consistent with the TCMP.

Section 501.25 Dredging and Dredged Material Disposal and Placement

(a) Dredging and the disposal and placement of dredged material shall avoid and otherwise minimize adverse effects to coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches to the greatest extent practicable. The policies of this section are supplemental to any further restrictions or requirements relating to the beach access and use rights of the public. In implementing this section, cumulative and secondary adverse effects of dredging and the disposal and placement of dredged material and the unique characteristics of affected sites shall be considered.

Compliance: Dredged material would be placed on a variety of areas and would have some effects on coastal waters and submerged lands such as temporarily burying benthic organisms and increasing turbidity in the area. One beneficial use, shore nourishment, would result in temporary restrictions to specific shore areas. Habitat losses and gains would result from measures outlined in the Wetland Value Assessment (WVA) (Appendix C to the FEIS). In some instances, impacts include loss of submerged lands. Although these measures would result in reducing the amount of submerged lands, fresh, intermediate, and brackish marsh would be created, restored, or enhanced, to mitigate this loss. In other instances, losses in coastal waters occur due to shore nourishment, but would result in providing shoreline protection at Texas and Louisiana Points and creating a new saline marsh along a 3-mile stretch of Gulf coastline. Other actions include placement of new work and maintenance dredged material in two ODMDSs occurring within Texas waters (i.e., portion of PA 3 and PA 4); other ODMDSs are associated with the Preferred Alternative's DMMP but occur beyond Texas waters. These ODMDSs are naturally dispersive; therefore, bottom impacts are expected to be temporary. Project features and measures as described in the WVA and DMMP are the result of coordination among agency personnel and other interested parties. All project induced impacts within Texas would be offset by the BU features and as described in the DMMP.

(1) Dredging and dredged material disposal and placement shall not cause or contribute, after consideration of dilution and dispersion, to violation of any applicable surface water quality standards established under §501.21 of this title.

<u>Compliance:</u> For all PAs, adequate dilution and dispersion occurs so that applicable surface water standards are not violated (FEIS Sections 4.4 and 4.6).

(2) Except as otherwise provided in paragraph (4) of this subsection, adverse effects on critical areas from dredging and dredged material disposal or placement shall be avoided and otherwise minimized, and appropriate and practicable compensatory mitigation shall be required, in accordance with §501.23 of this title.

<u>Compliance:</u> CNRAs would be impacted by the Preferred Alternative, as discussed above; however, DMMP measures consisting of beneficially used dredged material would result in creation, enhancement, and restoration of critical areas. All impacts within Texas would be offset by the DMMP and BU features. For example, in the Neches River BU area, DMMP measures would have a direct impact on submerged lands or open water, but would create 2,853 acres of emergent marsh, nourish 1,234 acres of existing marsh, and improve 871 acres of shallow-water habitat. Additionally, protection of the shorelines and creation, restoration, and enhancement of saline marshes would result from placement of dredged material on a 6-mile stretch of Gulf beach at Texas and Louisiana Points. The WVA (Appendix C) and sections 4.1, 4.2, and 5.0 of the FEIS discuss ecological impacts and benefits, modeling approaches, and mitigation.

(3) Except as provided in paragraph (4) of this subsection, dredging and the disposal and placement of dredged material shall not be authorized if:

(A) there is a practicable alternative that would have fewer adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches, so long as that alternative does not have other significant adverse effects;

<u>Compliance:</u> Channel construction and placement of new work and maintenance material have been designed to minimize adverse impacts to the environment. Placement of new work and maintenance material only in existing PAs was not an available option for this project due to the size and 50-year time frame. Sufficient upland sites are not available. The DMMP (Appendix D of the FEIS) provides a detailed description of all PAs and alternatives that were evaluated. The WVA (Appendix C of the FEIS) provides descriptions of the features that would offset all project-induced impacts within Texas.

(B) all appropriate and practicable steps have not been taken to minimize adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches; or

<u>Compliance:</u> All practicable steps (including use of confined upland PAs, existing PAs, selection of minimum channel size to meet the project needs, extensive beneficial uses, mitigation, and interagency coordination) have been taken to minimize adverse affects on these resources. For a discussion of all PAs that were evaluated, refer to the DMMP (Appendix D) and Chapter 2 of the FEIS. Associated minimization of adverse effects is described in the WVA (Appendix C) and Chapter 5 of the FEIS. All impacts within Texas would be offset by the BU features and as described in the DMMP.

(C) Significant degradation of critical areas under §501.23(a)(7)(E) of this title would result.

<u>Compliance:</u> Some critical areas would be affected by the project, as noted above. However, impacts to critical areas have been minimized to the greatest extent practicable, and net environmental benefits would result from the Preferred Alternative as discussed above. For a discussion of all PAs that were evaluated, refer to the DMMP (Appendix D) and Chapter 2 of the FEIS. Associated minimization of adverse effects is described in the WVA (Appendix C) and Chapter 5 of the FEIS. All impacts within Texas would be offset by the BU features as described in the DMMP.

(4) A dredging or dredged material disposal or placement project that would be prohibited solely by application of paragraph (3) of this subsection may be allowed if it is determined to be of overriding importance to the public and national interest in light of economic impacts on navigation and maintenance of commercially navigable waterways.

<u>Compliance:</u> Dredging and placement is not precluded by paragraph (3), as noted above.

(b) Adverse effects from dredging and dredged material disposal and placement shall be minimized as required in subsection (a) of this section. Adverse effects can be minimized by employing the techniques in this subsection where appropriate and practicable.

<u>Compliance:</u> Adverse effects of dredging and disposal, as described in the FEIS and associated DMMP, have been minimized as described under "Compliance" for paragraph (1) of this subsection. For a discussion of all PAs that were evaluated, refer to the DMMP (Appendix D) and Chapter 2 of the FEIS. Associated minimization of adverse effects is described in the WVA (Appendix C) and Chapter 5 of the FEIS. All impacts within Texas would be offset by the BU features as described in the DMMP.

(1) Adverse effects from dredging and dredged material disposal and placement can be minimized by controlling the location and dimensions of the activity. Some of the ways to accomplish this include:

(A) locating and confining discharges to minimize smothering of organisms;

(B) locating and designing projects to avoid adverse disruption of water inundation patterns, water circulation, erosion and accretion processes, and other hydrodynamic processes;

(C) using existing or natural channels and basins instead of dredging new channels or basins, and discharging materials in areas that have been previously disturbed or used for disposal or placement of dredged material;

(D) limiting the dimensions of channels, basins, and disposal and placement sites to the minimum reasonably required to serve the project purpose, including allowing for reasonable overdredging of channels and basins, and taking into account the need for capacity to accommodate future expansion without causing additional adverse effects;

(E) discharging materials at sites where the substrate is composed of material similar to that being discharged;

(F) locating and designing discharges to minimize the extent of any plume and otherwise control dispersion of material; and

(G) avoiding the impoundment or drainage of critical areas.

<u>Compliance:</u> PAs have been designed to minimize open-water impacts by using vertical storage of dredged material to create marshes or uplands or using existing and expanded upland confined placement, wherever practical. Changes in water circulation and salinity were modeled extensively, and mitigation and BU measures were conceptually designed based on modeling results. Mitigation within Louisiana and BU efforts were designed to improve or maintain ecological functions of the area studied. Erosion would be slowed by shore nourishment, a BU feature of the Preferred Alternative, in critically eroding areas along Texas and Louisiana Points. Channel morphology would change by deepening the navigation channels' existing footprint, by easing bends within the Sabine-Neches Canal, and by adding and/or modifying turning and anchorage basins within the Neches River reach and the Taylor Bayou subreach; however, the extent of improvements to the SNWW navigation features are limited by the net benefits derived as a result of the project, and by constraining the improvements to stay within the existing channel and basin boundaries as much as practicable. Maximum use of existing active and inactive PAs would be employed. Material would be beneficially used to provide shoreline protection and creation, enhancement, and restoration of marshes, both along the Gulf Coast and upstream within the SNWW system. Discharges would be confined with reinforced levees where applicable. Only appropriate material would be used for certain substrates and uses. No impoundment or draining of critical areas would occur as a result of the Preferred Alternative.

(2 Dredging and disposal and placement of material to be dredged shall comply with applicable standards for sediment toxicity. Adverse effects from constituents contained in materials

discharged can be minimized by treatment of or limitations on the material itself. Some ways to accomplish this include:

(A) disposal or placement of dredged material in a manner that maintains physiochemical conditions at discharge sites and limits or reduces the potency and availability of pollutants;

(B) limiting the solid, liquid, and gaseous components of material discharged;

(C) adding treatment substances to the discharged material; and

(D) adding chemical flocculants to enhance the deposition of suspended particulates in confined disposal areas.

<u>Compliance:</u> Sediments to be dredged from the SNWW have been tested for a variety of chemical parameters of concern. Samples yielded no cause for concern and sediments are safe for placement in the Gulf or beneficial use. A summary of these results is included in Section 3.4 of the FEIS.

(3) Adverse effects from dredging and dredged material disposal or placement can be minimized through control of the materials discharged. Some ways of accomplishing this include:

(A) use of containment levees and sediment basins designed, constructed, and maintained to resist breaches, erosion, slumping, or leaching;

(B) use of lined containment areas to reduce leaching where leaching of chemical constituents from the material is expected to be a problem;

(C) capping in-place contaminated material or, selectively discharging the most contaminated material first and then capping it with the remaining material;

(D) properly containing discharged material and maintaining discharge sites to prevent point and nonpoint pollution; and

(E) timing the discharge to minimize adverse effects from unusually high water flows, wind, wave, and tidal actions.

<u>Compliance:</u> Construction of reinforced containment levees would be used where necessary. PAs are confined with levees. Small, temporary levees may be created during marsh restoration efforts. Shore nourishment measures and placement in ODMDSs may have some temporary and local impacts by increasing turbidity; however, material to be generated from construction activities has been tested and found not to contain harmful concentrations of pollutants. Future maintenance material is anticipated to mirror existing maintenance material, which also has been extensively

tested and found to have no causes for concern (Section 3.4 of the FEIS). Discharges would not occur during conditions involving high water flows, waves, or tidal action.

(4) *Adverse effects from dredging and dredged material disposal or placement can be minimized by controlling the manner in which material is dispersed. Some ways of accomplishing this include:*

(A) *where environmentally desirable, distributing the material in a thin layer;*

(B) *orienting material to minimize undesirable obstruction of the water current or circulation patterns;*

(C) *using silt screens or other appropriate methods to confine suspended particulates or turbidity to a small area where settling or removal can occur;*

(D) *using currents and circulation patterns to mix, disperse, dilute, or otherwise control the discharge;*

(E) *minimizing turbidity by using a diffuser system or releasing material near the bottom;*

(F) *selecting sites or managing discharges to confine and minimize the release of suspended particulates and turbidity and maintain light penetration for organisms; and*

(G) *setting limits on the amount of material to be discharged per unit of time or volume of receiving waters.*

Compliance: All of the sites minimize or avoid adverse dispersal effects to the greatest extent practicable and incorporated hydrodynamic and sedimentation modeling of the area of interest. Material to be used as shore nourishment would be hydraulically discharged into the nearshore zone, with some material expected to flow over the existing marsh while the remainder flows into the nearshore waters. Sequenced discharge points would be used to disperse material across the ODMDSs. There are no sediments of concern.

(5) *Adverse effects from dredging and dredged material disposal or placement operations can be minimized by adapting technology to the needs of each site. Some ways of accomplishing this include:*

(A) *using appropriate equipment, machinery, and operating techniques for access to sites and transport of material, including those designed to reduce damage to critical areas;*

(B) *having personnel on site adequately trained in avoidance and minimization techniques and requirements; and*

(C) designing temporary and permanent access roads and channel spanning structures using culverts, open channels, and diversions that will pass both low and high water flows, accommodate fluctuating water levels, and maintain circulation and faunal movement.

<u>Compliance:</u> Where applicable, all sites in this project would meet this requirement; contracts would be written to ensure compliance with all standards.

(6) Adverse effects on plant and animal populations from dredging and dredged material disposal or placement can be minimized by:

(A) avoiding changes in water current and circulation patterns that would interfere with the movement of animals;

(B) selecting sites or managing discharges to prevent or avoid creating habitat conducive to the development of undesirable predators or species that have a competitive edge ecologically over indigenous plants or animals;

(C) avoiding sites having unique habitat or other value, including habitat of endangered species;

(D) using planning and construction practices to institute habitat development and restoration to produce a new or modified environmental state of higher ecological value by displacement of some or all of the existing environmental characteristics;

(E) using techniques that have been demonstrated to be effective in circumstances similar to those under consideration whenever possible and, when proposed development and restoration techniques have not yet advanced to the pilot demonstration stage, initiating their use on a small scale to allow corrective action if unanticipated adverse effects occur;

(F) timing dredging and dredged material disposal or placement activities to avoid spawning or migration seasons and other biologically critical time periods; and

(G) avoiding the destruction of remnant natural sites within areas already affected by development.

<u>Compliance:</u> BU sites meet these requirements. Currents would not be detrimentally affected by the Preferred Alternative. No sites that are advantageous for colonization of predators or nonindigenous species are proposed. Proper coordination with U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), under the requirements of the Endangered Species Act, was implemented and no impacts to endangered species or their habitats are anticipated. Cutterhead suction dredges do not impact spawning or migration. Impacts to sea

turtles would be avoided or minimized: (1) hopper dredging would be limited to the cooler months, when possible, when sea turtle activity and abundance is lowest; (2) dredges would employ trawls to safely remove sea turtles before being adversely affected by dredge equipment; and (3) qualified turtle observers would be used to document any turtles that become entrained by the hopper dredge dragheads (any information would be submitted accordingly to the USFWS and NMFS).

(7) Adverse effects on human use potential from dredging and dredged material disposal or placement can be minimized by:

(A) selecting sites and following procedures to prevent or minimize any potential damage to the aesthetically pleasing features of the site, particularly with respect to water quality;

(B) selecting sites which are not valuable as natural aquatic areas;

(C) timing dredging and dredged material disposal or placement activities to avoid the seasons or periods when human recreational activity associated with the site is most important; and

(D) selecting sites that will not increase incompatible human activity or require frequent dredge or fill maintenance activity in remote fish and wildlife areas.

<u>Compliance:</u> Placement of dredged material to provide for shore nourishment and creation of saline marsh may temporarily restrict recreational use of the area by the public at the Texas and Louisiana Points shoreline. Temporary and minor adverse effects to fisheries may result from altering or removing productive fishing grounds and interfering with fishing activity near or in the ODMDSs. However, BU and mitigation features would contribute significantly to the human use potential, particularly recreational fishing, by creating, restoring, and enhancing estuarine habitats necessary for marine life cycles (particularly several commercially and recreationally important species). During dredging cycles, some existing designated PAs can provide habitat for birds and wildlife species that pose an aircraft strike hazard, however; no new PAs would be constructed within the Federal Aviation Administration separation perimeters (refer to sections 3.14.4.1.2 and 4.15.2.11 of the FEIS for more details).

(8) Adverse effects from new channels and basins can be minimized by locating them at sites:

(A) that ensure adequate flushing and avoid stagnant pockets; or

(B) that will create the fewest practicable adverse effects on CNRAs from additional infrastructure such as roads, bridges, causeways, piers, docks, wharves, transmission line crossings, and ancillary channels reasonably likely to be constructed as a result of the project; or

(C) with the least practicable risk that increased vessel traffic could result in navigation hazards, spills, or other forms of contamination which could adversely affect CNRAs;

(D) provided that, for any dredging of new channels or basins subject to the requirements of §501.15 of this title (relating to Policy for Major Actions), data and information on minimization of secondary adverse effects need not be produced or evaluated to comply with this paragraph if such data and information is produced and evaluated in compliance with §501.15(b)(1) of this title.

<u>Compliance:</u> The SNWW deepening constitutes new work dredging to the existing ship channel. Some new access channels would have to be dredged to allow construction of mitigation sites within Louisiana but these would be as minimal as possible and would not create stagnant pockets and navigation hazards, and would not impact any CNRAs (except submerged lands). All impacts within Texas would be offset by the BU features and as described in the DMMP.

(c) Disposal or placement of dredged material in existing contained dredge disposal sites identified and actively used as described in an environmental assessment or environmental impact statement issued prior to the effective date of this chapter shall be presumed to comply with the requirements of subsection (a) of this section unless modified in design, size, use, or function.

<u>Compliance:</u> All PAs were reviewed by the Habitat Evaluation Workgroup (HW) of the ICT and no further environmental review was recommended for the existing PAs in active use. Existing upland confined placement areas are being modified to increase levee heights with new work material, but this work would not enlarge the footprint of the existing PAs. In addition, the renewed use of inactive PAs was also determined to not constitute adverse change to the existing environmental conditions. The ICT HW identified one existing upland PA (PA 24) required to be expanded that would result in converting 86 acres of freshwater wetlands into a confined placement area. However, the ICT HW concluded impacts to the 86-acre freshwater wetland would be fully offset by benefits derived from restoration features within the Neches River BU Feature.

(d) Dredged material from dredging projects in commercially navigable waterways is a potentially reusable resource and must be used beneficially in accordance with this policy.

<u>Compliance:</u> New work and future maintenance dredged material to be generated by the Preferred Alternative would be used beneficially for shoreline protection and restoring, creating, and enhancing wetlands where economically feasible, physically compatible, and environmentally beneficial. All impacts within Texas would be offset by the BU features and as described in the DMMP.

(1) If the costs of the beneficial use of dredged material are reasonably comparable to the costs of disposal in a non-beneficial manner, the material shall be used beneficially.

(2) If the costs of the beneficial use of dredged material are significantly greater than the costs of disposal in a non-beneficial manner, the material shall be used beneficially unless it is demonstrated that the costs of using the material beneficially are not reasonably proportionate to the costs of the project and benefits that will result. Factors that shall be considered in determining whether the costs of the beneficial use are not reasonably proportionate to the benefits include, but are not limited to:

(A) environmental benefits, recreational benefits, flood or storm protection benefits, erosion prevention benefits, and economic development benefits;

(B) the proximity of the beneficial use site to the dredge site; and

(C) the quantity and quality of the dredged material and its suitability for beneficial use.

(3) Examples of the beneficial use of dredged material include, but are not limited to:

(A) projects designed to reduce or minimize erosion or provide shoreline protection;

(B) projects designed to create or enhance public beaches or recreational areas;

(C) projects designed to benefit the sediment budget or littoral system;

(D) projects designed to improve or maintain terrestrial or aquatic wildlife habitat;

(E) projects designed to create new terrestrial or aquatic wildlife habitat, including the construction of marshlands, coastal wetlands, or other critical areas;

(F) projects designed and demonstrated to benefit benthic communities or aquatic vegetation;

(G) projects designed to create wildlife management areas, parks, airports, or other public facilities;

(H) projects designed to cap landfills or other waste disposal areas;

(I) projects designed to fill private property or upgrade agricultural land, if cost-effective public beneficial uses are not available; and

(J) projects designed to remediate past adverse impacts on the coastal zone.

(e) If dredged material cannot be used beneficially as provided in subsection (d)(2) of this section, to avoid and otherwise minimize adverse effects as required in subsection (a) of this section, preference will be given to the greatest extent practicable to disposal in:

(1) contained upland sites;

(2) other contained sites; and

(3) open water areas of relatively low productivity or low biological value.

<u>Compliance:</u> New work and future maintenance dredged material whose sediment characteristics preclude being used beneficially or are not economically feasible to be used beneficially would be placed in either the ODMDSs or upland confined PAs (see sections 2.1, 2.2.3, and 2.3.2 in the FEIS).

(f) For new sites, dredged materials shall not be disposed of or placed directly on the boundaries of submerged lands or at such location so as to slump or migrate across the boundaries of submerged lands in the absence of an agreement between the affected public owner and the adjoining private owner or owners that defines the location of the boundary or boundaries affected by the deposition of the dredged material.

<u>Compliance</u>: Placement areas are designed to prevent impacts to adjoining private lands. All property rights and boundaries associated with submerged lands would be observed.

Appendix I2

Compliance with Louisiana Coastal Management Program

Appendix I2

Compliance with Goals and Policies – Part I, Chapter 7, §700–§729
Dredging and Dredged Material Disposal and Placement
Sabine-Neches Waterway Channel Improvement Project
Environmental Impact Statement
Louisiana Coastal Zone Management Program
Consistency Determination

INTRODUCTION

Section 307 of the Coastal Zone Management Act of 1972, 16 USC 141 et seq., requires that "each Federal agency conducting or supporting activities directly affecting the coastal zone shall conduct or support those activities in a manner which is, to the maximum extent practicable, consistent with state approved management programs." In compliance with Section 307, a consistency determination has been prepared for the Sabine-Neches Waterway (SNWW) Channel Improvement Project (CIP). Coastal Use Guidelines were written to implement the policies and goals of the Louisiana Coastal Resources Program and to serve as a set of performance standards for evaluating projects. Compliance with the Louisiana Coastal Resources Program and, therefore, Section 307, requires compliance with applicable Coastal Use Guidelines.

PROJECT DESCRIPTION

The U.S. Army Corps of Engineers (USACE), Galveston District proposes to modify the navigation channels servicing the ports of Beaumont, Port Neches, Port Arthur, and Orange, Texas, in the interests of commercial navigation. These channels are collectively referred to as the SNWW, and the project to modify the SNWW is referred to as the CIP. The purpose of the CIP is to improve the transportation efficiency and safety of the SNWW's deep-draft navigation system, while protecting the quality of the area's coastal and estuarine resources.

The existing 40-foot inshore and 42-foot offshore SNWW project is a federally authorized and maintained waterway located in Jefferson and Orange counties, Texas, and Cameron and Calcasieu parishes, Louisiana. The existing SNWW consists of the following channel reaches, as listed from offshore to inshore: (1) Sabine Bank Channel; (2) Sabine Pass Outer Bar Channel; (3) Sabine Pass Jetty Channel; (4) Sabine Pass Channel; (5) Port Arthur Channel; (6) Sabine-Neches Channel; and (7) Neches River Channel.

The authorized depth of the channel in the Preferred Alternative would increase from 40 to 48 feet along the entire existing channel, and the offshore entrance channel would extend 13.2 miles farther into the Gulf of Mexico (Gulf). The Sabine Pass Jetty Channel, Sabine Pass Channel, Port Arthur and Sabine-Neches canals, and the Neches River Channel would be deepened from 40 feet to 48 feet. The authorized depth of the existing offshore Entrance Channel (Sabine Pass Outer Bar Channel and Sabine Bank

Channel) is currently 42 feet; the additional depth is needed to accommodate fluctuations in offshore surface water elevation. These channels and the proposed Sabine Bank Extension Channel would be deepened from 42 to 50 feet. This would increase the SNWW from 64 miles to approximately 77 miles in length. No modifications to the existing Sabine Pass Jetties would be required as part of the Preferred Alternative.

The Sabine Pass Jetty Channel and the majority of the inshore channels (Sabine Pass Channel, Port Arthur Canal, Sabine-Neches Canal, and Neches River Channel) would remain at their existing widths. With the exception of wider sections at anchorages or channel intersections, these channels transition from 500 feet wide between the jetties to 400 feet wide upstream of the Martin Luther King Bridge on the Sabine-Neches Canal and Neches River Channel. The Taylor Bayou Channels and Basins would also be widened and deepened to 48 feet. Although the Sabine-Neches Canal and Neches River Channel would not be widened, navigation efficiency would be improved with short stretches of selective widening and bend easings in both reaches, and the addition or enlargement of one anchorage and two turning/anchorage basins on the Neches River Channel.

Environmental affects addressed in the SNWW CIP Final Environmental Impact Statement (FEIS), particularly pertaining to coastal resources, have been analyzed in a large surrounding area that includes Sabine Lake and adjacent marshes in Texas and Louisiana, the Neches River Channel up to the new Neches River Saltwater Barrier, the Sabine River Channel to the Sabine Island Wildlife Management Area (WMA), the Gulf Intracoastal Waterway (GIWW), west to Star Bayou, the GIWW east to Gum Cove Ridge, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and offshore in the Gulf to 13.2 miles beyond the end of the current navigation channel.

Several project components would specifically occur within Louisiana and include:

- direct impacts from channel deepening along the northern side of the Sabine Pass Channel;
- placement of dredged material for beneficial use along Louisiana Point (which would involve regular shoreline nourishment using maintenance material from the Sabine Pass Channel);
- dredged material placement within placement area (PA) 5 (located in Louisiana at Sabine Pass);
- Willow Bayou mitigation areas (two areas) within Sabine National Wildlife Refuge (NWR) (which also includes the associated sediment source-a borrow trench and access channel from the GIWW in Sabine Lake);
- Black Bayou East mitigation areas (two mitigation areas and associated sediment source – the dredging of accumulated sediment in Lake Charles Deepwater Channel/GIWW); and
- Black Bayou West mitigation area (one mitigation area, including the sediment source from regularly scheduled maintenance dredging already occurring as an existing action for Sabine River Channel).

The SNWW study area contains a high concentration of significant coastal wetlands. The USACE, in coordination with an Interagency Coordination Team (ICT) comprised of numerous State and Federal agencies, including the Louisiana Department of Natural Resources (LDNR), developed a dredged material management plan (DMMP) that uses dredged material from the proposed SNWW CIP in an environmentally acceptable and economically practical manner. The ICT identified, within the proposed project footprint, 109,175 acres (171 square miles) in Texas and 197,530 acres (309 square miles) in Louisiana of coastal marsh, bottomland hardwood, and cypress-tupelo swamp habitats.

No net loss of coastal wetlands was a specific goal of the SNWW CIP ICT and alternatives evaluation. All impacts from the Preferred Alternative within Texas would be offset by the DMMP, and impacts in Louisiana would be offset through compensatory mitigation. The Preferred Alternative's mitigation plan consists of restoring five degraded marsh areas east of Sabine Lake near Willow and Black bayous, Louisiana. This mitigation measure would restore 2,783 acres of emergent marsh in existing open water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing, adjacent marsh. Material for marsh mitigation would come from regular maintenance dredging of the Sabine River Channel and from dedicated dredging of the Sabine Lake borrow trench and of accumulated sediments from the Lake Charles Deepwater Channel/GIWW (Figure 1.1-2 of the FEIS).

In Louisiana, beginning at the coast and working inland, the following protected and sensitive habitat areas are present within the study area (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority, 1998; U.S. Geological Survey-National Wetlands Research Center, 2004):

- 71,500 acres of saline, brackish, and intermediate marshes in the Louisiana Chenier Plain habitat at Louisiana Point, Blue Buck Point, and Johnson Bayou areas. Sensitive areas include Sabine Lake Ridges (33,500 acres of chenier ridge, and saline, brackish, and intermediate marsh), Johnson's Bayou Ridge (about 4,000 acres of saline and brackish marshes, and chenier ridges), West Johnson's Bayou (13,000 acres of brackish and intermediate marsh) and East Johnson's Bayou (26,719 acres of chenier ridge, and fresh, intermediate, and brackish marsh).
- 44,300 acres of brackish, intermediate, and fresh coastal marsh in the western half of the Sabine NWR. The Sabine NWR, as a whole, contains 124,500 acres of fresh, intermediate, and brackish marsh between Calcasieu and Sabine lakes in southwest Louisiana. Approximately 13,750 acres of marsh within this study area has degraded to open water. This sensitive area contains the Willow Bayou mapping unit (36,300 acres) and 8,000 acres in the west section of the Southeast Sabine mapping unit.
- 46,500 acres of brackish, intermediate, and fresh marsh in an area north of Willow Bayou and south of the GIWW. This sensitive area contains the Black Bayou mapping unit (36,300 acres), and 10,220 acres of fresh and intermediate marsh in the Southwest Gum Cove mapping unit.
- 25,700 acres of fresh and intermediate marsh and bottomland hardwood habitat in the Perry Ridge mapping unit, north of the GIWW and east of the Sabine River.

- 650 acres of cypress-tupelo swamp and bottomland hardwoods in the Blue Elbow Swamp, east of the Sabine River and north of Interstate 10.
- 7,000 acres of cypress-tupelo swamp and bottomland hardwoods in the Sabine Island WMA, north of the Blue Elbow Swamp and east of the Sabine River.

GUIDELINES

1. Guidelines Applicable to All Uses

Guideline 1.1: The guidelines must be read in their entirety. Any proposed use may be subject to the requirements of more than one guideline or section of guidelines and all applicable guidelines must be complied with.

Response: Acknowledged.

Guideline 1.2: Conformance with applicable water and air quality laws, standards, and regulations, and with those laws, standards and regulations which have been incorporated into the coastal resources program shall be deemed in conformance with the program except to the extent that these guidelines would impose additional requirements.

Response: Acknowledged.

Guideline 1.3: The guidelines include both general provisions applicable to all uses and specific provisions applicable only to certain types of uses. The general guidelines apply in all situations. The specific guidelines apply only to situations they address. Specific and general guidelines should be interpreted to be consistent with each other. In the event there is an inconsistency, the specific should prevail.

Response: Acknowledged.

Guideline 1.4: These guidelines are not intended to nor shall they be interpreted so as to result in an involuntary acquisition or taking of property.

Response: Acknowledged.

Guideline 1.5: No use or activity shall be carried out or conducted in such a manner as to constitute a violation of the terms of a grant or donation of any lands or water-bottoms to the State or any subdivision thereof. Revocations of such grants and donations shall be avoided.

Response: Acknowledged.

Guideline 1.6: Information regarding the following general factors shall be utilized by the permitting authority in evaluating whether the proposed use is in compliance with the guidelines.

a) Type, nature, and location of use.

b) Elevation, soil, and water conditions and flood and storm hazard characteristics of site.

c) Techniques and materials used in construction, operation, and maintenance or use.

d) Existing drainage patterns and water regimes of surrounding area including flow, circulation, quality, quantity, and salinity; and impacts on them.

e) Availability of feasible alternative sites or methods for implementing the use.

f) Designation of the area for certain uses as part of a local program.

g) Economic need for use and extent of impacts of use on economy of locality.

h) Extent of resulting public and private benefits.

i) Extent of coastal water dependency of the use.

j) Existence of necessary infrastructure to support the use and public costs resulting from the use.

k) Extent of impacts on existing and traditional uses of the area and on future uses for which the area is suited.

1) Proximity to and extent of impacts on important natural features such as beaches, barrier islands, tidal passes, wildlife and aquatic habitats, and forest lands.

m) The extent to which regional, State, and National interests are served including the National interest in resources and the siting of facilities in the coastal zones as identified in the coastal resources program.

n) Proximity to, and extent of impacts on, special areas, particular areas, or other areas of particular concern of the State program or local programs.

o) Likelihood of, and extent of impacts of, resulting secondary impacts and cumulative impacts.

p) Proximity to and extent of impacts on public lands or works, or historic, recreational or cultural resources.

q) Extent of impacts on navigation, fishing, public access, and recreational opportunities.

r) Extent of compatibility with natural and cultural setting.

s) Extent of long-term benefits or adverse impacts.

Response: Acknowledged.

Guideline 1.7: It is the policy of the coastal resources program to avoid the following adverse impacts. To this end, all users and activities shall be planned, sited, designed, constructed, operated, and maintained to avoid to the maximum extent practicable significant:

a) reductions in the natural supply of sediment and nutrients to the coastal system by alterations of freshwater flow.

Response: No alteration of freshwater flows would occur from the proposed project (Section 4.6 of the FEIS); however, additional sediments would be added to certain marsh areas to restore emergent marsh acreage and to allow for added productivity (sections 4.5 and 4.6 and Chapter 5 of the FEIS).

b) adverse economic impacts on the locality of the use and affected governmental bodies.

Response: The Preferred Alternative is expected to have a positive impact on the local economy (sections 1.0 and 4.15 of the FEIS); no adverse economic impacts on the locality or governmental bodies would occur as a result of the Preferred Alternative.

c) detrimental discharges of inorganic nutrient compounds into coastal waters.

Response: There could be a temporary increase in the concentration of inorganic nutrient compounds near the dredging BU and mitigation sites from resuspension of bottom sediments. Suspended particles resulting from placement would not result in detrimental effects to chemical and physical properties of the water column.

d) alterations in the natural concentration of oxygen in coastal waters.

Response: Oxygen concentrations at the dredging and placement sites could be reduced during dredging operations and temporarily afterward if organic or ammonia load in the sediments is sufficiently high. Anoxic conditions are not expected to develop, and no significant adverse impacts to aquatic species are expected (Section 4.5 of the FEIS).

e) destruction or adverse alterations of streams, wetlands, tidal passes, inshore waters and waterbottoms, beaches, dunes, barrier islands, and other natural biologically valuable areas or protective coastal features.

Response: Alterations to the SNWW, Sabine Lake, near-shore Gulf, beach, shallow-water areas, and wetlands are expected. Several project components would specifically occur within Louisiana and include direct impacts from channel deepening along the northern side of the Sabine Pass Channel, placement of dredged material for beneficial use along Louisiana Point (which would involve regular shoreline nourishment using maintenance material from the Sabine Pass Channel), dredged material placement within PA 5 (located in Louisiana at Sabine Pass), Willow Bayou mitigation areas (two areas) within the Sabine NWR (which also includes the associated sediment source-a borrow trench and access channel from the GIWW in Sabine Lake), Black Bayou East mitigation areas (two mitigation areas and associated sediment source-the dredging of accumulated sediment in the Lake Charles Deepwater Channel/GIWW), and Black Bayou West mitigation area (one mitigation area, including the sediment source from regularly scheduled maintenance dredging already occurring as an existing action for the Sabine River Channel). The compensatory mitigation for project-induced impacts are considered to be beneficial (Section 4.1 and Chapter 5 of the FEIS). The effects of dredging and dredged material deposition are discussed in more detail under Guidelines 4.1 to 4.7.

f) adverse disruption of existing social patterns.

Response: No disruption of existing social pattern is expected (Section 4.15 of the FEIS).

g) alterations of the natural temperature regime of coastal waters.

Response: The Preferred Alternative would not alter water temperatures in coastal waters (sections 4.4 and 4.6 of the FEIS).

h) detrimental changes in existing salinity regimes.

Response: A small increase in salinity would likely occur since alterations in an increase with saltwater intrusion would occur with deepening the SNWW. Essentially all detrimental impacts associated with the Preferred Alternative are from expected alterations in salinity. Extensive interagency coordination, combined with detailed ecological modeling, resulted in BU features and mitigation measures that offset and compensate for all ecological impacts (Chapter 5, appendices B and C of the FEIS).

i) detrimental changes in littoral and sediment transport processes.

Response: This plan would cause some changes in littoral and sediment transport processes. A small increase in Gulf shoreline erosion (0.42 foot/year) between 0.5 and 3.5 miles from the Sabine Jetty would be caused by changes in wave angles due to the offshore channel extension. This impact is more than offset by benefits of the Gulf Shoreline BU Feature. Beneficial changes would involve regular nourishment of 3 miles of shoreline at Louisiana Point once every 6 years, or eight placement episodes, or the 50-year project life.

j) adverse effects of cumulative impacts.

Response: A number of actions have influenced the study area and are expected to continue to do so. A cumulative impacts assessment was conducted that took into consideration 13 past or present actions, 6 reasonably foreseeable future actions, and 6 ongoing regional activities, initiatives, and programs that are likely to affect the study area. These included industrial activities such as pipelines and construction of liquid natural gas (LNG) facilities, as well as channel improvements and ecosystem restoration efforts. Details and additional discussion regarding the cumulative impact evaluation can be found in Section 4.16 of the FEIS; regional programs and initiatives are summarized in Chapter 7 of the FEIS.

Cumulative adverse impacts from past, existing, and reasonably foreseeable future projects, along with the Project, are not expected to have significant adverse effects within the study area. Many of the projects included in the cumulative impacts analysis are part of the continued port and shipping industry development. Other projects considered in the assessment are beneficial to certain natural resources and add to the diversity and health of the publicly held recreation and conservation areas, migratory bird habitats, Essential Fish Habitat (EFH), and other sensitive coastal resources. Existing governmental regulations, in conjunction with the goals and coordination of community planning efforts, address the

issues that influence local and ecosystem-level conditions. Cumulative adverse impacts that are expected to occur within the study area primarily include temporary and localized increased nitrogen oxides emissions and noise. Some projects considered in this assessment are beneficial to certain natural resources (predominantly wetlands and the species dependent on them) and add to the diversity and health of publicly held recreation and conservation areas, migratory bird habitats, EFH, and other sensitive coastal resources. Impacts associated with the Preferred Alternative have been fully offset by compensatory mitigation measures. In addition, the Preferred Alternative would have net beneficial effects on wetlands, water quality, and submerged aquatic vegetation (SAV) with the implementation of the Gulf Shoreline BU Feature at Louisiana Point. Results of cumulative impacts assessments for the Preferred Alternative are in Section 4.16.5 of the FEIS.

k) detrimental discharges of suspended solids into coastal waters, including turbidity resulting from dredging.

Response: Dredging and placement of dredged material would temporarily and locally increase turbidity and suspended solids in adjacent waters (sections 4.5 and 4.6 of the FEIS). The sediments have been determined to be suitable for placement, mitigation, and beneficial uses.

l) reductions or blockage of water flow or natural circulation patterns within or into an estuarine system or wetland forest.

Response: Gulf beach nourishment uses maintenance material from Sabine Pass Channel to reduce erosion impacts along Louisiana Point. Reducing erosion with maintenance material would alter flows and circulation patterns positively. Marsh creation, which would not use material from the project, would reestablish most of the natural circulation patterns and reduce marsh loss and salinity intrusion. Although beach nourishment and mitigation efforts may alter flow, alterations would be beneficial (Chapter 5, appendices B and C of the FEIS). No natural waterways would be blocked or otherwise restricted by navigation channel improvements or mitigation measures.

m) discharges of pathogens or toxic substances into coastal waters.

Response: Extensive analyses of sediment material associated with the project were conducted, including data recently collected in March 2008 and April 2009, and results indicate that there are no causes for concern related to pathogens or toxic substances. Section 3.4 of the FEIS discusses sediment testing results.

n) adverse alteration or destruction of archaeological, historical, or other cultural resources.

Response: Adverse effects or destruction of these resources is not expected. The USACE's Galveston District has consulted with the Louisiana State Historic Preservation Office in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, and has executed a Programmatic Agreement to cover completion of cultural resource surveys and assessments in mitigation areas prior to

construction. Should any historic properties be identified, measures would be taken to ensure that project impacts would be avoided or mitigated.

o) fostering of detrimental secondary impacts in undisturbed or biologically highly productive wetland areas.

Response: Most of the wetlands in the study area have been significantly altered by subsidence and saltwater intrusion, although most areas remain highly productive fish and wildlife habitats. No secondary impacts would be induced in these areas by the Preferred Alternative.

p) adverse alteration or destruction of unique or valuable habitats, critical habitat for endangered species, important wildlife or fishery breeding or nursery areas, designated wildlife management or sanctuary areas, or forest lands.

Response: Critical Habitat for the federally endangered piping plover would be directly affected from dredged material beneficial use for beach nourishment along a 3-mile stretch of Louisiana Point. Beach nourishment efforts would result in positive effects for piping plover habitat (Appendix G of FEIS). Wetland mitigation areas in the Sabine NWR would result in short-term, localized adverse effects but the net, long-term effects would be positive, as determined by the Wetland Value Assessment (WVA) Model (Appendix C of the FEIS). In addition to the Sabine NWR, the Sabine Island WMA is located in the Louisiana study area; however no salinity impacts from the Preferred Alternative would affect Sabine Island WMA.

q) adverse alteration or destruction of public parks, shoreline access points, public works, designated recreation areas, scenic rivers, or other areas of public use and concern.

Response: Beneficial alterations to shoreline at Louisiana Point and degraded wetlands in Sabine NWR would occur as a result of the Preferred Alternative.

r) adverse disruptions of coastal wildlife and fishery migratory patterns.

Response: Wintering waterfowl, shore birds, and wading birds could be temporarily displaced from PA 5, marsh mitigation areas, and the Gulf shoreline during dredged material placement activities. The adults of various aquatic species, including brown shrimp, white shrimp, blue crab, red drum, and menhaden, spawn in the Gulf, and the young juveniles of these species use deep tidal passes such as the SNWW for immigration to inland estuarine nursery areas. Increased turbidity resulting from dredging activities could have a temporary, localized, adverse effect on the movement of these organisms, but would not permanently disrupt wildlife and fishery migration patterns.

s) land loss, erosion, and subsidence.

Response: Slightly higher salinities may lead to the loss of 691 acres of marsh, associated SAV and shallow-water habitat, as stressed emergent marsh converts to open water. The Preferred Alternative's BU feature at Louisiana Point and mitigation measures would nourish highly eroded areas and restore

subsided wetlands (which would not result in land loss). The Louisiana Point BU Feature would regularly nourish 3 miles of shoreline. The Mitigation Plan compensates for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone.

t) increases in the potential for flood, hurricane, or other storm damage, or increases in the likelihood that damage would occur from such hazards.

Response: The Preferred Alternative would not increase potential for flood, hurricane, or other storm damage, or increase likelihood of damage (Section 4.1 of the FEIS). The Preferred Alternative's effect on storm surge was evaluated with hydrodynamic salinity (HS) modeling; no effect on storm surge was found, and minor additional land loss would not affect wetland buffer functions on storm impacts.

u) reductions in the long term biological productivity of the coastal ecosystem.

Response: The Preferred Alternative would cause reductions in marsh biological productivity through salinity increases and associated land loss; however, these expected effects would be offset by the mitigation efforts and the BU feature in Louisiana. The Mitigation Plan compensates for the Preferred Alternative's losses in marsh productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes in the Willow and Black Bayou watersheds. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of shallow-water habitat by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the marsh restoration zone. These efforts effectively mitigate losses in productivity and were modeled via WVA (Section 4.1 and Appendix C of the FEIS) and HS model (Section 4.1 of the FEIS).

Guideline 1.8: In those in which the modifier "maximum extent practicable" is used, the proposed use is in compliance with the guideline if the standard modified by the term is complied with. If the modified standard is not complied with, the use would be in compliance with the guideline if the permitting authority finds, after a systematic consideration of all pertinent information regarding the use, the site, and the impacts of the use as set forth in Guideline 1.6, and a balancing of their relative significance, that the benefits resulting from the proposed use would clearly outweigh the adverse impacts resulting from noncompliance with the modified standard and there are no feasible and practical alternative locations, methods, and practices for the uses that are in compliance with the modified standard, and:

a) significant public benefits would result from the use; or

b) the use would serve important regional, state, or national interests, including the national interest in resources and the siting of facilities in the coastal zone identified in the coastal resources program or the use is coastal water dependent.

The systematic consideration process shall also result in a determination of those conditions necessary for the use to be in compliance with the guideline. Those conditions shall assure that the use is carried out utilizing those locations, methods, and practices which maximize conformance to the modified standard; are technically, economically, environmentally, socially, and legally feasible and practical and minimize or offset those adverse impacts listed in Guideline 1.7 and in the guideline at issue.

Response: Acknowledged.

Guideline 1.9: Uses shall, to the maximum extent practicable, be designed and carried out to permit multiple concurrent uses which are appropriate for the location and to avoid unnecessary conflicts with other uses of the vicinity.

Response: The purpose of the Preferred Alternative is to improve navigational efficiency and thus result in a net benefit to the economy of the region and the Nation. Other uses of the channel, such as commercial and recreational fishing and water sports, are and would continue unaffected.

Guideline 1.10: These guidelines are not intended to be, nor shall they be, interpreted to allow expansion of governmental authority beyond that established by La. R.S. 49:213.1 through 49:213.21, as amended; nor shall these guidelines be interpreted so as to require permits for specific uses legally commenced or established prior to the effective date of the coastal use permit program nor to normal maintenance or repair of such uses.

Response: Acknowledged.

2. Guidelines for Levees

Not applicable.

3. Guidelines for Linear Facilities

Not applicable.

4. Guidelines for Dredged Spoil Deposition

Guideline 4.1: Spoil shall be deposited utilizing the best practical techniques to avoid disruption of water movement, flow, circulation, and quality.

Response: Placement of dredged material to build marsh and terraces in the Sabine NWR would not negatively disrupt water flow. Dredged material not beneficially used would be placed into upland confined PAs, which, like the channel improvements, would not negatively disrupt water movement, flow, or circulation. The sediments to be excavated are not contaminated, and no significant adverse effect on water quality is expected (sections 4.4 to 4.6 of the FEIS).

Guideline 4.2: Spoil shall be used beneficially to the maximum extent practicable to improve productivity or create new habitat, reduce or compensate for environmental damage done by dredging activities, or prevent environmental damage. Otherwise, existing spoil disposal areas or upland disposal shall be utilized to the maximum extent practicable rather than creating new disposal areas.

Response: No construction material would be used beneficially within Louisiana as most channels are too far to feasibly (both economically and physically) execute. The Sabine Pass Channel is located near Louisiana, but marshes near the channel are in good condition and offer no opportunities for restoration or mitigation. All mitigation areas within Louisiana would be constructed with borrow material from dedicated dredging or maintenance of the Sabine River Channel.

Guideline 4.3: Spoil shall not be disposed of in a manner which could result in the impounding or draining of wetlands or the creation of development sites unless spoil deposition is part of an approved levee or land surface alteration project.

Response: No dredged material would be used that would impound or drain wetlands. No new PAs would be created in wetlands.

Guideline 4.4: Spoil shall not be disposed of on marsh, known oyster or clam reefs, or in areas of submerged vegetation to the maximum extent practicable.

Response: Some submerged vegetation may be temporarily impacted during wetland mitigation, but restoration would improve conditions for SAV over the long term. The Preferred Alternative would restore and enhance degraded wetlands as determined by the WVA (Appendix C to the FEIS). No impacts to oyster reefs would occur from the Preferred Alternative.

Guideline 4.5: Spoil shall not be disposed of in such a manner as to create a hindrance to navigation or fishing, or hinder timber growth.

Response: Navigation or timber growth would not be hindered. Fishing activities could be temporarily affected during construction or placement activities.

Guideline 4.6: Spoil disposal areas shall be designed and constructed and maintained using the best practicable techniques to retain the spoil at the site, reduce turbidity, and reduce shoreline erosion when appropriate.

Response: The material to be used beneficially at Louisiana Point would cause temporary and localized increases in turbidity but would provide an overall benefit to the ecosystem by adding sediment to the littoral system and reducing shoreline erosion. Dredged material not used beneficially would be placed in confined PA 5. PAs are designed and managed to control turbidity and retain as much of the dredged material as practicable with use of confinement levees or spill boxes. Best management practices to minimize or avoid turbidity effects could include silt curtains.

Guideline 4.7: The alienation of state-owned property shall not result from spoil deposition activities without the consent of the Department of Natural Resources.

Response: No State lands would be alienated as a result of the proposed action.

5. Guidelines for Shoreline Modification

Response: Dredged material from the Sabine Pass reach of the SNWW would be pumped to Louisiana Point on alternated maintenance cycles (Appendix D of the FEIS) for shoreline restoration. Placement on this eroded shoreline would not be confined nor would any other structural measures be used.

Guidelines 5.1–5.9: Not applicable.

6. Guidelines for Surface Alterations

Not Applicable.

7. Guidelines for Hydrologic and Sediment Transport Modifications

Not Applicable.

8. Guidelines for the Disposal of Wastes

Not Applicable.

9. Guidelines for Uses That Result in the Alteration of Waters Draining into Coastal Waters

Not applicable.

10. Guidelines for Oil, Gas, and Other Mineral Activities

Not applicable.

CONSISTENCY DETERMINATION

The guidelines of Louisiana's Coastal Resources Program have been applied to the proposed project for the SNWW CIP. The USACE, Galveston District has determined that implementation of the Preferred Alternative, which provides for deepening of the SNWW from 40 to 48 feet and an offshore channel from 48 to 50 feet in depth from offshore to the Port of Beaumont Turning Basin, extending the 50-foot-deep offshore channel by 13.2 miles, tapering and marking the Sabine Bank Channel from 800 feet wide to 700 feet wide, the bend of easings on the Sabine-Neches Canal and Neches River Channel, deepening and widening of the Taylor Bayou navigation channels and turning basins to 48 feet, and the addition of new

anchorages/turning basins on the Neches River Channel, would be consistent to the maximum extent practicable, with the State of Louisiana's approved Coastal Resources Program.

REFERENCES

Louisiana Coastal Wetlands Conservation and Restoration Task Force. 1998. Caring for Coastal Wetlands, a summary of the 1997 Evaluation Report to the U.S. Congress on the effectiveness of Louisiana Coastal Wetland Restoration Projects. http://www.lacoast.gov/reports/program/CaringBrochure/index.htm (accessed February 2007). U.S. Geological Survey, National Wetlands Research Center, Lafayette, Louisiana.

U.S. Geological Survey-National Wetlands Research Center. 2004. Louisiana Coastal Areas Mapping Units for the Calcasieu-Sabine Basin. U.S. Department of the Interior, U.S. Geological Survey, National Wetlands Research Center, Lafayette, Louisiana and Coastal Restoration Field Station, Baton Rouge, Louisiana.

Appendix J

SNWW CIP Mitigation/
Beneficial Use Monitoring Plan

Document No. 090198
PBS&J Job No. 100011305

SABINE-NECHES WATERWAY
CHANNEL IMPROVEMENT PROJECT
FINAL MITIGATION/BENEFICIAL
USE MONITORING PLAN
SOUTHEAST TEXAS AND SOUTHWEST LOUISIANA

Prepared for:

U.S. Army Corps of Engineers
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June 2010

Printed on recycled paper

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Acronyms and Abbreviations

BU	beneficial use
CIP	Channel Improvement Project
CWPPRA	Coastal Wetlands Planning, Protection and Restoration Act
DMMP	dredged material management plan
GIWW	Gulf Intracoastal Waterway
ICT	Interagency Coordinating Team
mcy	million cubic yards
NWR	National Wildlife Refuge
ppt	parts per thousand
SAV	submerged aquatic vegetation
SNND	Sabine-Neches Navigation District
SNWW	Sabine-Neches Waterway
SONRIS	Strategic Online Natural Resources Information System
TNRIS	Texas Natural Resource Information System
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act

Sabine-Neches Waterway
Channel Improvement Project
Mitigation/Beneficial Use Monitoring Plan
Southeast Texas and Southwest Louisiana

BACKGROUND

The Sabine-Neches Waterway Channel Improvement Project (SNWW CIP) would deepen the SNWW to a depth of 48 feet for navigation purposes. This scenario is referred to as the Preferred Alternative. The project study area is located on the upper Texas Gulf Coast at the Texas-Louisiana state line and includes Sabine Lake and surrounding marshes in Texas and Louisiana, the Neches River channel up to the Neches River Saltwater Barrier, the Gulf Intracoastal Waterway (GIWW) west to Star Bayou and east to Gum Cove Ridge, the Sabine River to Niblett's Bluff, the Gulf shoreline extending to 10 miles either side of Sabine Pass, and 35 miles offshore into the Gulf.

The project would create the opportunity to restore and protect emergent marsh with dredged material in the Neches River Beneficial Use (BU) Feature. Beneficial use of maintenance material in the Gulf of Mexico reach of the SNWW is proposed to protect the Gulf shoreline and marshes adjacent to Gulf beaches in Louisiana and Texas. Creation of emergent marsh using borrowed material and maintenance material has been proposed in Louisiana to mitigate impacts resulting from the proposed project.

Recent guidance issued by the USACE requires monitoring for mitigation and ecosystem restoration projects (Brown, 2009a, 2009b). The guidance includes:

- Memorandum for Commanders, Major Subordinate Commands, Subject: Implementation Guidance for Section 2036 (a) of the Water Resources Development Act of 2007 (WRDA 07) – Mitigation for Fish & Wildlife and Wetland Losses, CECW-PC, dated August 31, 2009.
- Memorandum for Commanders, Major Subordinate Commands, Subject: Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) – Monitoring Ecosystem Restoration, CECW-PC, dated August 31, 2009.

The monitoring requirements in these guidance documents are similar for mitigation and ecosystem restoration projects.

PURPOSE

This document describes the monitoring plans for mitigation proposed in Louisiana as required by the Section 2036 guidance referred to above and the monitoring plans for beneficial use of dredged material in Texas and Louisiana as required by the Section 2039 guidance referred to above. Monitoring plans

described in this document are based on the assumptions that the relative sea level rise will be 1.1 feet and the freshwater inflows will be those projected by the Texas Water Development Board for the year 2060 using the Water Availability Model Run 8, modified to include "projected increased demand from existing water rights, expected change to return flows, projected new strategies to come online before 2060, and estimated year 2060 storage capacities for major reservoirs" (Brown and Stokes, 2009).

BENEFICIAL USE PLANS

All dredged material management plan (DMMP) BU features proposed for inclusion in the DMMP of the Preferred Alternative are summarized in Table 1. Three former marsh areas on the Neches River (Rose City East, Bessie Heights East, and Old River Cove) would be combined into one large management feature called the Neches River BU Feature (Figure 1). In the Gulf Shore BU Feature, maintenance material would be used to nourish Gulf shorelines at Texas and Louisiana Points (Figure 2).

Table 1
Areas Affected by Each Component of Neches River and Gulf Shore BU Features

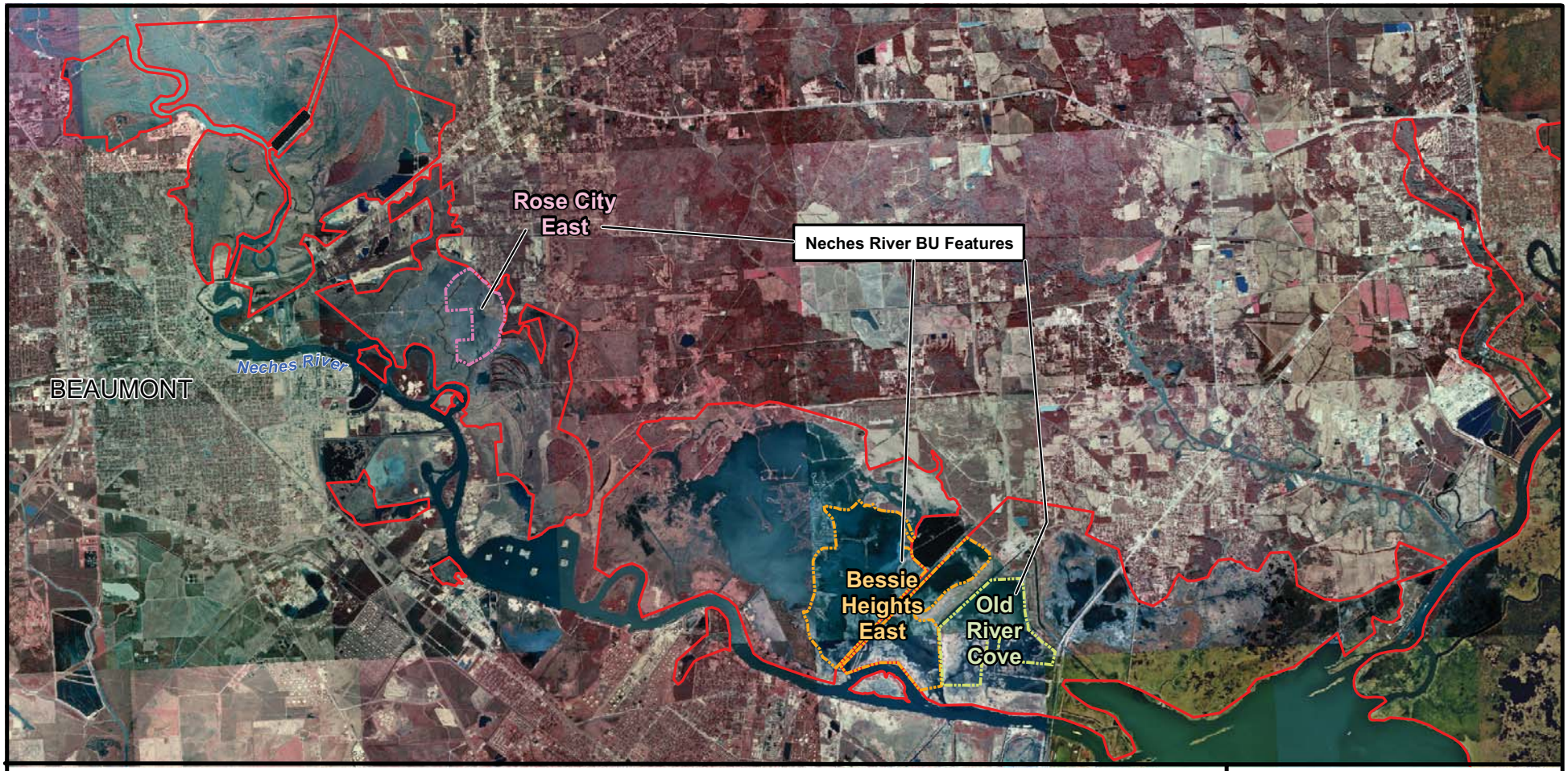
	Restored Emergent Marsh (ac)	Improved Shallow-water Habitat (ac)	Nourished Existing Marsh (ac)	Total Influence Area (ac)
Rose City East	345	72	151	568
Bessie Heights East	1,869	660	651	3,180
Old River Cove	639	139	432	1,210
Total	2,853	871	1,234	4,958
Gulf Shore BU	nourishes 6 miles of Gulf beach and saline marsh behind the beach			

Rose City East (component of Neches River BU Measure) TX 3-1 East

- Would restore 345 acres fresh marsh, enhance 72 acres of shallow water, and nourish 151 acres of existing marsh in two construction events. New work material from the Neches River Channel would be used to restore a 225-acre marsh, construct hydraulic containment levees, and raise sediment elevations. Maintenance material from the first maintenance cycle would restore an additional 120 acres of marsh. Influence area – 568 acres

Bessie Heights East (component of Neches River BU Measure) TX 5-2

- Would restore 679 acres of brackish and 1,190 acres of intermediate marsh, enhance 660 acres of shallow-water habitat, and nourish 651 acres of existing marsh. Marsh would be constructed with maintenance material from the Neches River Channel in seven maintenance cycles over 28 years. New work material would be used to build a hydraulic containment levee. Influence area – 3,180 acres



Rose City East

Bessie Heights East

Old River Cove

Hydrologic Unit

0 8,750 17,500

Feet

N W E S

Figure 1

Neches River

BU Feature

Prepared for: USACE	
Job No.: 100011305	Scale: 1 inch equals 8,750 feet
Prepared by: 18827/ 20192	Date: 10/14/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100011305/geo/figs/Figure_1.mxd

Shoreline Nourishment

Hydrologic Unit

2 1 0 2
Miles

N
W E
S

Figure 2

Gulf Shore BU Feature

Prepared for: USACE	
Job No.: 044198800	Scale: 1:93,500
Prepared by: A. Christiansen	Date: 04/28/2008

File: N:/Clients/U_Z/USACE/Projects/Sabine_Neches/044198000/figures/Fig2_5_3_vr2.mxd

Old River Cove (component of Neches River BU Measure) TX 6-1

- Would restore 639 acres of brackish marsh, enhance 139 acres of shallow-water habitat, and nourish 432 acres of existing marsh with new work material from Neches River Channel. New work material would be used to construct a hydraulic containment levee. Influence area – 1,210 acres

Gulf Shore BU Feature (Texas and Louisiana Points) TX 8-11 LA 5-2/6-2

- Would nourish 3 miles of Gulf shoreline on both sides of Sabine Pass, from 0.5 to 3.5 miles from the east and west jetties, using maintenance material from Sabine Pass Channel. Maintenance material would be placed, unconfined, along the shoreline every 3 years for 50-year period of analysis (eight placement episodes with approximately equal volumes of material for each state). Material placement would alternate between each state every 3 years. Material would nourish eroding marsh and possibly create new saline marsh. Historic dredging records indicate material from Sabine Pass averages 51 percent silt, 31 percent clay, and 18 percent sand. The material would be hydraulically pumped into the nearshore zone and some material would be expected to flow over existing marsh while the remainder would flow into the nearshore waters. This mix of materials does not contain typical beach-quality sand; however, resource agencies have agreed that returning the material to the littoral system would have a net beneficial effect, regardless of the material type. Total affected shoreline – 6.0 miles.

MITIGATION PLANS

Section 2036(a) guidance of WRDA 07 (Mitigation for Fish and Wildlife and Wetlands Losses), issued August 31, 2009, requires that the Preferred Alternative contain a specific plan to mitigate fish and wildlife losses since it has been determined that the Preferred Alternative would have unavoidable impacts after benefits of the DMMP BU features are applied. Adverse impacts to ecological resources caused by a proposed project must be avoided or minimized to the extent practicable, and remaining unavoidable impacts must be compensated to the extent justified. The Preferred Alternative must contain sufficient mitigation to ensure that the CIP would not have more than a negligible adverse impact on significant ecological resources.

USACE regulations (ER 1105-2-100) recognize wetland resources for special consideration in mitigation planning, and these are the type of resources that could suffer long-term impacts from the Preferred Alternative. The mitigation plan described below fulfills the special requirements for wetlands. The plan also contributes to multiagency regional plans (Louisiana Coast 2050 and the North American Waterfowl Management Plan) by restoring and preserving scarce and vulnerable wetlands and wildlife habitat, and using dredged material beneficially to the greatest extent possible.

Unavoidable impacts of the SNWW CIP remain only in Louisiana; all CIP impacts in Texas are minimized and offset by DMMP BU features. The mitigation plan was selected using the USACE certified version of IWR-PLAN software. Personnel from the following offices participated in at least one of two meetings to develop the mitigation plan.

- U.S. Fish and Wildlife Service (USFWS) Clear Lake (Texas) and Louisiana ecological services field offices, Chenier Plain National Wildlife Refuge (NWR), and Sabine NWR
- National Marine Fisheries Service – Galveston, Texas and Baton Rouge, Louisiana
- U.S. Environmental Protection Agency Region 6
- Texas General Land Office
- Texas Water Development Board
- Texas Parks and Wildlife Department – J.D. Murphree Wildlife Management Area
- Louisiana Department of Natural Resources
- Louisiana Department of Wildlife and Fisheries
- Sabine River Authority-Texas
- USACE (Galveston District and ERDC-CHL)

The mitigation plan would restore five degraded marshes east of Sabine Lake near Willow and Black bayous, Louisiana (Table 2) (Figure 3). Each of the mitigation marshes is described in detail below. The recommended mitigation plan compensates for the Preferred Alternative's salinity increase and associated losses in marsh and productivity by marsh creation activities that would influence a total of 8,095 acres of Louisiana marshes. The plan would restore 2,783 acres of emergent marsh in existing open-water areas within the marsh, improve 957 acres of existing open water by creating shallower, smaller ponds and channels within the restored marsh, and stabilize and nourish 4,355 acres of existing marsh located in and around the mitigation influence area.

Table 2
Acreage Created by Each Mitigation Site

Mitigation Site	Restored Emergent Marsh	Improved Shallow Water Habitat	Nourished Existing Marsh	Total Influence Area
Willow Bayou				
LA 21-8B	251	63	367	681
LA 2-ADD B	436	104	745	1,285
Subtotal	687	167	1,112	1,966
Black Bayou West				
LA 3-10R	792	356	1,317	2,465
Black Bayou East				
LA 3-15B	683	227	878	1,788
LA 3-18B	621	207	1,048	1,876
Subtotal	1,304	434	1,926	3,664
Total Mitigation	2,783	957	4,355	8,095

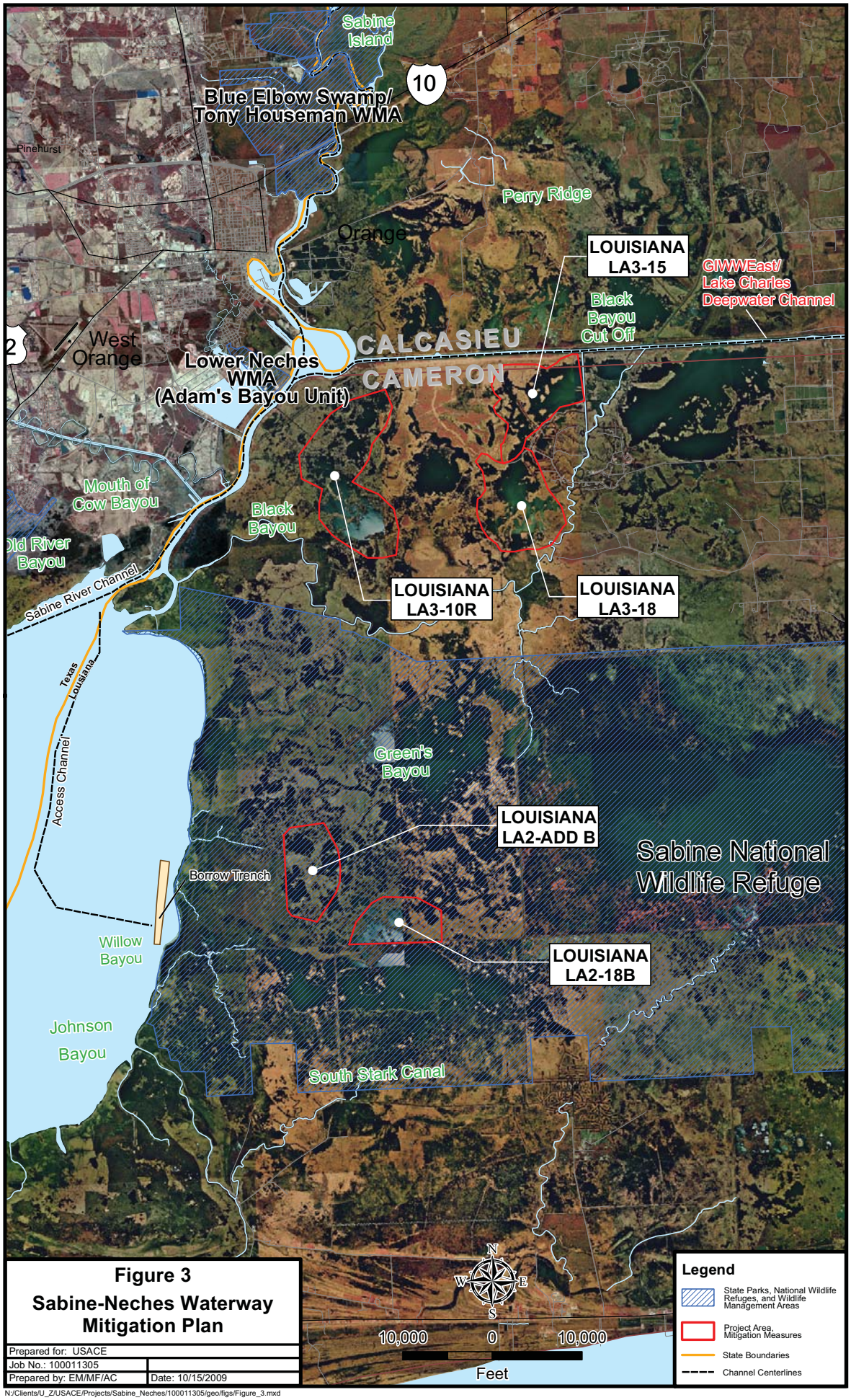


Figure 3

Sabine-Neches Waterway Mitigation Plan

Prepared for: USACE	
Job No.: 100011305	
Prepared by: EM/MF/AC	Date: 10/15/2009

N:/Clients/U_Z/USACE/Projects/Sabine_Neches/100011305/geo/figs/Figure_3.mxd

Marsh would be constructed by the unconfined flow of dredged material from a hydraulic pipeline. Frequent pipe movement and careful elevation control would be necessary to obtain the appropriate marsh elevations. A hydraulic pipeline dredge would be used to minimize turbidity. Small ponds and sinuous, interconnected channels would be created to maintain tidal connectivity, increase marsh edge, and create protected areas for submerged aquatic vegetation (SAV). Benthic fauna would be removed with sediment during dredging activities; however, benthic organisms can rapidly recolonize, and no long-term effects are anticipated. In order to maximize edge in the marsh, topographic relief would be created by varying the final elevation of material placement, and planting with appropriate native flora at each elevation. The varied topography would create differences in duration of tidal inundation, create different floral communities, and maximize biodiversity. Tidal creek channels would be constructed in the marsh creation area after the dredged material has settled. These would return the area to normal tidal regime, facilitate marine organism access, and allow water and nutrients to flow into the area.

Willow Bayou, LA 2-18B and LA 2-ADD B

- Would restore 687 acres of emergent marsh, improve 167 acres of shallow water, and nourish 1,112 acres of emergent marsh located within the Sabine NWR. About 3.1 million cubic yards (mcy) of material dredged from a 1.8-mile-long borrow trench in Sabine Lake would be used. The borrow trench would be located at least 1,000 feet from the Sabine NWR shore and would average 1,030 feet wide by 7.5 feet deep. The borrow trench would be continuous and parallel to the current shoreline, in line with the common longshore circulation pattern in Sabine Lake. Normal bay circulation would prevent hypoxic conditions detrimental to aquatic organisms, and would eventually fill the trench with Sabine River sediments. An access channel, approximately 8 miles long, from the GIWW near the mouth of the Sabine River would allow the dredge to reach the proposed borrow area. Borrow trench and access channel dredging would temporarily increase water column turbidity during dredging activities, with localized effects on nekton, phytoplankton, and water quality. Due to low salinity (1 to 6 parts per thousand [ppt]) in this area of Sabine Lake, live oyster reefs are not likely (Fagerberg, 2003). A study by T. Baker Smith, Inc. (2006) found no live oyster reefs in this area. SAVs are probably not in this part of Sabine Lake because of the shallow, turbid, and turbulent water. Influence area – 1,966 acres.

Black Bayou West, LA 3-10R

- Would restore 792 acres of emergent marsh, enhance 356 acres of shallow water, and nourish 1,317 acres of existing marsh. Material from maintenance dredging of the Sabine River Channel between East Pass and the GIWW would be used to restore a large area of marsh north of Black Bayou and west of Rusty Vincent Lake over a 30-year period. Maintenance dredging of the Sabine River Channel is considered a separate project within the SNWW navigation system, with a different non-Federal sponsor. Material would be hydraulically pumped into a large degraded marsh area west of Rusty Vincent Lake. This area is close to the navigation channel, minimizing pumping distance and cost. Marsh restoration would be accomplished in six 5-year dredging cycles, beginning by the first year of the completion of CIP construction. Each dredging cycle would pump approximately 526,000 cubic yards of material to create 132 acres with a total of 792 acres of emergent marsh created over 30 years. Influence area – 2,465 acres.

Black Bayou East, LA 3-15B and LA 3-18B

- Would restore 1,304 acres of emergent marsh, enhance 434 acres of shallow water, and nourish 1,926 acres of existing marsh. Marsh would be restored in two areas just west of the Black Bayou Cut-Off Canal using dedicated dredging of accumulated material in the Lake Charles Deepwater Channel/GIWW. The Lake Charles Deepwater Channel was constructed in 1926 and coincides along its 24.9-mile length with the GIWW between the Sabine River and Lake Charles. Communications with USACE, New Orleans District indicate the depth of the 30-foot channel has been reduced to approximately 12 feet deep. Dedicated dredging of the Lake Charles Deepwater Channel for Black Bayou mitigation efforts would remove and kill benthic organisms; however, constant ship traffic in the shallow channel is an ongoing disturbance to these organisms. Recovery of benthic organisms would be rapid (Sheridan, 1999). No impacts to salinity would be expected because the dredged section would not connect with the Sabine River Channel or the Calcasieu Ship Channel; therefore, there would be no connection with the saltwater wedge in the Calcasieu Ship Channel (there is no Sabine River wedge; Brown and Stokes, 2009). Approximately 10.5 mcy of material would be pumped from a 13-mile stretch of the GIWW into the two areas. The first (LA 3-15B) would be located adjacent to the GIWW and would have the shortest pumping distance; the second (LA 3-18B) would be located south of LA 3-15B and pumping would move to it after the first is complete. Influence area – 3,664 acres.

IMPLEMENTATION

Upon authorization of the CIP, the USACE would use its Navigational Servitude to obtain access for construction of the Texas and Louisiana DMMP BU features and the Louisiana mitigation measures for the purposes of planning, construction, and postconstruction monitoring. Landowners would be advised of the need for access for these activities. All restored areas would remain jurisdictional wetlands and continue to be subject to the Servitude; therefore, conservation easements would not be required. Agencies on the Interagency Coordinating Team (ICT) would be consulted to provide input to the future engineering, design, construction, and monitoring of the project. The ICT would participate in the detailed planning of the marsh creation areas, monitoring of construction of the mitigation areas, and postconstruction monitoring.

Pumping distances from all of the SNWW CIP channels are too long to permit use of new work or maintenance material from the proposed project to construct mitigation sites. For the BU sites, new work material is critical for the successful construction of containment levees and marsh creation. Therefore, construction contracts for mitigation and BU sites would incorporate an adaptive management approach to ensure that the initial construction contracts attain the appropriate elevation over the acreage specified for emergent marsh within each mitigation site.

The maximum optimal elevation for the marsh fill would be determined during preconstruction engineering and design. Elevation surveys would be conducted in the mitigation areas and nearby reference marshes. Dredged material quantities needed to achieve the targeted elevation would be calculated by taking into account future settling and compaction of placed material, as well as projected

relative sea level rise. The marsh fill would be sized to ensure creation of the requisite acres of emergent marsh, and it would be built to the highest elevation suitable for supporting marsh vegetation, as determined by preconstruction surveys and in consultation with the ICT. For planning and design purposes, this elevation is assumed to be approximately 1.6 to 1.7 feet NAVD88 after settlement. This should enable the marsh to withstand the projected rate of relative sea level rise over the period of analysis.

Elevations would be monitored during and immediately after placement to determine if material is settling as expected. One year after material placement, marsh elevations would be reviewed to identify whether other adjustments should be made to ensure that the target elevation has been met, and that tidal exchange and fisheries access are functioning as expected. Additional material would be added as needed at any point during or within 1 year of construction to ensure that the target marsh elevation is attained.

MONITORING PLANS

Monitoring Mitigation in Louisiana

Table 3 presents details of the monitoring plan for all of the mitigation sites in Louisiana, including the key monitoring parameters, periodicity, costs, and responsible parties. The same monitoring plan applies to all five mitigation sites since ecological success criteria are the same for all sites; they are ecologically similar and are situated relatively close to each other. Ecological success criteria for these mitigation sites are (1) each mitigation site contains 60 to 80 percent emergent marsh, 5 years after material placement; (2) each mitigation site remains intact and 60 to 80 percent vegetated with native, typical, emergent marsh through 50-year period of analysis; and (3) invasive noxious, and/or exotic plant species comprise less than 4 percent of mitigation site marsh cover at year 2 and year 5 after each material placement. The first criterion ensures that the requisite acres of emergent marsh are created and appropriately vegetated. The second criterion ensures that the mitigation sites will remain intact for the full period of analysis, producing the total benefits needed to mitigate for project impacts. The third criterion ensures that the mitigation sites are not overrun by invasive/noxious plants while typical marsh vegetation is trying to get established. Once established, marsh vegetation is expected to prevent the establishment of invasive, noxious, and/or exotic plants.

The USACE and the project non-Federal sponsor, the Sabine-Neches Navigation District (SNND) would manage the monitoring program. Information about plants colonizing the mitigation sites would be collected; however, past experience with marsh restoration in the area suggests soils at an appropriate elevation are naturally vegetated with typical marsh vegetation within a few years, and in many cases, planting is not required. The primary monitoring data for evaluating achievement of the ecological success criteria would be aerial photography collected according to procedures described by Steyer et al. (1995). Aerial photography of all five mitigation sites would be collected during the same data acquisition flight.

Table 3
Mitigation Monitoring in Louisiana for the
Sabine-Neches Waterway Channel Improvement Project

	Willow Bayou		Black Bayou West	Black Bayou East	
	LA 2-18B	LA 2-ADD B	LA 3-10R	LA 3-15B	LA 3-18B
Ecological Success Criteria					
Placed material will be 60–80% vegetated with native, typical, emergent marsh 5 years after placement of material	176 ac vegetated emergent marsh	305 ac vegetated emergent marsh	92 ac marsh after 1st maintenance dredging, 185 ac marsh after 2nd maintenance dredging, 277 ac marsh after 3rd maintenance dredging, 370 ac marsh after 4th dredging cycle, 462 ac marsh after 5th dredging cycle, and 554 ac marsh after 6th dredging cycle	478 ac vegetated emergent marsh	435 ac vegetated emergent marsh
Marsh remains intact and 60–80% vegetated with native, typical, emergent marsh through 50-year period of analysis	176 ac vegetated emergent marsh	305 ac vegetated emergent marsh	554 ac vegetated emergent marsh	478 ac vegetated emergent marsh	435 ac vegetated emergent marsh
Invasive, noxious, and/or exotic plants comprise less than 4% of marsh cover at yr 2 and yr 5 after each placement	Less than 7 ac with undesirable plants	Less than 12 ac with undesirable plants	Less than 22 ac with undesirable plants after the final dredging cycle	Less than 19 ac with undesirable plants	Less than 17 ac with undesirable plants
Monitoring Organization	U.S. Army Corps of Engineers and Sabine-Neches Navigation District will share responsibility and cost consistent with the apportionment of O&M costs for the project				
Cost and Periodicity					
Field survey of vegetation using Braun-Blanquet method and marsh elevation	2 years after material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) for each mitigation area is approximately $9,400.		2 yearrs after first dredging cycle placement and for 5 more cycles beginning 7 years after first dredging cycle. Total cost in constant dollars (4.375% interest rate) is approximately $23,000.	2 years after material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) for each mitigation area is approximately $9,400.	
Aerial photography, collection and interpretation, and data analysis and reporting	Aerial photography and data analysis and reporting (Yr 2, Yr 5, Yr 10, Yr 22, Yr 34, and Yr 46). Total cost in constant dollars is approximately $728,000				
Total Monitoring Estimated Cost over 50 years (constant dollars, 4.375% interest rate)	**$789,000**				

Table 3
Mitigation Monitoring in Louisiana for the
Sabine-Neches Waterway Channel Improvement Project
(cont'd)

Monitoring protocol (follow Steyer et al., 1995, Quality Management Plan for Coastal Wetlands Planning, Protection, and Restoration Act Monitoring Program), Frequency, and Duration

Emergent marsh

Monitor species composition and relative abundance using Braun-Blanquet method 2 yrs after placement of material and 5 yrs after placement of material. Monitor area of created emergent marsh using aerial photography at 2 yrs after placement of material, 5 yrs after placement of material, and every 12 yrs through Yr 46.

Disposition of Information and Analysis

Annually, the District Engineer will consult with State and Federal agencies regarding the status of mitigation efforts and prepare a report summarizing the results of the consultations and evaluating: ecological success of the mitigation to date, likelihood mitigation will achieve success defined in the mitigation plan, projected time line for achieving success, and recommendations for increasing the likelihood of success. Copies of this report will be provided to members of the consulting State and Federal agencies.

Data collected will be georeferenced and stored in an electronic database. Aerial photography will be listed in the electronic database and digital copies will be provided to each of the consulting agencies, the Texas Natural Resource Information System (TNRIS), and Strategic Online Natural Resources Information System (SONRIS). Data will also be provided to the Coastal Wetlands Planning Protection and Restoration Act (CWPPRA) Regional Monitoring Database at the Louisiana Department of Natural Resources.

Contingency Plan/Adaptive Management

Emergent marsh

ICT will review aerial photography and species diversity and relative abundance data collected by the Braun-Blanquet method 2 yrs after material placement. Past experience indicates that marsh soils at an appropriate elevation are relatively rapidly colonized by natural, emergent marsh vegetation in this area. Vegetation monitoring data will be reviewed to determine whether or not the rate of vegetation and extent of vegetation coverage is appropriate or if manual planting is needed. The ICT will determine if marsh planting is needed and if so, to what extent and in which areas. The data will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species.

Aerial photography at 5 yrs following material placement will be analyzed to determine if the rate of emergent marsh growth has proceeded as expected. If the extent of vegetation cover is not within the expected percentage range, the ICT will evaluate whether or not some corrective action, such as additional planting, marsh shaping, etc. is needed. The 5-yr review will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species. It is assumed that invasive or noxious species review will no longer be needed after marsh vegetation is fully established at yr 5. Aerial photography and ICT review to evaluate the extent of vegetative cover will be repeated in yrs 25, 35 and 45.

Project Closure

Mitigation and monitoring activities will cease and each project will be formally closed when it is determined that the desired acres of marsh have been maintained through the 50-yr period of analysis. The adaptive management process described is intended to allow periodic modifications of mitigation and monitoring in order to achieve the desired number of acres at the end of the project. The ICT will meet to evaluate data collected during the last aerial overflight and will provide a recommendation to the Division Commander in the last scheduled annual report to close the mitigation project.

Beneficial Use Monitoring in the Neches River BU Feature

Details of the monitoring plan for the BU sites in the Neches River BU Feature are described in Table 4. The ecological success criteria for these BU sites are the same as those for the mitigation sites in Willow and Black bayous. Ecological performance criteria for these BU sites are (1) each BU site contains 60 to 80 percent emergent marsh, 5 years after material placement; (2) each BU site remains intact and 60 to 80 percent vegetated with native, typical, emergent marsh through the 50-year period of analysis; and (3) invasive noxious, and/or exotic plant species comprise less than 4 percent of mitigation site marsh cover at year 2 and year 5 after each placement. The USACE and the SNND will manage the monitoring program for the first 10 years, and the SNND will assume responsibility for subsequent monitoring. The primary monitoring tool to evaluate achievement of ecological success criteria would be aerial photography. Photography of all BU sites in the area would be taken in each data acquisition flight. Invasive and noxious species would be identified by field surveys of species composition and relative abundance 2 and 5 years after placement of material.

Beneficial Use Monitoring on the Gulf Shore

Monitoring the Gulf Shore BU Feature is described in Table 5. Maintenance material for this project would be pumped along the nearshore zone at Texas and Louisiana Points with the expectation that some sediment will remain in the area and prevent the slight amount of shoreline erosion projected to occur because of the SNWW CIP. Some sediment deposited in the nearshore zone is expected to occasionally wash over the beach during high tide and storm events and nourish the marsh behind the beach. The objective of monitoring is to evaluate the success of the nearshore disposal in achieving the ecological success criterion of reducing shoreline erosion. Monitoring will be undertaken every 3 years beginning with the first placement, and will continue for two full 6-year cycles at each point, ending in year 13. Aerial photography would measure the position of the shorelines at Texas and Louisiana Points every 3 years beginning in the first year of placement and ending in year 13 year. It is anticipated that periodic monitoring over 13 years will be sufficient to document the behavior and movement of the dredged material in the littoral zone, and its affect on shoreline erosion.

Monitoring Cost Estimates

Cost estimates may change as detailed monitoring plans are designed and monitoring dates identified. For field measurements of vegetation (Braun-Blanquet method) and marsh elevation, cost estimates are based on two biologists spending a day in the field at each mitigation site or BU feature for each monitoring event. Costs are typically slightly higher for field surveys in later years. The cost of aerial photography includes acquisition, georeferencing, compiling photo-mosaics, and analysis and is estimated at $17,000/square kilometer (about 220 acres) based on information provided by Darryl Clark, USFWS-Louisiana (personal communication, 2009). Cost estimates include the cost of data management and distribution for the field data and aerial photography collected. Estimated costs also include costs for preparation of reports summarizing data for presentation to the Division Commander.

Table 4
Monitoring the Neches River Beneficial Use Feature
for the Sabine-Neches Waterway Channel Improvement Project

	Rose City East	Bessie Heights East	Old River Cove
Ecological Success Criteria			
Placed material will be 60–80% vegetated with native, typical, emergent marsh 5 years after placement of material	158 ac emergent marsh after one dredging cycle	1,308 ac emergent marsh after 28 years and seven maintenance dredging cycles	447 ac emergent marsh
Marsh remains intact and 60–80% vegetated with native, typical, emergent marsh at end of project, 50 years	242 ac emergent marsh	1,308 ac emergent marsh	447 ac emergent marsh
Invasive, noxious, and/or exotic plants comprise less than 4% of marsh cover	Less than 6 ac with undesirable plants after the final dredging cycle	Less than 52 ac with undesirable plants after the final dredging cycle	Less than 18 ac with undesirable plants
Placed material elevation	Maximum optimal elevation (as determined by preconstruction surveys in consultation with ICT) 1 year after placement of material.		
Monitoring Organization	USACE for 1st 10 years; SNND for monitoring after Yr 10 through 50-year period of analysis		
Cost and Periodicity			
Field survey of vegetation using Braun-Blanquet method and marsh elevation	2 years after new work and maintenance material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) is approximately $38,000.	2 years after first dredging cycle placement and 4 years after material placement. 2 yrs after each maintenance cycle (five more maintenance cycles). Total cost in constant dollars (4.375% interest rate) is approximately $53,000.	$42,650 2 years after material placement and 5 years after material placement. Total cost in constant dollars (4.375% interest rate) is approximately $33,000.
Aerial photography, collection and interpretation, and data analysis and reporting	Aerial photography and data analysis and reporting (Yr 2, Yr 5, Yr 9, Yr 15, Yr 20, Yr 24, Yr 28, Yr 32, and Yr 46) Total cost in constant dollars is approximately $736,000.		
Total Estimated Monitoring Cost, over 50 years (constant dollars, 4.375% interest rate)	**$860,000**		

Table 4
Monitoring the Neches River Beneficial Use Feature for the
Sabine-Neches Waterway Channel Improvement Project
(cont'd)

Monitoring protocol (follow Steyer et al., 1995, Quality Management Plan for Coastal Wetlands Planning, Protection, and Restoration Act Monitoring Program), Frequency, and Duration

Emergent marsh

Monitor species composition and relative abundance using Braun-Blanquet method 2 yrs after placement of material and 5 yrs after placement of material.

Monitor area of created emergent marsh using aerial photography at 2 yrs after placement of material, 5 yrs after placement of material, and every 12 years through Yr 45.

Disposition of Information and Analysis

Annually, the District Engineer will consult with State and Federal agencies regarding the status of marsh restoration efforts and prepare a report summarizing the results of the consultations and evaluating: ecological success of the marsh restoration to date, likelihood marsh restoration will achieve success defined in the beneficial use plan, projected time line for achieving success, and recommendations for increasing the likelihood of success. Copies of this report will be provided to members of the consulting State and Federal agencies.

Data collected will be georeferenced and stored in an electronic database. Aerial photography will be listed in the an electronic database and digital copies will be provided to each of the consulting agencies, the Texas Natural Resource Information System (TNRIS), and Strategic Online Natural Resources Information System (SONRIS). Data will also be provided to the CWPPRA Regional Monitoring Database at the Louisiana Department of Natural Resources.

Contingency Plan/Adaptive Management

Emergent Marsh

ICT will review aerial photography and species diversity and relative abundance data collected by the Braun-Blanquet method 2 yrs after material placement. Past experience indicates that marsh soils at an appropriate elevation are relatively rapidly colonized by natural, emergent marsh vegetation in this area. Vegetation monitoring data will be reviewed to determine whether or not the rate of vegetation and extent of vegetation coverage is appropriate or if additional planting is needed. The ICT will determine if marsh planting is needed and if so, to what extent and in which areas. The data will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species.

Aerial photography at 5 yrs following material placement will be analyzed to determine if the rate of emergent marsh growth has proceeded as expected. If the extent of vegetation cover is not within the expected percentage range, the ICT will evaluate whether or not some corrective action, such as additional planting, marsh shaping, etc., is needed. The 5-year review will also indicate if the percentage of noxious or exotic species is meeting the success criterion. If the percentage of these species exceeds 4 percent of the marsh cover, the ICT will propose necessary actions to remove and manage those species. It is assumed that invasive or noxious species review will no longer be needed after marsh vegetation is fully established at year 5. Aerial photography and ICT review to evaluate the extent of vegetative cover will be repeated in yrs 25, 35 and 45.

Project Closure

Monitoring activities will cease and each project will be formally closed when it is determined that the desired acres of marsh have been maintained through the 50-year period of analysis. The adaptive management process described is intended to allow periodic modifications in order to achieve the desired number of acres at the end of the project and ensure amounts of unwanted vegetation are minimized. The ICT will meet to evaluate data collected during the last aerial overflight and will provide a recommendation to the Division Commander in the last scheduled annual report to close monitoring of the beneficial use features.

Table 5
Monitoring Beneficial Use Sites on the Gulf Shoreline in Texas and Louisiana
for the Sabine-Neches Waterway Channel Improvement Project

	Texas Point	Louisiana Point
Ecological Success Criteria		
Shoreline erosion rate is decreased or shoreline accretion rate is increased	After two disposal events (12 years), shoreline erosion rate averages less than 44 ft/yr (1,150 ft of erosion between 1974 and 2000 [Morang, 2006; King, 2007])	After two disposal events (12 years), shoreline accretion rate averages more than 1.2 ft/yr (USACE, 2004)
Monitoring Organization	USACE for 1st 10 years; Sabine-Neches Navigation District for monitoring after Yr 10 through 50-year period of analysis	
Cost and Periodicity		
Aerial photography, collection and interpretation, and data analysis, and reporting	Yr 1, Yr 4, Yr 7, Yr 10, and Yr 13 after project start; total cost in constant dollars is approximately $294,000	
Total Estimated Monitoring Cost, over 13 Years (constant dollars, 4.375% interest rate)	**$294,000**	

Monitoring Protocol (follow Steyer et al., 1995, Quality Management Plan for Coastal Wetlands Planning, Protection, and Restoration Act Monitoring Program), Frequency, and Duration

Shoreline Change Rate

Calculate shoreline erosion or accretion between the shoreline identified in the Yr 1 baseline photo and each subsequent set of aerial photography (yrs 4, 7, 10, and 13). The ICT will identify specific protocols for making that calculation since Steyer et al. (1995) do not identify a specific protocol for this purpose.

Disposition of Information and Analysis

Annually, the District Engineer will consult with State and Federal agencies regarding the status of shoreline and marsh elevation changes and prepare a report summarizing the results of the consultations and evaluating: ecological success of the disposal activities to date, likelihood disposal activities will achieve success defined in the beneficial use plan, projected time line for achieving success, and recommendations for increasing the likelihood of success. Copies of this report will be provided to members of the consulting State and Federal agencies.

Data collected will be georeferenced and stored in a Microsoft Access database. Aerial photography will be listed in the Microsoft Access database and digital copies will be provided to each of the consulting agencies, the TNRIS, and SONRIS. Data will also be provided to the CWPPRA Regional Monitoring Database at the Louisiana Department of Natural Resources.

Contingency Plan/Adaptive Management

Shoreline Erosion/Accretion Rate

ICT will review aerial photography and calculate the shoreline erosion/accretion rate along the Gulf shoreline. The Texas and Louisiana Gulf shorelines for 3 miles on each side of the Sabine Pass jetties will be analyzed for each overflight to understand the rate and locations of change in shoreline features. The ICT will determine if modifications should be made to the disposal process in order to ensure the success criteria are met.

Aerial photography at 5 yrs following material placement will be analyzed to determine if the rate of emergent marsh growth is proceeding as expected. If the rate of emergent marsh creation is not proceeding as expected, the ICT will evaluate whether or not there is a need for additional data collection. If there is no need for additional data collection, the ICT will evaluate whether or not some corrective action, such as additional planting, marsh shaping, etc., is needed. This review process will occur after aerial photography is collected every 10th year through the SNWW CIP project life.

Project Closure

Monitoring activities will cease when it is determined that the dredged material disposal pattern is achieving the goal of decreasing the rate of shoreline erosion. The adaptive management process described is intended to allow modifications of disposal activities and monitoring every 3 yrs for the first 12 yrs of the project. The ICT will meet to evaluate data collected during the last aerial overflight and the last marsh elevation study and will provide a recommendation to the Division Commander in the last scheduled annual report to close the mitigation project.

Contingency Plan/Adaptive Management

The following contingency plan has been developed to guide corrective actions where monitoring demonstrates that mitigation measures and BU features are not achieving ecological success as measured by the success criteria. In this region, past experience indicates that marsh soils at an appropriate elevation are rapidly colonized by natural, emergent marsh vegetation. However, if monitoring determines that the extent of vegetation coverage does not meet ecological success criteria, manual planting would be employed to restore the requisite acres of emergent marsh at the times specified in tables 3 and 4. The ICT would determine if marsh planting is needed and if so, to what extent and in which areas. The ICT would also determine if noxious or exotic species are exceeding the percentage of marsh cover specified by criterion 3, and if so, propose necessary actions to remove and control the spread of those species. The likelihood of the need for corrective actions is considered to be low, because sufficient elevation would be provided by initial construction, and vegetation by typical marsh plants is typically easily achieved. The likelihood for the need to control invasives beyond the first 5 years is considered low for the Louisiana sites because undesirable plant species are generally not an issue in these marshes as long as the appropriate elevation is attained. The need for invasives control for the Texas BU sites is considered unlikely because invasives removal programs are typically only needed during the first 5 years of marsh establishment. Corrective actions for the Gulf Shore BU Feature are expected to be minimal. Any recommended modifications to pipe placement and construction techniques identified by the ICT after the first placement episode in each state would be applied in subsequent placement cycles.

SUMMARY

Ecological success criteria for the SNWW CIP focus on the creation and restoration of emergent marsh and reduced Gulf shoreline erosion. Achievement of these criteria is expected to be maintained for the 50-year period of analysis. Monitoring focuses on the collection of data, particularly aerial photography that allows the area of emergent marsh created in each of the Louisiana mitigation sites and the Neches River BU Feature to be determined. Aerial photography will also be utilized to monitor changes in the Gulf shoreline at the Gulf Shore BU sites.

The total estimated cost (constant dollars, 4.375 percent interest rate) for monitoring all mitigation and BU sites is $1,943,000 including $789,000 to monitor mitigation sites in Louisiana, $860,000 to monitor the Neches River BU Feature, and $294,000 to monitor the Gulf Shore BU sites. These cost estimates include field sampling, aerial photography, data management and analysis, and report preparation.

Monitoring will be conducted primarily according to Steyer et al. (1995) and provided to the Texas Natural Resource Information System, Strategic Online Natural Resources Information System in Louisiana, and the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Regional Monitoring Database at the Louisiana Department of Natural Resources. Analysis of data collected will be reviewed by the ICT and provided to the USACE Division Commander annually. This analysis will include recommendations for changes in mitigation and/or beneficial use methodology necessary to

achieve the ecological success criteria. Recommendations will also be made for necessary modifications to monitoring plans.

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Appendix K

Public Meeting Transcripts

SABINE-NECHES WATERWAY PUBLIC MEETING

JANUARY 26, 2010

REPORTED BY: Ada V. Christy, CSR, RPR

1 MR. REESE: Good evening. My name is
2 Randall Reese. I am the general manager of the
3 Sabine-Neches Navigation District. We are the local
4 sponsor for the U.S. Army Corps of Engineers on the
5 Sabine-Neches Waterway. At this time, I'd like to
6 introduce those present with the Navigation District
7 that are here with us tonight. We have Paul Beard, our
8 board chairman; Joe Johnson, our commissioner, one of
9 our commissioners. We have Clay Henderson, who is our
10 assistant general manager. And we have our attorney,
11 Hubert Oxford, who is with us tonight.
12 I know we have a good presentation tonight.
13 So I'm not going to delay in getting started. At this
14 time, I'd like to introduce Colonel David Weston, who is
15 the commander of the Galveston District, U.S. Army Corps
16 of Engineers.
17 COL. WESTON: Good evening ladies and
18 gentlemen. And thank you, Randy, for the introduction.
19 Pleased to be here tonight. As Randy mentioned, I'm
20 Colonel Dave Weston. I'm the commander of the Galveston
21 District for the U.S. Army Corps of Engineers. And I
22 welcome you to tonight's public meeting concerning the
23 Sabine-Neches Waterway Channel Improvement Project.
24 Specifically, we're here tonight to present
25 information and accept public comments on the following

1 draft documents that were released for public review on
2 December 24, 2009: The Draft Feasibility Report for the
3 Sabine-Neches Waterway Channel Improvement Project,
4 Southeast Texas and Southwestern Louisiana; the draft
5 Environmental Impact Statement, Sabine-Neches Waterway
6 Channel Improvement Project, Ocean Dredge Material
7 Disposal Site Designation; the draft General Conformity
8 Determination, Sabine-Neches Channel Improvement
9 Project.
10 And for the record, I'd like to state that
11 this public meeting is being convened at 7:00 p.m. on
12 January 26th, 2010, at the Beaumont Civic Center in
13 Beaumont, Texas.
14 As you know, the Corps of Engineers and the
15 Sabine-Neches Navigation District have been performing a
16 study analyzing potential modifications to the portion
17 of the Sabine-Neches Waterway that serves in the Ports
18 of Beaumont and Port Arthur, Texas.
19 Two objectives were identified from the
20 study. And these objectives were improving navigational
21 efficiency along the Sabine-Neches Waterway and
22 maintaining the ecological value of coastal and
23 estuarine resources within the project area.
24 A cost-effective plan has been identified
25 by the study that meets these objectives. This plan,

1 which we refer to it as the "tentatively recommended and
2 locally preferred plan," will be described by study team
3 members after my presentation. We are specifically
4 seeking input concerning the plan and associated
5 environmental impacts that are described in these
6 documents.
7 I hope that you all had an opportunity to
8 read the announcement of the public meeting either on
9 our website in the Galveston District or in the
10 individual announcements that were mailed to
11 individuals, agencies, organizations, and news media
12 believed to have an interest in these proceedings. The
13 meeting notice was also published in the Beaumont
14 Enterprise in Beaumont, Texas, and the Southwest Daily
15 News in Lake Charles, Louisiana.
16 An addi- -- an additional fact sheet is
17 also available at the entrance. I hope you had a chance
18 to take a look at that. The announcement mailing list
19 and a list of those present will be made a part of
20 record of this meeting. And a court reporter is here
21 who will transcribe these proceedings and all public
22 comments.
23 Before we go any further, I'd like to
24 introduce the public officials we have here tonight. We
25 have Mr. Fred Jackson representing the Jefferson County

1 Judge's Office. There he is. Additional, I'd like to
2 introduce those members of my team from the Corps of
3 Engineers that are here tonight: Mr. Arthur Janecka,
4 our deputy district engineer; Mr. Dolan Dunn, our chief
5 planning, environmental, and regulatory division;
6 Ms. Carolyn Murphy, our chief environmental section;
7 Mr. Byron Williams, project manager for the
8 Sabine-Neches Waterway Study; Ms. Sheri Willey, our
9 planning lead; Ms. Gloria Appell, our economics lead;
10 Ms. Janelle Stokes, our environmental lead; Ms. Nancy
11 Young, project engineer; and Ms. Samantha Lambert, our
12 hydrology and hydraulics engineer.
13 Now I'll turn this presentation over to
14 Mr. Byron Williams who will describe the ground rules
15 for the tonight's meeting. Thank you.
16 MR. WILLIAMS: Greetings again. My name is
17 Byron Williams, project manager for the Sabine-Neches
18 Waterway Project. First of all, we'd like to make sure
19 everyone has filled out an attendance card. We need the
20 cards to document all attendees here. In addition, if
21 you check off on the card that you would like to speak,
22 we need the card turned in so we may announce your name
23 at the appropriate time. So anyone who has not filled
24 out a card and would like to speak, please raise your
25 hand now, and we can have one handed to you.

1 Okay. Thank you.
2 Everyone who did fill out the card will
3 have an opportunity to speak after the presentations
4 have been made by the Corps and the Sabine-Neches
5 Navigation District. And if you do not wish to speak,
6 we do have 8-1/2 by 11 comment cards that you may fill
7 out and either place in the baskets that we have in the
8 rear of the room and/or send them in via snail mail.
9 Anyone would like a card to send in comments? Okay.
10 Thank you very much.
11 First of all, I'd like to emphasize that
12 this is not a voting contest. We're not going to decide
13 just by standing up if you're for or against the
14 project. That's not the purpose of tonight's meeting.
15 The format, what we're going to do is we're going to
16 have Clayton Henderson of the Sabine-Neches Navigation
17 -- Sabine-Neches Navigation District, he's the assistant
18 general manager. He's going to come up and give you an
19 overview of the Sabine-Neches Waterway. Followed by Ms.
20 Sheri Willey, she is the planning lead. She's going to
21 give an overview of the Feasibility Study and the
22 recommended plan. Followed by Ms. Jan Stokes, she's
23 going to give an overview of the Environmental Impact
24 Statement.
25 Afterwards, Colonel Weston is going to open

1 the floor to comments. First by recognizing all public
2 and state officials -- federal and state officials that
3 wish to comment. Then followed by the public agencies,
4 federal and state that wish to comment, resource
5 agencies. Then followed by individual comments
6 addressed in the cards that I mentioned earlier.
7 Everyone will get a chance to speak. All
8 comments, however, will be limited to three minutes. I
9 will be standing here, and I'll raise my hand when you
10 have 30 seconds left. Please adhere to
11 three -- three-minute time rule, as we'd like to be
12 courteous. And -- well, yeah, just adhere to the
13 three-minute time rule. I'm going to raise my hand. We
14 won't have a security come in and take you out. But
15 after three minutes, we'd like you to just properly sit
16 down. Thank you very much.
17 And also, as far as applause and reaction
18 to certain comments, we ask that you do not do that as
19 well. So we can keep the meeting in a orderly fashion.
20 First of all, I think I covered everything. Without the
21 further ado, I'm going to introduce Mr. Clayton
22 Henderson of the Sabine-Neches Navigation District.
23 MR. HENDERSON: You have to bear with me
24 for a second.
25 MR. WILLIAMS: I'm going to try lowering

1 these lights and see what you -- will you still be able
2 to see?
3 MR. HENDERSON: I will.
4 MR. WILLIAMS: Okay.
5 MR. HENDERSON: Thank you. Evening. I'm
6 Clayton Henderson, assistant general manager of the
7 Sabine-Neches Navigation District. Sabine-Neches
8 Navigation District is the local sponsor to the Army
9 Corps of Engineers for the Sabine-Neches Waterway. In
10 short, we act a lot of times as the middleman between
11 industry in the area and the federal government for the
12 project.
13 So what I want to do before getting into
14 details of a lot of what you're going to hear tonight is
15 give you a sort of a recap a little bit of what brings
16 us here tonight from the local sponsor's perspective,
17 and how we got to tonight. The Sabine-Neches Waterway
18 has a long history of improvements. You know, a lot of
19 times because it's been quite a while since our last
20 improvement, we tend to think that, well, we've never
21 improved it before. But you can see that we're pretty
22 good at it. We've been doing it for quite a while.
23 There's been a federal interest in the -- in the project
24 since even before 1912. But I wanted you to realize
25 that it's not something new. It's something that we do

1 continually. It's -- as an area, we've embraced in the
2 past. We've always will embrace it probably in the
3 future. Because it's what's drives our area
4 economically. And I want to say I think you'll see
5 tonight that we've gotten smarter as we've done the
6 improvements, both from an economic perspective and an
7 environmental perspective.
8 But as I mentioned, the federal government
9 and the local sponsor in the area held hands on this
10 project for -- for quite some time. Since 1875 federal
11 government has had a hand in the project. That led
12 ultimately to that 1912 first improvement of the
13 waterway.
14 But it's always been kind of a -- kind of a
15 two- to three-party perspective for the project.
16 There's the federal interest, there's the industry,
17 local industry, and then there's the local area, local
18 economy, and the -- and the citizens. And so though we
19 share the funding for -- for the project, federal
20 government does pay for a lot of maintenance. The
21 Navigation District will pay for things like the
22 placement of the dredge areas or locating the real
23 estate. And then private industry has to pay their
24 portion that's outside of that federal channel. So we
25 all kind of pay our share. And we all kind of pay as we

1 go on a -- on an improved project, always have. That's
2 not going to change as we go forward and as we go into
3 improved projects into the future.
4 But I do want to kind of touch base on kind
5 of some of the things that we were looking for about a
6 decade ago when we kicked off looking at improving our
7 channel. Two main tenants that we started with were
8 deepening and widening. And you've probably heard the
9 project referred to as a "deepening-widening project"
10 for quite some time. We like to drop that widening here
11 recently, and we call it "deepening." But I want to
12 emphasize tonight, because I've heard in some other
13 meetings here recently since that time that well, is
14 that's a big change for the project, whatever. And I
15 want to emphasize the fact that this -- this is actually
16 a quote from a presentation that was given in '99 from
17 the Navigation District. But originally, the idea was
18 obviously to deepen it from out in the Gulf of Mexico
19 all the way to Port of Beaumont. The widening was going
20 to be some widening, "strategic widening" we like to
21 call it here and there. But it was never going to be
22 just a bulk widening all the way up the waterway. But
23 the point that I want to make in that statement is the
24 -- the italicized portion there "was to improve the
25 transportation, efficiency, and navigational safety of

1 the waterway."
2 Even though we've dropped this -- the term
3 of the widening, we retained a lot of the aspects of the
4 project that are going to give us the benefits of that.
5 And we, as the local sponsor and asked to kind of speak
6 for the area in that regard, don't feel like we've given
7 up one inch in efficiency or navigational safety on the
8 waterway. So I want to make that at least clear from
9 the nav- -- from the Navigation District's perspective.
10 We do believe that we're -- we're getting what we paid
11 for when it comes to this Feasibility Study and a good
12 product that the -- that the Corps has put out.
13 But that doesn't mean that the channel
14 itself hasn't been driving us toward this improvement.
15 With the advent or the oncoming and deepening and
16 widening of the Panama Canal, with the regulations that
17 are going to cause the ship hulls to start changing
18 about 2015, we are already starting to see and feel the
19 -- the pressures of improving this channel. You saw on
20 the slide where we've been improving. This will be our
21 sixth time. And when it started out, we improved about
22 every ten years, and then it got to be about every 15 or
23 so. And this one's been -- been a pretty good -- good
24 time frame. It's been since 1960, '62ish that we're
25 living with that project -- with that -- with this

1 project. So 50 years is a good horizon, and the Corps
2 shoots for a 50-year horizon. But what we're seeing is
3 the ship industry, the shipping industry and industry in
4 general, really starting to pressure and push that
5 project's edges. And so though our waterway is
6 sufficient today, we are -- we are receiving ships that
7 could go deeper, that could go beyond the design limits
8 of the waterway even today. And so we think that this
9 improved waterway is perfect timing, right in line with
10 when we wanted it, how we wanted it. And we were
11 stating this a decade ago. And it's still true today,
12 and gets truer every day I think as we work and operate
13 on the waterway.
14 So in that vein, this has been a long
15 process. The civil works process is lengthy -- I'm not
16 going take you through every one of those blocks. But I
17 do want to highlight kind of where we are, kind of a you
18 are here map. On that slide, you'll see the different
19 colors. We're -- we're pretty much smack-dab in the
20 middle or just to the right of the second line there, on
21 about Block 9. It's about a 21-step process, ballpark.
22 But we do believe though, though that we're on the Step
23 9, which is the final Feasibility Report, and right
24 about where we are today. We're going to slip pretty
25 quickly beyond that and just -- and down -- we believe

it's going to be downhill from here as far as the time -- the timing. We're hopeful that we'll get a water resources bill that'll time right with our September chief signing this year. And we're hoping that -- what's going to cause -- is maybe we'll be doing the preliminary engineering by next year. So hope spring's eternal always for the local sponsor I know, but it does kind of give you an idea of where we are in the bigger scheme of things as we bring this Feasibility Report and this EIS to its public meeting.

In '99, we mentioned earlier, '97, '99 time frame, we did the reconnaissance phase to kind of see were we going to do to feasibility. And I think it's important to point this out. These bullets were right from -- kind of what was driving us in -- kind of what came out of the -- the reconnaissance study. And I think these are worth noting, because you're going to see we were pretty accurate with them.

The project was found to be, or at the time, the project was found to be in the interest of federal government, absolutely still is. The benefit-to-cost ratio 1.2 to 1. You're going to hear tonight some numbers that are going to jive with these numbers that are about a decade old. So I think the project, what we're seeing is and what I'm saying is

1 that it's fleshing out to be what we were expecting it
2 to be even a decade ago with a lot of changes. I think
3 Jan and them are going to go through a lot hurdles and a
4 lot of loops that changed as the process went along,
5 that public works process, to square nine, a lot work in
6 those nine squares. But you're going to see that things
7 were pretty accurate.
8 The one -- the one I do like to -- to point
9 out is just to give the Colonel one last time to -- to
10 let us buy it for $260 million. But we do think that
11 the price is going to be a little lower than that. But
12 that was leftover from the reconnaissance phase.
13 But the two big bullets that I think that I
14 want to land on, as far as how we kicked off the
15 feasibility were these two, which were -- those kind of
16 our action items from the reconnaissance phase, which
17 was at the end of the feasibility phase. And tonight
18 being part of that is to be able to have the Corps
19 describe and evaluate alternative plans. And you've
20 seen back there in the presentations, you're going to
21 hear a lot about it. I think Jan and her team and
22 Colonel and his team and Byron, they've done a great job
23 at fleshing out all the ways we could improve our
24 waterway. There's -- there's a lot of probable ways we
25 could have done it. I think they've gone through all

1 these turn -- alternatives. I think it was about 120 or
2 so, when it was all said and done. Quite a lot of work,
3 quite a lot of extensive study to do that. And then,
4 not just to throw out all those alternatives and bring
5 all of them to us and let the industry pick, but to kind
6 of boil that down and -- and to fully propose a
7 recommended project. And so I think you're going to
8 hear a lot of that tonight. And I don't think you're
9 going to be disappointed in that respect.
10 Some of the particulars as we went through
11 the feasibility phase is from the local sponsor's
12 perspective, and as we hold hands with the Corps of
13 Engineers, was that we cost shared the whole Feasibility
14 Study. We didn't put it all burden on the federal
15 government, 'cause we're asking the government to take a
16 look at our waterway. But at the same time, they
17 realize the importance federally of the waterway. So
18 they held hands with us on the cost of it, and we've
19 shared that. And it always would, and tonight
20 is -- will include the preparation of Environmental
21 Impact Statement. We always wanted that to be part of
22 our study. In 1912 that might not have been the case.
23 But I think we've grown quite a lot as far as the way we
24 look at our environment and the ecology of our waterway
25 as we look at doing improvements such as this.

1 Forty-eight months to complete the
2 Feasibility Study and the $7 million price tag on it
3 might have slid off of that a little bit. But I -- but
4 I want to leave with you with the idea that from the
5 local sponsor's perspective, we think we definitely are
6 going to get our money's worth out this product. And
7 out of the study that the Corps has put together, we
8 think it's great study, fine study. Might have taken a
9 little longer than we might have wanted overall, but I
10 think at the end of day, it's for a good reason. I
11 think it's going to be a -- you'll see, I think you'll
12 agree with me at the end of this that's it's a good
13 project. It's a fully vetted project. And we always
14 wanted it to be an open process. And so that's kind of
15 how we come here tonight, kind of where I'll leave you
16 tonight is we always wanted to fully identify the
17 stakeholders and urge their participation in it. I
18 think Jan did a magnificent job in getting all the state
19 and federal resources together. I mean, that is a huge
20 task. Because our waterway is unique in the sense of
21 its federal importance, plus it straddles two states.
22 You can just imagine all the things that went into that.
23 Some of you were part of that. So we encourage that.
24 We wanted that early on to continue to make this an open
25 process. And so I look forward to tonight, to your

1 comments as well. Local sponsor clearly is behind the
2 project, the way the Corps has been presented tonight.
3 And 100 percent happy to hear your comments on the
4 project. And I thank you for your time tonight and your
5 participation tonight.
6 MS. WILLEY: I'm Sheri Willey with the
7 Corps of Engineers. I'm the planning lead. I'm -- I
8 just want to go through the basic idea of how we did the
9 study and basic information for the study. It started
10 out with the study authority, that was in 1997. The
11 authority stated that the Corps should determine the
12 feasibility of modifying the channels to the Ports of
13 Beaumont, Port Arthur, and Orange. That was what
14 started the reconnaissance study that Clayton had
15 referred to. That began in 1998. And then from the
16 results of the reconnaissance study, we moved into the
17 feasibility phase, which started in 2000. This phase,
18 we're now at the point where we have the draft
19 Feasibility Report and the draft EIS, Environmental
20 Impact Statement, which is currently out for public
21 review.
22 Here's a list of those study participants.
23 As you can see, there's been coordination with a number
24 of agencies throughout the study process. Ms. Stokes
25 will address this coordination further in her portion of

1 the presentation. She'll go into a lot more detail.
2 The channel extends from the Gulf of Mexico
3 to the -- to the Port of Beaumont. The channel to
4 Orange portion of the waterway is -- was -- is not part
5 of the Feasibility Study. Here is the geographic limits
6 of the study area. It's a very, very large study area.
7 The GIWW that there is a portion of the GIWW, it extends
8 from Star Bayou on the west to Gun Cove Ridge on the
9 east. The Gulf shoreline that was studied extended ten
10 miles on each side of the channel. This area includes
11 two ports, the Port of Beaumont and the Port of Port
12 Arthur; two counties in Texas, Jefferson and Orange; two
13 parishes in Louisiana, Cameron and Cal- -- Calcasieu;
14 the Golden Triangle of -- of Beaumont, Port Arthur, and
15 Orange, as well numerous smaller cities and communities.
16 So it was a very wide study area. This is just an
17 example of some of the facilities at the Port of Port
18 Arthur and Port of Beaumont.
19 The existing study dimensions are listed
20 here. It currently is a 40-foot deep channel. It's
21 42 feet at the section out by the jetties. But
22 over -- we still refer to it as the "40-foot project."
23 It's divided into a number of reaches. And the total
24 length is about 64 miles.
25 The Feasibility Study has taken a number of

1 years, but this is because this project is one of the
2 most complex projects in the nation. The project area
3 is very large and involves, you know, the state of Texas
4 and Louisiana. In addition, the project area has
5 multiple water bodies: The GIWW, the Sabine-Neches
6 Waterway, Sabine Lake, the Neches River. With -- and
7 all of this has a complex salinity and circulation
8 pattern. So there was much to be studied.
9 The channel is the longest current channel
10 in the state of Texas at 64 miles. And with the
11 proposed project, would be approximately 76 miles long.
12 The deepening of such a channel will resort -- will
13 result in enormous amount of dredge material that either
14 has to be placed in upland or offshore placement areas,
15 or used beneficially.
16 The area also contains a very diverse
17 habitats from bottomland hardwoods to emergent wetlands
18 to open shal- -- shallow open water. All of these
19 factors have required a much more time-extensive study
20 effort to adequately evaluate potential project impacts
21 for the deepening of the waterway.
22 And when we start to look at the project,
23 we had -- we wanted to look at the problems and
24 opportunities. And we were looking at these three
25 categories: Navigation and commerce, environmental

1 concerns, and social and economic factors. Under
2 "navigation and commerce," the existing 40-foot depth
3 result -- results in draft restriction and affects the
4 navigation efficiency. The existing channel is designed
5 for loaded drafts of about 36 feet. The projected
6 increases in the Sabine-Neches Waterway commodity
7 transport will compound the existing problems with the
8 transportation efficiency. The majority of the tonnage
9 is carried in deep-draft vessels. And the vast majority
10 of the deep-draft traffic is compromised of crude oil
11 and petrochemical products. About three-quarters of the
12 crude oil tonnage is transported in vessels with design
13 drafts over the current project depth of 40 feet. Often
14 there is off-loading from the larger vessels offshore
15 that has to occur. And then the cargo is being brought
16 in by shuttle vessels. Also there's been transit rules
17 adopted by the Sabine pilots that result in daylight
18 only and one-way sailing restrictions for certain
19 conditions of the waterway.
20 For the environmental concerns, there was
21 salinity intrusion, loss or deterioration of wetlands,
22 the effects on water and -- or sediment quality,
23 increased inshore channel and Gulf shore erosion, and
24 beneficial use of dredge material. The definition of
25 "beneficial use of dredge material" would be that we

1 would use this material from either the construction of
2 deepening the channel or the maintenance of deepening
3 the channel in a beneficial way. And in this project,
4 we propose to use it to restore marsh and renourish the
5 Gulf shoreline.
6 Social and economic factors. The economic
7 effects of reduced transportation efficiency is one.
8 Also regional economic effects in Louisiana and Texas,
9 there could be economic growth, growth and development
10 with the deeper channel.
11 There's -- we also have to look at
12 potential impacts. The potential impact to the public
13 infrastructure -- excuse me. This includes the
14 Port Arthur hurricane protection levee, and then there
15 were various state highways and bridges that we had to
16 consider in the state. Also there is an increased taxes
17 required possibly to fund the channel improvements.
18 The Feasibility Study objectives. In 2000
19 we began the Feasibility Study and sponsored public
20 scoping meetings in Lake Charles and also Beaumont. The
21 planning objectives for the study were to improve the
22 navigation efficiency of Sabine-Neches Waterway while
23 maintaining or enhancing the affected area's coastal
24 estuarine resources.
25 The Sabine-Neches Waterway plays a

1 significant role in the economy of the Golden Triangle
2 area. The amount of vessel traffic along the waterway
3 is increasing with the economic growth of the area.
4 With the current channel dimensions, there are size
5 restrictions on the large vessels, which utilize the
6 channel. The current 40-foot depth and the channel
7 width restrict the vessel movement to one-way convoys or
8 daylight-only sailing. Tankers also must anchor
9 offshore and lighter their cargo into shallower drafts
10 that can be navigated, and that can navigate the
11 waterway. So all of these things were taken into
12 account to try to improve the navigational efficiency of
13 the waterway.
14 For the alternatives evaluated during the
15 screening, with any feasibility study we have to take
16 into account the no-action alternative. And that's
17 pretty self-explanatory, it's what would happen if
18 nothing was done. We'd have to take into account how
19 the, you know, if we just continue to maintain the
20 channel as it is right now.
21 Additionally, we looked at some
22 nonstructural alternatives. A traffic management
23 system, that is the system the Coast Guard, the Coast
24 Guard managed system. It's already in place, but we had
25 to take into account using that or, you know, fully

1 utilizing that system.
2 Also, the -- we had -- we looked into the
3 relaxation of the pilot rules, such as allowing some
4 two-way traffic in certain areas or different things
5 that would relax their rules somewhat. And see if that
6 would help the efficiency of the waterway.
7 And another of the nonstructural
8 alternatives we looked at were alternative mode of
9 commodity transport. Such as offshore terminals where
10 tankers can dock and connect to a pipeline to off-load
11 the product. Two of those that we looked at were the
12 Louisiana Offshore Oil Port (LOOP), which is existing.
13 And we also looked into the bulk oil offshore transfer
14 system BOOTS, which was proposed, but is not currently
15 an active project.
16 Structural alternatives. We looked at more
17 than 120 combinations of different channel depths and
18 widths. It would have taken up many, many slides. So
19 this is a very short summary. We've basically looked at
20 deepening to between 43- and 55-foot depths. And we
21 also looked at the widening from 500- to 700-foot for
22 all the different depths.
23 The tentatively recommended plan
24 consisted -- consists of deepening to 48-foot channel, a
25 dredge material management plan, beneficial use plan,

1 and marsh mitigation. The widening that we had looked
2 at earlier in the alternatives was not economically
3 justified, and therefore, it was removed from the study.
4 Here's some more details of the tentatively
5 recommended plan. As you can see, the entrance channel
6 would have to be extended out 13.2 miles offshore.
7 That's what would add the additional length on to the
8 channel when I said the 64 miles currently, and that's
9 to get to the proposed depth offshore.
10 Also there's some deepening and widening of
11 the Taylor Bayou channels and turn -- turning basins.
12 It's -- it's just -- it's not a full widening, it's just
13 partial areas that were of concern. It -- also adding
14 enlarging turning and anchorage basins along the Neches
15 River channel. And there were some -- there were also
16 some bend easings on the Sabine-Neches Canal and the
17 Neches River channel.
18 The long-term management of the dredge
19 material portion of the tentatively recommended plan
20 includes the maintenance material, which is going to
21 increase from on average 405 million cubic yards to
22 650 million cubic yards. The average annual cost
23 increase will go from 36 to 68 million. There will be
24 16 existing upland placement areas for this plan and two
25 expanded placement areas. Additionally, there are going

1 to be four of the -- the existing offshore placement
2 areas, as well as four new offshore placement areas.
3 And the tentatively recommended plan construction cost
4 is on the screen, one, uh-huh, one billion. And the
5 benefit-to-cost ratio is 1.3 to 1, which I know Clayton
6 pointed out when he had a slide that it -- the
7 reconnaissance that was a 1.2 to 1 benefit-cost ratio.
8 And now Jan Stokes will present the
9 environmental portion of the study.
10 MS. STOKES: I'm not as tall. I want you
11 to know that we are very aware of the sensitive nature
12 of the wetlands in this area. This -- one of the
13 greatest challenges of this study was determining what
14 the potential environmental effects of the -- of the
15 deeper navigation channel would have on the extensive
16 wetlands in the area. There are 400, about 440-square
17 mile of coastal marsh. And on -- and this is in both
18 Texas and in -- in Louisiana, about 26 square miles of
19 Cypress-Tupelo swamp and 14 square miles of bottomland
20 hardwood. And all of this was considered in all of the
21 environmental work that we did -- did in analyzing the
22 effects of the this project.
23 There -- the study area also includes
24 several protected areas. We have portions of the Sabine
25 National Wildlife Refuge and the Sabine Island Wildlife

1 Management Area in Louisiana. The study area also
2 includes all of the Texas Point National Wildlife
3 Refuge, the Blue Elbow Swamp Wildlife Management Area,
4 and the Lower -- Lower Neches Wildlife Management Area
5 in Texas and portions of the J. D. Murphree Wildlife
6 Management Area, and the McFaddin Wildlife Refuge.
7 We recognize in our studies that -- that
8 the wetlands in this area have been undergoing high
9 rates of -- of marsh loss like those in Louisiana and in
10 the Western Chenier Plain in Louisiana. And -- and more
11 recently have suffered additional impacts from the
12 Hurricanes Rita and Ike. Because of the extensive
13 sensitive wetlands in the area and the large size of the
14 study area, we chose a collaborative approach in
15 determining what the impacts would be and eval- -- and
16 evaluating what would be an appropriate mitigation plan.
17 We formed what we call an "Interagency
18 Coordination Team," or ICT for short. And all of these
19 agencies helped us evaluate impacts and plan mitigation.
20 We have a suite of federal agencies, prominently
21 U.S. Fish and Wildlife -- U.S. Fish and Wildlife and EPA
22 and National Marine Fisheries. And then we have a -- a
23 full suite of agencies from both Texas and Louisiana,
24 Texas General Land Office, Texas Commission on
25 Environmental Qual- -- Quality, Texas Parks and

1 Wildlife, Texas Water Development Board, Sabine River
2 Authority. In Louisiana we have Louisiana Department of
3 Natural Resources, Department of Environmental Quality,
4 and Department of Wildlife and Fisheries.
5 Representatives from all these agencies
6 helped us in the planning study. We also included a lot
7 of the -- the managers from all of the -- the wildlife
8 management areas and refuges in all of our
9 considerations.
10 From -- Sheri listed some of the
11 environmental concerns that we had in studying this
12 project. And we evaluated them with an extensive amount
13 of technical studies. And I'm not going to go through
14 each one of these here. But some of the most
15 significant, are a three -- three-dimensional
16 hydrodynamic salinity modeling study that helped us
17 determine what the salinity impacts are likely to be
18 with the project. We looked at what effects there might
19 be on the shoreline of a longer navigation -- navigation
20 channel into the Gulf. We looked at the potential
21 effects of the new vessel fleets that would be using the
22 waterway on erosion in certain parts of the channel. We
23 looked at the potential for additional contaminants. We
24 modeled placing the material in the new offshore
25 placement areas, what the effect would be and in -- we

1 used modeling to determine the size that we needed to
2 have. Also, very significantly we used ecological
3 modeling to determine what -- what to -- to quantify
4 what the environmental impacts would be and to help us
5 determine what was the amount of mitigation that would
6 be required. What we -- the -- the modeling that we
7 used, the -- the model that we used is the same model
8 that has been used for about 15 years in Louisiana to
9 model CWPPRA project studies -- CWPPRA projects. And so
10 it's a well recognized model in this area. We also did
11 air modeling, air emissions modeling to determine if
12 there would be any air impacts during construction. We
13 did surveys for threatened and endangered species and
14 for cultural resources, archeological sites and -- and
15 shipwrecks.
16 Do you know what, I -- when I deleted, I
17 deleted the wrong slide. Okay. I'm going to tell you
18 the primary impact of this -- that we found was an
19 increase in salinity caused by the deeper navigation
20 channel. And this leads to a decrease in marsh
21 productivity and an increase in marsh land loss. Go
22 ahead. Skip that one. There we go. And go on.
23 The salinity changes are greatest in the
24 Sabine Lake, Port Arthur areas, and in the lower reaches
25 of the Neches and Sabine Rivers. We found negligible

1 impacts on the -- on the upper rivers north of I-10 and
2 the habitats for the swamp and bottomland hardwood. If
3 in -- however, we did identify -- point -- 1-1/2 to
4 2 parts per thousand increase in the lake and in the
5 lower -- the lower rivers. There's not much impact at
6 all in the southern parts near the -- near the
7 shoreline.
8 We used the -- the ecological model to
9 estimate what this additional salinity, what the impact
10 it might have on land loss. And these are the -- the
11 estimated -- this is the estimated increase in land loss
12 from the salinity. It was a -- a total of about
13 938 acres of loss in the study area, 691 acres in
14 Louisiana, and 247 in Texas. I want to point out that
15 this is a small, less than 1 percent, increase over what
16 we would expect in the area that is occurring now.
17 We -- there is a large land loss that occurs in this
18 area now, and the additional land loss would be a small
19 percentage.
20 When -- we are also planning to use a lot
21 of material beneficially to restore marsh. And when we
22 do that, we will be building about 2,800 acres of marsh,
23 which will more than offset the amount of -- of acres
24 that would be lost with the project. However, all of
25 this beneficial use of the restoration of marsh is in

1 Texas. And that leaves the 691 acres in Louisiana
2 without compen- -- with -- without -- without
3 compensation. And so we have developed an extensive
4 mitigation plan to -- to compensate for those -- those
5 losses.
6 There were some other minor environmental
7 effects. There is one wetland on the Neches River that
8 is being taken for the expansion of one of the placement
9 areas. That would convert 86 acres of marsh to the
10 placement area. And that -- that is included in
11 the -- the -- the impacts that I mentioned on the -- on
12 the slide before. There is also potential for impacts
13 to threatened and endangered sea turtles with all of the
14 offshore dredging that we do with the hopper dredges.
15 So we have developed management measures using draghead
16 deflectors. Yeah, let's see, monitoring on -- on the
17 boat during the -- during the dredging and relocation
18 trolling prior to the dredging to -- to keep the loss of
19 -- of sea turtles to a minimum. There is wintering --
20 there is critical habitat for the Piping Plover over
21 wintering at Louisiana Point. The beneficial use
22 project that we have there should help stabilize that
23 shoreline and provide protection -- additional
24 protection for the habitat that is there. And so we see
25 that as a long-term beneficial effect.

1 There are two major beneficial use features
2 that we're proposing with this project. One is
3 extensive restoration of degraded marsh on the Neches
4 River in three areas: Rose City, Bessie Heights,
5 and -- and Old River Cove. This is -- would result in
6 over 2,800 acres of new restored emergent marsh in this
7 area. In the others, Gulf shoreline beneficial use, in
8 both -- at both Texas Point and Louisiana, this would
9 use maintenance material to -- and that would be placed
10 along the shorelines to add material back into
11 the -- into the -- into the littoral drift and help with
12 the erosion -- high erosion rate in Texas and just
13 provided additional stabilizing material for the
14 Louisiana side.
15 This is a map of the Neches River areas.
16 Rose City is on the left side, upstream part of your
17 map. Bessie Heights and Old River are down near
18 the -- the mouth of -- of the Neches River. The Old
19 River Cove area is on Texas Parks and Wildlife property
20 for the most part. And the -- I think the Rose City and
21 Bessie Heights, these are on private property. The next
22 slide.
23 These are the locations of the proposed
24 beneficial use shoreline nourishment projects. They're
25 three miles on either side of the jetties. They -- each

1 side would -- would have material placed on the
2 shoreline every six years. And the material is coming
3 from Sabine Pass. It's coming from both states, and so
4 it would be used equally. The quantities would be split
5 equally between two states. The -- as I mentioned
6 earlier, the -- all the restoration, the beneficial use
7 features in -- in Texas, it fully compensates for all
8 the salinity and land loss impacts of the project in
9 Texas. It -- it more than compensates for it. But
10 there are unavoidable impacts in Louisiana that we were
11 unable to use. We were unable, although we searched
12 diligently. We were unable to find any beneficial use
13 projects that would offset those losses.
14 And so we are proposing to restore marsh in
15 five areas in Louisiana. Two are in the Willow Bayou
16 Watershed, and three are in the Black Bayou Watershed.
17 Here are numbers from the restored emergent marsh. In
18 each of the areas, as you'll see it's nearly 2,800 acres
19 of restored marsh in total in Louisiana. These are
20 the -- this is a map of the locations, the loca- -- the
21 Willow Bayou Watershed is in the -- in the bottom part
22 of the picture. That's in the Sabine National Wildlife
23 Refuge. The areas to the north are on private property.
24 That -- and that's Black Bayou Watershed.
25 And here we are. This is the estimated

1 completion, this our schedule for the remainder of the
2 study. The -- the reports were released for -- for
3 comment on the 24th of December. We -- comments are due
4 back to us on the 10th of February. And we hope to have
5 a review of the final EIS in August of this year
6 followed by approval of a chief's report in September.
7 Thank you.
8 MR. WILLIAMS: Okay. Before we start, I
9 would just like to remind everyone to be mindful of the
10 time again. And to turn off your cell phones or put
11 them on vibrate if you have them. In addition, just
12 like remind that this is not a question, ask, and answer
13 period. It's just a vent for you to say your comments
14 so we can record them. And your comments will be
15 addressed in the EIS. Right, Colonel.
16 COL. WESTON: Okay. Thanks, Byron. And
17 thanks to the folks that made those presentations. As
18 Byron just mentioned, we're go through the comment
19 period now. And then we'll start off with public
20 officials that are here and then go to general public at
21 large. So first of all, I'd like to invite Mr. Fred
22 Jackson from Jefferson County Judge's -- County Judge's
23 Office to --
24 MR. JACKSON: I'll waive comment.
25 COL. WESTON: Okay. And then we also have

1 Justin Veillon from Congressman Kevin Brady's office.
2 Like to make a statement?
3 MR. VEILLON: We have no comments at this
4 time.
5 COL. WESTON: Okay. And then Scott Hall
6 from the Lower Neches Valley Authority. Care to make a
7 statement?
8 MR. HALL: No comment.
9 COL. WESTON: All right. That was easy.
10 Okay. And we're going to go to the -- the public
11 comment period now, I have my notebook here. Okay.
12 Again, as Byron mentioned, we'd like you to, you know,
13 try to -- try your best to limit your comments to three
14 minutes. That means you, you know, you got to be pretty
15 succinct with your ideas and your thoughts on the
16 project. Specificity in -- in what your issue is with
17 the project would be great. And then Byron's going be
18 the time keeper. And he'll give us the high sign at
19 about 30 seconds out. And so if you could close up
20 that -- that thought that you're trying to express at
21 that point in time, and then we'll move on to the next
22 feature -- next speaker, really appreciate it. I would
23 tell you, three minutes is going to fly by for you. And
24 it is a pretty short period. But you have -- you have
25 time. And I'll talk about that a little bit later to

1 provide us more detailed comments in this process after
2 tonight's meeting. So -- so you'll have time to expand
3 on -- on those thoughts and ideas that you express here.
4 So -- okay. We're going to start with the public
5 comments. And the first individual I'd like to call on
6 is Mr. David Corban.
7 MR. CORBAN: Good evening. My name is
8 David Corban. I'm a lawyer with Fulbright & Jaworski,
9 L.L.P. And I'm authorized to make the following
10 comments on behalf of Shell Pipeline, Explorer Pipeline,
11 Enterprise Products, Kinder Morgan, and the other
12 members of the Texas Energy Coalition. The Texas Energy
13 Coalition was founded in 1995. And its membership is
14 made up of pipeline transmission companies that work
15 together on issues of common interest.
16 Prior to the release the Sabine-Neches
17 Waterway Draft Feasibility Report or DFR on
18 December 24, 2009, there was no prior communication by
19 the sponsors of the proposed project with the pipeline
20 industry regarding pipeline relocation issues. This was
21 the case, despite repeated requests to the Corps of
22 Engineers for information about the proposed project's
23 potential impact on the pipeline industry.
24 The DFR that was made available for the
25 first time in late December, describes a large number of

1 pipeline relocations that the project will require. The
2 replacement of pipelines to transport essential
3 commodities, such as natural gas, not only is costly but
4 also requires years of advance planning and coordination
5 and creates operational and engineering burdens for an
6 industry that has strategic significance to the American
7 economy. Yet the DFR provides little detail about the
8 project's impact on pipeline operations, which pipelines
9 will be need to be relocated, where those pipelines are
10 located at the present time, or costs are estimated for
11 pipeline relocations.
12 Given these circumstances, we do believe it
13 is unrealistic to expect that our members could provide
14 any meaningful comments on the DFR by
15 February 10th, 2010. We believe that a more realistic
16 comment period would allow at least 120 days. And we
17 therefore respectfully request that the comment period
18 be extended to at least April 26, 2010. In making this
19 request, we assume that the Corps will promptly and
20 definitively identify the pipelines that will need to be
21 moved, the owner of each such pipeline, and sufficient
22 information to enable us to understand and respond to
23 the Corps' estimate of the cost for moving such
24 pipelines.
25 Based upon the DFR, we do understand the

1 Corps of Engineers to have acknowledged that this
2 project, as proposed, would be a deep-draft project for
3 cost sharing purposes. And further, as required by the
4 deep-draft cost sharing provision of the Water Resources
5 Development Act of 1986, that the Corps will recommend
6 that half of the pipeline relocation cost for this
7 deep-draft project be borne by the pipeline owner. And
8 the other half by the local sponsor for the project. We
9 appreciate the opportunity to comment on this project.
10 COL. WESTON: Okay. Thank you. Next, I'd
11 like to call Ms. Linda Mathews.
12 MS. MATHEWS: I'm Linda Mathews. I
13 represent Enterprise Products Company here tonight. I
14 appreciate the opportunity to comment. We did get the
15 Feasibility Study the end of December. We have several
16 departments right now trying to investigate the -- which
17 pipelines are involved and make sure we have all of them
18 identified. And we do not believe that we will be able
19 to get that together by February 10th with any
20 meaningful comments. And so we would just like to
21 concur with the Texas Energy Coalition, the request for
22 a 120-day extension. Thank you.
23 COL. WESTON: Thank you. Next will be
24 Mr. Ronald Moon.
25 MR. MOON: Yes, my brother and I had a

1 dredge material containment area No. 11 on Pleasure
2 Island leased for five years. We did studies with Lamar
3 University and Texas A&M. Spoil in No. 11 is on the
4 north end of lake. And if these dredge material
5 containment areas are built like this design, they can
6 be beneficial. I'm not against the dredging. I'm just
7 pointing out the problems that these dredge sites have
8 from the intercoastal waterway from Galveston all the
9 way to Mississippi. I realized all these studies that
10 you've already done. Is there anybody going to be doing
11 studies as the dredging is done on the impact on the
12 fisheries? Because we have witnessed shrimp kills, fish
13 kills right there on the dredge material compartment No.
14 8 on Pleasure Island. We have got experience in these
15 areas for 32 years now that we've been watching them,
16 and fishing in them, and being out there all the time.
17 We've witnessed all this stuff. Now, you combine those
18 with all the dredge material containment areas all the
19 way up in the coastal canal, it's got a devastating
20 effect on the fisheries. Because high tides and storms
21 put the fish in these compartments, and they become
22 trapped, and they die. We've reported it to the Corps
23 on the island several times, and they come out and say,
24 "Well, that's going to happen." This is 2010.
25 Something's got to be done. These areas have to be

1 managed and watched properly. The placement spoil and
2 dredge material containment No. 8 is not being watched.
3 The south effluent ditch was filled completely with
4 silt. So the last two dredging operations in there, the
5 maintenance dredging, the water had not enough area to
6 be released. It all had to go through the north
7 effluent ditch. And it overflowed the road in two of
8 their dredgings. That's not supposed to happen. So
9 something needs to be done, and more management needs to
10 be done. But it definitely has an impact. And it has
11 for years. Has there been any marine biologist done
12 studies on the actual dredge material that's being dug
13 up off the bottom? What are the organisms involved,
14 marine life that's being dredged out of the channel?
15 Because we know what's on the top and bottom of the
16 soil. There's a lot more I'd like to say, but I don't
17 have time.
18 COL. WESTON: Thank you. Next will be
19 Mr. Dennis Moon.
20 MR. D. MOON: I'll waive mine.
21 MR. MOON: Okay. We tried to get his three
22 minutes, but they wouldn't let me.
23 COL. WESTON: And again, I know these times
24 are short. Like I said, there's -- there are other
25 avenues to talk about here shortly to -- to expand on

your -- on your comments for us. Next I'll follow with Mr. John Whittle.

MR. WHITTLE: Thank you. I, too, would like to suggest that February the 10th is a very short deadline. And three minutes is a very short time to comment on a 2,286-page EIS and other documents. My name is John Whittle. I'm secretary of the Golden Triangle Audubon Society and sitting on other Audubon boards. However, I need to stress that these comments have not yet been endorsed by any Audubon unit, because there's not been time since we received them.

My major concern is the coastal marshes and wetlands and Sabine Lake and the wildlife that uses them be protected from the adverse effects of increased salinities and unnatural increased water flow as from the Gulf under all conditions, both normal and abnormal, such as major hurricanes. Fully understand the beneficial function of coastal marshes and attenuating the inflow of water from tropical storms and hurricanes, but equally understand that they will not do this if they have already been degraded by the time of the event. This requires that salinity levels not be allowed to increase, the existing channels not be exposed to increased exchange with Gulf salt water.

The first real issue I have is one of

1 alternatives. The only alternative to no action that is
2 comprehensively addressed are those which the only
3 difference is the depth to which it's proposed to raise
4 the channel. These are in the larger picture, only
5 relatively small changes and one major alternative. I
6 believe the need for and common sense requires a broader
7 approach to the issues so that an outcome that solves
8 the problem that is the best possible from an
9 environmental's perspective can be selected.
10 The first obvious alternative we can
11 discuss in the draft document, involves an offshore oil
12 terminal after the manner of the -- the LOOP, the
13 Louisiana offshore project. This is has been
14 successful, involved vanishing small environmental
15 impact during construction and operation. They survived
16 two or three major hurricanes without environmental
17 damage, being restored to full commercial operation in
18 remarkably short times. Such a port could be located so
19 as to be capable of accommodating the very large crude
20 carriers up-to-date. While the proposed increase in
21 depth and channels in Sabine-Neches will only have a
22 comparatively small effect on the capacity of time
23 'cause they can be accommodated. This alternative is
24 dismissed in the draft document with minimal discussion.
25 Founded in part because the proponents for such a port

1 have not yet coalesced into a partnership with the
2 resources and desire to pursue it in an immediate future
3 and a Sabine-Neches-related location. However, I do not
4 believe they should prevent it being a third alternative
5 and a need for EIS. It is also indicated that such a
6 port would not address the prime objective increasing
7 the efficiency of the waterway system, because it would
8 serve only one commodity, namely oil. The nu- -- yet
9 it's clear, the root cause of any efficiency is the
10 number of oil tankers using the system. And there is no
11 significant demonstrated need to use larger drafts. If
12 the tanker traffic is removed from the waterway system,
13 basic traffic will be cut to a fraction of its current
14 volume, and the inefficiency will be no more.
15 I wanted to go on, Mr. Chair -- Chairman,
16 and say something about the increased effects of
17 increased water flow up a bigger channel during
18 hurricanes to the detriment of all the areas around
19 Sabine Lake, Bridge, City, Orange. The MRGO in New
20 Orleans was recently closed, and the Corps lost a court
21 decision who was responsible for the Katrina disaster.
22 And the Corps was found liable having not looked after
23 the marshes that surrounded the MRGO and not doing a
24 good EIS in the first place. I will submit further
25 comments in writing. And I appreciate the opportunity,

however brief, to address this.

COL. WESTON: Next I'll call Mr. Richard Harrel.

MR. HARREL: My name is Richard Harrel. And I'm with a citizen's environmental group, Clean Air and Water Incorporated. It's been active in this area for the past 40 years. My statement will be very, very short in that I will say ditto to Dr. Whittle's remarks.

COL. WESTON: Thank you. Next will be Mr. James Kaucher.

MR. KAUCHER: I'm Jim Kaucher. I'm the plant manager at the Sabine Pass LNG. And Cheniere and Sabine Pass LNG Terminal strongly support the proposed deepening and widening project of the Sabine-Neches Waterway. We wish to see our waterway remain highly competitive with other ports and waterways by being able to accommodate the larger ships that now carry so much of the world's trade with a higher degree of safety.

Of course, for our part we are most interested in promoting the capability of the Sabine-Neches Waterway to safely handle the world's largest existing LNG carriers. These ships are nearly 1,150 feet in length and 180 feet in breadth. These very large LNG carriers, like the other large ships trading into our area, are presently limited to a

1 40-foot freshwater depth when entering the
2 Sabine-Neches. Many such vessels would come in deeper
3 if the water -- waterway channels were deeper and wider.
4 Any deepening or widening will make our waterway a more
5 competitive for business that uses the larger ships and
6 automatically adds additional safety margins for the
7 existing shipping already present.
8 Cheniere supports the project and the
9 U.S. Army Corps of Engineers and hopes the deepening and
10 widening work will proceed without delay.
11 COL. WESTON: Thank you. Next will be
12 Mr. Chris Fisher.
13 MR. FISHER: My name is Chris Fisher. I'm
14 the port director of the Port of Beaumont. We manage
15 the public docks and wharves of the Port of Beaumont.
16 We are located at the very top end of the Sabine-Neches
17 Waterway. So the transportation efficiency of the
18 waterway is very important to us. Our sole mission is
19 to generate and create jobs for our area and generate a
20 positive economic impact.
21 The public docks are more directly a small
22 portion of the total economic activity that takes place
23 along the waterway. We handle about 200 deepwater
24 vessels, about 25,000 railcars, and 15,000 trucks
25 through the port, annually 3 to 4 million tons. This

1 generates about 2,000 jobs annually, about 150 million
2 in economic impact.
3 The transportation efficiency that this
4 channel -- that this project provides is greatly needed
5 to the Port of Beaumont, not only to allow us to grow
6 and satisfy our mission of -- of generating creating
7 jobs, but we're also the number one strategic port in
8 the country and handle more military cargo than any
9 other port in the U.S., and second in the world in
10 support of our troops in national defense. Therefore,
11 the transportation and navigational safety on the
12 waterway that this project provides is certainly very
13 important to us, and the Port of Beaumont has been a
14 strong supporter of this project since its inception.
15 And we strongly applaud the work the Sabine-Neches
16 Navigation District and the Corps has done to bring the
17 project to this point. Thank you.
18 COL. WESTON: Thank you. Next will be
19 Ms. Gina Dorsey.
20 MS. DORSEY: Good evening. I'm Gina Dorsey
21 from Kinder Morgan. I concur with the comments that
22 were presented by Fulbright & Jaworski. My question is:
23 Of course, there are numerous pipeline companies
24 affected by this project. And of course, we would have
25 to go through a series of planning and design and all

1 that to get the pipelines removed or relocated as part
2 of this project. And my question is more on the -- on
3 the extent of the permitting process for that.
4 Typically we had to go through surveys and planning
5 associated with those permits. Will the permits for the
6 pipelines that we have to remove or relocate be somewhat
7 relaxed or automated if they are done as part of this
8 project? That's my comment or question.
9 COL. WESTON: Okay. And -- and again,
10 we're not going answer the questions --
11 MS. DORSEY: Right.
12 COL. WESTON: Tonight. But -- but we'll
13 take a look at those and -- and get the appropriate
14 answers. I don't have anymore cards here. So the first
15 thing I'd ask, is there anybody here who didn't a chance
16 to turn in a card that would like to stand up and make
17 a -- make a comment on the -- on the project? Okay. So
18 we've gone through the list of cards.
19 And -- and again, I tell you, we welcome
20 your comments and -- and -- and constructive criticisms
21 of the work that we've done. And we look forward to
22 seeing those in further detail if you didn't get a
23 chance to -- to obviously make full comments. And we
24 understand it's a very technical report. It's a -- and
25 very lengthy. And so we look forward to seeing the

1 further comments that you may have as we go through
2 the -- the public process here.
3 In conclusion, the written comments on the
4 Draft Feasibility Report, the draft DIS, the draft DIS
5 for the designation of the ocean dredge material
6 disposal sites currently must be received on or before
7 February 10th, 2010, which is the conclusion of the
8 45-day comment period that began on December 24th of
9 2009. Comments on the air conformity determination must
10 be received on or before February 26th, 2010.
11 In closing, I'd like to thank the
12 Sabine-Neches Navigation District for their efforts and
13 assistance, not only as partners for the Feasibility
14 Report to date, but for their efforts and assistance for
15 setting up this meeting for us here. And I'd like to
16 thank each and every one of you for your attendance and
17 expressing your interest in the outcome of this project.
18 So again, we look forward to getting your comments
19 further clarified. And we -- and we hope folks that
20 didn't get a chance to come tonight will also provide us
21 those inputs. The information on how to do that is
22 in -- is in some of the brochures in the back. So thank
23 you very much for coming out. And this concludes the
24 meeting, and it is adjourned. Thank you.
25 (The meeting concluded at 8:07 p.m.)

THE STATE OF TEXAS :
COUNTY OF JEFFERSON :

I, ADA V. CHRISTY, a Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the facts as stated by me in the caption hereto are true; and same were reduced to typewriting under my direction; that the above and foregoing meeting as set forth in typewriting is a full, true, and correct transcript of the proceedings had at the time of taking of said meeting.

I further certify that I am not, in any capacity, a regular employee of the party in whose behalf this meeting is taken; and I certify that I am not interested in the cause, nor of kin or counsel to either of the parties.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, on this, the _____ day of February, 2010.

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SABINE-NECHES WATERWAY PROJECT

US ARMY CORPS OF ENGINEERS

JANUARY 27, 2010

7:00 P.M.

LAKE CHARLES CIVIC CENTER

JEAN LAFITTE ROOM, THIRD FLOOR

LAKE CHARLES, LOUISIANA

1 A P P E A R A N C E S

2

3

4 Janelle Stokes - US Army Corps of Engineers

5 Sheri Willey - US Army Corps of Engineers

6 Byron Williams - US Army Corps of Engineers

7 Col. David Weston - US Army Corps of Engineers

8 Randall Reese - Sabine-Neches Navigation District

9 Clayton Henderson - Sabine-Neches Navigation District

10 Arthur Janecka - US Army Corps of Engineers

11

12 Reporter: Betty Curry Minton, RPR, CCR

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1 P R O C E E D I N G S,

2

3 MR. REESE: We would like to go ahead and
4 get started. Good evening, my name is Randall Reese.
5 I'm the general manager of the Sabine-Neches Navigation
6 District. We're the local sponsor for the US Army
7 Corps of Engineers for the Sabine-Neches Waterway. At
8 this time, I'd like to introduce the other members of
9 the Navigation District that are here with us tonight.
10 We have Paul Beard our board chairman and Joe Johnson
11 is here with us tonight, one of our commissioners here
12 with us. We have Clayton Henderson here with us, our
13 assistant general manager.
14 We have a good presentation to present
15 tonight and without any further delay, I'd like to go
16 ahead and introduce Colonel David Weston. He is with
17 the Galveston District US Army Corps of Engineers.
18 COL. WESTON: Thanks, Randy. Good evening,
19 ladies and gentlemen. I'm pleased to be here tonight.
20 As Randy mentioned, I'm Colonel Dave Weston. I'm the
21 Commander of the US Army Corps of Engineers District in
22 Galveston, Texas. And I'm here to talk to you tonight
23 and welcome you to the public meeting of the
24 Sabine-Neches Waterway Channel Improvement Project.
25 Specifically, we're going to present

1 information and accept public comment on the following
2 draft documents that were released for public review on
3 December 24th, 2009; The Draft Feasibility Report for
4 the Sabine-Neches Waterway Channel Improvement Project
5 Southeast Texas and Southwest Louisiana; The Draft
6 Environmental Impact Statement for the Sabine-Neches
7 Waterway Channel Improvement Project for Southeast
8 Texas and Southwest Louisiana; The Draft Environmental
9 Impact Statement for the Sabine-Neches Waterway Channel
10 Improvement Project, The Ocean Dredge Material Disposal
11 Site Designation and the Draft General Conformity
12 Determination Sabine-Neches Channel Improvement
13 Project.
14 And for the record, I'd like to state this
15 public meeting is being convened at 7:00 p.m. on
16 January 26, 2010 at the Lake Charles Civic Center in
17 Lake Charles, Louisiana.
18 As you know or are learning here tonight,
19 the Corps of Engineers and the Sabine-Neches Navigation
20 District have been performing a study analyzing the
21 potential modification to the portion of the
22 Sabine-Neches Waterway that serves the ports of
23 Beaumont and Port Arthur, Texas. The two objectives
24 were identified for the study. These objectives were
25 improvement and navigational efficiency along the

1 Sabine-Neches Waterway and maintain the ecological
2 value of coastal and estuary sources within the project
3 area.
4 The cost effective plan as been identified
5 by the study that meets these objectives. This plan
6 will be referred to as the tentatively recommended and
7 locally referred plan will be described by study team
8 members in the following presentations.
9 We are specifically seeking input tonight
10 concerning the plan and associated environmental impact
11 that are described in these documents. I hope that all
12 of you have had an opportunity to read the announcement
13 of the public meeting either on our Galveston District
14 webpage or any individual announcements that were
15 mailed to individuals, agencies, organizations and news
16 media believed to have an interest in these
17 proceedings. The meeting notice was also published in
18 the Beaumont Enterprise in Beaumont, Texas and the
19 Southwest Daily News here in Lake Charles.
20 An additional fact sheet is also available
21 at the entrance here as you came in. The announcement
22 mailing list and a list of those present tonight will
23 be made a part of the record of this meeting. A court
24 reporter is here who will transcribe these proceedings
25 and all public comments.

1 Before we go any further, I'd like to
2 introduce those members of my District that are here
3 tonight representing the Corps of Engineers. Starting
4 with Mr. Arthur Janecka, who is my deputy district
5 engineer. Mr. Dolan Dunn who's my chief environmental
6 and regulatory; Ms. Carolyn Murphy my chief of the
7 environmental section; Mr. Byron Williams, my project
8 manager for the Sabine-Neches Waterway Study; Ms. Sheri
9 Willey our planning lead; Ms. Gloria Appell our
10 economic lead; Ms. Janelle Stokes our environmental
11 lead; Ms. Nancy Young project engineer; and Ms.
12 Samantha Lambert our hydrology and hydraulics engineer.
13 Now, I'll turn the meeting over to Mr. Byron Williams,
14 the project manager. He's going to describe the ground
15 rules for tonight's meeting and we will proceed from
16 here. Thank you.
17 MR. WILLIAMS: Thank you, Colonel Weston.
18 First, I'd like to ask did everyone fill out an
19 attendance card. We not only use an attendance card to
20 record your attendance but we also use them to
21 determine who would like to make a comment. So if
22 anyone doesn't have a card and you would like one,
23 please raise your hand. One will be brought to you.
24 Okay. Those who have filled out a card, you will be
25 given an opportunity to speak after all presentations

1 have been made. And if you do not wish to speak but
2 you would still like to make a comment, we also have 8
3 1/2 by 11 comment cards which you can fill out and
4 place in one of the baskets that we have in this room
5 or you can email or you can snail mail us. So if
6 anyone would like one of those comment cards, please
7 raise your hand. Okay. Thank you.
8 We want to emphasize that this is not a
9 voting contest simply to determine if you are for or
10 against the project tonight. So I would like to start
11 with the format. First, I'm going to introduce
12 Mr. Clayton Henderson, the assistant general manager
13 for the Sabine-Neches Navigation District he will be
14 giving you the project introduction; followed by Sheri
15 Willey, she's our planning lead. She's going to talk
16 about the planning study; and then followed by Ms.
17 Janelle Stokes. She's the environmental lead and she's
18 going to discuss the summary of the environmental
19 study.
20 Afterwards Colonel Weston is going to open
21 the floor for comments. First, he's going to recognize
22 federal and state officers. Then he'll recognize
23 federal and state resource agencies. Thirdly, he'll
24 recognize any individuals who have filled out comment
25 cards and would like to speak.

1 Again I'd like to remind you anyone who has
2 requested to speak will have an opportunity tonight. I
3 would like to ask you during the comment period that
4 you be courteous and have your phones off or on
5 vibrate, do not talk and please hold the applause and
6 or reactions until afterwards so that we can maintain
7 order at the meeting. Each comment period will be
8 three minutes. When 30 seconds are remaining, I'll
9 raise my hand at the table. Please act accordingly and
10 adjust your speech to finish in 30 seconds. A mic will
11 be brought to you when it is time to speak. You may
12 stand up at your chair. That's our mic. Okay.
13 Without further ado, I'd like to introduce
14 Mr. Clayton Henderson of the Sabine-Neches Navigation
15 District. Thank you.
16 MR. HENDERSON: Thank you, Byron. My name
17 is Clayton Henderson. I'm the assistant general
18 manager for the Sabine-Neches Navigation District.
19 We're the local sponsor to the Army Corps of Engineers
20 for the Sabine-Neches Waterway Project. So what I'd
21 like to do before we get into the technical aspect that
22 you're going to hear tonight is give you an idea of
23 what the project looks like through the local sponsors
24 eyes and what brings us here tonight.
25 I'd like to start with just a little bit of

1 the projects history. I know it seems this is the
2 first time we've done an improvement project on the
3 Sabine-Neches Waterway. Because it's been quite a
4 while, almost 50 years, since we've done an improvement
5 project.
6 You can see by the slide we're pretty good
7 at it. We've been doing it for quite a while. In
8 1912, we did the first improvement project. Took a
9 meandering river and dug it to about 25 feet,
10 straightened some of the bends and curves all of the
11 way up to the Beaumont channel, and we've done it five
12 times total. Hopefully, the sixth time will be this
13 year in 2010. That's kind of what brings us to
14 tonight. I wanted to point out that it may seem that
15 the improvement project is new for all of us. It may
16 be new to this generation, but it's not a new thing to
17 the waterway to the project itself, and we've become
18 pretty good at improving the project both from an
19 economical standpoint but we believe also from an
20 environmental standpoint. I think you're going to see
21 a lot of that tonight as they give you the details.
22 We've definitely learned our lessons as
23 we've gone since 1912, and I think you're going to see
24 the best product put forward tonight, both economically
25 and environmentally.

1 As I said, the project has a long history.
2 The total involvement started back in 1875. The local
3 sponsor was designated in 1909 for that first
4 improvement project and since then, it's always been,
5 we believe, a perfect coordination as far as the
6 federal project goes. Although the federal government
7 pays for the lion's share of the maintenance of the
8 project. The local sponsor has a big hand in paying
9 for the real estate or the placement areas where you
10 put the dredge material that you dredge out of the
11 channel and then industry kind of plays the other part
12 of that perfect triangle and paying their share of
13 their terminals and when they dredge their terminal
14 anything that is outside of the federal footprint. So
15 we do believe that the way our project was engineered,
16 the one we're living with now and the one that we're
17 going to go forward with is a really good coordinated
18 effort. We share the burden all of the way around and
19 it really gives everyone a seat at the table as we
20 discuss the waterway going forward.
21 Some of the original tenets that we started
22 with for this feasibility study were pretty simple to
23 deepen the channel and to widen the channel starting
24 off in the Gulf of Mexico and going all of the way up
25 to the Port of Beaumont for the deepening and widening.

1 And you may have seen as you've been following the
2 project along here lately, we have dropped the widening
3 from the terminology it has been just a deepening
4 project.
5 I wanted to point out to you this is an
6 excerpt from the original feasibility bullets back in
7 1999. And one of our original tenets was to be sure
8 that we kept the vision to improve the transportation,
9 efficiency and navigational safety of the waterway. So
10 although we have dropped the word "widening," we
11 absolutely haven't dropped off the efficiency or the
12 safety of the waterway and no doubt we're strategically
13 widening places we have absolutely adjusted. I think
14 you're going to hear a lot of that as the specifics
15 roll out for tonight.
16 Let me back up one. Also, I want to point
17 out that the waterway has been driving us as we go
18 along. This project although I said it's been about
19 50 years since we've improved the project, it doesn't
20 mean we haven't been needing an improved project. With
21 the way the world vessels are going and the world
22 market is going, vessels are getting bigger, with the
23 Panama Canal improving itself coming due pretty soon
24 and with the regulations requiring double hull tankers
25 in 2015. Our waterway is already seeing vessels that

1 are easily exceed the design limits currently so
2 they'll come either short loaded so they can make it up
3 the waterway to design depth or they'll come fully
4 loaded and have to offload offshore and lighter. All
5 of those things impact the efficiency of the waterway
6 and it impacts industry and ultimately impacts our
7 area.
8 So part of this channel improvement was to
9 alleviate that specifically. So the need is still
10 there. It's still driving us. Although it's taken us
11 a little while to get to it, we believe it's going to
12 be just in time and a perfect fit for our area once we
13 get it out.
14 But it's a bit of process to get there.
15 The federal civil works process it looks pretty lengthy
16 I know on that slide about a 21-step process on that
17 slide starting with the identification of improvement
18 need all of the way through the operation and
19 maintenance of a channel once it's authorized and
20 constructed.
21 But to give you an idea of where we are
22 tonight, we're highlighted there at block eight or nine
23 which is the finalization of the Feasibility Report.
24 So it looks like we have a long way to go, but we
25 really believe we've climbed a lot of the hill going

1 forward essentially to get us here tonight. And going
2 forward, we believe that things are going to go a
3 quicker pace hopefully with a local sponsor so we are
4 looking for a chief's report sometime this September to
5 sign off on the feasibility study and then we can
6 swiftly move into the Water Resource Act passed by
7 Congress this year and that will put us into the
8 preliminary engineering design in 2011 and 2012. So
9 it's taken a little bit, sure, but we do believe as we
10 go forward, we're going to see the pace pick up quite a
11 bit.
12 We started the reconnaissance phase in '97
13 and through '99. I wanted to kind of point out some of
14 the things that it did propose as we were going to go
15 into the feasibility phase as a way for you to kind of
16 gauge some of the things you're going to hear tonight.
17 The reconnaissance report said the project would be
18 found in the federal interest and that we would have a
19 favorable benefit cost ratio about 1.2 to 1. I think
20 you're going to hear some numbers from Ms. Willey that
21 are going to dovetail right with that but these are
22 decade old numbers or predictions. You're going to see
23 that the feasibility study track pretty much along with
24 what the reconnaissance report predicted.
25 The yardage is quite large although we're

1 going to be a little north -- quite a bit north of the
2 260 million dollar price tag on the thing. You
3 probably all can agree with me that over a decade and
4 with the scale of economy and industry and also with
5 the cost of doing business in industry has really
6 accelerated that project cost, but the benefit to cost
7 ratio was maintained and I believe even improved just a
8 little bit so you're going to see that.
9 In the feasibility phase, it was pretty
10 simply from a local sponsor as we listen to industry
11 and we saw the need for an improved channel, the
12 direction we were giving the Corps as we were asking
13 them to do a feasibility study for our project or for
14 our current project was to describe and evaluate
15 alternative plans for improvement probably a lot of
16 ways we can come up with and there were a lot of ways
17 that came up to improve our project.
18 I believe Jan and her team went through 120
19 different alternatives just on the environmental side
20 of things. And so they had to wade through quite a bit
21 of alternatives to get it down to a presentable
22 package. And then ultimately proposed the recommended
23 project. I think you're going to see that tonight. I
24 think that the Colonel and his staff and over the years
25 they've done a great job at doing just that that led to

1 a complex project like we see tonight. It's a tough
2 thing to wrestle down. But I think you're going to see
3 and agree with me that they've done quite a job doing
4 that.
5 As we went through the feasibility phase,
6 some of the particulars were the cost sharing between
7 the navigational district and the federal government to
8 pay for actually doing the study. And early on even
9 before we started this thing, we knew that we would be
10 at a meeting much like tonight where you would be
11 presented with an environmental impact statement
12 because the project does have such an environmental
13 impact. It's a very large waterway. It touches a lot
14 of ecosystems and so Jan's work has been cut out for
15 her probably from the beginning, but I think she's done
16 a good job of gathering all of the agencies to kind of
17 sit down and go through that.
18 The 48 months to complete, 78 million
19 dollars to do that absolutely got escalated, but I
20 think most of that could be attributed to new policies
21 within the Corps. Our project was the first project to
22 go through some of the new policies. And in the end, I
23 think, it was a good thing for our project to go
24 through those because the project we are now going to
25 pass on to headquarters for their review phase is a

1 better project for it. It's going to be a more vetted
2 project for it. And as I said in the beginning since
3 1912, we looked at getting better at doing projects and
4 I think this is a part of it. So it's a little bit
5 painful at times for us to go through those over and
6 over, but at the end of the day, I think we're going to
7 see the results and the benefits of that when it goes
8 into the headquarter's review phase.
9 So the project all along and this process
10 all along has always meant to be an open process. We
11 wanted early on to identify the stakeholders and urge
12 their participation in the project. We wanted
13 intensive state and federal resource agency
14 involvement. Jan has done, I think, a great job as far
15 as coordinating all of the different agencies. This
16 waterway splits two states, a lot of federal interest
17 as well. So that's been quite a task to do but if --
18 some of you may have been at some of those coordination
19 team meetings, and you'll see that we were able to
20 smooth out the majority of the wrinkles environmentally
21 and so I think you're going to see some benefits of
22 that tonight as well.
23 And so I look forward to your open comments
24 tonight to continue that openness. I think as you hear
25 the details of the project, you're going to see that

1 the project that the Corps is proposing tonight and as
2 we press it forward, is the project that we all can get
3 behind and endorse. It's a project that more
4 importantly that we started out looking toward and you
5 can see that tonight. Thank you for your time and now
6 I would like to introduce you to Ms. Sheri Willey and
7 she's going to go through some of the details.
8 MS. WILLEY: Good evening. My name is
9 Sheri Willey and I'm the planning lead on the project
10 and I'm going to be giving you an overview of the
11 project and then Ms. Stokes will be following up with
12 the environmental portion. This is the study authority
13 that gave us the authority to study this project. This
14 authority stated that the Corps should determine the
15 feasibility of modifying the channels to the ports of
16 Beaumont, Port Arthur and Orange. The reconnaissance
17 study began in 1998 with the feasibility study starting
18 in 2000. The results of this is the Draft Feasibility
19 Report and The Draft Environmental Impact Statement
20 currently out for public review.
21 Here's a list of the study participants.
22 As you can see there's been coordination with a number
23 of agencies throughout the study process. These were
24 the cooperating agencies for the environmental review.
25 There's also going to be another list of agencies that

1 Ms. Stokes will be providing in her presentation that
2 is the interagency coordination team.
3 The channel extends from the Gulf of Mexico
4 to the Port of Beaumont. The channel to the Orange
5 portion of the waterway is not a part of this
6 particular study. The geographic limits of the study
7 area is a very extensive study area, 2000 square miles.
8 It includes Sabine Lake, the marshes in Texas and
9 Louisiana, the Neches River Channel, Sabine River, a
10 portion of the Gulf Intracoastal Waterway is the
11 portion that extends to Star Bayou on the west and to
12 Gum Cove Ridge on the east. Also the Gulf of Mexico
13 shoreline extends ten miles on either side of the
14 channel. That was the portion that was in the study
15 area. Also it extended 35 miles offshore into the Gulf
16 of Mexico.
17 It includes two ports, the Port of Beaumont
18 and the Port of Port Arthur. Two counties in Texas,
19 Jefferson and Orange. Two parishes in Louisiana,
20 Cameron and Calcasieu. The Golden Triangle that
21 includes Beaumont, Port Arthur and Orange, Texas and
22 numerous smaller cities and communities. This is just
23 a picture of -- a photo of some of the facilities on
24 the Port of Port Arthur and also the Port of Beaumont.
25 Of the existing Sabine-Neches Waterway

1 project dimension, it's current project is a 40-foot
2 deep channel. It's divided into a number of channel
3 reaches, the total length is about 64 miles. The
4 Feasibility Study has taken several years, but this is
5 because the project is one of the most complex projects
6 in the nation. The project area is very large
7 involving the states of Texas and Louisiana. In
8 addition, the project area has multiple water bodies
9 such as the GIWW, the Sabine-Neches Waterway, Sabine
10 Lake, Neches River. All of these have a complex
11 salinity and circulation pattern.
12 The channel is the longest current channel
13 in Texas at 64 miles and with the proposed project will
14 be approximately 76 miles long. Deepening such a
15 channel would result in an enormous amount of dredge
16 material that either has to be placed in upland or
17 offshore placement areas or used beneficially.
18 The area also contains very diverse habitat
19 from bottom land hardwoods to emergent wetlands to
20 shallow open water. All of these factors have required
21 a much more time extensive study effort to adequately
22 evaluate potential project impact of deepening the
23 waterway.
24 We had to look into the problems and
25 opportunities for the study. These were the categories

1 that were addressed: Navigation and commerce,
2 environmental concerns, and social and economic
3 factors. For navigation and commerce, the existing
4 40-foot depth results in draft restriction and affects
5 the navigation efficiency. The existing channel is
6 designed for loaded drafts of 36 feet. Projected
7 increases in the commodity transport will compound the
8 existing problems of the transportation efficiency.
9 The majority of the Sabine-Neches Waterway
10 tonnage is carried in deep draft vessels and the vast
11 majority of deep draft traffic is comprised of crude
12 oil and petrochemicals. Three quarters of the crude
13 oil tonnage is transported in vessels with design
14 depths over the current projected depth of 40 feet.
15 Because of this, offloading from very large -- from
16 large vessels offshore occurs with the cargo being
17 brought in on shuttle vessels.
18 Also there's been transit rules adopted by
19 the Sabine pilots that result in daylight only and one
20 way sailing restrictions for certain conditions. There
21 are a number of environmental concerns. Saltwater --
22 I'm sorry. Salinity intrusion, loss and deterioration
23 of wetlands, effects of water and sediment quality,
24 increased inshore channel and Gulf shore erosion and
25 also the beneficial use of dredge material. What the

1 beneficial use of dredge material definition is is that
2 you would use the material from the construction of the
3 deeper channel or the maintenance of that channel for a
4 beneficial use, and in this project, we propose to use
5 it to restore marsh and renourish the Gulf shoreline.
6 There were a number of social and economic
7 factors. The economic effects of reduced
8 transportation efficiency. There's regional economic
9 effects in Louisiana and Texas. Additionally, there
10 could be economic growth and development in the areas
11 near the waterway. There's potential impacts to public
12 infrastructure. Some of this infrastructure that we
13 had to consider includes the Port Arthur hurricane
14 protection levee and various state highways and
15 bridges. Additionally, there are pipeline relocations
16 and removals to be considered and also the increased
17 taxes required to fund the channel improvements.
18 As we stated before, the objectives of the
19 study are to improve the navigational efficiency of the
20 Sabine-Neches Waterway and maintain and/or restore
21 coastal and estuary natural resources.
22 In 2000 we began the feasibility study and
23 sponsored public scoping meetings here in Lake Charles
24 and also in Beaumont. The plan objectives were to
25 improve this navigation efficiency while maintaining or

1 enhancing the effected areas coastal and estuary
2 resources. The Sabine-Neches Waterway plays a
3 significant role in the economy of the `Golden Triangle
4 area, the amount of vessel traffic along the waterway
5 is increasing with the economic growth of the area.
6 As I've stated before with the current
7 channel dimensions, there are size restrictions on the
8 large vessels which utilize the channel. The current
9 40-foot depth and width of the channel restrict the
10 vessel movement to one way convoys and daylight sailing
11 -- daylight only sailing. Additionally, the tankers
12 must anchor offshore and lighter the cargo to get into
13 the waterway.
14 There are a number of alternatives
15 evaluated in the study. First alternative that we
16 always must consider is the no action alternative. It
17 would be the plan that we would maintain the existing
18 waterway but not improve it. Additionally, we looked
19 at some nonstructural alternatives. Traffic management
20 system which is a Coast Guard managed system that is
21 already in place. Also the relaxation of pilot rules
22 such as allowing -- possibly allowing two way traffic
23 in certain areas to see if that would be possible while
24 improving the efficiency. Also we considered
25 alternative mode of commodity transport, such as the

1 Louisiana offshore oil port LOOP or the bulk oil
2 offshore transfer system BOOTS. The LOOP is an
3 existing system and BOOTS was proposed but is not
4 currently active.
5 The structural alternatives that were
6 considered during this study were extensive. More than
7 120 combinations of different channel depths and
8 widths. Deepening ranged from 43-feet to 55-feet, and
9 then we looked into the widening from 500 to 700 feet
10 wider for all -- I'm sorry. 500 to 700 feet for all
11 depths.
12 The tentatively recommended plan consists
13 of deepening to 48-foot channel, dredge material
14 management plan, beneficial use plan and marsh
15 mitigation.
16 As was mentioned before, the widening was
17 dropped out of the project because it was not
18 economically justified. The tentatively recommended
19 plan includes the deepening from the -- deepening the
20 entire Sabine-Neches Waterway to Beaumont to 48 feet.
21 In doing so we would have to extend the entrance
22 channel over 13 miles offshore to reach that depth
23 contour.
24 Also we're deepening and widening Taylor
25 Bayou Channel and Turning Basin, adding and enlarging

1 turning and anchorage basins along the Neches River
2 Channel and bend easements on the Sabine-Neches Canal
3 and Neches River Channel.
4 For long-term management of the dredge
5 material, we are looking at increases of the
6 maintenance material from 405 million cubic yards to
7 650 million cubic yards over the entire 50-year project
8 life that we had to examine. The average annual cost
9 increase is from 36 to 68 million dollars.
10 Additionally, we're going to be using the 16 existing
11 upland placement areas, expanding two of the placement
12 areas, and using the four existing offshore placement
13 areas as well as four additional offshore placement
14 areas. The tentatively recommended plan, we have a
15 construction cost of a little over 1 billion dollars
16 and the benefit to cost ratio is 1.3 to 1.
17 At this time Ms. Stokes will come up and
18 continue the presentation with the environmental
19 aspect.
20 MS. STOKES: Good evening. The
21 Sabine-Neches Waterway Feasibility Study needed to
22 consider an extremely large complex and sensitive study
23 area for all of the environmental impact analyses. The
24 area contains about 440 square miles of coastal marsh,
25 26 square miles of Cypress Tupelo swamp and 14 square

1 miles of bottomland hard woods. It also contains a
2 number of protected lands in protected status that are
3 held by a National Wildlife Refuge and Wildlife
4 Management Areas.
5 It includes -- in Louisiana it includes
6 portions of the Sabine National Wildlife Refuge and the
7 Sabine Island Wildlife Management Area. In Texas the
8 study area includes all of Texas Point National
9 Wildlife Refuge, the Blue Elbow Swamp Wildlife
10 Management Area and the Lower Neches Wildlife Area, and
11 it also effects portions of the J. D. Murphree Wildlife
12 Management Area and the McFaddin National Wildlife
13 Refuge.
14 The environmental impact assessment has
15 recognized that wetlands in this area have been
16 undergoing high rates of marsh loss like those in the
17 Western Cheniere Plain in Louisiana and more recently
18 have suffered adverse effects of Hurricanes Rita and
19 Ike.
20 Because of the large and sensitive study
21 area and the complex environmental issues that we are
22 facing, we used a collaborative approach in assessing
23 the impacts and determining the mitigation. And we
24 formed what we call an Interagency Coordination Team.
25 As you can see this team is very large.

1 It contains members from federal agencies
2 like EPA, US Fish and Wildlife with representatives
3 from both Texas and Louisiana, Natural Marine Fisheries
4 also with representatives from both states, Natural
5 Resources Conservation Service.
6 In Texas, we had Texas General Land Office,
7 Commission on Environmental Quality, Water Development
8 Board, and Parks and Wildlife, the Sabine and Neches
9 River Authorities. And in Louisiana, we had
10 representatives from the Department of Natural
11 Resources, Department of Environmental Quality and
12 Department of Wildlife and Fisheries.
13 We had meetings over several years, I think
14 five years worth of meetings to evaluate all of these
15 -- to evaluate this project and it was an enormous
16 amount of work that was done by all of these agency
17 representatives and we really appreciate their
18 involvement in helping in studying this project. We
19 couldn't have done it without them.
20 We also included many of the actual men on
21 the ground, men and women on the ground that manage
22 these refuges and wildlife management areas. They
23 participated in the ICT Team.
24 Sheri listed all of the environmental
25 concerns or most of the major environmental concerns

1 that we had and these are the technical studies or most
2 of the technical studies that we undertook in order to
3 address these concerns. I'm not going to go through
4 all of them, but I want to talk about some of the most
5 significant. And those are the hydrodynamic salinity
6 modeling. There was a large 3D estuary model run by
7 the environmental -- it used to be a Waterway
8 Experiment Station Corps laboratory for us to evaluate
9 salinity and circulation and surface elevation changes
10 that could occur with the deepening project.
11 We modeled different project effects. We
12 modeled the potential for the longer offshore channel
13 to affect erosion on the shoreline at the Gulf on
14 either side of the jetties. We looked at the potential
15 for the changes in vessel fleets coming up the confined
16 channel to increase erosion along the channel. We
17 looked at the offshore disposal sites and did modeling
18 to make sure that we had the right size and placement
19 areas and to determine what the possible impacts
20 offshore would be.
21 Very significantly, we used an ecological
22 model to evaluate the impacts to the wetland
23 communities. We used a model that has been used for
24 more than ten years in Louisiana, The Wetlands Value
25 Assessment Model if you're familiar with it, to

1 quantify the impact to the environmental communities
2 and to help us then determine what the amount of
3 mitigation that would be required for those damages
4 that could not be avoided.
5 The primary impact that we found after all
6 of these studies was that there would be an increase in
7 salinity caused by the deeper navigational channel and
8 this would lead to a decrease in marsh productivity and
9 an increase in marsh loss. Salinity changes would be
10 felt the highest in Sabine Lake and the lowest reaches
11 of the Neches River and Sabine River, and those changes
12 would be on the order of about one and a half parts per
13 thousand possibly up to two parts per thousand in the
14 average condition.
15 There was no significant change found in
16 the upper regions of both the rivers and the
17 Cypress-Tupelo Swamp Habitat north of Interstate 10 and
18 very little change down toward the mouth. So the major
19 differences were in the Sabine Lake and the lower
20 regions.
21 The ecological model that we used then
22 predicted an increase in land loss that would be
23 associated with the increase in salinity. In Texas,
24 it's predicted that there would be around 250 more
25 acres lost over what is occurring now. And in

1 Louisiana about 690 acres more than what is occurring
2 now. There is extensive land loss that is occurring in
3 this area, both in Texas and Louisiana. And when you
4 compare this loss with the channel to what is occurring
5 now, it would be less than between a half percent and
6 one percent increase.
7 I'm going to describe the beneficial use
8 areas that we have been able to develop in a little
9 while and those areas are primarily located in Texas
10 along the Neches River Channel. And they restore about
11 2,800 acres on the Neches River Channel which more than
12 offsets the loss in Texas, but we were unable although
13 we tried -- we tried diligently over several years to
14 find cost effective beneficial use opportunities in
15 Louisiana that would actually restore marsh. And so
16 that leaves 691 acres in Louisiana as an unavoidable
17 impact that we addressed with a very robust mitigation
18 plan.
19 There were some other minor impacts
20 associated with the project for example on the Neches
21 River 86 acres of fresh marsh would be converted into a
22 placement area. The offshore channel deepening has the
23 potential to effect threatened and endangered sea
24 turtles, and we have consulted with the National Marine
25 Fisheries to develop management measures to help us

1 avoid those impacts to the greatest extent possible
2 with using pre-construction, relocation surveys and
3 drag head deflectors and monitors on the dredges.
4 There is critical piping-plover habitat at
5 Louisiana Point where we have another beneficial use
6 area that is shoreline nourishment and consultation
7 with Fish and Wildlife determine that there might --
8 that the project would have a long-term beneficial
9 effect by stabilizing and possibly providing more habit
10 there.
11 The beneficial use areas are of two major
12 types as I described before. There was a large
13 beneficial use project on the Neches River that would
14 restore over 2,800 acres of emergent marsh in three
15 areas on the river at Rose City, Bessie Heights and Old
16 River Cove. The other beneficial use feature is Gulf
17 shoreline nourishment and that would occur at both
18 Texas point and Louisiana point. This would be done
19 with maintenance material and the placement would
20 alternate from one placement cycle to the next between
21 Texas and Louisiana so that all of the maintenance
22 material is shared equally between the two states.
23 This map shows the location of the
24 beneficial use areas on the Neches River for Rose City
25 it is on the upstream end on the left and Bessie

1 Heights and Old River Cove are on your right toward the
2 -- near the mouth of the Neches River. These are the
3 locations of the beneficial use shoreline nourishment
4 projects on either side of the jetties. It would
5 extend about three miles from each side of the jetties.
6 As I mentioned before the beneficial use
7 features in Texas actually fully compensate or more
8 than compensate for all of the impacts that were
9 projected for Texas using the ecological model but
10 unavoidable impacts in Louisiana remain. And so for
11 those impacts, we propose to restore marsh in five
12 large degraded marsh areas in the Willow Bayou and
13 Black Bayou watersheds. They restore -- restoration
14 that we would be doing with these mitigation measures
15 has exactly the same on the ground effect of the
16 beneficial use areas in Texas where we are restoring
17 marsh. They just have different names because the
18 material has different origin and it has different
19 funding implications.
20 These give you the acres for each one of
21 the areas proposed for mitigation. I'm not going to
22 read them all here but you'll see it's over 2,700 --
23 nearly 2,800 acres of mitigation and for the loss of
24 690 acres or the predicted loss of 690 acres. Several
25 times more than are predicted to be lost.

1 These are the locations of the mitigation
2 areas. At the southern part, you will see two areas in
3 the Sabine National Wildlife area. In the northern
4 part, there are three areas that are located on private
5 property just south of the GIWW in the Black Bayou
6 Watershed.
7 This is the estimated completion schedule
8 for our project right now. We released the draft of
9 our environmental impact statement and a feasibility
10 report on December 24th and comments on the EIS are due
11 back on February 10th. If you have comments on the
12 conformity determinations those do not have to be
13 returned until the 26th of February. We plan to have
14 the public review of the final EIS in August of this
15 year and hope to have approval of -- by the chief of
16 engineers in September. And that's all. Thank you. I
17 think it's Colonel Weston.
18 COL. WESTON: Okay. Thank you for those
19 presentations and I hope you found them to be
20 informative. What we're going to start now is the
21 comment period of the presentation. Before I do that,
22 I would like to acknowledge my lack of time and space
23 situational awareness. At the beginning I said we were
24 starting the meeting on the 26th of January which is
25 the meeting I was at last night. We are actually

1 starting this meeting the day of the 27th of January.
2 I know you all know that. But I caught myself after I
3 was sitting there thinking how unsmart I was when I
4 said the 26th. So it is the 27th in case you were
5 wondering.
6 We will go to the public comment period
7 here today and just remind you as Byron talked about we
8 are looking about a three-minute comment from you. So
9 be concise in your thought and your delivery, and he
10 will give you the high sign about 30 seconds out by
11 raising his hand. At that point, we would like you to
12 wrap up the thought you're on. We understand you may
13 have more comments than that. As you've seen with the
14 material if you picked up some on the way in, we have
15 other methods and means for you to continue to do that.
16 You can continue to fill out your comments on the
17 comment card here tonight, for example, or you can go
18 to the webpage or mail them in within the timelines
19 that were just talked about. So with that, we'll get
20 started here with the presentations and I'll start off
21 with first Mr. Darryl Clark.
22 MR. CLARK: All right. Thank you, Colonel.
23 I had to be first. Okay. Yes, I'm Darryl Clark. I'm
24 from the Fish and Wildlife Service. I work in
25 Louisiana, Lafayette, Louisiana at the Louisiana field

1 office in the ecological services branch and I have
2 positive comments for the whole process. I've been
3 with the process I believe ten years now. I started in
4 the year 2000 as those of you know who started with the
5 program way back then. I'm not going to give Official
6 Department of Interior or Fish and Wildlife Service
7 comments at this time, although Janelle Stokes and
8 Carolyn have received and we have submitted a draft
9 Fish and Wildlife Coordination Act report in 2008 and
10 that is being revised now, and it's in the final
11 process should be submitted within a few weeks.
12 I was the primary reviewer, member of the
13 team for the Fish and Wildlife service for the
14 Louisiana part of the project primarily reviewing the
15 Louisiana impacts and Louisiana and the benefits of
16 beneficial use and mitigation in Louisiana. And I want
17 to mention as I've already submitted for the Department
18 of Interior comments that the draft environmental
19 impact statement is well written and describes Fish and
20 Wildlife resources especially in Louisiana and project
21 impacts and benefits in Louisiana all very well.
22 I want to thank the Galveston Corps for
23 being open-minded for various beneficial use and
24 mitigation types of measures that are included in the
25 final plan, especially the Gulf of Mexico beneficial

1 use along the shoreline. There were many naysayers
2 that said the material is not going to stick. It's
3 going to go away, but it actually has been tried on the
4 Texas Point side and worked.
5 And we -- I was on the hydrodynamic
6 modeling team although I'm not an engineer. But they
7 seemed to have done a good job with that. We used that
8 material, that data as Jan mentioned to fit into The
9 Wetlands Value Assessment Ecological Model to arrive at
10 the impacts and the benefits which I'm not going to go
11 over. Jan just mentioned that. We are pleased at the
12 ratio benefits to impacts multi-times, the benefits are
13 multi-times larger than the impacts that were predicted
14 by the models.
15 In Louisiana the threatened endangered
16 species are not -- the project is not likely to
17 adversely effect the threatened endangered species in
18 Louisiana and as Jan mentioned the piping-plover
19 habitat will actually be enhanced by the beneficiary
20 use along the Gulf shoreline. So we'd like to also
21 recommend the ICT Team be constituted for the
22 development of the final BU and mitigation plan. Thank
23 you very much.
24 COL. WESTON: Thank you. The next
25 individual will be Mr. Darryl Reed.

1 MR. REED: Thank you. I just want to
2 comment that I think your whole plan looks excellent
3 from an untrained eye. It looks like it's a well
4 needed channel expansion. I along with two others here
5 work for TARGA Resources a pipeline company. This
6 project doesn't interfere with any of our Sabine River
7 pipeline crossings of that we're very happy. However
8 TARGA Resources is a successor in interest to Dynegy
9 and there are several Dynegy pipelines that will be
10 affected or previously owned by Dynegy Pipeline that
11 will be affected and are slated for relocation in this
12 study. That is the Pelican 10-inch line and the
13 Pelican 12-inch line. I just kind of wanted to go on
14 record to say we'll make our comments. Of course,
15 we're totally adverse to having to relocate those
16 pipelines and it's mainly at the southern portion of
17 the proposed entrance expansion and the ODMDS's
18 proposed.
19 However, the cost of relocation is
20 tremendous plus the cost -- the loss of service and
21 production from those pipelines, there gathering lines
22 from offshore wells would be a tremendous loss of
23 dollars for the company. And so that's just the only
24 thing I had to say. We will be sending you a letter.
25 But it looks like a very good and well conceived

1 project.
2 COL. WESTON: Thank you. Next will be
3 Mr. David Richard.
4 MR. RICHARD: When you're on this side of
5 Sabine, it's Richard. Thank y'all for coming over here
6 and I appreciate Janelle's work. I've been involved
7 with this a long time. My name is David Richard and
8 I'm executive vice president of Stream Property
9 Management and we manage probably the majority of
10 private lands of Louisiana side that would be effected.
11 Three minutes is not near long enough to answer
12 13 years of work. So I'm going to make it brief on a
13 couple of things.
14 In your -- and I want to say that I think
15 we were very ably represented by Darryl. Darryl, I
16 know has put in a lot of time from the Fish and
17 Wildlife Service perspective. I've got two or three
18 things I want to say. Number one, after the advent of
19 Hurricane Ike, I feel like deep water channels as we've
20 seen channels across the State of Louisiana has
21 accentuated flooding from hurricanes. And I did not
22 see a hydrodynamic model that looked at hurricane
23 surge. We've done a number of those in Louisiana and I
24 suspect that the deepening of that channel is going to
25 accentuate that.

1 One thing I don't see in your plan is ways
2 to control the hydrology. What it is going to do and
3 what we've seen and I think what your model shows is it
4 going to increase the salinity in the northern portion
5 of Sabine Lake which should be the fresher areas of
6 Sabine Lake. We would propose to contain that water
7 inside the channel instead of letting it circulate in
8 Sabine Lake.
9 Also, I didn't see tidal amplitude and
10 maybe y'all ran tidal amplitude and tidal amplitude is
11 also going to increase due to the deepening of the
12 channel. I do think the economics, I understand your
13 economics and I understand the port. I also would like
14 to see more of the spoil used beneficially. We are in
15 desperate needs. We have huge losses in Louisiana and
16 we would like to see as much spoil as possible used.
17 The beneficial use areas that are on the north end of
18 the Black Bayou area are actually using spoil from the
19 Sabine River going to the Port of Orange unless I'm
20 mistaken which is outside of the project that you are
21 actually doing here. So it would actually be dedicated
22 mitigation, I suppose, to go to the Port of Orange.
23 Which is fine, beneficial use in Louisiana to Orange,
24 we support that all of the way along.
25 Deepening of the channels and the building

1 of the channels have caused tremendous problems as
2 we've just seen with the closing of the MR-GO in New
3 Orleans that caused extensive flooding in the lower
4 Ninth Ward and St. Bernard Parish. Again I think this
5 has been a long process and I want to commend
6 especially Janelle for having to go through the many
7 comments and the many remarks that were made and I'll
8 send my detailed remarks by email I'm sure. Thank you.
9 COL. WESTON: Thank you. Next will be
10 Mr. James Kaucher.
11 MR. KAUCHER: I'm Jim Kaucher. I work for
12 the Sabine Pass LNG in Cheniere. The Sabine LNG
13 terminal strongly supports the proposal of deepening
14 and widening of the Sabine Waterway. We wish to see
15 our waterway remain highly competitive with other ports
16 and waterways by being able to accommodate the larger
17 ships that now carry so much of the worlds trade with a
18 higher degree of safety.
19 Furthermore, we are most interested in
20 promoting the capability of the Sabine-Neches Waterway
21 to safely handle the worlds largest LNG carriers.
22 These ships are nearly 1,100 feet in length and 108
23 feet in breath. These very large LNG carriers are
24 presently limited to a 40-foot fresh water draft when
25 entering the Sabine-Neches Waterway. Many such vessels

1 would come in deeper if the waterway's channels were
2 deeper and wider. Any deepening or widening will make
3 our waterway more competitive to business. It uses the
4 larger ships and automatically eliminates the
5 untraditional safety margins for the existing shipping
6 already present.
7 LNG Cheniere supports this project and the
8 US Army Corps of Engineers work will proceed.
9 COL. WESTON: Okay. Thank you. That's all
10 of the cards I have for folks that indicated that they
11 would like to make a public comment. Is there anyone
12 else in the room that either didn't get their card in
13 or is having a change of thought and would like to
14 stand up and make a public comment at this time? Okay.
15 I don't see anybody raising their hand.
16 So in conclusion, the written comments on
17 the Draft Feasibility Report, the Draft Environmental
18 Impact Statement, the Draft Environmental Impact
19 Statement for the Designation of Ocean Dredge Material
20 Disposal Sites must be received on or before
21 February 10, 2010, the conclusion of the 45-day comment
22 period that began on December the 24th, 2009.
23 Comments on the General Conformity
24 Determination must be received on or before
25 February 26, 2010 and acknowledged as many of you said

1 this is a complex project with a complex study area.
2 Many of your comments, I'm sure will be more detailed
3 than was provided tonight, and we look forward to
4 receiving those by the deadlines so we can take a fair
5 shot of analyzing and assessing the merits, et cetera,
6 with respect to the overall project of your comments.
7 I would like to thank those of you who came out and
8 showed interest in the project this evening and made
9 your comments to us. Those are greatly appreciated.
10 I also would like to take time to thank the
11 Sabine-Neches Navigation District who's our local
12 sponsor. For those of you not familiar with Civil
13 works projects, they are cost shared between the
14 federal government and the local government entity. So
15 there's a considerable investment on their part in this
16 project and they have been great partners over what's
17 already been ten years going on this particular
18 Feasibility Report Study. So I thank them here in
19 public and also for their assistance in setting up this
20 meeting for us. Again, thank y'all for your
21 attendance, and the interest that you have shown. I
22 will now adjourn this meeting. Thank you.
23 (MEETING CONCLUDED AT 8:00 P.M.)
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1 C E R T I F I C A T E

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4 I, Betty Curry Minton, Registered Professional
5 Reporter, Certified Court Reporter for the State of
6 Louisiana, do hereby certify that the above and
7 foregoing testimony was taken by the undersigned and
8 represents a true and correct copy of the proceedings
9 had at the time and place set forth on page one (1)
10 hereof.
11 I further certify that I am not related to any
12 of the parties named herein, nor their counsel, and
13 have no interest, financial or otherwise, in the
14 outcome of the proceedings.
15 IN WITNESS WHEREOF, I have hereunto affixed my
16 significant at Lake Charles, Louisiana, this 8th day of
17 February, 2010.

18

19

20

21 _____

22 Betty Curry Minton, RPR, CCR

23

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25