DRAFT
STATEMENT OF FINDINGS
AND
FINDING OF NO SIGNIFICANT IMPACT
FOR

CEDAR BAYOU, TEXAS, DRAFT DREDGED MATERIAL MANAGEMENT PLAN AND ENVIRONMENTAL ASSESSMENT (CHANNEL FROM MILE -2.5 TO MILE 3.0), CHAMBERS COUNTY, TEXAS

1. Purpose. This document addresses the proposed construction of a new placement area (PA) for Cedar Bayou in Chambers and Harris Counties, Texas. The need for the new PA was identified when the U.S. Army Corps of Engineers (USACE), Galveston District preliminary assessment which resulted in a determination that due to current capacity, engineering, and environmental issues with the existing PAs, a new Dredged Material Management Plan (DMMP) should be developed to identify a new base plan for a minimum of 20 years of capacity for future maintenance of the lower 5.8 mile channel.. This Environmental Assessment (EA) was prepared in accordance with the National Environmental Policy Act of 1969 (NEPA) and Council on Environmental Quality (CEQ) regulations to document findings concerning the environmental impacts of the proposed action.

2. Proposed Action. The new PA would be located approximately two miles from the mouth north/northwest of Cedar Bayou on an approximately 110-acre property that was previously developed for a RV park. The property is generally rectangular in shape with the long sides running in an approximately northeast to southwest direction. For the purposes of this document, the northeast end would be referred to as the north end and southwest end as the south end. The site is bounded by Tri-Cities Beach Road to the south, Houston Light and Power (HL&P) canal to the west, Cedar Bayou to the north, and vacant property to the east. Existing infrastructure within the site includes asphalt surfaced roads, and underground utilities including storm and sanitary sewers, sanitary pump station, and water distribution pipes. The roads within the footprint of the TSP are heavily deteriorated. Additionally, while the underground utilities were installed, they were not hooked up to any systems.

All access to the project area for initial construction and subsequent maintenance would be from Tri-Cities Beach Road. The containment levees would be constructed to about elevation +32 feet (NAVD 88) with a 10-foot crown width, and side slopes of 1 vertical to 3 horizontal. Actual levee heights relative to existing elevations would vary from about 12 feet at the south end of the PA to over 20 feet where existing canals cross the levee alignment at the north end. This is a typical containment levee template for USACE Galveston District dredge material PAs.

The containment levee footprint and proposed borrow areas would be cleared of vegetation and existing infrastructure. The resulting exposed ends of storm sewers would be grouted and the sanitary sewer and water pipes would be capped prior to containment levee construction. Debris removed from the levee footprint and borrow area would be buried onsite within the existing canals connected to Cedar Bayou and located at the north end of the PA. Containment levees would be constructed across the canals prior to debris burial in order to isolate the debris from Cedar Bayou.

The initial construction of the containment levee would consist of borrowing materials from the interior of the PA either by excavation of suitable fill soils and hauling to the levee construction area, or by side-cast methods. The borrow method used is dependent upon location of suitable fill soils and would be determined during the Preconstruction Engineering and Design phase. The containment levee would be constructed using the semi-compacted technique by compacting the borrow material in 12-inch lifts using a bull dozer of minimum specified size. The final crown and outside slope of the containment levees would be seeded using the hydro-mulch method.

An effluent drop-outlet structure would be constructed at the north end of the PA with discharge into Cedar Bayou. The structure would be positioned far enough away from the containment levee to allow future levee raisings as required over the life of the PA.
The current plan has a 5-year dredging cycle for the lower portion of the CBNC. The estimated dredge quantities are shown in Table 2.3 by dredging cycle, portion of the CBNC being dredged, and by where the material would be placed. During dredging operations the dredged material would be discharged into the new PA near the southwest corner in order to provide the greatest possible ponding time and distance between influent and the outlet structure. The drop-outlet structure weir acts as a filter mechanism and would be composed of wooden stop-logs for ponding level control. Clean water would be discharged into Cedar Bayou through a discharge pipe which would be buried under the containment levee and connected to the drop-outlet structure.

3. Alternatives. The Galveston District considered 4 alternatives along with the continued use of the existing PA 6 to resolve the lack of placement area capacity. Alternative 1 was the No Action plan; alternative 2 was creating beneficial use sites at Marrow Marsh, Negrohead Lake, Ash Lake, and Fisher Lake. Alternative 3 was creating a confined upland PA east of the land fill. Alternative 4 was creating a confined upland PA at the abandoned RV Park.

Alternative 4 was identified as the tentatively selected plan (TSP).

4. Coordination. A Public Notice (PN) and Notice of Availability (NOA) will be issued to interested parties including Federal and state agencies. The PN and NOA will describe the proposed action and announced the availability of the Draft EA. Comments on the PN and Draft EA and the District's responses are included in Appendix A of the Final EA.

5. Environmental Effects. Galveston District has taken every reasonable measure to evaluate the environmental, social and economic impacts of the proposed project. Based on information provided in the EA and coordination with Federal, state, and local agencies, temporary and permanent effects resulting from the proposed project have been identified and can be found in Section 4 of the Draft EA. The following resources and the effects of the proposed project have been identified:

- The TSP would result in the permanent construction of a placement area; however, the PA would be limited in spatial extent and would not impact the overall project area.
- Construction of the TSP would change the current land use for the project footprint. However, this land has very little development or farmland potential.
- Project related air quality impacts were evaluated by calculating the worst case emissions for construction of the proposed project (Appendix D). Air contaminant emissions from construction would be considered *de minimus* emissions compared to those from existing sources in the HGB region. Due to the short-term duration of construction activities, there would be no long-term impacts. Emissions from these activities would not adversely impact the long-term air quality in the area.
- Heavy machinery would be the major source of noise during construction. However, construction is proposed to occur during daylight hours when occasional loud noises are tolerable to surrounding NSRs. None of the NSRs would be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems. Therefore, noise related impacts would be considered minimal and temporary in duration.
- Potential impacts to water quality associated with the construction of the tentatively selected alternative consist of erosion and sedimentation during construction. During construction, storm water runoff could carry sediment off site into Cedar Bayou and potentially result in temporary increases in Total Suspended Solids (TSS). These impacts would be temporary in duration and minimal in extent. The USACE would require the construction contractor prepare a Storm Water Pollution Prevention Plan (SW3P) and implement erosion and sedimentation control Best Management Practices (BMPs) to minimize any detrimental effects to water quality during construction. No long-term effects to water quality are expected as a result of construction of the TSP. A Section 404(b)(1) analysis was prepared and is included in Appendix C of this Draft EA. The USACE would also acquire 401 Water Quality Certification from Texas Council on Environmental Quality.
- The potential for RSLR to impact the tentatively selected plan is minimal. The calculated worst case using tide gauges is under a foot (0.9 ft) and the worst case using monitored subsidence is 1.5 ft. RSLR will not have an impact on the armoring requirements for the placement areas. Finally, impacts on surge levels

due to the project, with and without RSLR, are expected to be extremely minimal and insignificant.

- Construction of the tentatively selected alternative would not intercept contaminated soils and/or groundwater, disturb any hazardous materials or create any potential hazard to human health.
- There are no prime or unique farmlands located within the TSP footprint.
- Construction of the TSP would result in the filling of approximately 2.54 acres of wetlands. All impacts to wetlands would be fully compensated for by creating 2.64 acres of wetland on-site pursuant to the Mitigation Plan described in further detail in Section 5.0 of the Draft EA to achieve a "no net loss" of wetland acres and functions.
- The project footprint has been mostly cleared of vegetation since the 1950s. There are small clusters of trees, primarily on the southern and eastern side of the TSP footprint that would be removed. Most of these trees are less than 10 years old and are primarily Chinese tallow. Construction of the TSP is anticipated to have a minimal and localized effect to wildlife populations in the vicinity of the project.
- Noise from construction of the TSP would affect small mammals and birds in the area immediately surrounding the project footprint. Depending on the species affected, construction may result in their displacement to surrounding areas. Similar habitat is located in the surrounding area where displaced wildlife could find suitable habitat.
- An assessment of the construction of the TSP's potential to affect federally listed threatened and endangered species and their habitat was documented in a BA (Appendix B). No critical habitat has been designated in or around the project footprint. Only federally listed threatened and endangered species documented as occurring in Chambers County by the Clear Lake Office of the USFWS were considered in further detail in the BA. The BA concludes that the TSP would not affect any federally listed threatened or endangered species or their habitats.
- There are no Historic Properties located within or adjacent to the footprint of the proposed PA; therefore no Historic Properties will be affected by construction of the TSP.
- Construction of the TSP would impact the aesthetics of the project area. Approximately ¼ mile of the project footprint is visible from the bayou; this area currently consists of four canals constructed for the abandoned RV park. Construction of the TSP would change the setting from four canals to a levee. However, since the project footprint has already been heavily disturbed and no longer in a natural forested setting, the aesthetic impacts from construction of the TSP would be considered minor.
- No impacts to recreational resources would occur due to construction or future use of the TSP.
- Construction of the TSP would not result in impacts to the traffic and circulation within the project area. No road closures would result from construction or maintenance activities.
- Construction of the TSP would not have adverse or disproportionate impacts on minority or low-income populations. The socioeconomic analysis shows that the area within one mile of the project footprint does not contain a higher percentage

of minority or low-income families than the overall project area, Chambers or Harris Counties. No impacts to socioeconomics and Environmental Justice would result from construction of the TSP.

It is the District's conclusion that the proposed project will not have a significant impact on the environment or to the surrounding human population.

6. Determinations. The proposed replacement of the outlet works were determined to be compliant with the following Federal legislation: NEPA, Endangered Species Act, Clean Water Act, Fish and Wildlife Coordination Act, National Historic Preservation Act, Clean Air Act, Executive Order 11990 (Protection of Wetlands), Executive Order 11988 (Floodplain Management), CEQ (Memorandum; Prime or Unique Farmlands), Executive Order 12898 (Environmental Justice), Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, Executive Order 13112 (Invasive Species), Migratory Bird Treaty Act (MBTA), Memorandum of Agreement between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agricultural to Address Aircraft-Wildlife Strikes, Protection of Environment, Executive Order 11514, and Executive Order 13186 (Migratory Bird Habitat Protection).

7. Findings. Based on my analysis of the Draft EA and other information pertaining to the proposed project, I find that the proposed construction of the new PA will not have a significant effect on the quality of the human environment. After consideration of the information presented in the Draft EA, I have determined that an Environmental Impact Statement is not required under the provisions of NEPA, Section 102, and other applicable regulations of the USACE, and that the proposed project may be constructed.

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(date)

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Richard P. Pannell
Colonel, U.S. Army Corps of Engineers,
District Engineer

US Army Corps
Galveston District

Cedar Bayou, Texas

Dredged Material Management Plan and Environmental Assessment

(Channel from Mile -2.5 to Mile 3.0)

U.S. Army Corps of Engineers
Galveston District
Southwestern Division

Draft Environmental Assessment
September 2014

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Acronyms

ACHP	Advisory Council on Historic Properties
BA	Biological Assessment
BMP	Best Management Practice
BU	Beneficial Use
CBNC	Cedar Bayou Navigation Channel
CEQ	Council on Environmental Quality
CY	Cubic Yards
DMMP	Dredged Material Management Plan
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
ER	Engineer Regulation
HGB	Harris/Galveston/Brazoria Attainment Area
HSC	Houston Ship Channel
HSWA	Hazardous and Solid Waste Amendments
HTRW	Hazardous, Toxic, Radioactive Waste
K	Thousand
LPG	Liquid Petroleum Gas
M	Million
MCY	Million Cubic Yards
MOA	Memorandum of Agreement
MBTA	Migratory Bird Treaty Act
NAAQ	National Ambient Air Quality
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRCS	Natural Resource Conservation Service
NSR	Noise Sensitive Receptor
NWI	National Wetland Inventory
PA	Placement Area
RCRA	Resource Conservation and Recovery Act
RCT	Railroad Commission of Texas
RSLR	Relative Sea Level Rise
SHPO	State Historic Preservation Officer
SW3P	Storm Water Pollution Prevention Plan
TCEQ	Texas Council of Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSP	Tentatively Selected Plan
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service

1.0 Introduction

The purpose of this Environmental Assessment (EA) is to document the proposed construction of a new, upland confined placement area (PA) for the Cedar Bayou Dredged Material Management Plan (DMMP) and to present the potential environmental effects of the proposed project. The proposed PA would establish 20 years of dredged material capacity using the most cost effective and environmentally acceptable approach practicable.

This EA presents potential environmental effects associated with construction and use of the new upland PA by the U.S. Army Corps of Engineers (USACE), Galveston District (the District). It describes the proposed project and presents the project purpose and need, alternatives, the affected environment, and predicted consequences to the natural and human environment. The public will have the opportunity to provide comments on the proposed project during the public noticing period. The final EA will contain the public comments received during the public notice period along with the District's responses to these comments.

This document is consistent with the National Environmental Policy Act (NEPA) of 1969 (42 USC § 4321) by describing the systematic, interdisciplinary evaluation of potential effects to the natural and human environment for issues of concern. This EA is consistent with the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR Parts 1500-1508), USACE Engineer Regulation (ER) 200-2-2 (*Environmental Quality: Procedures for Implementing NEPA*, 33 CFR 230), and ER 1105-2-100 (*Planning Guidance Notebook*).

1.1 Project Description

The District completed a preliminary assessment (Cedar Bayou Navigation Channel, Texas Final Preliminary Assessment, dated February 2010) which resulted in a determination that due to current capacity, engineering, and environmental issues with the existing PAs, a new DMMP should be developed to identify a new base plan for a minimum of 20 years of capacity for future maintenance of the lower 5.8 miles of channel. USACE policy requires environmentally sound dredging and placement or management of dredged material as defined by applicable laws and policies. This can best be achieved through the development of a long-term management strategy for dredged material as delineated in a DMMP.

1.2 Identification of the Project Study Area

The project study area is defined as a 6-mile radius centered on the lower portion of the Cedar Bayou Navigation Channel (CBNC). The lower portion of the CBNC consists of the area between the confluence of the CBNC with the Houston Ship Channel (HSC; approximate mile marker -2.5) to an area just north of Ijams Lake (approximate mile marker 3) (see Figure 1.1). This project study area was selected since 6 miles is the maximum practical pumping distance of dredged material. Beyond this distance, the actual costs of pumping dredged material increase dramatically and the efficiency of the pumping decreases significantly. The project study area was defined for the purpose of identifying potential measures and project alternatives.

Figure 1.1. Cedar Bayou Navigation Channel DMMP Project Area

1.3 Purpose and Need for the Project

The purpose of this project is to develop a DMMP that would accommodate at least 20-year placement of dredged material associated with maintenance dredging of the lower portion of the CBNC. An Environmental Statement was prepared in 1975 for six PAs to provide capacity for the lower CBNC (USACE, 1975). A DMMP is needed because these six PAs for lower portion of the CBNC no longer have dredged material placement capacity sufficient to accommodate 20 years of maintenance 6dredging (USACE 2010). This lack of capacity is due to the fact that only one of the six previously authorized PAs (PA6) is still available. Oysters have established in three of the open water PAs (PAs 2-4) making them unavailable for use due to environmental concerns; PA 1 (Hog Island) was never constructed and is now classified as intertidal marsh; and PA 5 (Boaz Island is no longer available due to lack of capacity, environmental limitations, and issues with real estate). In 2005, and Environmental Impact Statement was prepared for the Upper CBNC which considered the use of PA 6 as a placement area alternative for that project (USACE, 2005). However, it was determined early on during the study that the PA would not have the capacity for the volume of maintenance material for both upper and lower CBNC projects. As such, PA 6 was dropped from consideration for the upper portion of the CBNC. Current estimates show that the remaining capacity of PA6 is 738,138 cubic yards (CY) which is insufficient to handle the 967,978 CY of material that would be generated from the first dredge cycle to return the lower CBNC to authorized depth of 10 feet.

1.4 Study Authority

DMMP Studies for existing projects are conducted pursuant to existing authorities for individual project operation and maintenance, as provided in public laws authorizing specific projects. Table 1.1 provides dates and descriptions of authorized project features for the CBNC.

Table 1.1. Authorization Documents for Cedar Bayou, Texas Project

Date	Project and Work Authorized	Documents
September 19, 1890	Congress, by act of September 19, 1890, appropriated as follows: “Improving Cedar Bayou, Texas, by removal of bar at the mouth of said bayou, where it empties into Galveston Bay; Completing improvement, eighteen thousand one hundred and fifty dollars.”	Rivers and Harbor Act of 1890 (26 Stat. 444)
July 3, 1930	Provides for a “channel 10 feet deep and 100 feet wide from Houston Ship Channel to a point on bayou 11 miles above the mouth.” The project also includes the jetties at the mouth of the bayou provided for under the previous project.	Rivers and Harbor Act of 1930, P.L. 520 (S. Doc. No. 107, 71st Cong., 2d sess.)
November 17, 1986	Deauthorization of “the project for navigation, Cedar Bayou (mile 3.0 to mile 11.0), Harris, Texas, authorized by the River and Harbor Act of September 19, 1890, as amended by the River and Harbor Act of July 3, 1930, Public Law 520, Seventy-first Congress.”	WRDA 1986, P.L. 99-662, (100 Stat 4219), Sec 1002

Table 1.1. Authorization Documents for Cedar Bayou, Texas Project		
Date	**Project and Work Authorized**	**Documents**
December 11, 2000	Reauthorization "for construction of a navigation channel 12 feet deep by 125 feet wide from Mile -2.5 (at the junction with the Houston Ship Channel) to Mile 11.0 on Cedar Bayou."	WRDA 2000, P.L. 106-541, (114 STAT. 2632), Sec 349(a)(2).
November 8, 2007	Section 349(a)(2) of the WRDA 2000 (114 Stat. 2632) is amended by striking "12 feet deep by 125 feet wide" and inserting "that is 10 feet deep by 100 feet wide". Specifies cost sharing for construction and operation and maintenance of the project shall be determined in accordance with Section 101 of the Water Resources Development Act (WRDA) of 1986	WRDA 2007, P.L. 110-114 (121 Stat. 1041), Sec. 3147

2.0 Alternatives

The Galveston District identified 46 measures (2 non-structural and 44 structural measures; see Table 2.1). These measures were subjected to two initial screenings in order to remove any of the measures that were flawed before combining them into full alternatives and pursuing in-depth analysis. The majority of the measures were dropped from further consideration due to engineering issues, environmental issues, or initial projected costs. Some of the measures were also dropped due to foreseeable real estate issues or because the measure would conflict with another Federal Project. Additionally, the non-structural measure "Deauthorize Channel and Utilize another Port" was eliminated due to the fact that the upper channel was recently reauthorized and is currently undergoing Project Engineering and Design; if the lower channel is not maintained there would be no access to the upper channel.

TABLE 2.1. Project Measures					
Alternative	**Iteration of Screening Dropped**	**Reason(s) for Dropping**	**Alternative**	**Iteration of Screening Dropped**	**Reason(s) for Dropping**
Creation of Bird / Habitat for Wildlife	1st	1, 3	Sediment Basin in Channel	1st	2
Utilize property in foreclosure	1st	4	Behind Spillman Island – BU	1st	2, 5
HSC Atkinson Island Cells	1st	5	Brinson Point Shoreline	1st	3
Private property disposal	1st	1, 4	Morgan Point to Red Bluff Shoreline	1st	3
Reclaim degraded borrow pits	1st	1	Base Material for Roads and Parking Areas	1st	1
Create "Woodstock" PA by "Snoopy"	1st	1, 2	Sediment Control Structures	1st	3
Ijams Lake Marsh Creation	1st	5	Scott Bay Marshes	1st	2
Waste Management (Baytown Landfill)	1st	1	Jennings Tract – BU	2nd	2, 4
Any Area Northeast of PA 6	1st	1, 2	PA 6 Land Swap	2nd	1, 2

TABLE 2.1. Project Measures					
Alternative	**Iteration of Screening Dropped**	**Reason(s) for Dropping**	**Alternative**	**Iteration of Screening Dropped**	**Reason(s) for Dropping**
Open Water Sites	1st	1	Upland East of Land Fill (extended)	2nd	3
Alternative Channel	1st	1, 2, 3, 4	Deauthorize Channel	2nd	See below
PA 14/15 Marsh Creation	1st	5	PA Borrow MOA	2nd	1
Remove Oysters from Existing Open Water PAs	1st	1	Boaz Island (PA 5)	2nd	1, 2, 3, 4
Boaz Island (PA 5) Fringe Marsh	1st	1, 2, 3, 4	Upland East of Marrow Marsh	2nd	1, 2, 3
Unconfined Disposal to Create Oyster Habitat	1st	1	South of APL Road	2nd	1, 3, 4
Goose Creek Stream Project	1st	2	PA 6 Tip to Tip Expansion	2nd	1, 2
Tabbs Bay Evergreen Point Shoreline – BU	1st	2, 3	No Action	Carried Forward	
Marsh Creation north of Atkinson Island	1st	3, 5	Ash Lake - BU	Carried Forward*	
Regional Sediment Management (RSM)	1st	3	Fisher Lake – BU	Carried Forward*	
Expand Hogg Island (Existing PA 1)	1st	1	Negrohead Lake - BU	Carried Forward*	
Utilize old pits NW of power-lines ROW (near HL&P canal)	1st	1, 2	Marrow Marsh – BU	Carried Forward*	
Filter wetland opportunities for industry	1st	1, 2	Upland East of Land Fill	Carried Forward	
Upland next to Baytown Landfill	1st	1	Abandoned RV Park	Carried Forward	

*These four measures were combined into one alternative and carried forward for further analysis

1. Environmental Issues; 2. Engineering Issues; 3. Initial Projected Costs; 4. Real Estate; 5. Conflicts with Another Federal Project

Upon completion of the second iteration of the screening, seven measures remained. These seven measures were then combined to create four alternatives (Figure 2.1). These four alternatives consisted of:

- Alternative 1 - No Action;
- Alternative 2 - Beneficial Use (BU) Sites (a combination of the Marrow Marsh, Negrohead Lake, Ash Lake, and Fisher Lake measures);
- Alternative 3 - A confined upland PA east of the land fill; and
- Alternative 4 - A confined upland PA at the abandoned RV park.

Each of these alternatives is further described in the following sections.

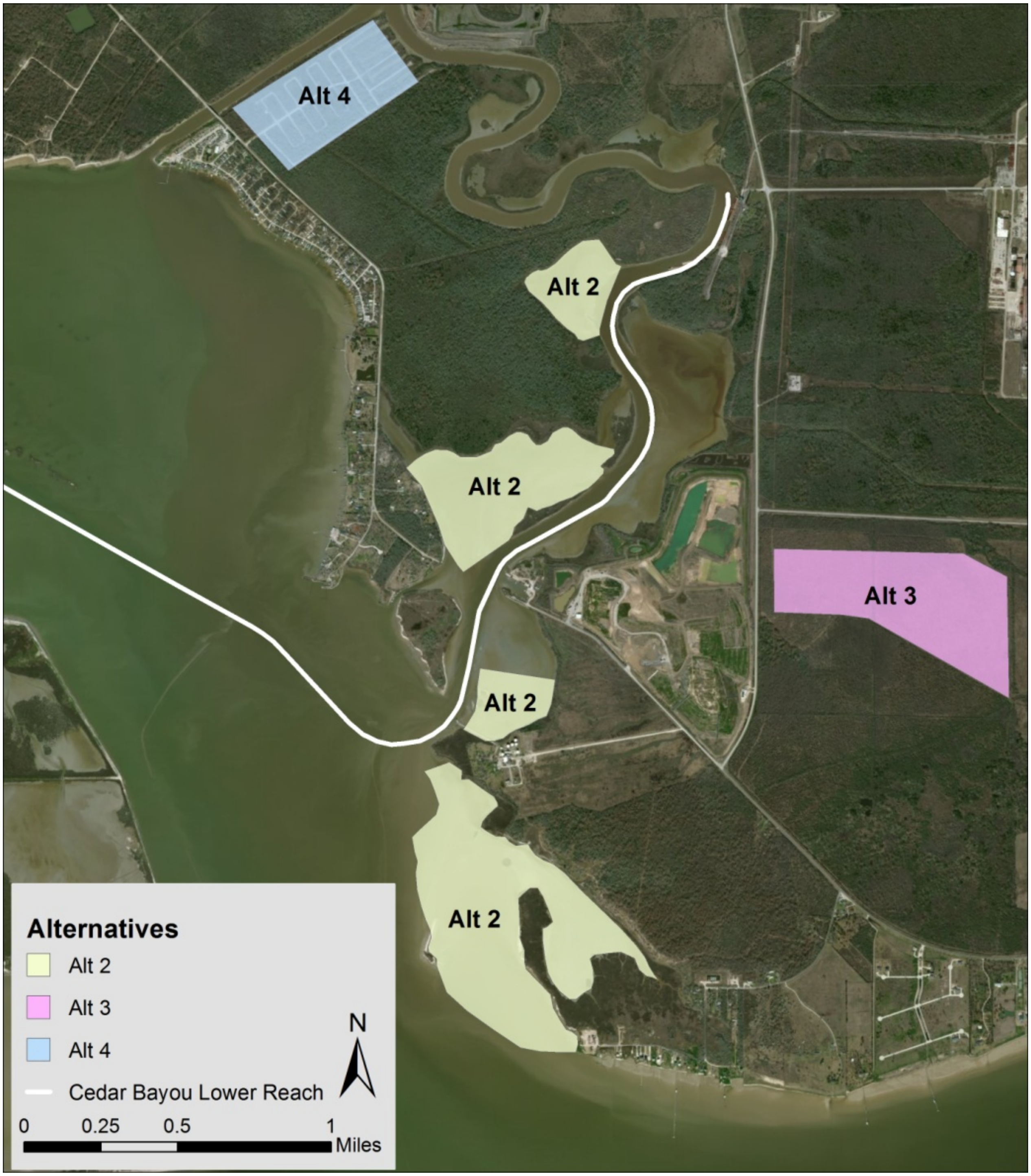

Figure 2.1. Location of Alternatives for the CBNC DMMP

2.1 Alternative 1: No Action

Under the No Action Alternative, the base plan would continue to identify the use of the six authorized PAs. However, five of those PAs are no longer available for use as described in Section 1.3. Therefore, all dredged material from the Lower Channel would continue to be pumped into PA 6. Continued use and normal routine maintenance of PA 6 would include period levee raising to bring the PA to its optimal height and spillbox replacement within the limits of dike. Despite these routine management measures to maximize capacity, calculations show that PA 6 would not have sufficient capacity for 20 years of maintenance dredging for the entire Lower Channel. Therefore, under the No Action Alternative, maintenance dredging of the channel would continue until PA 6 ran out of capacity, which would occur in 2016 after the next maintenance cycle that would dredge the channel to authorized project depth of 10 feet. At this point, maintenance dredging would no longer be possible and the channel would begin to shoal in at approximately one foot per year, until the channel would reach its natural depth of approximately seven feet.

2.2 Alternative 2: BU Sites

Alternative 2 consists of beneficial use of dredged material to create a combined total of 370 acres of marsh at four locations (Marrow Marsh, Negrohead Lake, Ash Lake, and Fisher Lake) near the mouth of and along the lower portion of the CBNC. The continued use of PA 6 as described under the No Action Alternative would also be included in Alternative 2. Table 2.1 in Section 2.0 lists the preliminary measures including BU sites that were considered for screening, as well as the iteration of screening where the measure was dropped (if it was dropped), and the reason(s) for dropping it. All but the four BU measures that are now included under Alternative 2 were screened out, mostly during the first iteration of screening per the screening criteria listed in Section 3.1 of the DMMP report. Initial analysis of the four remaining BU sites indicate that, individually, these sites were not feasible for long term use due to their limited capacity and size, as these sites are located in very shallow water that is only a few feet deep. Therefore, they were grouped together as Alternative 2.

2.3 Alternative 3: Confined Upland PA East of Land Fill

This alternative consists of the creation of a new confined upland PA (see Figure 2.3). The proposed upland site location was determined to meet reasonable size, location, and environmental criteria for further consideration. The proposed upland PA would be located approximately 1 ½ miles east-north east of the mouth of Cedar Bayou on uplands east of the land fill. Under this alternative, dredged material would also continue to be placed in PA 6.

Figure 2.2. Plan View of Alternative 2

Figure 2.3. Plan View of Alternative 3

2.4 Alternative 4: Confined Upland PA at the Abandoned RV Park

This alternative consists of the creation of new confined upland PA (see Figure 2.4). This proposed upland site is located approximately two miles north-northwest of the mouth of Cedar Bayou on the southwest bank just across the Cedar Bayou from existing PA 6. This proposed new upland PA would be located such that the maximum pumping distance from the Cedar Bayou Bay segment (about 3.2 miles) would approximately equal the maximum pumping distance (about 3.1 mile) for the Bayou segment to existing PA 6. Under this alternative, dredged material would also continue to be placed in PA 6. The configuration of the proposed upland PA site as shown in Figure 2.4 was determined to meet reasonable size, location, cost, and environmental criteria for further consideration.

Reconfiguring the proposed PA 7 footprint to exclude impacts to tidal wetlands along Cedar Bayou would have reduced the site footprint by approximately 25 acres which would have dramatically decreased its capacity below the 20 years required for the DMMP. Extending the PA 7 configuration south to regain the capacity associated with that 25 acres would have resulted in impacts to high quality forested uplands and riparian forested wetlands located in that area. Thus, the proposed TSP represents the least cost environmentally acceptable plan for the DMMP.

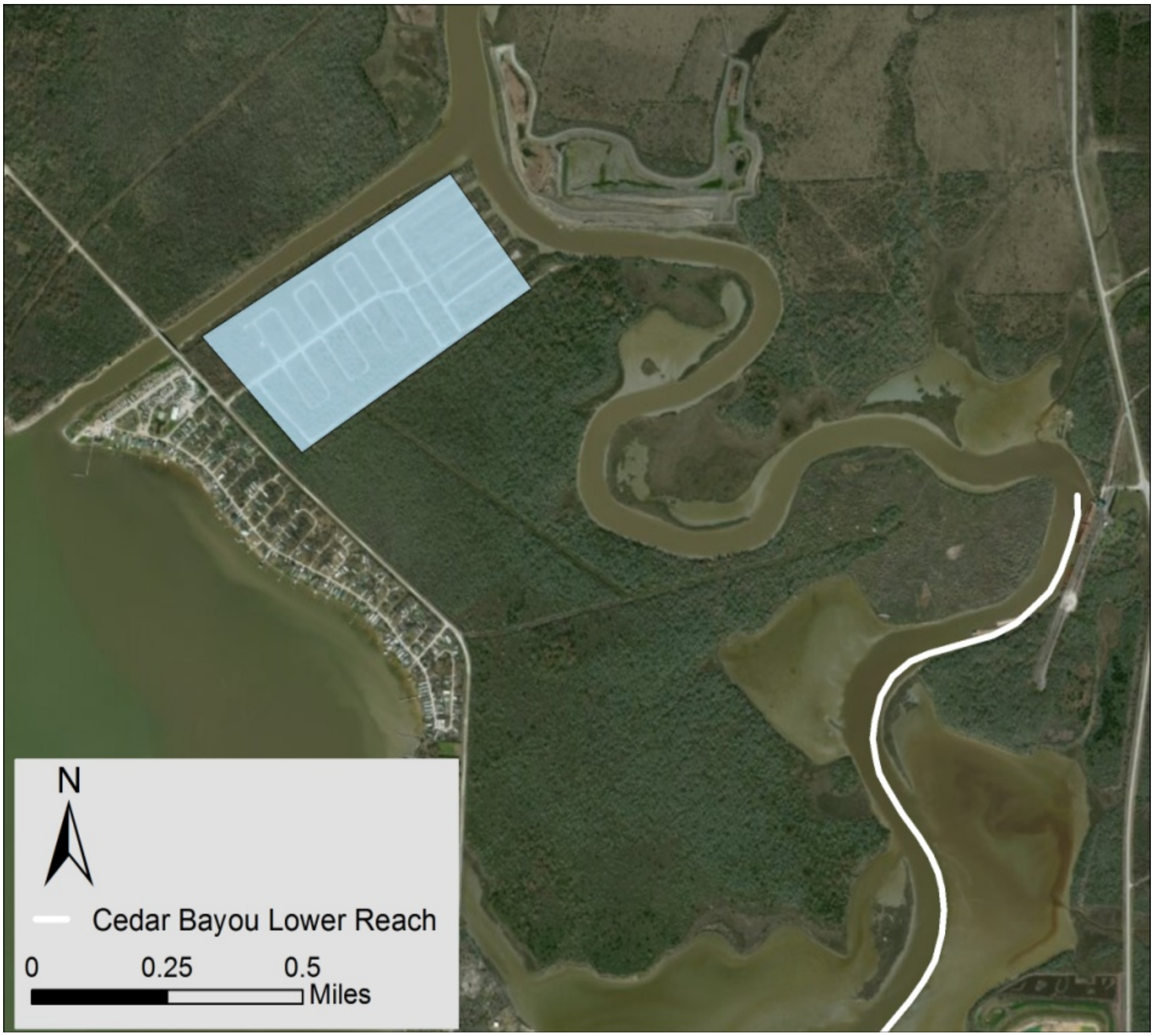

Figure 2.4. Plan View of Alternative 4

2.5 Evaluation Criteria and Alternatives Screening

The USACE and the non-Federal Sponsor are looking for the least cost, environmentally acceptable alternative that meets the needs of the project. Five criteria were used to compare and evaluate the four alternatives: 1) 20 years of dredged material capacity, 2) environmental acceptability, 3) real estate costs, 4) construction costs, and 5) environmental mitigation costs (see Table 2.2).

Table 2.2 Comparison of Alternatives

Evaluation Criteria	Alt 1 (No Action)	Alt 2 (BU)	Alt 3 (Upland PA – East of Landfill)	Alt 4 (New PA – RV Park)
Provides 20 Years Dredged Material Capacity	No	No	Yes	Yes
Environmentally Acceptable	Yes	Yes	Yes	Yes
Real Estate Costs*	None	None	$10,200,000	$2,400,000
Construction Costs*	None	**	$3,900,000	$3,900,000
Environmental Mitigation Costs*	None	None	None	$500,000
Total Construction Costs	---	---	$14,100,000	$6,600,000

**All costs are approximate preliminary costs (Oct 2011 price levels) developed for screening purposes*
*** Costs were not developed for BU due to insufficient capacity*

Alternative 1 (No-Action Alternative) would continue the use of only PA 6 for both the Bay and Bayou Reaches. Under Alternative 1, PA 6 would be at full capacity after the first maintenance cycle, falling drastically short of the capacity requirements needed to continue maintenance through the 20-year period of analysis. From a plan formulation perspective, Alternative 1 was not considered a viable alternative since it would not provide sufficient capacity for 20 years. However, Alternative 1 is evaluated in EA as is required.

Alternative 2 (BU with continued use of PA 6) would also not provide sufficient placement capacity for maintenance material over the 20-year period of analysis. Prior to the final screening of the alternatives, depth surveys for the BU measures were completed and analyzed. Due to the very shallow depths (3 feet on average) and low maximum target elevations required for developing marsh sites, all of the BU sites would be full after two cycles of maintenance dredging for the Bay Reach. Even with the addition of BU, PA 6 would reach capacity after only 3 cycles of maintenance dredging for the Bayou Reach. Alternative 2 was dropped from further consideration since it failed to provide sufficient placement capacity to continue maintenance dredging of the channel through the 20-year period of analysis. Since this alternative was dropped on the basis of capacity, construction costs were not developed for the alternative.

Alternatives 3 and 4 include the construction of new PAs on vacant tracts of land for the placement of dredged material from the Bay Reach in addition to the continued use of PA 6 for the placement of material from the Bayou Reach. Both alternatives would provide sufficient capacity to continue maintenance dredging of the project through the 20-year period of analysis.

Though Alternative 3 would be the environmentally preferred alternative as it involves no impacts to aquatic resources, Alternative 4 would still be environmentally acceptable since the unavoidable impacts to the 2.56 acres of tidal marsh could be resolved through mitigation. The overall estimated cost to implement Alternative 3 ($14M) was substantially higher than the estimated cost for Alternative 4 ($6.6M) primarily due to land costs. Alternative 3 real estate costs were twice that of Alternative 4 because the current land owner of the Alternative 3 site intends to develop the land commercially, whereas the current land owner of the Alternative 4 site wants to sell the land. Therefore, due to overall lower costs for implementation, Alternative 4 was identified as the Tentatively Selected Plan (TSP).

2.6 Tentatively Selected Plan

The TSP includes the continued maintenance of the lower CBNC with continued placement into PA 6. The containment dike at PA 6 would be raised 11 feet to its maximum height over the next three remaining maintenance cycles (See Table 2.4), the last of which would occur in 2026 at which time the PA would be filled to capacity. In addition to the continued use of PA 6, the TSP would also include construction and placement of maintenance material into a new PA, (hereafter referred to as PA 7) (Figure 2.5). The proposed PA 7 would be located on an approximately 110-acre property that was previously developed for a RV park. The site is situated on the west side of Cedar Bayou opposite PA 6, approximately two miles north/northwest from the mouth of Cedar Bayou. The property is generally rectangular in shape with the long sides running in an approximately northeast to southwest direction. The site is bounded by Tri-City Beach Road to the southwest, Houston Light and Power (HL&P) canal to the northwest, Cedar Bayou to the east and north, and vacant property to the southeast. Existing infrastructure within the site includes asphalt surfaced roads, and underground utilities including storm and sanitary sewers, sanitary pump station, and water distribution pipes. The existing roads within the footprint of the proposed PA 7 are heavily deteriorated. Additionally, while the underground utilities were installed, they were not hooked up to any systems.

All access to the construct and maintain the proposed PA 7 would over existing land from Tri-City Beach Road. The containment dikes would be constructed to an elevation of approximately +32 feet (NAVD 88) with a 10-foot crown width, and side slopes of 1 vertical to 3 horizontal. Actual containment dike heights relative to existing ground elevations at the site would vary from about 12 feet at the southwestern end of the proposed PA to over 20 feet where existing canals cross the containment dike alignment at the northeastern end. The containment dike toe would be the limit of maximum disturbance of within the proposed PA 7 footprint as construction would be performed within the interior of the project site. This is a typical containment dike template for USACE Galveston District dredge material PAs. The maximum capacity of the proposed PA 7 would be 4.5 million CY.

Material to construct the proposed containment dikes would be borrowed from areas located on the inside of the proposed PA footprint, generally just inside the limits of the proposed toe of the dike. The containment dike footprint and proposed borrow areas would be cleared of vegetation and existing infrastructure in preparation for construction. The resulting exposed ends of any abandoned storm sewers would be grouted and the sanitary sewer and water pipes would be capped prior to containment dike construction. Debris removed from the footprint of the proposed containment dike and borrow areas would be buried inside the proposed PA. Asphalt materials from demolition of the existing roads within the site would be collected and buried within the interior of the PA in areas where the drainage/sewer infrastructure will have been removed. Debris from demolition of drainage and sewer consisting of concrete rubble and cast iron piping would be buried in the canals within the limits of the PA only after the exterior containment dike has been constructed in order to isolate the debris from Cedar Bayou. Containment dikes would be constructed across these canals prior to debris burial in order to isolate the debris from Cedar Bayou.

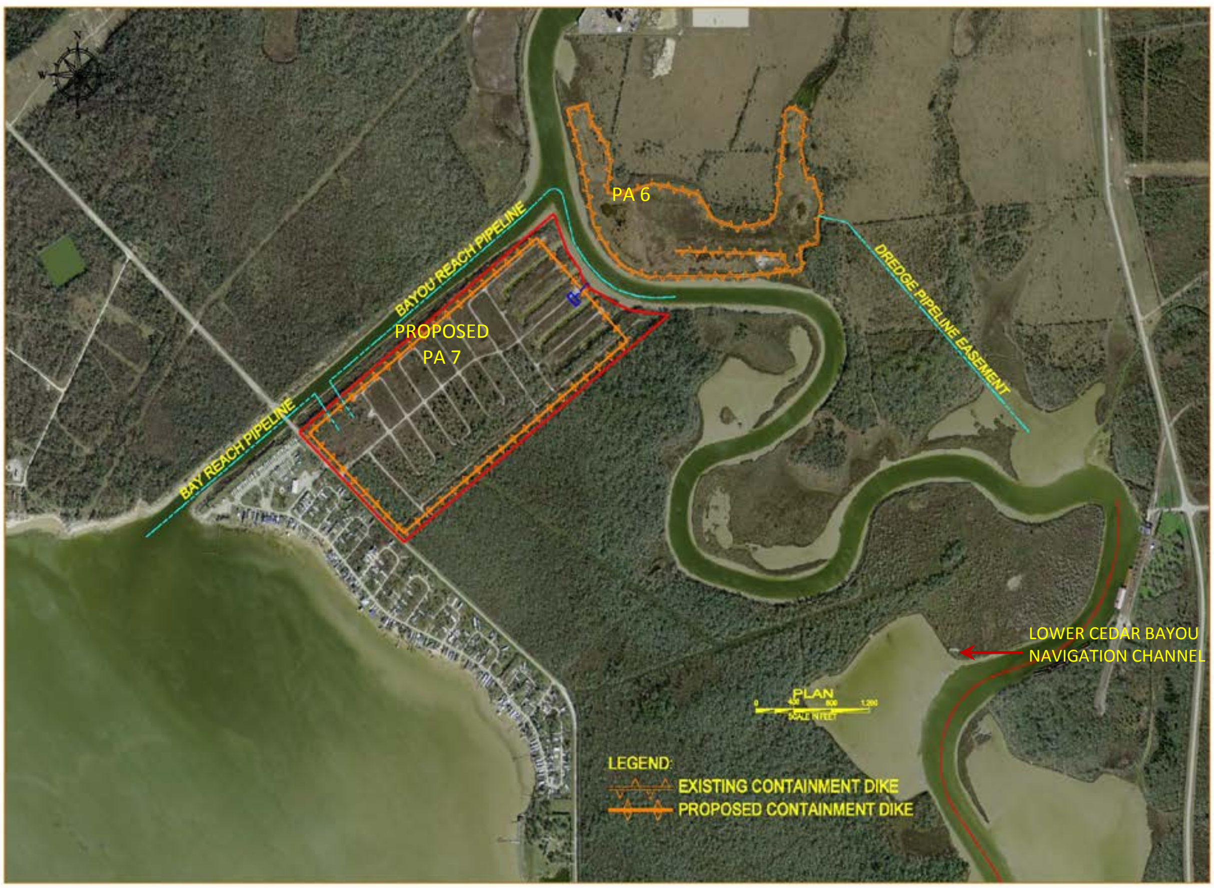

Figure 2.5. Placement Area locations (PA 6 and proposed PA 7) for the lower CBNC TSP.

The initial construction of the containment dike would consist of borrowing materials from the interior of the proposed PA 7 either by excavation of suitable fill soils and hauling to the containment dike construction area, or by side-cast methods. The borrow method used is dependent upon location of suitable fill soils and would be determined during the Preconstruction Engineering and Design phase. The containment dike would be constructed using the semi-compacted technique by compacting the borrow material in 12-inch lifts using a bull dozer of minimum specified size. The final crown and outside slope of the containment dikes would be seeded using the hydro-mulch method.

An effluent drop-outlet structure (spill box and outfall pipeline) would be constructed at the northeast end of the proposed PA 7 with discharge into Cedar Bayou. The structure would be positioned far enough away from the containment dikes to allow future containment dike raisings as required over the life of the proposed PA.

The current maintenance plan for the lower portion of the CBNC is to dredge the channel every 5-years. The estimated dredged material quantities generated from the maintaining the lower portions of the CBNC and the combined volumes of dredged material received by the PA 6 and the proposed PA 7 for each 5-year dredging cycle are shown in Table 2.3.

Table 2.3 – Dredging Volumes for Each Maintenance Cycle

Description	Bay Reach	Bayou Reach	Totals
Paid Volume[1]/Cycle[2] (CY)	319,295	184,205	503,500
Non-Pay Volume/Cycle (CY)	63,859	36,841	100,700
Permit Volume/Cycle (CY)	---	25,000	25,000
Totals/Cycle (CY)	383,154	246,046	629,200
Paid Volume/One Time Additional Depth (CY)	204,170	134,608	338,778
Totals/20-YR (CY)	1,736,786	1,118,792	2,855,578

[1]*Paid Volume includes advance maintenance and allowable overdepth*

[2]*5-Year Maintenance Cycle*

[3]*First Maintenance Cycle Only - Year 2016*

Total volumes of dredged material to be dredged from each reach of the lower CBNC and placed in the existing PA 6 and proposed PA 7 during each maintenance cycle are shown in Table 2.4. These volumes include the Federal maintenance dredged material from the CBNC (paid and estimated non-paid contract volumes) as well as permitted dredging volumes from Table 2.3. During dredging operations, dredged material would be discharged into the new PA near the southwest corner to provide the greatest possible ponding time and distance between influent and the outlet structure. The drop-outlet weir structure would be composed of wooden stop-logs to control ponding levels and promote sedimentation within the proposed PA 7. Clean water would be discharged into Cedar Bayou through the drop outlet structure discharge pipe which would be buried beneath the containment dike.

Table 2.4 - Cedar Bayou 20-Year Dredging Quantities and Placement Plan				
Year	Dredging Volumes (CY)		Placement Plan Volumes (CY)	
	Bay Reach (Station 0+00 to Station 180+00)	Bayou Reach (Station 180+00 to Station 301+56.27)	New Upland PA (PA 7)	Existing PA 6
2015				
2016	587,324	380,654	721,932	246,046
2017				
2018				
2019				
2020				
2021[c]	383,154	246,046	383,154	246,046
2022				
2023				
2024				
2025				
2026	383,154	246,046	383,154	246,046
2027				
2028				
2029				
2030				
2031	383,154	246,046	629,200	0
2032				
2033				
2034				
Totals[1]	1,736,786	1,118,792	2,117,440	738,138

[1] Table only includes volumes for dredging work and does not include quantities for construction, maintenance, or rehabilitation of the PAs.

3.0 AFFECTED ENVIRONMENT

3.1 Project Area

The proposed PA 7 would be constructed within 6 miles of the lower reach of Cedar Bayou, located in Chambers and Harris Counties, Texas. The currently maintained lower reach of Cedar Bayou begins at the intersection of the Houston Ship Channel (Mile -2.5), wraps around the southern extent of Boaz Island and extends up the Bayou to Mile 3.0 (refer to Figure 1.1). The lower reach is divided into two sections identified as the Bay Reach (Mile -2.5 to Mile 0) and the Bayou Reach (land cut) which begins at Mile 0 and ends at Mile 3.0.

The Project Study Area (see Figure 1.1) is located in a region known as the Gulf Coast Prairies and Marshes Ecoregion (Gould, 1975). This region is a narrow band about 60 miles wide along the Texas coast bordering the Gulf of Mexico and stretching from the Sabine River to the Rio Grande. The region is generally flat and gradually slopes coastward from an elevation of approximately 245 feet (Diamond and Smeins, 1984). The existing ground elevation of the proposed PA 7 is approximately 5 feet. It is comprised of shallow bays, estuaries, salt marshes, dunes, and tidal flats, as well as tallgrass coastal prairie, riparian forests, mottes and coastal woodlots, and dense brush habitats.

The climate in the project area is classified as humid subtropical (Pidwirny, 2006). Spring thunderstorms occasionally bring tornadoes to the area. Prevailing winds are from the southeast during most of the year, bringing moisture and occasional tropical storms from the Gulf of Mexico. During the summer months, it is common for the temperature to reach over 90°F (32°C), with an average of 99 days per year above 90°F (32°C). Winters in the project area are fairly temperate. The average high in January, the coldest month, is 63°F (17°C), while the average low is 45°F (7°C).

Based on an examination of historic maps and aerial photos, the land within the proposed PA 7 footprint had already been cleared of trees and vegetation for unknown purposes by the early 1950s. In the 1970s, during construction of the HL&P diversion canal, it appears that excavated material from the canal was placed in the current TSP's footprint. The proposed TSP's footprint was also used as a staging area. By the late 1980s, construction of an RV park had commenced. The area had been stripped of most of the remaining trees and vegetation, some roads were constructed and canals had been excavated. By the mid-1990s, development of the RV park had ceased, most likely due to frequent flooding of the area. At the time development was abandoned, all roads had been constructed and underground utility lines had been put in place, although no underground utilities had been hooked up, and no overhead utilities had been installed.

3.2 Land Use

As discussed in Section 3.1, the land within the proposed PA 7 footprint was under development to be a RV Park in the late 1980s and early 1990s. Most of the trees and vegetation were removed during that time frame and very little has returned. At this time, the land is vacant and is not being used.

3.3 Air Quality

The project area is located in an area designated as the Houston-Galveston-Brazoria Intrastate Air Quality Control Region (HGB) by the EPA. The HGB is in attainment or unclassified with the NAAQS for all criteria pollutants except ozone and was classified as having marginal nonattainment with the 8-hour NAAQS for ozone as of 20 July, 2012.

3.4 Noise

The area surrounding the Proposed PA 7 footprint primarily consists of forested/scrub lands. The noise levels in this area generally range from faint to moderate. However, there are noise sources in the area that periodically generate greater levels than typically encountered. These sources consist of the Tri City Beach Road and navigation on Cedar Bayou.

Noise Sensitive Receptors (NSRs) are facilities or areas where excessive noise may disrupt normal activity or cause annoyance or loss of business. NSR's found in the study area include: residential neighborhoods (Bay Oaks Harbor) and recreational facilities (Baytown RV Resort – Galveston Bay). Both of these places are immediately south of the project footprint (see Figure 3.1).

3.5 Water Quality

The tidal portion of Cedar Bayou (TCEQ Segment 0901) has been identified as impaired by the Texas Commission on Environmental Quality and is included in the 303(d) list (TCEQ 2008). The tidal portion of Cedar Bayou is located between the confluence of Cedar Bayou and Galveston Bay to an area approximately 1.4 miles upstream of I-10 in Chambers and Harris Counties, completely encompassing the project area. TCEQ listed Cedar Bayou as impaired for three reasons: dioxin was found in edible tissue in 2002; bacteria levels identified in 2006; and PCBs were found in edible tissue in 2008. The water quality data can be found in Appendix I.

Figure 3.1. 1-Mile Buffer Surrounding the TSP (Proposed PA 7)

3.6 Sediment Quality

Sediment quality data on channel sediments are provided in Appendix I. The sediment quality data are based on analyses of composite samples comprised of subsamples collected perpendicular to the centerline of the Cedar Bayou Channel. There are no enforceable sediment quality criteria or standards with which to compare concentrations in the sediment; although, there are guidelines used as 'red flag' values to look for cause of concern from NOAA Screening Quick Reference Tables. No Effects Range Low (ERLs) were exceeded, except for mercury. In samples where the concentration of mercury did exceed the ERL, they did not exceed the Effect Range Medium (ERM) value.

Also, dioxin and furan analyses on sediment samples were conducted. The results, both raw data and data normalized to total organic content of the individual sediments, are included in the report in Appendix I. The range of dioxin values at 6.1 to 9.2 picograms/gram is similar to that found in the Houston Ship Channel recently which were considered to reflect the low level dioxin/furan background that is ubiquitous in environmental media throughout the United States including coastal areas [State of Finding for Galveston Harbor and Channel and Houston Ship Channel Dredging Project, January 10, 2012].

In conclusion, there is nothing in the chemical analyses that would indicate a concern with the placement of these sediments, under the guidance provided by the Inland Testing Manual. Sediments that collect in Cedar Bayou between dredging cycles have been regularly sampled for size characteristics since the 1980s. The average historical sediment grain size distribution for Cedar Bayou is given in Table 3.1. The sediments in this reach are primarily clays and silts with a relatively small sand fraction. The D_{50}, which represents the median particle size, indicates an overall size characteristic of very fine silty clay.

Table 3.1 Sediment and Grain Size Analysis

Project Segment	Average Composition (5)			D_{50} (mm)
	Sand	Silt	Clay	
Lower Bayou	19.0	36.1	45.0	0.018

.

3.7 Relative Sea Level Rise

The USACE analyzed the Relative Sea Level Rise (RSLR) for Cedar Bayou by looking at low, intermediate, and high rates of future sea-level change pursuant to EC 1165-2-212 (Figure 3.2 and Appendix G). Based on this analysis, the RSLR over the next 20 years is predicted to be between 0.4 feet and 1.6 feet.

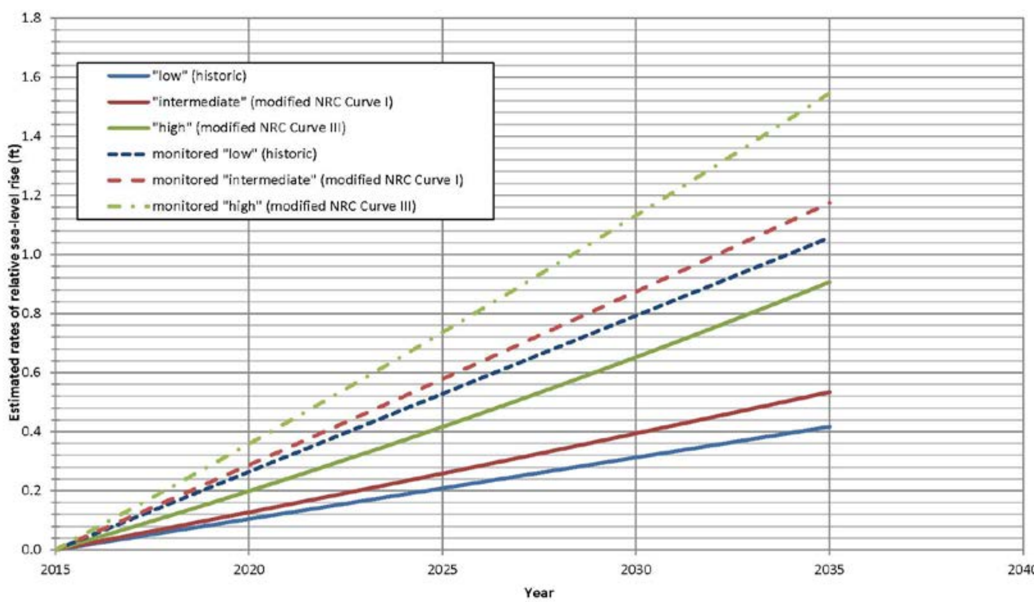

Figure 3.2. Relative Sea Level Rise Over Project Life of 20 Years

3.8 Hazardous, Toxic, and Radioactive Waste

On March 27, 2013, the USACE conducted a search of environmental databases for potential hazardous, toxic, and radioactive wastes for the TSP. A one-mile search radius from outside boundary of the proposed PA 7 footprint was used to investigate surrounding environmental conditions (see Figure 3.1).

According to the EPA's Environmental Justice Viewer, two toxic release sites (Koppel Steel Corp and Ecolochem) are located upstream from the project footprint. Additionally, two waste water release sites (Siemens Water Tech and Ipsoco Koppel Tubulars Corp) are also located immediately upstream. All four of these plants are permitted and continually monitored by TCEQ for compliance with state standards (EPA 2013).

The Railroad Commission of Texas's (RCT) website was investigated to find information on oil and gas wells, pipeline data, and liquid petroleum gas sites (LPG; RCT 2013). Based on this search, one LPG site was located just south of the project footprint (this is the Galveston Bay KOA service station located on Tri-City Beach Road). One crude gathering pipeline is located between the southern edge of the project footprint and Tri-City Beach Road. This pipeline belongs to Exxonmobile Pipeline Company and is reported as being abandoned (RCT 2013). There are also numerous oil wells located west of the project footprint, on the west side of the HL&P Channel.

Databases of Federal and state inventory listings that would pose a low risk of HTRW contamination to the environment within the proposed project area were examined. These listings include: Emergency Release Reports, RCRA-Non Generator, Industrial Hazardous Waste, Facility Index System, RCRA Conditionally Exempt Small Quantity Generator, RCRA Administrative Action Tracking System, Aboveground Storage Tank, Aerometric Information Retrieval System, RCRA Small Quantity Generator, and the Underground Storage Tank databases. No sites relevant to the TSP were identified in these databases.

3.9 Prime and Unique Farmlands

Prime farmland soils are defined by the Secretary of Agriculture in 7 CFR, Part 657 (Federal Register, Vol. 43, No. 21) as those soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The soil quality, growing season, and moisture supply are available to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. Some soils are considered prime farmland in their native state, and others are considered prime farmland only if they are drained or watered well enough to grow the main crops in the area. Soil Survey Geographic Database information acquired from the NRCS indicates that the soils located within the project footprint are not considered prime farmlands (NRCS 1999). "Unique farmlands" is a category of farmlands that is recognized by the NRCS. Unique farmlands have very specific and rigid criteria in the states where they occur. There are no soils recognized as "Unique Farmlands" in the state of Texas (Brown, 2002).

3.10 Wetlands

There are four canals cut into the eastern side of project footprint. These canals were excavated in the late 1980s during the initial construction of the proposed subdivision. The three northern canals are classified on the National Wetland Inventory (NWI) as estuarine and marine deepwater; however, a portion of the southernmost canal is classified in the NWIs as estuarine and marine wetland. This area is estuarine marsh and is dominated by smooth cordgrass (*Spartina alterniflora*). These results were verified during a field visit in July of 2012 and a second field visit in July of 2013. Based on the field visits and aerial imagery, it was determined that the shorelines surrounding the project site contain approximately 5.44 acres of estuarine intertidal emergent wetlands dominated by smooth cordgrass.

3.11 Vegetation

The existing vegetative cover within the proposed PA 7 footprint was mostly cleared as early as the 1950s and subsequently cleared again in the 1970s and 1980s. All that currently remains are a few forested stands scattered throughout the site, primarily on the southern edge (see Figure 3.1). The vegetation can be divided into three categories: forested/scrub, grassland/scrub, and wetlands; the approximate area of each category is presented in Table 3.2. Forested/scrub upland vegetation occurs as patchy areas in the southwest quarter of the site clustered between the interior roads of the proposed PA that were constructed during previous development. In these areas vegetation is dominated by cedar elm (*Ulmus crassifolia*), water oak (*Quercus nigra)*, Chinese tallow (*Triadica sebifera*), hackberry (*Celtis laevigata*), trumpet creeper (*Campsis radicans*), giant ragweed (*Ambrosia trifida*), poison ivy (*Toxicodendron radicans*), thorn locust (*Gleditsia triacanthos*), and cedar (*Juniperus* spp.). Grassland/scrub areas are dominated by upland species such as peppervine (*Ampelopsis arborea*), sumpweed (*Iva annua*), giant verbena (*Verbena bonariensis*), giant ragweed (*Ambrosia trifida*), muscadine (*Vitis rotundifolia*), trumpet creeper (*Campsis radicans*), and Illinois bundle flower (*Desmanthus illinoensis*). Vegetation in these upland scrub communities, due to the current plant composition, is considered marginal habitat for many species, with low intrinsic wildlife value.

Tidal wetlands occur along Cedar Bayou at the shorelines the surrounding the site and as fringe marsh within the interior canals. Dominant species within these wetlands consist primarily of smooth cordgrass (*Spartina alterniflora*); however, salt cedar (*Tamarix* spp.), hackberry (*Celtis laevigata*), cedar, Parkinsonia (*Parkinsonia aculeate*), and baccharis (*Asteraceae* spp.) may occur at higher elevations immediately adjacent to the marsh due to the steep slopes of the banks along Cedar Bayou.

Table 3.2 Vegetation within the Footprint of the TSP	
Vegetation Community	Approximate Acres
Forested/Scrub	40
Grassland/Scrub	50
Wetlands	2.56
Roads (non-vegetated area)	18.5

Forested communities located to the south and north (across the HL&P Channel) of the proposed PA7 footprint consist of riparian forests, upland pine areas, and open canopy areas dominated by a variety of woody species including oaks, pines, elms, and ashes, though some invasive species may occur in areas throughout. Dominant species typically encountered in these forested communities include water oak (*Quercus nigra*), willow oak (*Quercus phellos*), loblolly pine (*Pinus taeda*), live oak (*Quercus virginiana*), pecan (*Carya illinoinensis*), water hickory (*Carya aquatica*), common persimmon, green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), winged elm (*Ulmus alata*), cedar elm (*Ulmus crassifolia*), hackberry (*Celtis laevigata*), sweetgum (*Liquidambar styraciflua*), American sycamore (*Platanus occidentalis*), slippery elm (*Ulmus rubra*), white ash (*Fraxinus americana*), red mulberry (*Morus rubra*), yaupon (*Ilex vomitoria*), Chinese privet (*Ligustrum sinense*), possumhaw (*Ilex decidua*), boxelder (*Acer negundo*), cockspur hawthorn (*Crataegus crus-galli*), green hawthorn (*Crataegus viridis*), dwarf palmetto (*Sabal minor*), western soapberry (*Sapindus saponaria*) and in wetter areas black willow and buttonbush. Herbaceous and vine layers constitute a minor portion of this vegetative community and include slender woodoats (*Chasmanthium laxum*), southern arrowwood (*Viburnum dentatum*), poisonbean, eastern baccharis (*Baccharis halimifolia*), American beautyberry (*Callicarpa americana*), Alabama supplejack (*Berchemia scandens*), muscadine (*Vitis rotundifolia*), saw greenbrier (*Smilax bona-nox*), roundleaf greenbrier (*Smilax rotundifolia*), field blackberry, honeysuckle (*Lonicera japonica*), and peppervine (*Ampelopsis arborea*).

3.12 Invasive Species

Invasive species are both native and non-native species of plants or animals that heavily colonize a particular habitat resulting in adverse effects to that habitat. Invasive species are able to invade and begin to alter an ecosystem within a few decades because they have few natural pests or diseases in an ecosystem. Growth rates and specialized reproductive characteristics enable invasive species to outcompete other plants or animals in the ecosystem. The most common invasive plant species in the project area include giant salvinia (*Salvinia milesta*), Chinese tallow (*Triadica sebifera*), salt cedar (*Tamarix ramosissima*), deep-rooted sedge (*Cyperus entrerianus*), Brazilian peppertree (*Schinus terebinthifolius*), chinaberry tree (*Milia azedarach*), Japanese honeysuckle (*Lonicera japonica*), Chinese privet (*Ligstrum sinense*), common water hyacinth (*Eichhornia crassipes*), alligator weed (*Alternanthera philoxeroides*), trifoliate orange (*Poncirus trifoliate*), and guineagrass (*Urochloa maxima*).

3.13 Wildlife

Riparian forests in the area surrounding lower CBNC provide important stopover habitat for migrating neo-tropical songbirds of the Central Flyway (Barrow et al., 2005), as well as songbirds, wintering birds, and year-round residents. During spring and fall migration, neo-tropical migrants such as American redstarts (*Setophaga ruticilla*), Baltimore orioles (*Icterus galbula*), and black-throated green warblers (*Dendroica virens*) are likely to use the project area. During winter, typical migrant species include ruby-crowned kinglet (*Regulus calendula*), yellow-rumped warbler (*Dendroica coronata*), white-throated sparrow (*Zonotrichia albicollis*), and yellow-bellied sapsucker (*Sphyrapicus varius*). Typical wintering waterfowl include wood duck (*Aix sponsa*) and mallard (*Anas platyrhynchos*) (Guilfoyle 2001). Year round residents of these forest include the tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), Carolina chickadee (*Poecile carolinensis*), downy woodpecker (*Picoides pubescens*), northern cardinal (*Cardinalis cardinalis*), and red-bellied woodpecker (*Melanerpes carolinus*) (Guilfoyle, 2001). Wading birds, such as the great egret (*Ardea alba*), great blue heron (*Ardea herodias*), and little blue heron (*Egretta caerula*), also use the bottomland within the project area (Guilfoyle, 2001).

While it is possible to see these birds foraging and loafing within the project area, most nesting activity is usually confined to nearby colony locations between March through August. The closest known rookery to the immediate project area is Cedar Bayou Channel (600-180) located at the mouth of Cedar Bayou, which has been inactive since 1990 (USFWS, 2014).

Wetlands provide habitat for waterfowl such as black-bellied whistling-duck (*Dendrocygna autumnalis*), northern shoveler (*Anas clypeata*), mallard, northern pintail (*Anas acuta*), blue-winged teal (*Anas discors*), gadwall (*Anas strepera*), American wigeon (*Anas americana*), and mottled duck (*Anas fulvigula*) and roseate spoonbill (*Platalea ajaja*).

The following six bird species may be also found in the project area and are identified as *Birds of Conservation Concern (USFWS*, 2008), which identifies both migratory and non-migratory bird species) that represent the USFWS's conservation priorities for those species in need of conservation action (US. Fish and Wildlife Service, 2008):

1) Reddish egret (*Egretta rufescens*) - coastal marshes and ponds;
2) American Oystercatcher (*Haematopus palliatus*) - sandy beaches, mudflats, and occasionally rocky shores where mollusk prey can be found;
3) Gull-billed tern (*Sterna nilotica*) - sandy beaches and mudflats;
4) Sandwich tern (*Thalasseus sandvicensis*) - sandy beaches and mudflats;
5) Black skimmer (*Rynchops niger*) - sandy or gravelly bars and beaches, shallow bays, estuaries, and salt marsh pools; and

6) Least tern (*Sterna antillarum athalassos*) - broad, level expanses of open sandy or gravelly beach, dredge spoil and other open shoreline areas, and more rarely, inland on broad river valley sandbars.

While it is entirely possible to see these birds foraging and loafing within the project area, most nesting activity is usually confined to nearby colony locations between March through August. The closest known rookery to the immediate project area is Cedar Bayou Channel (600-180) located at the mouth of Cedar Bayou, which has been inactive since 1990 (USFWS, 2014). The nearest active bird rookery is located St. Mary's Island (600-166), which is over 7 miles away from the project site.

The area also provides habitat for numerous small to medium-sized mammals including raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), eastern fox squirrel (*Sciurus niger*), eastern gray squirrel (*Sciurus carolinensis*), cottontail rabbit (*Sylvilagus* spp.), striped skunk (*Mephitis mephitis*), nine-banded armadillo (*Dasypus nobemcinctus*), and rodents, including hispid cotton rat (*Sigmodon hispidus*), white-footed mouse (*Peromyscus leucopus*), deer mouse (*Peromyscus* spp.), and house mouse (*Mus musculus*). Typical large mammals found within the area include white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), North American beaver (*Castor canadensis*), feral hog (*Sus scrofa*), feral dogs (*Canis lupus familiaris*), feral cats (*Felis catus*), and North American river otter (*Lontra canadensis*).

3.14 Fisheries and Essential Fish Habitat

In the Gulf of Mexico, essential fish habitat (EFH) consists of those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity of species that are federally managed by the Gulf of Mexico Fisheries Management Council (GMFMC) and by the National Marine Fisheries Service (NMFS), pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). By definition, EFH includes those waters and substrate necessary for fish and shellfish spawning, breeding, feeding, and growth through maturity. "Waters" include aquatic areas and associated physical, chemical, and biological properties currently or historically utilized by the fisheries. "Substrate" includes any sediment, hard bottom, structures underlying the waters, and associated biological communities (U.S. Department of Commerce 2007). Those activities potentially impacting EFH may result in either direct (e.g., physical disruption) or indirect (e.g., loss of prey species) effects, and can be site-specific, habitat-wide, cumulative, and/or synergistic effects.

The project area is located in Ecoregion 4 and includes EFH designated by the GMFMC for red drum (*Sciaenops ocellatus*), white shrimp (*Litopenaeus setiferus)*, brown shrimp (*Farfantepenaeus aztecus,)* and Spanish mackerel (*Scomberomorus maculatus*). Details regarding specific habitat requirements for each of these species follow in Table 4. The project area also includes EFH for highly migratory species managed by NMFS including: scalloped hammerhead sharks, blacktip sharks (*Carcharhinus limbatus*), bull sharks (*Carcharhinus leucas*), lemon sharks (*Negaprion brevirostris*), spinner sharks (*Carcharhinus brevipinna*), bonnethead sharks (*Sphyrna tiburo*), Atlantic sharpnose sharks (*Rizoprionodon terraenovae*), and finetooth sharks (*Carcharhinus isodon*). EFH in the project vicinity includes estuarine emergent marsh, estuarine mud, sand and shell substrates (including oyster reef), and the estuarine water column.

TABLE 3.3: Habitat Requirements of Species with EFH in the Project Study Area

Species	Location/Distribution
Red Drum	Red drum commonly occur in all of the Gulf's estuaries, but also occur in a variety of habitats, ranging from depths of about 130 feet offshore to very shallow estuarine waters; the GMRMC considers all estuaries to be EFH for the red drum. Estuaries are important for both habitat requirements and for dependence on prey species which include shrimp, blue crab, striped mullet, and pinfish. Schools are common in the deep Gulf waters, with spawning occurring in deeper water near the mouths of bays and inlets and on the Gulf side of the barrier islands. Red drum are associated with a variety of substrate types including sand, mud, and oyster reefs. (GMFMC 2010).
Brown Shrimp	Brown shrimp are most abundant in central and western Gulf of Mexico and found in estuaries and offshore waters to 360 feet with the post-larval individuals typically occurring within estuaries. Post-larval individuals and juveniles are associated with shallow vegetated habitats, but are also found over silty-sand; non-vegetated mud bottoms are preferred. Adults typically occur outside of bay areas in marine waters extending from mean low tide to the edge of the continental shelf and areas associated with silt, sand, and sandy substrates. (GMFMC 2010).
Spanish Mackerel	Pelagic species are found in neritic waters and along coastal areas, inhabiting the estuarine areas; especially higher salinity areas, during seasonal migrations. Spanish mackerel are rare and infrequent inhabitants of Gulf estuaries, where spawning occurs offshore from May to October. Nursery areas are in estuaries and coastal waters year-round. Larvae are found offshore over the inner continental shelf, most commonly in water depths less than 150 feet. Juveniles are found offshore, in beach surf, and occasionally in estuarine habitat; juveniles prefer marine salinity and clean sand substrate. (GMFMC 2010).
White Shrimp	White shrimp are offshore and estuarine dwellers; pelagic or demersal depending on their life stage. Eggs are demersal and larval stages are planktonic, and both occur in nearshore marine waters. Post-larvae become benthic upon reaching the nursery areas of estuaries, seeking shallow water with muddy sand bottoms that are high in organic detritus. Juveniles move from the estuarine areas to coastal waters as they mature. The adults are demersal and generally inhabit nearshore Gulf of Mexico waters in depths less than 100 feet on soft mud or silty bottoms. (GMFMC 2010).
Scalloped Hammerhead Sharks,	Common, large, schooling sharks of warmer waters, migrating seasonally north-south along the eastern coastal and offshore waters of the United States, including the Gulf of Mexico. Neonates may occur in nearshore coastal waters, bays and estuaries of the Gulf of Mexico from Texas to the southern west coast of Florida; Juveniles can be found in coastal areas in the Gulf of Mexico from southern mid-coast of Texas, eastern Louisiana to the southern west coast of Florida and the Florida Keys, and in offshore waters from the mid-coast of Texas to eastern Louisiana. Adults may occur in Coastal areas in the Gulf of Mexico along the southern Texas coast, and eastern Louisiana through the Florida Keys, as well as offshore from southern Texas to eastern Louisiana.

Species	Location/Distribution
Blacktip Sharks	Blacktips are fast-moving sharks, occurring in shallow waters and offshore surface waters of the continental shelf. Blacktips are viviparous, and young are born in bay systems in late May and early June after a year-long gestation period. The reproductive cycle occurs every 2 years. Juveniles are found in all Texas bay systems in a variety of habitats and shallow coastal waters from the shore to the 82 foot isobath (NMFS, 2006a). They feed mainly on pelagic and benthic fishes, cephalopods and crustaceans, and small rays and sharks (Froese and Pauly, 2012). Juvenile blacktip sharks occur in the Gulf and estuarine portions of the study area and adults in the Gulf portions of the study area.
Bull Sharks	Bull sharks are coastal and freshwater sharks that inhabit shallow waters, especially in bays, estuaries, rivers, and lakes. They frequently move between fresh and brackish water and are capable of covering great distances. Adults are often found near estuaries and freshwater inflows to the sea (Froese and Pauly, 2012). Bull sharks are viviparous, have a gestation period of a little less than 1 year, and it is assumed the reproductive cycle occurs every 2 years. Juveniles are found in waters less than 82 feet deep in shallow coastal waters, inlets, and estuaries (NMFS, 2006a). They feed on bony fishes, sharks, rays, shrimp, crabs, squid, sea urchins, and sea turtles (Froese and Pauly, 2012). Juvenile bull sharks occur in the Gulf and estuarine portions of the study area.
Lemon Sharks	Feeds mainly on fish but also takes crustaceans and mollusks. (Froese and Pauly, 2012). Occurs on continental and insular shelves, frequenting mangrove fringes, coral keys, docks, sand or coral mud bottoms, saline creeks, enclosed bays or sounds, and river mouths. May enter fresh water. Occasionally moves into the open ocean, near or at the surface, apparently for purposes of migration.
Spinner Sharks	Found on the continental and insular shelves from close inshore to offshore. Makes vertical spinning leaps out of the water as a feeding technique in which the sharks spins through a school of small fish with an open mouth and then breaks the surface. Feeds mainly on pelagic bony fishes, also small sharks, cuttlefish, squids, and octopi. Viviparous. Forms schools. Highly migratory off Florida and Louisiana and in the Gulf of Mexico.
Bonnethead Sharks	Bonnethead sharks can be found on sand or mud bottoms in shallow coastal waters. The bonnethead shark is viviparous, reaching sexual maturity at about 30 inches. The pups are born in late summer and early fall, measuring 12 to 13 inches (Froese and Pauly, 2012). Both juveniles and adults inhabit shallow coastal waters up to 82 feet deep, inlets, and estuaries over sand and mud bottoms (Froese and Pauly, 2012; NMFS, 2006a). They feed mainly on small fish, bivalves, crustaceans, and octopi (Froese and Pauly, 2012). Juveniles and adults occur year-round in the Gulf and estuarine portion of the study area.
Atlantic Sharpnose Sharks	Atlantic sharpnose shark inhabits intertidal to deeper waters, often in the surf zone off sandy beaches, bays, estuaries, and river mouths (Froese and Pauly, 2012). They are viviparous, and mating occurs in June, with a gestation period of about a year (NMFS, 2006a). They feed on fish, shrimp, crab, mollusks, and segmented worms (Froese and Pauly, 2012). Juvenile Atlantic sharpnose shark occur in the Gulf and estuarine portions of the study area.

The MSFCMA established procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Any Federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the above-mentioned Act. This EA serves to initiate EFH consultation under the MSFCMA.

The Gulf of Mexico and Galveston Bay also support extensive commercial and recreational fisheries. The Gulf waters in the vicinity of the project support a variety of species of commercial and recreational importance that are typically found within Galveston Bay. Leading commercial fisheries include gulf menhaden (*Brevoortia patronus*), and shrimp, and shellfish fisheries. Galveston Bay is the state's largest estuarine source of seafood, and is one of the major oyster producing areas in the country (GBEP, 2008).

Other commercial and recreational species in the project vicinity may include Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), southern flounder (*Paralichtys lethostigma*), spot (*Leiostomus xanthurus*), sea trout (*Cynoscion nebulosus*), sand trout (*Cynoscion arenerius*) and striped mullet (*Mugil cephalus*). These species are ubiquitous along the Texas coast with seasonal differences in abundance.

3.15 Threatened and Endangered Species

The USFWS and the NMFS identified the threatened or endangered species in Table 8 as possibly occurring in Chambers and Harris Counties. The bald eagle has been recently delisted but the protections provided by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act remain in effect. State of Texas listed species potentially occurring in the project area are also included in Table 8.

A Biological Assessment (BA) has been prepared that includes information on the distribution and habitat requirements of these species, as well as their occurrence within the project area (see Appendix B). However, only those federally listed threatened and endangered species listed were considered in further detail in the BA. The BA addresses the proposed project’s potential impact on federally listed threatened and endangered species and species of concern. Of these species listed in Table 8, only the brown pelican and the hawsbill, Kemp’s ridley and loggerhead sea turtles are known to occur in the project area; however, no nesting sites for brown pelicans or sea turtles are located in the project area. Other species listed in Table 8 that are known to occur in the study area counties are not likely to occur in the vicinity of the project due to lack of suitable habitat or known range limits. There is no designated critical habitat for any of the listed species within the project area.

While suitable habitat for piping plover occurs along the sandy beach shorelines of the Gulf of Mexico and some dredged material islands along the GIWW in Galveston County, these species are not likely to occur in the vicinity of the project due to lack of suitable habitat.

Table 3.3. Federal and State Listed Threatened and Endangered Species in Harris and Chambers Counties, Texas.

Group	Name	Federal Status	Agency/ County*	State Status	Found in TSP Footprint
Birds	American peregrine falcon (*Falco peregrinus anatum)*			Threatened	Possible
Birds	bald eagle (*Haliaeetus leucocephalus*)	Recovery	USFWS/C,H	Threatened	Possible
Birds	brown pelican (*Pelecanus occidentalis*)	Recovery	USFWS/C		Possible
Birds	peregrine falcon (*Falco peregrines)*			Threatened	Possible
Birds	piping plover (*Charadrius melodus*)	Threatened	USFWS/C	Threatened	No
Birds	reddish egret (*Egretta rufescens)*			Threatened	Possible
Mammals	West Indian manatee (*Trichechus manatus*)	Endangered	USFWS/C,H		No
Mammals	blue whale (*Balaenoptera musculus*)	Endangered	NMFS		No
Mammals	finback whale (*Balaenoptera physalus*)	Endangered	NMFS		No
Mammals	humpback whale (*Megaptera movaeangliae*)	Endangered	NMFS		No
Mammals	sei whale (*Balaenoptera borealis*)	Endangered	NMFS		No
Mammals	sperm whale (*Physeter macrocephalus*)	Endangered	NMFS		No
Mollusks	Louisiana pigtoe (*Pleurobema riddellii)*			Threatened	No
Reptiles	green sea turtle (*Chelonia mydas*)	Threatened	NMFS and USFWS/C	Threatened	No
Reptiles	hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	NMFS and USFWS/C		Possible
Reptiles	Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	NMFS and USFWS/C	Endangered	Possible
Reptiles	leatherback sea turtle (*Dermochelys coriacea*)	Endangered	NMFS and USFWS/C	Endangered	No
Reptiles	loggerhead sea turtle (*Caretta caretta)*	Threatened	NMFS and USFWS/C	Threatened	Possible
Reptiles	alligator snapping turtle (*Macrochelys temminckii)*			Threatened	No
Reptiles	northern scarlet snake (*Cemophora coccinea copei)*			Threatened	Possible
Reptiles	smooth green snake (*Liochlorophis vernalis)*			Threatened	Possible
Reptiles	Texas horned lizard (*Phrynosoma cornutum)*			Threatened	Possible
Reptiles	timber/canebrake rattlesnake (*Crotalus horridus)*			Threatened	Possible
Plants	Texas prairie dawn-flower (*Hymenoxys texana*)	Endangered	USFWS/H		No

* NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service; C = Chambers County; H = Harris County
Sources: NMFS, 2014; USFWS, 2014a; Texas Parks and Wildlife Department, 2014.

3.16 Historic Properties

There are nine cultural resources located within one kilometer of the proposed PA 7. These resources include seven archeological sites, a historical marker commemorating the Bell Prairie Plantation, and the Cedar Bayou Archeological District. Two of the seven archeological sites are shell middens (41HR76 and 41HR136), one is the historic Bell Prairie Plantation home site (41HR609), and the remaining four are of unknown type (41HR52, 53, 137, and 138). Of these nine resources, only the Cedar Bayou Archeological District overlaps with the eastern corner of the proposed project area. This district was listed on the National Register of Historic Places in 1979 and reflects the significant prehistoric and historic use of Cedar Bayou. The proposed project area, as mentioned earlier, has been heavily impacted by past construction and dredging activities, including those areas within the archeological district. Based on the previous impacts and an investigation by the USACE Staff Archeologist, it has been determined that the proposed PA 7 will have no adverse effect upon Historic Properties within the project area. That determination is being coordinated with the Texas State Historic Preservation Officer (SHPO). The SHPO coordination will be included in Appendix A-2 of this EA.

3.17 Aesthetic Resources

Natural and cultural features that give the project area landscape its character include topographic features, existing structures, and vegetation. While aesthetics are most often thought of as a visual resource, the aesthetic integrity of an area is also heavily influenced by both audible and olfactory impacts. The overall setting along lower CBNC is largely undeveloped forest, though a large solid waste facility (landfill) operated by Waste Management occurs along the east side of the channel at the mouth of the channel, and Cedar Crossing Business Park, an industrial facility, occurs on the east side of the channel just downstream of SH99 (Grand Parkway). Though few facilities occur along the lower CBNC, the area is expected to undergo rapidly changes as new industrial complexes and docking facilities are continually being built.

3.18 Recreational Resources

Though water-based recreation tends to be concentrated in the area associated with the bay section of the lower CBNC, Cedar Bayou itself provides opportunities for recreational boating, water sports and fishing as well as access to Galveston Bay. Although there are numerous recreational facilities along Cedar Bayou and in Galveston Bay, the only recreational facility within one mile of the project footprint is the Baytown RV Resort. This location is primarily a RV park and campground. Additionally, there is a public golf course next to the Baytown RV Resort.

3.19 Traffic and Circulation

There is only one primary road within one mile of the proposed PA 7, the Tri-Cities Beach Road. While not a main or heavily travelled thoroughfare, this road is the only land connection between the community of Bay Oaks Harbor and Baytown. This road is located immediately south and west of the project footprint (see Figure 3.1).

Cedar Bayou is located immediately north and east of the site. The channel is extremely important as a waterborne transportation link between Baytown and Galveston Bay, providing access for both recreational and commercial boating traffic between residential and industrial facilities. As such, the Cedar Bayou plays a vital role in the economic success of Baytown and the industries all along the bayou.

3.20 Socioeconomics

According to the 2010 Census, there were approximately 319 people living within one mile of the TSP footprint. The data presented below were obtained from the 2010 Census and the EPA's Environmental Justice viewer.

Table 3.4. Comparison of Socioeconomic Factors

	1-Mile R of the TSP Footprint	Project Area	Chambers County, TX	Harris County, TX
Total Persons	319	82,378	44,761	1,076,395
Total Households	137	27,861	15,168	352,651
Percent Minority	34%	54%	48%	55%
Per Capita Income	$35,167	$22,066	$21,158	$27,867
Race and Ethnicity				
White	83%	68%	78%	62%
Black or African-American	7%	14%	14%	18%
American Indian or Alaska Native	1%	1%	1%	0%
Asian	0%	2%	2%	10%
Native Hawaiian or Other Pacific Islander	0%	0%	0%	0%
Other Race	9%	15%	13%	7%
Two or More Races	0%	2%	2%	2%
Hispanic	25%	37%	32%	26%
Age				
Age 0-4	5%	8%	9%	8%

Table 3.4. Comparison of Socioeconomic Factors				
	1-Mile R of the TSP Footprint	Project Area	Chambers County, TX	Harris County, TX
Age 0-17	24%	29%	29%	29%
Age 18+	76%	71%	71%	71%
Age 65+	10%	9%	9%	8%
Educational Attainment*				
Less than 9th Grade	5%	11%	8%	7%
9th – 12 Grade, No Diploma	14%	12%	11%	8%
High School Graduate	25%	30%	28%	23%
Some College, No Degree	40%	33%	37%	30%
Associate Degree	9%	7%	8%	7%
Bachelor's Degree or more	17%	14%	16%	33%
Median Household Income Level in 1999				
Less than $15,000	5%	12%	11%	8%
$15,000 - $25,000	10%	11%	9%	8%
$25,000 - $50,000	18%	27%	25%	21%
$50,000 - $75,000	30%	18%	19%	18%
Greater than $75,000	38%	31%	35%	45%

Table 3.4 shows the socio-economic data in four categories: a 1-mile buffer of the TSP footprint (see Figure 3.1), the project area (see Figure 1.1), Chambers County, and Harris County. Based on a comparison of this data, the area within one mile of the TSP footprint has a smaller percentage of the population claiming minority status and a higher per capita income than seen in the other three categories. The other categories (Age, Educational Attainment, and Median Household Income Levels) all appear to be very similar. The area within one mile of the TSP footprint should not be considered socially or economically disadvantaged.

Industry utilizes CBNC to transport raw ores and finished fitted pipe to and from manufacturing facilities located throughout CBNC. Manufacturing facilities support the local economy by providing jobs and tax base for local Baytown public services. Recreation traffic primarily utilizes the bay reach of Cedar Bayou for access to Trinity Bay and Galveston Bay.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Effects to the Project Study Area

The following sections include the anticipated effects of the No Action Alternative and the TSP Alternative on the resources described in Section 3.0 of this EA. For each resource discussed, the future assumptions each alternative have been generally summarized and documented to establish the framework within which impacts to resources have been evaluated. Both direct and indirect effects have been considered in the evaluation of impacts.

4.2 Impacts to Land Use

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to land use from implementation of the TSP. Land use in the surrounding project area would continue to experience changes due to urban sprawl and overall population growth in the region. Land use changes due to commercial and industrial growth in the overall region would also continue, but may be protracted without continued maintenance of the lower CBNC. Additionally, due to the frequent flooding of the project site, it is unlikley that the site would be used for residential, commercial, or industrial development or for farmland.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

Construction of the proposed PA 7 would change the current land use within its footprint from vacant open disturbed upland habitat fringed with estuarine intertidal wetlands along the man-made canals within the site to a raised upland confined PA fringed with estuarine intertidal wetlands along Cedar Bayou. With continued maintenance of the lower CBNC land use changes due to commercial and industrial growth in the overall region would be expected to follow the same trends as the No Action Alternative, though changes may occur at a slightly faster rate depending upon economic growth. Therefore, construction of PA 7 and continued maintenance of the lower CBNC would not be considered an adverse impact to the land use.

4.3 Impacts to Air Quality

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to air quality that would have resulted from the construction emissions generated from building a new confined upland PA. Once PA 6 runs out of capacity, maintenance dredging would no longer be performed. Eventually there would likely be additional vessel traffic under the No Action Alternative as the channel begins to shoal in. This would occur as more vessel trips would be required to move the same amount of cargo in light-loaded barges through a shallower channel. Therefore, Under the No Action Alternative, there would be a potential for increases in air emissions from increased barge traffic.

TSP – Alternative 4: PA 7 (Confined Upland PA at the Abandoned RV Park)

Under the TSP Alternative, there would be an increase in construction-related air emissions as a result of construction of the proposed PA 7. These emissions would be temporary and short-term lasting only during the duration of the construction contract.

Project construction related air quality impacts were evaluated by calculating the worst case emissions for construction of the proposed project (Appendix D). The Harris/Galveston/Brazoria Attainment Area is currently classified as marginal nonattainment for NOX and VOC. Air contaminant emissions from construction would be considered *de minimus* emissions (11.8970 tons NOX and 1.1484 tons VOC) compared to those from existing sources in the HGB region. Due to the short-term duration of construction activities, there would be no long-term impacts. Emissions from these activities would not adversely impact the long-term air quality in the area.

Vessel-related emission from barge traffic are expected to be less in the near future as there would be less vessel traffic compared to the No Action Alternative. Periodic maintenance dredging would continue providing the full navigable channel depth to barge traffic. Over the course of a full year, a deeper maintained channel would allow barges to be loaded deeper translating into fewer vessel trips to move the same amount of cargo. As such, there would potentially be fewer air emissions and less noise associate with barge traffic under the TSP Alternative as a result in more efficient movement of cargo through the channel.

4.4 Impacts from Noise

Alternative 1: No Action

Under the No Action Alternative, noise levels would not increase. However, there would likely be an increase in the frequency of noise related an increase in barge traffic as a result of the increase in light-loaded barge tows required to move the same amount of cargo through a shallower channel that would result from increased shoaling in the absence of continued maintenance dredging.

TSP – Alternative 4: PA 7 (Confined Upland PA at the Abandoned RV Park)

Heavy machinery would be the major source of noise during construction and maintenance/repair of the containment dike. However, construction or maintenance would only occur during daylight hours when occasional loud noises are tolerable to the surrounding NSRs. None of the NSRs would be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems. The use of the new PA as described in the TSP would result in increasing the noise level near two of the NSR's (the RV park and the subdivision); however, there wouldbe a containment dike and a stand of trees between the added noise source and the NSRs which would act as a buffer for the noise. Additionally, pumping into the PA would occur on a five year interval and be limited to daylight hours when this type of activity is common. Therefore, noise related impacts would be considered minimal and temporary in duration.

4.5 Impacts to Water Quality

Alternative 1: No Action

Under the No Action Alternative, there would be potential impacts to water quality as a result of increased light-loaded barge vessel traffic that would be necessary to move the same amount of cargo through a shallower channel. Temporary localized trubitiy associated with maintenance dredging would not occur after PA 6 was filled to capacity and maintenance dredging ceased. However, increases in turbidity within the channel may occur as a result of the increased barge vessel traffic due to the reduced barge and vessel under keel depths and vessel propellers being closer to a shallower channel bottom.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

Temporary localized turbidity associated with lower CBNC would continue to occur as they have in the past during periodic maintenance dredging events. Turbidity levels within the lower CBNC would return to normal between maintenance dredging cycles, therefore the impacts of continued maintenance are considered to be minor. Potential impacts to water quality associated with the construction of the proposed PA 7 would consist of erosion and sedimentation during construction. During construction, storm water runoff could carry sediment off-site into Cedar Bayou and potentially result in temporary increases in Total Suspended Solids (TSS). These impacts would be temporary in duration and minimal in extent. The USACE would require the construction contractor to prepare a Storm Water Pollution Prevention Plan (SW3P) and implement erosion and sedimentation control Best Management Practices (BMPs) to minimize any detrimental effects to water quality during construction. A Section 404(b)(1) analysis form is included as Appendix C. The USACE would also acquire 401 Water Quality Certification from TCEQ. Release of water from the PA during maintenance disposal would be controlled by a spill box, ensuring that TCEQ guidelines for release are complied with.

The proposed project would disturb more than one acre of land, therefore the USACE would require the construction contractor to obtain a Texas Pollutant Discharge Elimination System (TPDES) storm water permit from TCEQ before the start of construction and to comply with all permit conditions. Any effects to water quality associated with the construction of the new facility would be short term and minimized by the use of BMPs.

The construction of the proposed PA 7 would not exacerbate bacterial, dioxin, or PCB levels to areas downstream of the project footprint. No long-term effects to water quality are expected as a result of the proposed project.

4.6 Impacts to Sediment Quality

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to sediment quality.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

A comparison of sediment quality data (Appendix I) with sediment quality screening guidelines indicates that Cedar Bayou sediments in the region are suitable for upland confined disposal. Therefore, unacceptable adverse impacts on sediment quality are not expected to result from dredging and discharge operations.

4.7 Impacts from Relative Sea Level Rise

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts from RSLR.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

The potential for RSLR to impact the TSP is minimal. The calculated worst case using tide gauges is under a foot (0.9 ft) and the worst case using monitored subsidence is 1.5 ft. The existing PAs in the vicinity currently do not have any type of armored protection and any new PAs would be constructed in a similar manner using typical construction methods. RSLR would not have an impact on the armoring requirements for the PAs. Finally, impacts on storm surge levels due to the project, with and without RSLR, are expected to be extremely minimal and insignificant.

4.8 Impacts to or from Hazardous, Toxic and Radioactive Waste Sites

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to or from HTRW sites.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

Construction of the TSP would not intercept contaminated soils and/or groundwater, disturb any hazardous materials or create any potential hazard to human health. The USACE would require the contractor take appropriate precautions to prevent, minimize and control the spill of fuels, lubricants, and/or other hazardous materials in the construction areas. In the event that hazardous materials are discovered during implementation of the proposed project, the Project Sponsor would be required to handle, manage, and dispose of petroleum products, hazardous materials and other toxic waste in accordance with the requirements of local, state and federal agencies.

4.9 Impacts to Prime and Unique Farmlands

Alternative 1: No Action

There are no prime or unique farmlands located within the project footprint.

Alternative 4: Confined Upland PA at the Abandoned RV Park

There are no prime or unique farmlands located within the project footprint.

4.10 Impacts to Wetlands

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to wetlands.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

While there are approximately 5.44 acres of wetlands (estuarine intertidal marsh) within the canals and along Cedar Bayou adjacent to the project area, construction of the TSP would only result in the filling of and impacts to approximately 2.56 acres of the wetlands in the four canals. All impacts to wetlands would be fully mitigated by creating 2.64 acres of wetlands onsite pursuant to the Mitigation Plan described in detail in Section 5.0. The proposed mitigation would generate 2.30 AAHUs providing a net increase in 1.26 AAHUs over the impact with-project conditions and an overall increase of 0.35 AAHUs above the No Action Plan. Thus, there would be a "no net loss" of wetland function and area and would fully compensate the loss of 0.91 AAHUs as a result of the construction of the proposed PA 7.

4.11 Impacts to Vegetation

Alternative 1: No Action

Once filled to capacity, PA 6 would not continue to receive maintenance material from the lower CBNC. Without the continued periodic placement of dredged material within PA 6, the disturbed interior of the site and surrounding dikes would likely begin to revegetate with opportunistic herbaceous and scrub shrub vegetation dominated by invasive species such as phragmites and Chinese tallow. The footprint of the proposed PA 7 is mostly cleared of trees and vegetation and is periodically mowed. It is most likely that the site vegetation would not change much over time if not maintained by mowing as practiced by the current landowner. However, should this practice cease it is probable that additional scrub shrub and forested species dominated by invasives would take over the site.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

The project footprint has been mostly cleared of vegetation since the 1950s. There are small clusters of trees in the area identified as forested/scrub, primarily on the southeastern side of the project footprint that would be removed to construct the containment dike. Most of these trees are less than 10 years old and are primarily invasive species. Following construction of the proposed PA 7, only vegetation on the top and side slopes of the containment dike would be managed to control the growth of woody vegetation that may interfere with maintenance of the dike. Vegetation within the containment dike would not be removed. Material would be pumped into the PA during maintenance dredging cycles, temporarily flooding the site. Over time, much of the scrub/shrub and herbaceous vegetation may die off, though between dredging cycles some species may continue to grow or reestablish within the limits of the containment dike. This is common practice for upland confined PAs and does not affect management of the site for capacity. Because of previous disturbance within the footprint of the proposed PA7, most of the upland vegetation, due to the current plan composition, is considered marginal habitat for many species, with low intrinsic wildlife value (USFWS, 2014) and mitigation for these uplands is not warranted.

4.12 Impacts from Invasive Species

Alternative 1: No Action

As stated in Section 4.11, without the continued periodic placement of dredged material into PA 6, the disturbed interior of the site and surrounding dikes would likely revegetate with both native and opportunistic herbaceous and scrub shrub vegetation dominated by invasive species such as phragmites and Chinese tallow. The cleared areas of the proposed PA 7 would also continue revegetate over time, and that newly scrub shrub and forested area would likely increase the dominance of invasive species throughout the site.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

The area surrounding the TSP is already heavily infested with invasive species, primarily Chinese tallow. It is unlikely that construction of the TSP would have an effect on the invasive species or result in an increase in their spread within the limits of the PA. Only vegetation in the footprint of the containment dike will be cleared and grubbed for construction of the dike which will then be planted with grasses and maintained as a park-like setting to facilitate future maintenance. Otherwise, the site will not be managed for invasive plants that may grow within the interior of the PA. In addition, the in the unlikely event that invasive species would establish in the mitigation site, they would be removed to ensure they comprise no more than 5 percent of the species composition per the monitoring plan described in Section 5.3.

4.13 Impacts to Wildlife

Alternative 1: No Action

Under the No Action Alternative, PA 6 would continue to receive maintenance dredged material from the lower CBNC until it reached capacity. Once maintenance dredging has ceased, wildlife that populated PA would be expected to utilize PA 6 without experiencing temporary displacement that would occur due to noise and filling of the PA during cyclical dredged material placement events. Therefore, no impacts to wildlife are anticipated under the No Action Alternative.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

Implementation of the TSP is anticipated to have a minimal and localized effect to wildlife populations in the vicinity of the project. Noise from continued placement of dredged material into PA 6 and construction and placement of material into PA 7 would affect small mammals and birds in the area immediately surrounding the project footprint. Depending on the species affected, construction of PA 7 may result in their temporary or permanent displacement of wildlife to surrounding areas. Similar or better habitat is located in the surrounding area where displaced wildlife could find permanent suitable habitat; some wildlife species would be expected to return and continue to use the available habitat in PAs between dredging events. Noise from construction is anticipated to temporarily disturb feeding behavior of wading birds and other aquatic and semi-aquatic bird species inhabiting the project area; however, suitable feeding habitat is present within the surrounding area. If project activities requiring vegetation removal or disturbance must be conducted during nesting season (March 15th through August 15th) surveys for nests would be conducted prior to commencing work. If a nest is found, and if possible, a buffer of vegetation would be allowed to remain around the nest until young have fledged or the nest is abandoned. The District would coordinate with the USFWS to establish recommendations for sufficient buffer distances prior to initiating work at the site to protect nesting birds, if present. The nearest active bird rookery is located St. Mary's Island, which is over 7 miles away from the project site; due to this long distance construction activities from the project would not have an impact on this rookery (USFWS, 2014).

4.14 Impacts to Fisheries and Essential Fish Habitat

Alternative 1: No Action

Under the No Action Alternative, the channel would be maintained and PA 6 would continue to receive maintenance dredged material from the lower CBNC until it reached capacity. Fish within the project vicinity would continue to avoid direct dredging impacts from continued maintenance dredging of the exiting channel by swimming away from the disturbance. During maintenance dredging, turbidity levels in the estuarine water column would periodically increase. These impacts would be minor in nature and of short duration, occurring only during dredging events, resulting in no adverse effects to EFH or fisheries.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

The impacts of maintenance dredging and construction of the TSP on fish would be similar to those effects experienced under the No-Action Alternative. Fish within the project vicinity would swim out of the area avoid direct placement activities within interior ends of the man-made canals to construct PA 7. Construction of PA7 would result in temporary increases in turbidity levels in the estuarine water column similar to levels experience during continued routine maintenance dredging. These impacts would be minor in nature and of short duration, resulting in no adverse effects to EFH or fisheries. Permanent impacts to 2.56 acres of tidal marsh dominated by *Spartina alterniflora* would be mitigated in-kind and on-site by constructing 2.64 acres tidal marsh as described in Section 5.0.

4.15 Impacts to Threatened and Endangered Species

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to threatened and endangered species.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

An assessment of the construction of the TSP's potential to affect federally listed threatened and endangered species and their habitat is documented in a BA (Appendix B). No critical habitat has been designated in or around the project footprint. Only federally listed threatened and endangered species documented as occurring in Harris and Chambers Counties by the Clear Lake Office of the USFWS were considered in further detail in the BA. The BA concludes that the TSP would not affect any federally listed threatened or endangered species or their habitats.

4.16 Impacts to Historic Properties

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to Historic Properties.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

The Cedar Bayou Archeological District is the only Historic Property within the footprint of the proposed PA, however all areas within the proposed footprint have been subjected to extensive modification from previous construction and dredging activities. Therefore, the TSP will have no adverse effect upon Historic Properties.

4.17 Impacts to Aesthetic Resources

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to aesthetic resources. Once full capacity has been reached, PA 6 would likely begin to revegetate with both native and opportunistic herbaceous and scrub shrub vegetation including invasive species such as phragmites and Chinese tallow. The overall view-shed would be similar to other areas in the vicinity dominated by forested and scrub-shrub species.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

Construction of the proposed PA 7 would impact the aesthetics of the project area. Approximately ¼ mile of the project footprint is visible from the bayou; this area currently consists of four canals constructed back into upland for the abandoned RV Park development. Construction and continued maintenance of the proposed PA 7 would change the setting from an upland site dominated by forest and scrub shrub habitat with an emergent tidal fringe wetland along the perimeter of the four canals to a setting that includes a grass-covered containment dike with emergent tidal fringe wetlands along the toe of the containment dike at Cedar Bayou. There would be no changes to aesthetic resources associated with the continued maintenance of PA 6. Since the footprint the proposed confined upland PA has already been heavily disturbed by past development and no longer supports a natural forested setting, the aesthetic impacts from construction of the TSP would be considered minor.

The portion of the containment dike for the proposed confined upland PA that would occur along Tri-City Beach Road would be approximately 12 feet high. However, the containment dike would be set back from the road and existing vegetation (mainly trees and shrubs) along the road would help obscure the containment dike from being seen from the road, the RV park, or the nearby subdivision.

4.18 Impacts to Recreational Resources

Alternative 1: No Action

Under the No Action Alternative, there would be no impacts to recreational resources as the majority recreational vessels are typically not draft restricted at the shallowest shoaled depth (7 feet) that is expected in the lower CBNC when capacity of PA 6 is reached and maintenance dredging is discontinued.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

No benefits to recreational resources would occur with continued maintenance of the lower CBNC as the majority recreational vessels are typically not draft restricted under the No Action Alternative and would not be expected to receive added benefits from continued maintenance of the channel. Marine based recreation could be temporarily adversely affected by equipment during maintenance events due to the presence of stationary dredging equipment in the channel. However, recreational boating access between the upper reaches of Cedar Bayou and Galveston Bay would still be available via the Houston Lighting and Power Canal located along the north side of the proposed PA

All access to construction the proposed PA 7 would be from the existing Tri-City Beach Road. Once constructed, public access to the new PA site would not be physically restricted by the use of fencing or other barrier, though the levees may be generally perceived as providing a physical barrier. Wet areas within the site are generally not considered a safety risk as the site borders deeper water.

4.19 Impacts to Traffic and Circulation

Alternative 1: No Action

Under the No Action Alternative, there would be impacts to roadway traffic and circulation. However, barge-related vessel traffic would be expected to increase as an increased number of light-loaded barge vessel traffic would be necessary to move the same amount of cargo through a shallower unmaintained channel.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

Implementation of the TSP would not result in negative impacts to the roadway traffic and circulation within the project area. No road closures would result from construction and use of the TSP. While construction equipment would use the Tri-City Beach Road to access the TSP footprint during construction and any subsequent maintenance activities, this use of the road would be limited and any impacts to traffic would be minor and temporary. Additionally, vessels traffic related to commercial navigation would likely benefit from construction and use of the TSP as there would be a fewer number of fully-loaded barges expected to move the same amount of cargo through a fully maintained channel

4.20 Impacts to Socioeconomic Resources

Alternative 1: No Action

Under the No Action Alternative, the lower CBNC would eventually run out of PA capacity and could no longer be maintained to full depth. At that time, the channel would fill in until it returned to its natural depth of about 7 feet. This would severely limit the ability to load barges transiting the channel to full capacity, requiring a greater number of light-loaded vessel transits to move the same amount of cargo. Limitations to the barge traffic and delays in cargo throughput would be expected to negatively impact the businesses along the CBNC and to the community of Baytown. The loss of commercial/industrial activity would adversely affect employment and employee income in the short-run. High unemployment would potentially increase rates of out migration. Unemployment and out migration would potentially affect the regional tax base and public services.

TSP – Alternative 4: Confined Upland PA at the Abandoned RV Park

The TSP would not have adverse or disproportionate impacts on minority or low-income populations. The socioeconomic analysis shows that the area within one mile of the project footprint does not contain a higher percentage of minority or low-income families than the overall project area, Chambers or Harris Counties. No impacts to socioeconomics and Environmental Justice populations would result from implementation of the TSP. The continued maintenance of the lower CBNC would benefit commercial/industrial activity and support continued employment and employee income in the area. Unemployment would potentially reduce rates of out migration.

5.0 MITIGATION

Public law and USACE policy require that potential adverse impacts of a project on fish and wildlife resources, including wetlands, be identified during project planning and mitigated during project implementation, and that mitigation shall be accomplished through appropriate actions to avoid, minimize, and compensate for unavoidable losses as required to clearly demonstrate efforts made to meet the goal of "no net loss" of wetlands. Mitigation planning under existing USACE policy requires the ability to quantify fish and wildlife resources, to estimate the impacts of a proposed project on those resources, and to use an incremental analysis technique to develop a mitigation plan which is cost-effective.

All practicable means to avoid or minimize environmental impacts due to construction of the TSP have been considered. The TSP has been designed with the smallest practicable footprint to still meet the requirements of the proposed project. In addition, 40 CFR §1505.2(c) states that a monitoring and enforcement program shall be adopted and summarized where applicable for any mitigation.

5.1 Habitat Evaluation Procedure Analysis

Habitat Evaluation Procedure (HEP) analysis, developed by USFWS, was performed on the project area for the TSP to determine the project impacts and appropriate amount of mitigation that would be required to replace the values and functions of the aquatic habitat lost due to construction of the PA. The full HEP analysis report can be found as Appendix E. The summary results of the HEP analysis are presented here.

<u>TSP Impact HEP Analysis</u>

Based on data from field investigations and aerial photos, it is estimated that the project site contains approximately 5.44 acres of estuarine tidal fringe wetlands located along the shorelines of Cedar Bayou (Figure 5.1). Results and comparison of Without- and With-Project AAHUs for Red Drum, Brown Shrimp Placement Area Impact HEP Analysis are presented in Table 5.1.

Without-project, the AAHUs for red drum and brown shrimp would be 1.40 AAHUs and 2.49 AAHUs, respectively. Based on the results in Table 1, the composite or average AAHU value for the species for the project area under the without-project scenario would be 1.95 AAHUs. Construction of the TSP would result in fill being placed in the canals to the limit of the TSP footprint, resulting in impacts to approximately 2.56 acres of emergent tidal fringe wetlands located along the shorelines of the canals within the site (Figure 5.2). With-project, the AAHUs for red drum and brown shrimp would be reduced to 0.76 AAHUs and 1.32 AAHUs, respectively, while the overall site average would be reduced to 1.04 AAHUs. Based on the without- and with-project results, the net average annual impact due to construction of the proposed PA would be a loss of 0.64 AAHUs and 1.17 AAHUs, for the red drum and brown shrimp, respectively. Overall, this would amount to an average loss of 0.91 AAHUs for the project site.

Figure 5.1 Proposed Placement Area and Existing Tidal Wetlands

Table 5.1. Comparison of Without- and With-Project AAHUs for Red Drum, Brown Shrimp Placement Area Impact Analysis

	WITHOUT-PROJECT AAHUs	WITH-PROJECT AAHUs	CHANGE AAHUs
RED DRUM	1.40	0.76	-0.64
BROWN SHRIMP	2.49	1.32	-1.17
SITE AVERAGE	1.95	1.04	-0.91

5.2 Proposed Placement Area and Resulting Tidal Wetland Impacts.

Mitigation HEP Analysis

In order to compensate for this loss of 2.56 acres of tidal wetland habitat, four compensatory mitigation alternative plans were investigated. The goal of the mitigation alternatives would be to replace the ecological functions and services provided by wetlands that would be impacted by construction of the TSP. All four plans consist of the creation of wetlands in conjunction with invasive vegetation management.

5.2 Mitigation Alternatives

Implementation guidance for Section 2036(a) of WRDA 07 (Mitigation for Fish and Wildlife and Wetland Losses), issued August 31, 2009, requires that water resource projects resulting in wetland impacts within the service area of a mitigation bank shall first consider the use of a bank (assuming appropriate credits are available). The draft EA was developed this fall (2013), and at that time, there were no approved mitigation banks in this area that could have been used for mitigation planning. Very recently, a new mitigation bank – the Gulf Coast Plains Mitigation Bank (GCPMB) - was been established that could have potentially been used for mitigation planning for this project, as the project does occur within the bank's secondary service area. While the GCPMB has the appropriate type of credits available for mitigation for impacts resulting from this project, the credits are determined using the Tidal Fringe Interim Hydrogeomorphic Model (iHGM), which has not been certified or approved for use in Civil

Works planning projects by the EcoPCX and HQ. As such, mitigation alternatives that included onsite and in-kind wetland creation was considered and evaluated for the project.

Each of the mitigation alternatives discussed below would include onsite excavation of the higher elevation upland habitats located between the excavated canals within the abandoned RV park to an elevation that is appropriate to support estuarine intertidal emergent marsh. These uplands have been periodically cleared of vegetation since the 1950s. There are small clusters of trees and shrubs within the footprints of the mitigation alternatives that would be removed during excavation of the uplands to target marsh elevation. Most of these trees shrubs are less than 10 years old and include invasive species.

Mitigation Alternative Plan 1

Under Mitigation Alternative Plan 1, 2.64 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass would be created to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 5.52 acres of wetlands at the project site, resulting in a “no net loss” of wetland area. To create the 2.64 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 5.3). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

Mitigation Alternative Plan 2

This alternative would create 2.73 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 5.29 acres of wetlands at the project site, resulting in a “no net loss” of wetland area. To create the 2.73 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 5.4). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction, by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on 3 foot centers.

Figure 5.3. Mitigation Alternative Plan 1

Figure 5.4 Mitigation Alternative Plan 2

This alternative would create 3.01 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 5.57 acres of wetlands at the project site, resulting in a “no net loss” of wetland area. To create the 3.01 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 5.5). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction, by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

Mitigation Alternative Plan 4

This alternative would create 3.61 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 6.17 acres of wetlands at the project site, resulting in a “no net loss” of wetland area. To create the 3.61 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 5.6). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction, by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

Construction of the proposed project would impact approximately 2.56 of the existing 5.44 acres of estuarine intertidal emergent wetlands dominated by smooth cordgrass located at the project site. Each of the proposed mitigation alternative plans would more than replace the habitat acres lost from construction activities, by creating 2.64, 2.73, 3.01 or 3.61 acres of wetlands, resulting overall in approximately 5.52, 5.61, 5.89 or 6.49 acres of wetlands at the project site. Implementation of any of the mitigation plans in addition to the project impacts, would provide about the same habitat quality (HSI) for red drum, as the percentage of available open water edge fringed with persistent emergent vegetation would remain relatively unchanged despite the overall gain in marsh area. Mean temperature, salinity and water depth would also remain unchanged. Likewise, the HSI for brown shrimp, would remain relatively unchanged from the without project condition as the area of estuary that is vegetated, though somewhat larger, would

Figure 5.5. Mitigation Alternative Plan 3

Figure 5.6. Mitigation Alternative Plan 4

still have about the same percent cover for the species. For all mitigation alternatives, AHHUs for both species and the site average would increase as a result of the overall increase in wetland acreage. For each of the four mitigation alternatives plans, the project variable trends and calculation of HSIs for red drum and brown shrimp are presented in Appendix A.

The net average annual impact (adverse or beneficial) of the proposed project is equal to the difference between the without-project AAHUs and the with-project AAHUs. Overall, post-project implementation, including project impacts and mitigation, this project site would yield an average of 2.30, 2.34, 2.5 and 2.81 AAHUs (Table 5.2). These results reflect a very slight net gain in the overall site average of 0.35, 0.39, 0.55, and 0.86 AAHUs above the without-project condition of implementing no project at all, demonstrating full compensation for impacts. Based on these results, any of the proposed mitigation alternative plans would provide full replacement for the predicted losses.

Table 5.2. Comparison of Net Change between in AAHUs for the Impact and Impact Plus Mitigation With-Project Scenarios

MITIGATION ALTERNATIVE	EVALUATION SPECIES	IMPACT WITH-PROJECT AAHUS	IMPACT + MITIGATION WITH-PROJECT AAHUS	NET CHANGE AAHUs
PLAN 1 (create 2.64 acres)	red drum	0.76	1.42	0.66
	brown shrimp	1.32	3.18	1.86
	Site Average	1.04	2.30	1.26
PLAN 2 (create 2.73 acres)	red drum	0.76	1.45	0.69
	brown shrimp	1.32	3.23	1.91
	Site Average	1.04	2.34	1.3
PLAN 3 (create 3.01 acres)	red drum	0.76	1.52	0.76
	brown shrimp	1.32	3.49	2.17
	Site Average	1.04	2.50	1.46
PLAN 4 (create 3.61 acres)	red drum	0.76	1.67	0.91
	brown shrimp	1.32	3.94	2.62
	Site Average	1.04	2.81	1.77

Cost Effectiveness and Incremental Cost Analysis

Cost Effectiveness and Incremental Cost Analysis (CE/ICA) was used to evaluate the best mitigation plan based on habitat benefits determined through HEP outputs and construction and maintenance costs. Annualized costs for the proposed mitigation alternative plans were developed CE/ICA using a 3.75% interest rate and a 0.071962 amortization factor for construction (amortized over the 20-year project life) (Table 6). The costs took into consideration both mitigation plan construction costs, monitoring the year of construction and annual monitoring for the first five-years after construction. Using CE/ICA, mitigation plans providing the greatest increase in benefits for the least increase in costs are identified as the "Best Buy" plans. The No Action plan and four mitigation plans were evaluated and the results are shown in Table 5.2 and Figure 5.7.

Based on the results of the HEP analysis and CEICA, Mitigation Alternative Plan 1 was identified as most cost-effective, incrementally effective solution proposed, providing 2.30 AAHUs at an average annual cost of $33,185, and incremental cost of $14,428.26 per AAHU over the No Action Plan. Mitigation Alternative Plan 1 was selected as the recommended mitigation plan. This plan had the lowest incremental cost per unit of output, and it is a cost effective solution and the least expensive alternative plan with a total cost of $464,421. The 2.30 AAHUs (site average) that would be generated from the 2.64 acres of estuarine intertidal emergent wetlands created under Mitigation Alternative Plan 1 would provide a net increase in 1.26 AAHUs over the impact with-project conditions and an overall increase of 0.35 AAHUs above the No Action Plan. Thus, Mitigation Alternative Plan 1 would result in "no net loss" of wetland function and area and would fully compensate the loss of 0.91 AAHUs as a result of the construction of the proposed PA.

Table 5.3. Cost Effectiveness and Incremental Cost Analysis
of Mitigation Alternative Plans
(October 2012 Prices, 3.75% Interest)

Mitigation Alternative Plan	Net increase in AAHUs	Total Costs (Construction plus monitoring)	Average Annual Cost	Average Annual Cost per AAHU	COST EFFECTIVE	Incremental Cost per Output
No Action	0.0	$0	$ 0.00	---	BEST BUY	---
Plan 1	2.30	$ 464,421	$ 33,185	$ 14,428.26	BEST BUY	---
Plan 2	2.34	$ 476,140	$ 34,029	$ 14,542.31	YES	---
Plan 3	2.50	$ 515,525	$ 36,863	$ 14,745.20	YES	---
Plan 4	2.81	$ 589,326	$ 42,174	$ 15,008.54	BEST BUY	$ 17,355.56

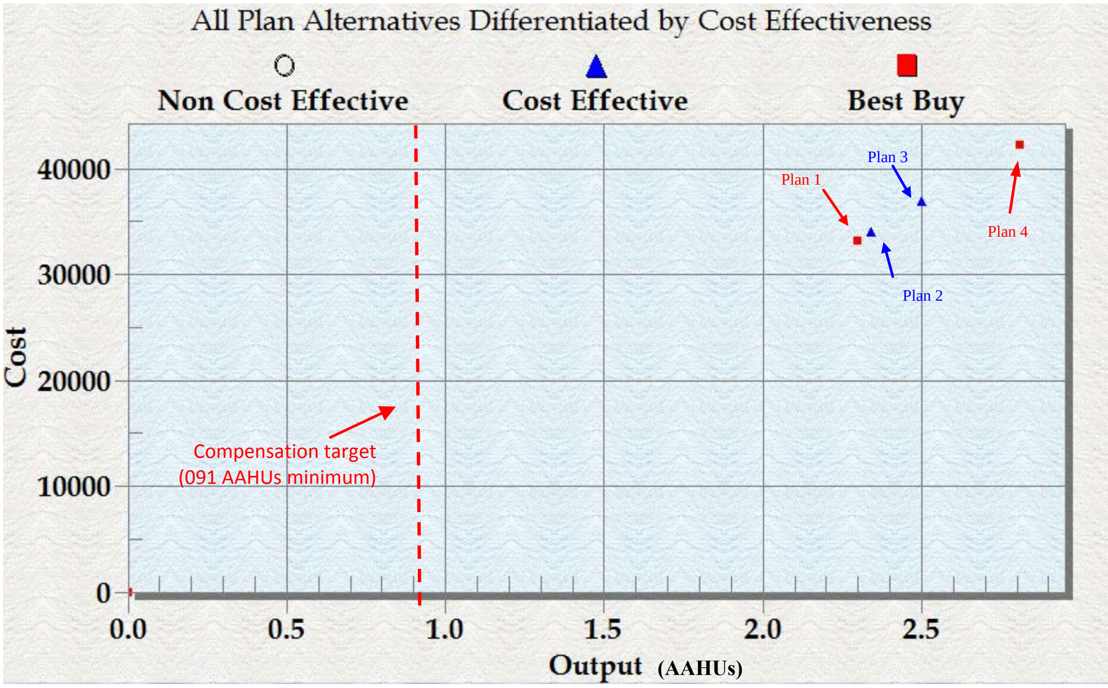

Figure 5.7. Cost Effective and Best Buy Plans.

5.3 Monitoring

The USACE Galveston District and Project Sponsor would be responsible for the implementation and costs of monitoring activities at the mitigation site. Parameters to be monitored include the presence of invasive/noxious/exotic plant species and establishment of native/typical emergent marsh. Smooth cordgrass dominates fringe marsh along the shoreline and it is expected that this species would expand and colonize the area along the newly created marsh, the shoreline and within the canals. Table 5.3 describes the objectives, performance standards, monitoring methods, and remedial actions associated with monitoring these parameters.

Table 5.4 Summary of Monitoring Objectives and Performance Standards		
Monitoring Parameters		
Objective	Ensure that estuarine marsh has been established	
Performance Standards	Invasive species should comprise less than 5 percent of vegetative cover	The marsh site should contain 60 to 80 percent cover of smooth cordgrass (*Spartina alterniflora*) five years post construction
Monitoring Methods	Visual observation along transects with photo documentation	
Remedial Actions	Implement any necessary actions to remove and manage undesirable species	Additional planting and consider use of fill material to establish appropriate elevation for growth
Schedule	Monitor annually until performance standards are met	

Estuarine intertidal marsh dominated by *Spartina alterniflora* would be expected to establish quickly within the mitigation site, provided the proper target elevation is achieved after construction. Though invasive species are problematic within the upland habitats of the proposed PA footprint, they would not be expected to be present within estuarine intertidal marsh when constructed at the proper elevation for tidal inundation of estuarine waters. Invasive species populating the mitigation footprint would be considered an unlikely scenario, but would be managed if necessary through removal.

The resource being mitigated is intertidal marsh comprised of a monotypic stand of smooth cordgrass (*Spartina alterniflora*). For this resource, visual observation with photo documentation at fixed points within the marsh is an acceptable method for estimating percent foliar cover of marsh vegetation without the need for using scientific sampling protocols that employ transects and quadrats that may increase time, effort and costs associated with monitoring.

Monitoring would occur the year of construction and for the first five-years after construction. Monitoring costs include costs for annual site visits beginning after construction and for the first 5 years, followed by an analysis of the monitoring observations and report documenting the monitoring effort and results. The mitigation site would be determined to be successful if both performance standards are met. Remedial actions as described in Table 5.3 would be implemented if performance standards are not met after annual monitoring results are analyzed in order to correct any observed problems.

6.0 CUMULATIVE IMPACTS

A cumulative effect is defined as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR Part 1508.7). The following analysis abides by the CEQ's Considering Cumulative Effects under the National Environmental Policy Act (CEQ, 1997), and Memorandum and Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (CEQ 2005).

The geographic scope for the cumulative effects analysis focuses on changes to the region of the upper and lower CBNC. The discussion includes a general reference to overall influences to the region as a result of the navigation improvements in Galveston Bay. The general timeframe over which future anticipated impacts have been considered is 20 years.

Specific projects that are occurring or expected to occur in the project area that may have a cumulative effect to the environment are described in the following sections.

Dredging of the Lower Channel of Cedar Bayou, Texas

In 1931, the USACE dredged a 3.5 mile segment of the authorized channel from the HSC to just upstream of the mouth of Cedar Bayou to dimensions of 10 feet deep at mean low tide (MLT) and 100 feet wide (bottom width). In 1975, the 10-foot deep by 100-foot wide channel was extended to Mile 3. The USACE continues to maintain these dimensions in the lower 5.7 miles of the CBNC (from the HSC to Mile 3), with the last maintenance dredging being completed in 1999. Past maintenance dredging of the Lower Channel has been performed approximately every five years. Future maintenance dredging of the channel would continue to occur every 5 years.

Dredging of the Upper Channel of Cedar Bayou, Texas

Above Mile 3, no Federal navigation improvements have been made, and Cedar Bayou Channel remains a relatively natural channel. Construction of the navigation channel for Upper Channel of the Cedar Bayou, Texas Project (Mile 3 to SH 146) has been reauthorized. Once construction has been completed, maintenance dredging of the Upper Channel would occur approximately every 5 years, along with the continued maintenance dredging of the Lower Channel (between the HSC and Mile 3).

Grand Parkway

The Grand Parkway is a proposed four-lane, 170-mile circumferential highway that would eventually traverse seven counties and encircle the greater Houston area. Factors evaluated during the continuing development of the various segments of the proposed highway include existing and future traffic demands, land acquisition, construction funding, and environmental impacts. The segment of the Grand Parkway that is most relevant to this cumulative impact assessment is Segment I-2. The entire length of Segment I-2 would extend along SH 99 from SH 146 on the southeast side of Baytown, across Cedar Bayou to FM 1405 and northeast to IH 10. Segment I-2 received a Record of Decision (ROD) in August 1998. A reevaluation of the EIS was prepared in 2012. The first phase of Segment I-2 (IH 10 to FM 1405) was completed and opened to traffic in 2008. TXDOT is currently working on the design of Segment I-2 from FM 1405 to SH 146.

Cedar Crossing Industrial Park and Other Present and Future Developments

Cedar Crossing Industrial Park is a 15,000-acre industrial and business development that is located on the east side of Cedar Bayou near SH 99 and was purchased by a local investment group led by Fidinam Capital. The industrial park includes rail line and has direct access to the proposed Grand Parkway, SH 146, and IH 10. It operates a dock at Mile 2.5 of Cedar Bayou. Recent purchases and developments within the park include purchases by Bailey Capital, Home Depot, Inc., and Wal-Mart for development of regional distribution centers.

Other developments that may reasonably be expected to occur in the project vicinity include residential development on the west side of Cedar Bayou near Galveston Bay and industrial development of the large tracts of currently undeveloped properties on the east side of the bayou.

Transportation

Several planned road and highway projects and studies would impact the project region. These include highway projects listed in TxDOT's 2022 Metropolitan Transportation Plan (MTP) and Transportation Improvement Plan (TIP) for the region, and other local transportation developments in the area. These projects would have cumulative impacts to the area by converting land use and land cover, creating impervious cover, and potentially affecting runoff and water quality.

Industrial

The project region has a large industrial base associated with the Port of Houston and oil and gas activities in the area. Further development of industries in the area would continue, and additional waterborne, roadway, and rail transportation would be required to support it. These developments would also cumulatively impact the project region.

Navigation

Projects involving navigation are occurring in the Houston-Galveston area and are associated with the HSC and auxiliary channels. An ongoing deepening and widening project in the HSC sponsored by the USACE and the Ports of Galveston and Houston would continue. Besides improving the navigation channels, the HSC deepening and widening project involves beneficial use of dredged material for island and marsh creation.

The past and reasonably foreseeable future impacts within the project area would a result of the three largest projects – past construction and continued maintenance of the Lower Channel, future construction and maintenance of the Upper Channel, and Grand Parkway construction – are discussed in more detail in this section along with the future impacts from the TSP for the Cedar Bayou DMMP are shown in Table 6.1.

Table 6.1 Cumulative Impacts				
Resource Type	Cedar Bayou DMMP	Dredging of the Upper Channel of Cedar Bayou, Texas	Dredging CBNC Lower Channel	Grand Parkway
Aquatic Habitats				
Open Water	2.6 acres *Man-made canal	128 acres	28 acres	NI
High Salt Marsh	NI	NI	120 acres	NI
Low Salt Marsh	NI	3.6 acres	6.9 acres	NI
Brackish Marsh	2.56 acres	0.2 acres	NI	NI
Freshwater wetlands	NI	NI	NI	No USACE jurisdictional impacts
Man-Made Ponds	NI	NI	NI	0.4 acres
Essential Fish Habitat	NI	135.8 acres	NA	NI
Upland Habitat				
Native Hardwoods	NI	5.5 acres	NA	24 acres
Tallow-dominated woodlands	40 acres	5.9 acres	NA	189 acres
Scrub/Shrub	50 acres	64 acres	NA	NA
Improved Pasture	NI	56.4 acres	NA	NA
Threatened and Endangered Species	NI	NI	NI	NI
Cultural Resources	NI	NI	NI	NI
HTRW Sites	NI	NI	NA	NI
Floodplains	NI	NA	NA	Negligible
Socioeconomics				
Environmental Justice	NI	NI	NI	NI
Relocations	0	0	0	0
Noise Impacts	Temporary	Temporary	NI	1 school
Parks	NI	Temporary Noise	NI	Noise

NI = No Impacts; NA = Not Available

Past, present, and future development in the project study area has had both adverse and beneficial cumulative effects to the surrounding environment. Potential adverse effects resulting from past, present and future development in the area includes loss of wetlands and forested areas along the Cedar Bayou corridor, and air and water quality impacts. Beneficial effects of development in the project study area include conversion of bay bottom to emergent marsh (beneficial use sites), and new economic and employment opportunities associated with sustained or improved navigation related commerce.

Additional housing, infrastructure, and commercial and public land uses required to serve the future population would result in continued development in the region. As development continues, transportation improvements would be needed. The conversion of natural wildlife habitat and agricultural lands into commercial, residential or industrial land uses would continue to disrupt and disperse fish and wildlife populations. The loss of wetlands and forested areas in the area would continue to affect natural resources. Development of sites that can be used beneficially for the environment would preserve, restore, and create habitat to ensure the ecosystem's sustainability.

The proposed project is anticipated to result in both adverse and beneficial impacts to the surrounding physical, biological, and human environments. All adverse impacts that are anticipated to occur due to construction of the proposed project would be minimal. Adverse impacts to environmental resources would be minimal.

Adverse impacts to the physical environment include those impacts associated with moving sediments from one location to another to construct PA 7 and continue maintaining the lower CBNC. Land use and topography within the footprint of the proposed PA 7 would be permanently changed from by raising the elevation of the area to construct containment dikes for the PA. Although construction of the new PA and continued maintenance dredging would affect water quality, the impacts would be minor as a result of temporary, localized turbidity during those actions. Use of best management practices and spill prevention measures would result in minimal adverse impacts to water quality and aquatic resources in the project study area.

Adverse impacts to the biological environment include those impacts associated with the alteration of the existing disturbed upland habitat and tidal estuarine fringe wetlands along man-made canals within the project site. Upland vegetation would be permanently affected in the footprint of the proposed PA 7 by the construction of containment dikes and period placement of maintenance dredged material over time. Unavoidable wetland impacts would be fully compensated per the mitigation plan described in Section 5.0. Minimal and localized adverse affects to aquatic habitat located outside the proposed PA 7 footprint would be expected due to the potential increase in turbidity within the water column and the potential fallout of sediment on the bay bottom. Minimal, temporary, and localized impacts to wildlife resources are expected. Wildlife in the vicinity of the project area may be permanently or temporarily displaced due to the presence of construction activities. Displaced wildlife could find permanent suitable habitat in similar areas located adjacent to the project site; some wildlife species would be expected to return and continue to use the available habitat in PAs between dredging events.

Adverse impacts from the proposed project on the human environment are anticipated, but would be minimal. Air quality impacts from construction of the PA would be minor as they are temporary and of short duration, with emissions below within de minimis levels. Continued maintenance of the channel would involve fewer air emissions and less noise associate with barge traffic under the TSP Alternative as a result in more efficient movement of cargo through the channel using fewer vessels. Any adverse noise impacts during construction of PA 7 would be temporary during construction and periods of maintenance dredge material placement. Marine based transportation and recreation could be temporarily adversely affected by equipment during construction of the PA and use of stationary dredging and during subsequent maintenance dredging within the lower CBNC. Recreational boating access between the upper reaches of Cedar Bayou and Galveston Bay would still be available via the Houston Lighting and Power Canal located along the north side of the proposed PA. Visual and aesthetic resources would be minimally impacted as construction of containment dikes would alter view-fields from Tri-City Beach road from an upland forest/scrub shrub community to that of an upland confined PA, though some vegetated buffer may return along the road just outside the toe of the containment dike.

Beneficial effects of the proposed project would include more regular maintenance dredging cycles and more efficient dredged material management allowing the lower CBNC to remain open without draft restrictions. Existing jobs would be retained and potential jobs would be created, enhancing the socioeconomic wellbeing of the communities surrounding the project area.

As a result of past and present activities, the proposed PA construction would occur within an area that has undergone extensive channel and placement area construction, and urban, industrial and commercial development. As such, the area is considered disturbed compared to other areas of Cedar Bayou upstream of the project site. Construction of the proposed PA 7 for the Cedar Bayou DMMP would impact approximately 2.56 acres of estuarine intertidal emergent marsh dominated by *Spartina alterniflora* that occurs along the shorelines of dead end man-made canals constructed during past development of the site and an RV park. These impacts would be fully offset by creating 2.64 acres of estuarine intertidal emergent wetlands at the project site by excavating upland areas along the shoreline of Cedar Bayou. The habitat assessment that was performed on the project area and TSP demonstrating the values and functions of the impacted aquatic habitat that were lost due to construction of the PA have been fully mitigated is provided in Section 5.0 and Appendix E of this EA. The water column and water quality would be temporarily affected by turbidity during construction activities. Emissions from construction activities would not exceed air quality standards (see Appendix D). All other impacts associated with the proposed PA for the Cedar Bayou DMMP would be temporary or short-term impacts during the duration of project construction as discussed in Section 4.0 of this EA. The continued maintenance of the Lower CBNC would have long term beneficial impacts on the socioeconomics of tenants and customers in the project area by allowing vessels to continue calling on the port facilities along Cedar Bayou.

In conclusion, the anticipated adverse impacts of the proposed project to human health and the environment are minimal and would not significantly contribute to the cumulative effects of past, present and future projects within the project vicinity.

7.0 COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

The planning of the proposed project is in accordance with the "USACE Campaign Plan" goals. Potential direct and indirect effects inside and outside the project areas have been considered. Risk and uncertainty have been considered in evaluating alternatives, which are discussed in this document. The TSP has been selected based on interdisciplinary coordination that utilizes the best professional and technical expertise available during the planning process.

Further, this EA has been prepared to satisfy the requirements of all applicable environmental laws and regulations. Preparation was in accordance with the CEQ's implementing regulations for NEPA, 40 CFR Parts 1500 – 1508, and the USACE Engineer Regulation (ER) 200-2-2, Environmental Quality: Procedures for Implementing NEPA. The planning and implementation of the proposed project is consistent with the USACE Environmental Operating Principles.

The following list of applicable environmental laws and regulations were considered in the planning of this project, and their status of compliance to each.

<u>National Environmental Policy Act</u>: This environmental assessment has been prepared in accordance with CEQ's implementing regulations for NEPA. The environmental and social consequences of the TSP have been analyzed in accordance with NEPA and presented in the assessment.

<u>Endangered Species Act</u>**:** A Draft BA has been prepared to support the USACE coordination of the draft EA's Proposed Action with the USFWS and NMFS regarding threatened, endangered or proposed species and their critical habitats in the project area. Status information on species was obtained from the USFWS (2014 b) and NMFS (2014). Additional information regarding threatened, endangered or proposed species and their critical habitats in the project area was provided by the USFWS in a Planning Aid Letter (PAL) on August 5, 2014 (Appendix A-1). The

BA concluded that the Proposed Action would have no effect on Federally listed threatened or endangered species (Section 4.13). The BA is provided in Appendix B.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act provides for consultation with the USFWS and, in Texas, with TPWD whenever the waters or channel of a body of water are modified by a department or agency of the U.S. Under this Act, the Federal department or agency shall consult with the USFWS and the State agency with a view to the conservation of wildlife resources. The Act's purposes are to recognize the vital contribution of our wildlife resources to the Nation, and their increasing public interest and significance, and to provide that wildlife conservation receive equal consideration and be coordinated with other features of water-resource development programs through planning, development, maintenance, and coordination of wildlife conservation and rehabilitation. A PAL was prepared by the USFWS on August 5, 2014, and is included in Appendix A-2. Submittal of the Draft EA will serve to initiate coordination with TPWD.

The District concurs with PAL recommendations 10, 14 and 15 pertaining to the West Indian manatee, bald eagle, sea turtles and essential fish habitat. In fulfillment of the requirements of the Migratory Bird Treaty Act (MBTA), the District would implement the recommendations 9 and 13 regarding nesting birds and rookeries, but would coordinate with the USFWS to establish sufficient buffer distances prior to initiating work at the site. If project activities requiring vegetation removal or disturbance must be conducted during nesting season (March 15th through August 15th) surveys for nests would be conducted prior to commencing work. If a nest is found, and if possible, a buffer of vegetation would be allowed to remain around the nest until young have fledged or the nest is abandoned.

The District does not concur with the USFWS's assessment that the alternatives considered do not fully demonstrate efforts to avoid or minimize wetland impacts at the project site (PAL recommendation1). Alternative sites to the proposed TSP were considered throughout the screening process. USACE policy requires that for a DMMP, the selected plan must be the least cost, environmentally acceptable plan. Some sites considered during the screening process included greater environmental impacts than the TSP, while others included fewer impacts but involved higher construction and or maintenance costs. Raising levees at the existing nearby PA6, as recommended in the PAL, is currently included in the TSP. Levees at PA6 would raised to their maximum height over the next three remaining maintenance cycles (See Table 2.4), the last of which would occur in 2026 at which time the PA would be filled to capacity. Reconfiguring the proposed PA7 footprint to exclude impacts to tidal wetlands along Cedar Bayou would reduce the site footprint by approximately 25 acres which would dramatically decrease its capacity below the 20 years required for the DMMP. Extending the PA7 configuration south to regain the capacity associated with that 25 acres would have resulted in impacts to high quality forested uplands and riparian forested wetlands located in that area. Thus, the proposed TSP represents the least cost environmentally acceptable plan for the DMMP.

The District does not concur with the PAL recommendation 2 which would require all removing infrastructure debris and placing it offsite at a suitable landfill. Asphalt materials from demolition of the existing roads within the site would be collected and buried within the interior of the PA in areas where the drainage/sewer infrastructure will have been removed. Debris from demolition of drainage and sewer consisting of concrete rubble and cast iron piping would be buried in the canals only after the exterior containment dike has been constructed in order to isolate the debris from Cedar Bayou. All debris would eventually be covered with maintenance dredged material. The District is not aware of any water quality issues that may be caused by burial of demolished concrete and piping inside the confined limits of the PA dike. The District will coordinate with the TCEQ to ensure compliance with the 404(b)(1) guidelines regarding water quality and implement best management practices to avoid debris and soil during construction of the dike from entering the nearby waterways as outlined by recommendation 12.

PAL recommendations 1, 3, 4, and 5 pertain to beneficial use of dredged material and included comments regarding the Corps' reluctance to use dredge material beneficially, and consider additional BU opportunities. USACE policy requires that BU opportunities be considered during plan formulation. For DMMPs, the USACE must select the least cost placement plan that provides sufficient placement capacity for the period of analysis for the project (in this case 20 years). Thus, a TSP for a DMMP may include BU alternatives when they are the least cost option. More than a dozen BU alternatives (Table 2.1) within a 6-mile radius of the project area were explored during the screening process for the Cedar Bayou DMMP study, four of which were combined (Alternative 2) and carried forward for further analysis. In addition, the three additional BU sites suggested by the USFWS in the August 5, 2014 PAL were considered. However, BU opportunities either didn't provide enough capacity due to the shallow nature and small size of the sites, and or when combined), were too costly due to the number and proximity of the sites requiring relocation of the dredging plant and pipelines. Such was the case regarding Alternative 2 as well as the three suggested sites in the August 2014 PAL. In addition, many of the proposed BU sites located in the bay would have required extensive shoreline protection from wind driven waves due to the large fetch at these locations. This would further increase costs for some sites, including the sites suggested in the PAL.

PAL recommendation 6 called for the inclusion of an upland component to the HEP analysis to mitigate for impacts to forest and scrub shrub habitat, yet the discussion of habitat in the PAL described these upland resources as having low value for wildlife due to the current plant composition which includes invasive and exotic species. Furthermore, the uplands located within the limits of the proposed PA7 are not considered significant resources for which impacts must be mitigated as they are not technically, institutionally, or publicly recognized as having substantial non-monetary value from an ecological, cultural or aesthetic standpoint (Engineering Regulation 1105-2-100). Based on USACE regulation and the PAL's description of the uplands at the project site, mitigation for this upland habitat is not warranted as recommended.

The District does not concur with PAL recommendations 7 and 11. The currently proposed mitigation plan provides sufficient compensation for impacts resulting from the proposed TSP as discussed in Section 5.0. Most of the shoreline and tidal marsh surrounding the site of the proposed PA7 do not appear to be eroding or require protection, save for the 680-feet of shoreline located immediately northwest of the Tri City Bridge along the HL&P Canal. Adding shoreline protective measures at this one location would considerably increase project costs and provide less than 0.2 acre of additional tidal marsh habitat. Should future shoreline erosion at this or any other location threaten the proposed PA 7, the District may consider implementing recommendation 7 to protect the PA.

The District would implement PAL recommendation 8, in part. Invasive species populating the tidal marsh mitigation footprint would be considered an unlikely scenario, but would be monitored and managed if necessary through removal to ensure they comprise less than 5 percent of vegetative cover as described in Section 5.3. As discussed in Section 4.11, only vegetation on the top and side slopes of the PA containment dike would be managed to control the growth of woody vegetation that may interfere with maintenance of the dike following construction; this would include removing invasive woody vegetation. During maintenance cycles, dredged material would be pumped inside the PA temporarily flooding the vegetation. Some plants may die off, though between dredging cycles, some species would be expected to continue to grow or reestablish within the site. Vegetation within the interior of containment dike would not be removed or managed to control invasive species.

Clean Water Act: The Proposed Action was analyzed pursuant to Section 404(b)(1) of the Clean Water Act and this analysis is included in Appendix C. Coordination with the TCEQ will be pursued. The TCEQ is responsible for the issuance of the state water quality certification pursuant to Section 401 of the Clean Water Act. A copy of the state water quality certification will be included in Appendix C of the final EA.

National Historic Preservation Act: Compliance with the NHPA requires identification of all properties in the project area listed on, or eligible for listing on, the NRHP. For any adverse affects to Historic Properties, mitigation measures must be developed in consultation with the SHPO and the Advisory Council on Historic Preservation (ACHP). No listed properties or properties eligible for listing have been identified within the vicinity of the project area. Coordination with the SHPO has been initiated, seeking concurrence with a determination of no effect to Historic Properties by construction of the TSP. A copy of the SHPO consultation letter will be included in Appendix A of the final EA.

Clean Air Act: NAAQS have been established by the EPA to protect public health and welfare. The State of Texas has adopted these standards as the air quality criteria for the state. The TSP is located in Harris County which is a non-attainment area for ozone. Emissions from the construction of the TSP are not considered regionally significant (Section 4.3; Appendix D).

Executive Order 11990 (Protection of Wetlands): The TSP has been analyzed for compliance with Executive Order 11990. Construction of the project would result in impacts to 2.56 acres of wetlands. These wetlands are located within previously disturbed areas (channels cut into the uplands during construction of the abandoned RV Park). Mitigation for the impacts is described in Section 5 and will be coordinated with USFWS and NMFS.

Executive Order 11988 (Floodplain Management): Federal agencies are directed to evaluate the potential effects of proposed actions in floodplains. Construction activities would occur within floodplains as the result of construction of the TSP. No practicable alternatives exist for avoiding impact to floodplains that would serve the purpose and need of the proposed project.

Council on Environmental Quality (Memorandum; Prime or Unique Farmlands): There are no Prime or Unique Farmlands within the footprint of the TSP.

Executive Order 12898 (Environmental Justice): Federal agencies are required to identify and address (as appropriate) disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. Construction of the TSP would have no disproportionately high or adverse impacts on minority or low-income populations.

Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984: The Hazardous, Toxic, and Radioactive Waste (HTRW) assessment performed as part of the proposed project complies with the requirements of RCRA and HSWA. There are no known HTRW sites that would be affected by construction of the TSP.

Migratory Bird Treaty Act (MBTA): The MBTA of 1918 extends Federal protection to migratory bird species. The nonregulated “take” of migratory birds is prohibited under this act in a manner similar to the prohibition of “take” of threatened and endangered species under the Endangered Species Act. EO 13186 “Responsibility of Federal Agencies to Protect Migratory Birds” requires Federal agencies to assess potential effects of their actions on migratory birds.

The timing of construction activities would be coordinated to avoid impacts to migratory and nesting birds. In fulfillment of the requirements of the MBTA, the District would coordinate with the USFWS to establish sufficient buffer distances prior to initiating work at the site. If project activities requiring vegetation removal or disturbance must be conducted during nesting season (March 15th through August 15th) surveys for nests would be conducted prior to commencing work. If a nest is found, and if possible, a buffer of vegetation would be allowed to remain around the nest until young have fledged or the nest is abandoned.

Memorandum of Agreement between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agricultural to Address Aircraft-Wildlife Strikes: This Memorandum of Agreement (MOA) was developed with the intention to minimize wildlife risks to aviation and human safety, while protecting the Nation's valuable environmental resources. Pursuant to this MOA, Agencies should not construct projects within a specified distance of airports that may become an attractant to wildlife deemed hazardous to aircraft. There are no airports within the distances specified in the MOA.

Protection of Environment, Executive Order 11514: This EO directs federal agencies to "initiate measures needed to direct their policies, plans and programs so as to meet national environmental goals." The proposed project complies with EO 11514.

Executive Order 13186 (Migratory Bird Habitat Protection): Section 3a and 3e of EO 13186 directs federal agencies to evaluate the effects of their actions on migratory birds, with emphasis on species of concern, and inform the USFWS of potential negative effects to migratory birds. Construction of the TSP is not anticipated to have an effect on migratory bird populations.

7.0 CONCLUSIONS

As presented in Section 4.0 – Environmental Consequences, construction of the TSP would result in minor and/or temporary impacts to environmental resources within the project footprint. The following conclusions summarize the findings of this EA:

- The TSP would result in the permanent construction of a PA; however, the PA would be limited in spatial extent.
- Construction of the TSP would change the current land use for the project footprint. However, this land has very little development or farmland potential.
- Project related air quality impacts were evaluated by calculating the worst case emissions for construction of the proposed project (Appendix D). Air contaminant emissions from construction would be considered *de minimus* emissions compared to

those from existing sources in the HGB region. Due to the short-term duration of construction activities, there would be no long-term impacts. Emissions from these activities would not adversely impact the long-term air quality in the area.

- Heavy machinery would be the major source of noise during construction. However, construction is proposed to occur during daylight hours when occasional loud noises are tolerable to surrounding NSRs. None of the NSRs would be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems. Therefore, noise related impacts would be considered minimal and temporary in duration.
- Potential impacts to water quality associated with the construction of the tentatively selected alternative consist of erosion and sedimentation during construction. During construction, storm water runoff could carry sediment off site into Cedar Bayou and potentially result in temporary increases in Total Suspended Solids (TSS). These impacts would be temporary in duration and minimal in extent. The USACE would require the construction contractor prepare a Storm Water Pollution Prevention Plan (SW3P) and implement erosion and sedimentation control Best Management Practices (BMPs) to minimize any detrimental effects to water quality during construction. Release of water during disposal operations would be managed to comply with TCEQ guidelines. No long-term effects to water quality are expected as a result of construction of the TSP.
- The potential for RSLR to impact the TSP is minimal. The calculated worst case using tide gauges is under a foot (0.9 ft) and the worst case using monitored subsidence is 1.5 ft. RSLR would not have an impact on the armoring requirements for the PAs. Finally, impacts on surge levels due to the project, with and without RSLR, are expected to be extremely minimal and insignificant.
- Construction of the tentatively selected alternative would not intercept contaminated soils and/or groundwater, disturb any hazardous materials or create any potential hazard to human health.
- There are no prime or unique farmlands located within the TSP footprint.
- Construction of the TSP would result in the filling of approximately 2.56 acres of wetlands. All impacts to wetlands would be mitigated pursuant to the Mitigation Plan described in further detail in Section 5.0.
- The project footprint has been mostly cleared of vegetation since the 1950s. There are small clusters of trees, primarily on the southern and eastern side of the TSP footprint that would be removed. Most of these trees are less than 10 years old and are primarily Chinese tallow. Construction of the TSP is anticipated to have a

minimal and localized effect to wildlife populations in the vicinity of the project. Noise from construction of the TSP would affect small mammals and birds in the area immediately surrounding the project footprint. Depending on the species affected, construction may result in their displacement to surrounding areas. Similar habitat is located in the surrounding area where displaced wildlife could find suitable habitat.

- An assessment of the construction of the TSP's potential to affect federally listed threatened and endangered species and their habitat was documented in a BA (Appendix B). No critical habitat has been designated in or around the project footprint. Only federally listed threatened and endangered species documented as occurring in Chambers County by the Clear Lake Office of the USFWS were considered in further detail in the BA. The BA concludes that the TSP would not affect any federally listed threatened or endangered species or their habitats.
- There are no Historic Properties located within or adjacent to the footprint of the proposed PA; therefore no Historic Properties would be affected by construction of the TSP.
- Construction of the TSP would impact the aesthetics of the project area. Approximately ¼ mile of the project footprint is visible from the bayou; this area currently consists of four canals constructed for the abandoned RV park. Construction of the TSP would change the setting from four canals to a containment dike. However, since the project footprint has already been heavily disturbed and no longer in a natural forested setting, the aesthetic impacts from construction of the TSP would be considered minor.
- No impacts to recreational resources would occur due to construction or future use of the TSP.
- Construction of the TSP would not result in impacts to the traffic and circulation within the project area. No road closures would result from construction or maintenance activities.
- Construction of the TSP would not have adverse or disproportionate impacts on minority or low-income populations. The socioeconomic analysis shows that the area within one mile of the project footprint does not contain a higher percentage of minority or low-income families than the overall project area, Chambers or Harris Counties. No impacts to socioeconomics and Environmental Justice would result from construction of the TSP.

In summary, construction of the TSP is anticipated to result in minimal localized and temporary adverse affects to the surrounding environment. No significant impacts to environmental resources within the project study area are anticipated. Therefore, the preparation of an Environmental Impact Statement is not required.

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Appendix A

Agency Correspondence

Appendix A-1

U.S. Fish and Wildlife
Planning Aid Letter

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Coastal Ecological Services Office
17629 El Camino Real #211
Houston, Texas 77058-3051
281/286-8282 FAX: 281/488-5882

August 5, 2014

Colonel Richard Pannell
US Army Corps of Engineers
Attention: Andrea Catanzaro
PO Box 1229
Galveston, TX 77553-1229

Dear Colonel Pannell:

The enclosed report provides planning assistance on the proposed construction of a new upland confined placement area for the Cedar Bayou Dredged Material Management Plan (DMMP) that would provide 20 years of dredge material capacity for lower reaches of Cedar Bayou and its confluence at the Houston Ship Channel. Located approximately four miles southeast of Baytown, Texas, the lower portions of Cedar Bayou form the boundary between Harris and Chambers Counties with the proposed upland placement area located in Chambers County. The end result will be a 100-acre upland placement area constructed at the intersection of Cedar Bayou and the HL&P Canal on a previously disturbed 110 acre site. The Corps proposes to construct 2.64 acres of wetlands as mitigation for unavoidable impacts to 2.56 acres of estuarine intertidal emergent wetlands at the project site. The Corps has not identified suitable mitigation for associated upland impacts.

The purposes of this letter are to identify and describe existing fish and wildlife resources within the proposed project areas; evaluate and compare currently proposed alternatives; identify modifications or additional alternatives needed to address fish and wildlife related problems, opportunities, and planning objectives; and to recommend preliminary measures for resource protection during early project planning. This planning assistance is provided, pursuant to the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and is intended to assist in the preparation of your Environmental Assessment (EA). The information contained here does not represent a final report of the Secretary of the Interior within the meaning of Section 2(b) of the FWCA. This report was prepared in accordance with the scope of work agreed to by our agencies, and it is being provided for equal consideration for fish and wildlife conservation in the planning of Cedar Bayou Dredged Material Management Plan.

We appreciate the opportunity to participate in the planning of this project. If you have any questions or comments concerning this report, please contact staff biologist Donna Anderson at (281) 286-8282.

Sincerely,

acting for

Edith Erfling
Field Supervisor

CEDAR BAYOU DREDGED MANAGEMENT PLAN

Prepared by:
Coastal Ecological Services Field Office
Houston, Texas

U.S. Fish and Wildlife Service
Region 2
Albuquerque, New Mexico

August 5, 2014

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CEDAR BAYOU DREGED MATERIAL MANAGEMNT PLAN

Construction of new Placement Area to increase capacity for the next 20 years

Introduction

Cedar Bayou originates approximately eleven miles northwest of the City of Liberty and runs south forty-six miles to its mouth on Trinity Bay with both tidal and non-tidal reaches. Navigation along Cedar Bayou was well established by 1854 where it remained an important water route through the 1900s with fifteen to thirty miles remaining navigable depending on the season. The Galveston Corps of Engineers (Corps) dredged a 3.5 mile segment of the Cedar Bayou Navigation Channel (CBNC) from the Houston Ship Channel (HSC) to just upstream of the mouth of Cedar Bayou in 1931 when it became an authorized federal channel. The CBNC was dredged to a depth of 10 feet at mean low tide and a width of 100 feet. As commercial interests increased, the channel was dredged an additional 3 miles (Mile 3) up Cedar Bayou in 1975. The Corps continued to maintain the lower 5.7 miles of the channel (HSC to Mile 3) every five years until 1999 when federal budget constraints were implemented resulting in significant amounts of build-up silt in the channel. The Corps anticipates future dredging of the channel to occur on a five year cycle beginning in 2016.

Cedar Bayou flows into Galveston Bay, a shallow and very productive bay estuary system. Galveston Bay is the sevenths largest estuary in the country and is second only to the Chesapeake Bay in productivity. Fishing and businesses associated with the bay contribute more than $1 billion to the local economy each year (Galveston Texas Baykeeper, 2011). Local residents understand how the economic health of the area is closely tied with the environmental health of the bay system. As such, the Service supports efforts to improve water quality in and around the Galveston Bay area and strives to continually work with partners to implement improved clean water practices.

The tidal portion of Cedar Bayou (TCEQ Segment 0901) was identified as an impaired water body by the Texas Commission on Environmental Quality (TCEQ) and is included in the 303(d) list (TCEQ 2008). The tidal portion of Cedar Bayou is located between the confluence of Cedar Bayou and Galveston Bay to an area approximately 1.4 miles upstream of Interstate10 in Chambers and Harris Counties. TCEQ listed Cedar Bayou as impaired for three reasons: dioxin was found in edible tissue in 2002; bacteria levels indicative of possible sewage contamination identified in 2006; and Polychlorinated biphenyl was found in edible fish tissue in 2008. Since the listing by TCEQ, there is growing public concern over possible impacts to the oyster industry and the many recreational and commercially important fish species of Galveston Bay because the two water bodies are connected.

Project Background and Purpose

The Galveston District Corps was recently tasked with developing and/or updating many of the Dredge Material Management Plans (DMMP) along the Texas coast. This effort will forecast future dredging events and placement area capacity for the next 20 years. Such is the case for the lower 5.8 miles of the CBNC. Previous Corps assessments determined the remaining capacity along the lower reaches of the CBNC inadequate to accommodate future dredging needs. Out of six previously authorized placement areas in this section of the CBNC, only one (PA 6) still has available capacity. However, the remaining capacity in PA 6 is insufficient to accommodate the 967,978 cubic yards (CY) expected from the first dredge cycle necessary to return the channel to a depth of 10 feet. As a result, the Corps has designated that PA6 receive only future maintenance material.

To accommodate future maintenance dredge cycles (scheduled for every five years once deepened), the Corps plans to place the dredged material into PA 6 until it reaches capacity, most likely in 2026 (USACE, 2014). Table 1 shows the proposed dredging amounts for the duration of the project.

Table 1 Dredge amounts for the CBNC

Year	Dredging Volumes (CY)		Placement Plan Volumes (CY)	
	Bay Reach	Bayou Reach	New Upland PA	Existing PA 6
2015				
2016	587,324	380,654	721,932	246,046
2017				
2018				
2019				
2020				
2021	383,154	246,046	383,154	246,046
2022				
2023				
2024				
2025				
2026	383,154	246,046	383,154	246,046
2027				
2028				
2029				
2030				
2031	383,154	246,046	629,200	0
2032				
2033				
2034				
Total	**1,736,786**	**1,118,792**	**2,117,440**	**738,138**

Source: USACE 2014

Description of the Project Area and Alternatives under Consideration

The Corps has defined the project area as a six mile radius centered on the lower portion of the CBNC (Figure 1). The lower portion of the reach begins at the confluence of the CBNC and the HSC to an area just north of Ijams Lake (outlined in white in Figure 1).

Source: USACE, 2014

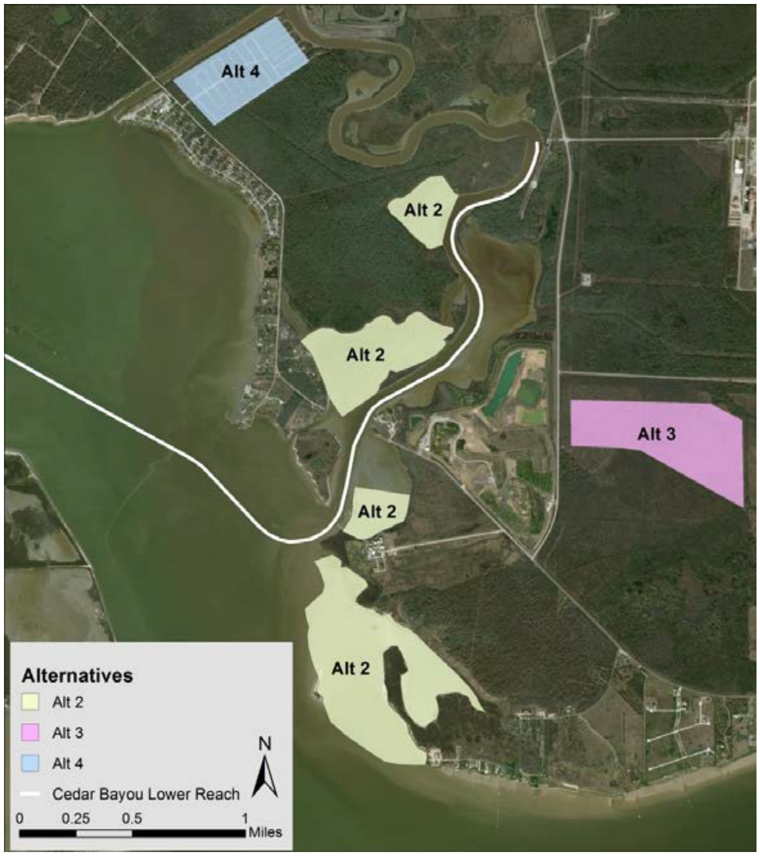
Figure 1 Cedar Bayou Navigation Channel project area

The Corps completed several iterations of alternative screening where seven measures remained. Three of the measures were combined creating the following four alternatives where one was selected to move forward as the Tentatively Selected Plan (TSP):

- Alternative 1 – No Action
- Alternative 2 – Beneficial Use Sties
- Alternative 3 – Confined upland placement east of the land fill
- Alternative 4 - Confined upland placement at the abandoned RV park

Alternative 1 (No action): Under this alternative, the Corps would continue to pump material into PA 6 until capacity is reached in 2016 when the channel is dredged to 10 feet. At that time, no additional capacity would be available and dredging would discontinue resulting in siltation of the channel at a rate of almost one foot per year.

Alternative 2: The Corps identified four beneficial use opportunities along the CBNC: Marrow Marsh, Fisher Lake, Ash Lake, and Negrohead Lake (Figure 2). Under this alternative, dredge material would continue to be placed in PA6. The Corps has eliminated this alternative due to limited beneficial use capacity, size, and cost comparison with the other alternatives.



Source: USACE, 2014

Figure 2 CBNC Alternative 2 potential BU sites

Alternative 3: The Corps identified property of suitable size and location for the construction of a PA. The property lies approximately 1 ½ mile east-north east of the mouth of Cedar Bayou on uplands east of a landfill (Figure 2). Placement into PA6 would continue under this alternative.

Alternative 4 (TSP): The Corps proposes to construct a PA on a 110-acre site north of the existing Cedar Bayou entrance providing almost equal pumping distances for both the upper and lower reaches of the CBNC. The proposed site is a previously constructed RV park that never opened however all the infrastructure (asphalt roads, storm and sanitary sewers, sanitary pump station, and water distribution pipes) remains. Removal of the entire infrastructure would occur prior to the construction of the PA. As described in the draft biological assessment, the Corps proposes to bury the infrastructure debris onsite within the existing canals connected to Cedar Bayou located on the north side of the PA. Dikes will be constructed at the north end of the property prior to debris burial. An outfall water structure (red drawing in Figure 3) will be placed at the north end of the property to allow for drainage into Cedar Bayou. Placement of material into PA6 would continue under this alternative.

The proposed TSP project site is bounded by Tri-Cities Beach Road to the southwest, HL&P canal to the northwest, Cedar Bayou to the northeast and vacant property to the southeast.

Source: USACE, 2014

Figure 3 Proposed TSP footprint

Existing Habitat Resources

The Service attempted to visit the site on April 29, 2014; however, due to the presence of the chain entrance and "No Trespassing" signs, Service staff remained outside the entrance. Limited visual inspection of the property confirmed the presence of paved roads, additional debris and trash, overgrown trees and shrubs, and fringe habitat along the shoreline. A subsequent site visit was conducted with U.S. Army Corps of Engineers (Corps) representatives on July 2nd, 2014 where access to the entire property was granted.

Service staff toured the site by foot and vehicle and found the roads and infrastructure to be generally intact with dense vegetation and piles of debris scattered throughout the property. CORPS staff indicated the property owner typically mows several times a year making passage through the site easier. Much of the upland site has colonized with invasive and exotic vegetative species that typically have little wildlife value.

Review of historical aerial photography of the TSP project site indicates the east side canals are subject to the ebb and flow of the tidally influenced bayou and the transport of sediment from upper watersheds. Deposition of sediment seems to accumulate in this area but can be washed out during high flood events. Overall, the fringe marshes in this area seem to be resilient. Conversely, the fringe marsh along the HL&P Canal just east of the Tri City Beach Road Bridge appears to experience higher amounts of erosion from vessel traffic. This area may be best served by the addition of reef domes (or other similar protection measures) that acts to trap sediment and protect the shoreline.

Geographic Information System (GIS) and the National Wetlands Inventory Mapper (NWI) (U.S. Fish and Widlife Service), were used to identify habitat cover-types in and around the project area. The following habitat types were identified:

Wetlands – Four canals were cut during initial construction of the RV park in the late 1980s along the northernmost area bordering CBNC. Review of NWI classifies the three northern canals and a portion of the fourth as estuarine and marine deepwater habitat. The remainder portion of the fourth canal is classified as estuarine and marine wetlands dominated by smooth cordgrass (*Spartina alterniflora*). Service staff observed the canals during the July 2, 2014 site visit and concluded the canals appear to have naturalized some 30 years post construction. Each of the tidally influenced canals are tree lined (Figures 4, 5, and 6) and fringed with intertidal marsh. This fringe marsh creates a transitional zone (between open water and upland habitat) providing excellent breeding, feeding, sheltering, and nesting habitat for aquatic (commercially and recreationally important) and terrestrial species alike.

The canals are subjected to infrequent sediment deposit and flush events due to upstream storm events. As a result, there does appear to be some sediment build up along some of the canals. Sediment buildup was especially noted along canal number 4 where portions of the canal have almost entirely silted in creating quality tidal marsh habitat.

Besides the four canals, fringe emergent wetlands line the western boundary of the property bordering the HL&P Canal. The Corps has verified this finding on two separate site visits conducted in 2012 and 2103 and determined the entire project site contains 5.44 acres of estuarine intertidal wetlands.

Figure 4 Interior canal looking inward

Figure 5 Interior canal tidal fringe marsh habitat

Figure 6 Interior canal looking outward towards CBNC

Uplands - The property was cleared of all vegetation in the 1950s and was subsequently cleared again in the 1980s. Since then, portions of the property are now overgrown with native and invasive species due to minimal management. During the July 2nd 2014 site visit, Corps staff identified the following upland species: pepper vine *Ampelopsis arborea*, Blue vervain *Verbena hastata*, iron weed *Veronia baldwinii,* Illinois bundle flower *Desmanthus illinoensis,* giant ragweed *Ambrosia trifida*, Chinese tallow *Triadica sebifera*, hackberry *Celtis occidentalis,* and trumpet creeper *Campsis radicans*. Approximately 90 acres of the property lies within this habitat type.

Because of previous disturbance, upland portions of the property most likely are considered marginal habitat for many species; however, common occurrences of small to medium sized terrestrial species such as rabbits, raccoon, mice, rats, snakes, lizards, are expected to occur in the grasses, shrubs, and trees. While the property may provide basic shelter and feeding opportunities, the intrinsic wildlife value does remain low due to the current plant composition. To the north (across the HL&P Canal) and south of the property, there are forested communities of oaks, pines, elms, and ashes interspersed with open canopy areas which may be highly suitable for many migratory bird and terrestrial species. However, the Corps reports (USACE, 2014) invasive species occur throughout these forested areas.

If the property were to remain without any management whatsoever, it is likely that the property would eventually re-vegetate and become a forested community once again with possible invasive species present.

Figure 7 View of uplands at project site

Figure 8 View of uplands at project site looking towards CBNC

Impacts

The Corps identified habitat types and acreage to be impacted by the TSP:

Table 2 Habitat types found on the TSP

Vegetation Community	Approximate Acres
Forested/Scrub	40
Grassland/Scrub	50
Wetlands	2.56
Roads (non-vegetated area)	18.5

Source: USACE 2014

For the sake of simplicity, the Service has categorized the forested/shrub and the grassland/shrub into uplands and does not dispute the Corps delineation for that portion of the TSP. However, the Corps only identifies 2.56 acres of impacted wetlands present in Table 2 and the Service has serious concerns regarding additional construction impacts to the remaining canal wetlands and the open water habitat. Corps staff reports the avoided wetland area is "anywhere from 25 to 140 feet of wetland fringe will remain within a given interior canal beyond the toe of the PA" (Catanzaro/personal communication 2014). Each of the interior canals range from 750 to over 900 feet long and the TSP proposes to negatively impact anywhere from 82 to 97 percent of each canal.

Existing Fish and Wildlife Resources

Threatened and Endangered Species

According to Section 7(a)(2) of the Endangered Species 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 federally listed species. Therefore, you should use this and other current information to evaluate the project for its potential effects to listed species. The Service's Consultation Handbook (http://endangered.fws.gov/consultations/s7hndbk/s7hndbk.htm) is available to assist you with further information on definitions, process, and fulfilling Endangered Species Act requirements.

Our records indicate (accessed on March 10, 2014) that the following delisted (DM), endangered (E), and threatened (T) species are documented and known to occur in the following counties:

Chambers County:

- Bald eagle (*Haliaeetus leucocephalus*) - DM
- Brown pelican (*Pelecanus occidentalis*) - DM
- Piping plover (*Charadrius melodus*) – E and 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*) – E and T
- Loggerhead sea turtle (*Caretta caretta*) – T

Harris County:

- Bald eagle (*Haliaeetus leucocephalus*) - DM
- Texas prairie dawn-flower (*Hymenoxys texana*) - E

Bald Eagles

Review of Service files does indicate a bald eagle's nest located approximately 1.2 miles northwest of the immediate project area. This nest had been active in the recent past, however after the 2013 nesting season, the nest fell apart. This pair of eagles has been sighted in the area and is believed to have nested nearby, however this was confirmed by Service staff.

The Houston area boasts resident and migrant bald eagles. Most eagles return to their territory and begin preparing the nest by early October. Courtship follows and 1-3 eggs are usually laid between December and January. The parents take turns incubating the eggs for 35 days until hatching. Once hatched, eaglets will remain in the nest for 10-12 weeks until fledging. Once fledged, the sub-juveniles will remain with the parents around the nest for another six weeks until flight and feeding skills have been mastered.

Although the bald eagle was delisted in 2007, it is still afforded protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (40 Stat. 755; 16 U.S.C. 703-712) (MBTA).

Brown Pelican

Delisted in 2009, the brown pelican made a remarkable recovery since being listed in 1970. Brown pelicans are abundant along the Texas coast, can be found nesting with other colonial waterbirds, and will likely be encountered loafing in the project area. No longer protected under the Endangered Species Act and with no proposed critical habitat, the brown pelican continues to be protected by the MBTA.

Sea Turtles

Our review of the proposed project only focused on the effects of the construction of the PA on sea turtle nesting and other terrestrial activities because the Service has jurisdiction of sea turtles when on land only. While there is no nesting habitat within the proposed project areas, sea turtles are known to frequent Galveston Bay during the spring, summer, and fall months. Special precautions should be taken to avoid impacts to any of the sea turtle species during construction activities. Since the National Marine Fisheries Service (NMFS) has jurisdiction of sea turtles in the oceans, seas, bays, and estuaries, we recommend that you contact NMFS at 727-824-5312 to discuss the possible impacts the project may have on sea turtle migration between the Gulf of Mexico and Galveston Bay.

Piping Plovers

The project area does not lie within the critical habitat for the piping plover nor does the project area exhibit any of the substrate characteristics preferred by this bird. Piping plovers do frequent tidally exposed mud flats and prefer to roost on sandy substrate, neither of which were observed within the project area.

Texas Prairie Dawn-flower

The Texas prairie dawn-flower is known to occur only on specific soil types in Harris County and has not been documented to occur in Chambers County. The proposed PA location does not exhibit any of the soil types compatible for the plant to persist nor are any of the associated species believed to be present.

Marine Mammals

The West Indian manatee *Trichechus manatus* is a rare visitor to the Texas coast and while unlikely, could be seen within the channels of the project area. In the event a manatee is encountered during the construction processes, further coordination with the Coastal Ecological Services Field Office (281) 286-8282 is necessary.

Migratory Birds

The Service published the *Birds of Conservation Concern 2008* (BCC) in December, 2008. The overall goal of the BCC is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent our highest conservation priorities and to draw attention to species in need of conservation action (US. Fish and Wildlife Service, 2008). The following are six species on the BCC lists that may utilize the habitat types within or immediately adjacent to the project area:

1) Reddish egret (*Egretta rufescens*) - coastal marshes and ponds
2) American Oystercatcher (*Haematopus palliatus*) - sandy beaches, mudflats, and occasionally rocky shores where mollusk prey can be found
3) Gull-billed tern (*Sterna nilotica*) - sandy beaches and mudflats
4) Sandwich tern (*Thalasseus sandvicensis*) - sandy beaches and mudflats
5) Black skimmer (*Rynchops niger*) - sandy or gravelly bars and beaches, shallow bays, estuaries, and salt marsh pools
6) Least tern (*Sterna antillarum athalassos*) - broad, level expanses of open sandy or gravelly beach, dredge spoil and other open shoreline areas, and more rarely, inland on broad river valley sandbars

All of the above birds of conservation concern can be found nesting within colonial bird rookeries from March through August along the upper Texas coast. These rookeries, whether found on shore or on adjacent islands, can be easily disturbed by human presence ultimately causing nest failure in some cases. The Service and its partner's monitors 26 species of birds annually that nests in colonies along the Texas coast. Review of the Texas Colonial Waterbird Society Database (Texas, 2013) indicates six rookeries within the project area; two are active and four are inactive. Cedar Bayou Channel (600-180), the closest to the immediate project area has been inactive since 1990. Alexander (600-161) and St. Mary's Islands (600-166) are both active sites however Alexander Island supports less than a dozen breeding pairs annually. For the 2013 survey, St. Mary's Island had almost 1400 breeding pairs from 11 species of birds, but this island lies 7.25 miles north of the CBNC and construction activities from the project should not impact the birds at this distance. While it is entirely possible to see various species of these birds foraging and loafing within the project area, most nesting activity is usually confined to nearby colony locations. Mueller and Glass (1988) recommend construction activities should not be conducted within 1000 feet of a colonial waterbird colony during nesting season due to possible nest abandonment. Should the proposed construction be within 1000 feet of a rookery island, please contact the Service's Coastal Ecological Services Field Office at (281) 286-8282 for further instructions.

Additionally, the abundance of trees located on this property may provide suitable stop-over habitat for many neo-tropic migratory bird species migrating each spring and fall onto the Texas coast. These stop-over areas provide critical resting and foraging habitats for non-native and native migratory birds. All native (*e.g.*, waterfowl, shorebirds, passerines, hawks, owls, vultures, falcons) and many non-native migratory birds are afforded protection under the MBTA. Under the MBTA, it is unlawful "by any means or manner, to pursue, hunt, take, capture, [or]] kill" any migratory bird, part, nest or egg of any such bird except as permitted by regulation. The provisions of the MBTA extend to native and migratory birds, active nests, their eggs and young. For a list of non-native species that are exempt from the provisions of the MBTA, please see the Federal Register Notice at http://www.fws.gov/migratorybirds/issues/nonnative/Final%20NonNative%20Species%20List.pdf

Mitigation Alternatives Analysis

The Service's *Habitat Evaluation Procedure* (HEP) (U.S. Fish and Wildlife Service, 1980) was used to evaluate habitats in the project area should impacts be unavoidable. The HEP requires the use of Habitat Suitability Index (HSI) models developed for indicator species that best represent groups of species that use a specific habitat. Habitat units (HU) are derived by multiplying the HSI by the area of available habitat at a point in time. Future predictions can be made by comparing future conditions with and without impacts from a proposed project. The result (Average Annual Habitat Units (AAHUs)) is then annualized over the life of the project. This outcome is used to determine the amount of necessary mitigation for each habitat type impacted by the proposed project.

The Corps is mandated to only analyze wetland impacts which are reflected by the HEP species chosen. The red drum and brown shrimp are adequate to assess impacts to wetlands at the project site. The Service recognizes the value of upland scrub/shrub habitat and recommends the Corps mitigate for all upland impacts.

Table 3 With and Without Project AAHUs

	Without-Project AAHUs	With-Project AAHUs	Change in AAHUs
Red drum	1.40	0.76	-0.64
Brown shrimp	2.49	1.32	-1.17
Site average	1.95	1.04	-0.91

Source: (USACE, 2014)

Four mitigation alternative plans involved restoring or creating additional wetland habitat with three of the four canals located at the north end of the property. Subsequently, a cost analysis was performed for each of the alternatives with the following alternative being selected:

> Creation of 2.64 acres of estuarine intertidal emergent marsh resulting in a total of 5.52 acres of wetlands at the project site (Figure 4). The restoration would take place on the southeastern edge of the property where two of the canals would be re-contoured to the same height as a reference marsh in the immediate area and subsequent marsh cordgrass *Spartina alterniflora* plantings.

The Service has concerns regarding proposed impacts to the remaining wetlands at each of the four canals. The Corps proposed to excavate a significant portion of each wetland area for the construction of the containment levee and the proposed outfall structure. Additionally, we propose that water quality in these wetlands may be impaired as a result of the proposed outfall structure to be located in canal three. Further, we anticipate long term impacts to these wetlands from this action where part or full functionality of each wetland area may be lost.

Figure 9 Corps proposed mitigation plan

While the proposed mitigation meets the criteria set forth by federal government's "no net loss" policy, the Service recommends the Corps consider additional alternatives. Along with the proposed mitigation plan, the Service strongly urges the Corps to evaluate and invest in ecologically beneficial long term shoreline protection measures for the 680-foot shoreline east of the Tri City Beach Bridge (Figure 5) in the HL&P Canal. Review of historic aerial photography suggests this shoreline experiences erosion and would benefit from additional protective measures and increased tidal fringe habitat. The fringe habitat found along this shoreline may be as or more productive than the remaining fringe/edge habitat found in the four canals post project.

Figure 10 Shoreline east of Tri City Beach Bridge

The Service recommends ecologically beneficial structures such as rock breakwaters or reef domes because they promote a more uniform sediment accumulation throughout the entire area behind the breakwaters while providing ingress and egress opportunities for aquatic species. Additionally, marsh plantings can supplement sediment accumulation provided by the rock structures, provide soil stability, and aerial parts form a mass that dissipates wave energy (Knutson, 1977). The Service was successful in establishing marsh in a variety of settings and is available to provide technical assistance with this conservation measure.

Recommendations

The Service provides the following concerns and recommendations for the proposed project:

1. The alternatives presented in the Draft EA (USACE 2014) do not fully demonstrate efforts to avoid or minimize wetland impacts at the project site. As such the Service recommends the Corps evaluate additional alternatives such as levee raising at one or more of the nearby PAs, reducing the TSP footprint to exclude wetland impacts, identify additional BU sites, or a combination of these or previous alternatives to accommodate the anticipated dredge material. The Service would appreciate the opportunity to evaluate and comment on any additional alternatives the Corps might present.
2. Should the TSP move forward as identified in this letter, the Service strongly recommends removal of all infrastructure debris off-site and placed at a suitable landfill. The Service has significant concerns regarding burial of various materials on the property and adjacent to Cedar Bayou. Deterioration and degradation of pipes, asphalt, and other equipment has the potential to cause significant water quality issues in an already impaired water body.
3. The Service is concerned about the Corps reluctance to use dredge material beneficially. We understand the Corps' mandate to operate under the least costly and least environmentally damaging alternative. However, the Galveston Corps beneficially uses approximately 3.2 million CY out of the 30 to 40 million CY dredged annually along the Texas coast. The Service challenges the Corps to use all of the material from this project beneficially.
4. Identify additional BU opportunities within the 6-mile radius of the project area. The Service identified three additional BU sites requiring further investigation (Appendix), and would be happy to work with the Corps to evaluate the extent of the beneficial use of that material.
5. The Service recommends the Corps incorporate additional BU opportunities into the TSP. Should PA 7 be fully constructed, the Corps has little or no reason to explore any further BU opportunities in the area. The Service, along with other state and federal natural resource agencies, identified beneficial use opportunities along Cedar Bayou and recommends the Corps select Alternative 2 and construct a placement area with a reduced footprint if necessary to accommodate the additional dredge material as the TSP. This option provides an immediate environmental benefit along with the likely 20 year capacity necessary to complete the DMMP.
6. Include an upland component to the HEP analysis to mitigate for impacts to forested scrub/shrub habitat. This habitat type encompasses approximately 80% of the proposed TSP location and as such should be mitigated for. We request the opportunity to review and comment on the proposed upland mitigation once complete.

7. Evaluate, design, and build shoreline protective measures for the 680-feet of shoreline immediately northwest of the Tri City Bridge along the HL&P Canal in addition to the currently proposed mitigation plan.
8. Develop an invasive species management plan. Invasive species, such as Chinese tallow, are successional and relatively fast colonizers once a site is heavily disturbed. The Service recommends invasive species remain less than 5% of the total vegetation over the entire site should the TSP move forward.
9. Evaluate the project area and identify any habitat that could support nesting birds. In the event active nests, birds, eggs, and young are present in the project area, we recommend implementation of construction methods and designs (i.e. seasonal restrictions on vegetation clearing during the nesting season from March 15 through August 15) prior to the commencement of any clearing activities.
10. All construction crew members should be able to correctly identify the West Indian manatee should they encounter one in CBNC or any of the canals. Additionally, someone with stop work authority should be present with the crew at all times in the event a manatee is present within 50 feet of the immediate project area. Installation work may resume once the manatee has left the project area on its own accord. Please notify our office immediately at (281)286-8282 should staff see a manatee within or near the project area.
11. Develop a plan to identify protective shoreline measures that provide an ecological benefit to fish and wildlife resources along the property boundaries. Specifically, we recommend the Corps avoid all edge habitat within the construction footprint and take measures to ensure its productivity over the life of the project. The Service requests an opportunity to review and comment on this plan.
12. Implement best management practices in accordance with TCEQ to avoid debris and soil from entering the nearby waterways.
13. Should a rookery be present, the Service recommends delaying construction at that specific site if a buffer of 1,000 feet cannot be maintained or until birds have fledged, usually by August 15th.
14. Should a bald eagle's nest be present within the immediate project area, consult the National Bald Eagle Management Guidelines at http://www.fws.gov/midwest/eagle/pdf/NationalBaldEagleManagementGuidelines.pdf for construction recommendations and contact our office at 281-286-8282 for further instructions.
15. Coordinate with NMFS (727-824-5312) to address any proposed essential fish habitat and sea turtle impacts and mitigate appropriately.

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Appendix B

Draft Biological Assessment

DRAFT

BIOLOGICASSESSMENT

FOR

FEDERALLY-LISTED
THREATENED AND ENDANGERED SPECIES

CEDAR BAYOU DREDGED MATERIAL MANAGEMENT PLAN
CHAMBERS AND HARRIS COUNTIES, TEXAS

1.0 INTRODUCTION

1.1 Purpose of the Biological Assessment

This Biological Assessment (BA) is being prepared for the purpose of fulfilling the U.S. Army Corps of Engineers (USACE) requirements as outlined under Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended. This BA is also being prepared to assist the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in fulfilling their obligations under the ESA. The proposed Federal action is the construction of a new placement area (PA) along Cedar Bayou in Chambers and Harris Counties, Texas.

This BA evaluates the potential impacts that the proposed work may have on federally listed threatened and endangered species identified by the USFWS and NMFS as occurring within the proposed action area as described in Section 1.2.1 below. Table 1 identifies federally listed threatened and endangered species for Chambers and Harris Counties, Texas. This species list was obtained from databases managed by the USFWS (USFWS 2013) and the NMFS (NMFS 2013).

The bald eagle and brown pelican have been delisted (in 2007 and 2009, respectively) and are no longer protected under the Endangered Species Act. However, these species are still afforded protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act (40 Stat. 755; 16 U.S.C. 703-712) (MBTA). Therefore, these species will not be further addressed in this BA.

Table 1. Federally-Listed Threatened and Endangered Species in Harris and Chambers Counties, Texas.				
Group	Name	Federal Status	Agency/ County*	Found in TSP Footprint
Birds	bald eagle (*Haliaeetus leucocephalus*)	Recovery	USFWS/C,H	Possible
Birds	brown pelican (*Pelecanus occidentalis*)	Recovery	USFWS/C	Possible
Birds	piping plover (*Charadrius melodus*)	Threatened	USFWS/C	No
Mammals	West Indian manatee (*Trichechus manatus*)	Endangered	USFWS/C,H	No
Mammals	blue whale (*Balaenoptera musculus*)	Endangered	NMFS	No
Mammals	finback whale (*Balaenoptera physalus*)	Endangered	NMFS	No
Mammals	humpback whale (*Megaptera movaeangliae*)	Endangered	NMFS	No
Mammals	sei whale (*Balaenoptera borealis*)	Endangered	NMFS	No
Mammals	sperm whale (*Physeter macrocephalus*)	Endangered	NMFS	No
Reptiles	green sea turtle (*Chelonia mydas*)	Threatened	NMFS and	No
Reptiles	hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	NMFS and USFWS/C	No
Reptiles	Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	NMFS and USFWS/C	Possible
Reptiles	leatherback sea turtle (*Dermochelys coriacea*)	Endangered	NMFS and USFWS/C	No
Reptiles	loggerhead sea turtle (*Caretta caretta)*	Threatened	NMFS	Possible
Plants	Texas prairie dawn-flower (*Hymenoxys texana*)	Endangered	USFWS/H	No

* NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service; C = Chambers County; H = Harris County

Sources: NMFS, 2014; USFWS, 2014a.

1.2 Description of the Proposed Project and Existing Habitats

1.2.1 Identification of the Proposed Action Area

The PA would be located approximately two miles north/northwest from the mouth of Cedar Bayou on an approximately 110-acre property that was previously developed for a RV park (Figure 1). The property is generally rectangular in shape with the long sides running in a northeast to southwest direction. The site is bounded by Tri-Cities Beach Road to the southwest, Houston Light and Power (HL&P) canal to the northwest, Cedar Bayou to the east and north, and vacant property to the southeast. Existing infrastructure within the site includes asphalt surfaced roads, and underground utilities including storm and sanitary sewers, sanitary pump station, and water distribution pipes. As can be seen in Figure 2, the roads within the footprint of the TSP are heavily deteriorated. Additionally, while the underground utilities were installed, they were not hooked up to any systems.

Figure 1. Project Footprint and a 1 Mile Buffer

Figure 2. Deteriorated status of the roads within the footprint of the TSP

All access to the project area for initial construction and subsequent maintenance would be from Tri-City Beach Road. The containment dikes would be constructed to about elevation +32 feet (NAVD 88) with a 10-foot crown width, and side slopes of 1 vertical to 3 horizontal. Actual containment dike heights relative to existing elevations would vary from about 12 feet at the southwestern end of the PA to over 20 feet where existing canals cross the containment dike alignment at the northeastern end. This is a typical containment dike template for USACE Galveston District dredge material PAs. The maximum capacity of the proposed PA would be 4.5 MCY.

The containment dike footprint and proposed borrow areas would be cleared of vegetation and existing infrastructure. The resulting exposed ends of storm sewers would be grouted and the sanitary sewer and water pipes would be capped prior to containment dike construction. Debris removed from the containment dike footprint and borrow area would be buried onsite. Asphalt materials from demolition of the existing roads within the site would be collected and buried within the interior of the PA in areas where the drainage/sewer infrastructure will have been removed. Debris from demolition of drainage and sewer consisting of concrete rubble and cast iron piping would be buried in the canals only after the exterior containment dike has been constructed in order to isolate the debris from Cedar Bayou.

The initial construction of the containment dike would consist of borrowing materials from the interior of the PA either by excavation of suitable fill soils and hauling to the containment dike construction area, or by side-cast methods. The borrow method used is dependent upon location of suitable fill soils and would be determined during the Preconstruction Engineering and Design phase. The containment dike would be constructed using the semi-compacted technique by compacting the borrow material in 12-inch lifts using a bull dozer of minimum specified size. The final crown and outside slope of the containment dikes would be seeded using the hydro-mulch method.

An effluent drop-outlet structure would be constructed at the north end of the PA with discharge into Cedar Bayou. The structure would be positioned far enough away from the containment dikes to allow future containment dike raisings as required over the life of the PA.

The current plan has a 5-year dredging cycle for the lower portion of the CBNC. The estimated dredge quantities are shown in Table 2 by dredging cycle, portion of the CBNC being dredged, and by where the material would be placed. During dredging operations the dredged material would be discharged into the new PA near the southwest corner in order to provide the greatest possible ponding time and distance between influent and the outlet structure. The drop-outlet structure weir acts as a filter mechanism and would be composed of wooden stop-logs for ponding level control. Clean water would be discharged into Cedar Bayou through a discharge pipe which would be buried under the containment dike and connected to the drop-outlet structure.

Table 2 Cedar Bayou 20-Year Dredging Quantities and Placement Plan

Year	Volumes (CY)[1]		Placement Plan Volumes (CY)[1]	
	CBNC Upper Portion	CBNC Lower Portion	TSP (PA 7)	Existing PA 6
2015				
2016	658,078	184,200	658,078	184,200
2017				
2018				
2019				
2020				
2021	319,300	184,200	319,300	184,200
2022				
2023				
2024				
2025				
2026	319,300	184,200	319,300	184,200
2027				
2028				
2029				
2030				

Table 2 Cedar Bayou 20-Year Dredging Quantities and Placement Plan				
Year	Volumes (CY)[1]		Placement Plan Volumes (CY)[1]	
	CBNC Upper Portion	CBNC Lower Portion	TSP (PA 7)	Existing PA 6
2031	319,300	184,200	503,500	
2032				
2033				
2034				
Totals	1,615,978	736,800	1,800,178	552,600
[1] *The volumes shown do not include Permit Dredging or estimated non-pay volumes.*				

The estimated non-pay volumes are 100,700 cy per five-year dredging cycle and the estimated permit dredging volumes are 25,000 cy per five-year dredging cycle.

1.2.2 Existing Habitat

Based on an examination of historic maps and aerial photos, the land within the TSP footprint had already been cleared of trees and vegetation for unknown purposes by the early 1950s. In the 1970s, during construction of the HL&P diversion canal, it appears that excavated material from the canal was placed in the current TSP's footprint. The proposed TSP's footprint was also used as a staging area. By the late 1980s, construction of an RV park had commenced. The area had been stripped of most of the remaining trees and vegetation, some roads were constructed and canals had been excavated. By the mid-1990s, development of the RV park had ceased, most likely due to frequent flooding of the area. At the time development was abandoned, all roads had been constructed and underground utility lines had been put in place, although no underground utilities had been hooked up, and no overhead utilities had been installed.

All that currently remains are a few large trees sparsely scatted throughout the TSP footprint, primarily on the southern edge (see Figure 1). The vegetation within the footprint of the TSP can be divided into three categories: forested/scrub, grassland/scrub, and wetlands (Table 3). The vegetation in the forested/scrub area consists primarily of: cedar elm (*Ulmus crassifolia*), water oak *(Quercus nigra)*, Chinese tallow (*Triadica sebifera*), hackberry (*Celtis laevigata*), trumpet creeper (*Campsis radicans*), giant ragweed (*Ambrosia trifida*), poison ivy (*Toxicodendron radicans*), thorn locust (*Gleditsia triacanthos*), and cedar. Vegetation in the grassland/scrub area consists primarily of peppervine (*Ampelopsis arborea*), sumpweed (*Iva annua*), giant verbena (*Verbena bonariensis*), giant ragweed (*Ambrosia trifida*), mustang grape (*Vitis mustangensis*), trumpet creeper (*Campsis radicans*), and Illinois bundle flower (*Desmanthus illinoensis*).

There are four canals cut into the northeastern side of project footprint. These canals were excavated in the late 1980s during the initial construction of the proposed RV park. The three northern canals are classified on the National Wetland Inventory (NWI) as estuarine and marine deepwater; however, a portion of the southernmost canal is classified in the NWIs as estuarine and marine wetland. This area is estuarine marsh and is dominated by smooth cordgrass (*Spartina alterniflora*). These results were verified during a field visit in July of 2012 and a second field visit in July of 2013. During the field visit, it was determined that the southernmost canal was all estuarine marsh, and that the three northernmost canals had estuarine marsh extending an average of 10 feet from the shoreline along approximately 70% of the canals. Salt cedar (*Tamarix* spp.), hackberry (*Celtis laevigata*), juniper (*Juniperus* spp.), parkinsonia (*Parkinsonia aculeate*), and baccharis (*Asteraceae* spp.) are also located all along the edges of the canals.

Table 3. Vegetation within the Footprint of the TSP

Vegetation Community	Approximate Acres
Forested/Scrub	40
Grassland/Scrub	50
Wetlands	2.56
Roads	18.5

There are forested communities to the east and west of the TSP footprint (across the HL&P Channel). These communities consist of riparian forests, upland pine areas, and open canopy areas dominated by a variety of woody species including oaks, pines, elms, and ashes. Invasive species occur throughout these communities.

2.0 STATUS OF THE LISTED SPECIES KNOWN TO OCCUR IN THE PROPOSED ACTION AREA

2.1 Piping Plover

2.1.1 Habitat

Piping plovers typically inhabit shorelines of oceans, rivers, and inland lakes. Nest sites include sandy sparsely vegetated beaches; sandbars; causeways; bare areas on dredge-created and natural alluvial islands in rivers; riparian gravel pits; and sand, gravel, or pebbly mud on interior alkali lakes and ponds (AOU, 1998). On the wintering grounds, these birds use beaches, mudflats, sandflats, dunes, and offshore islands (Haig and Elliott-Smith, 2004).

2.1.2 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). 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.

2.1.3 Distribution in Texas

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 (Haig and Elliott-Smith, 2004). The species is a common migrant and rare to uncommon winter resident on the upper Texas coast (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).

2.1.4 Presence in Proposed Action Area

The piping plover overwinters along the Texas coast and uses beaches and tidal flats (TOS 1995); however, the species is a common migrant and rare to uncommon winter resident on the upper Texas coast (Lockwood and Freeman, 2004). No USFWS-designated Critical Habitat for the piping plover is present within the study area. There is no suitable habitat (tidally exposed mud flats or sandy substrates) for wintering piping plovers in the study area, and TPWD TXNDD data (2007a) show no documented records within the project area.

2.2 West Indian Manatee

2.2.1 Habitat

Manatees are found in marine, estuarine, and freshwater environments and feed on a wide variety of aquatic plants, including submerged, floating, and emergent vegetation. Preferred habitat includes 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. It is not averse to traveling through dredged canals or using quiet marinas. Manatees prefer waters that are at least 3.3 to 6.6 feet in depth; along coasts that are often in water 9.9 to 16.5 feet deep. They usually avoid areas with strong currents (NatureServe, 2012). The manatee ranges from the southeastern U.S. and coastal regions of the Gulf of Mexico, through the West Indies and Caribbean, to northern South America.

2.2.2 Range and Distribution in Texas

Manatees are extremely rare in Texas, although in the late 1800s they apparently were not uncommon in the Laguna Madre. A manatee was seen in the Port Mansfield Harbor in 2005. Several recent sightings were also reported in the Corpus Christi Bay area, with one of these occurring in January 2011 in Rockport, Texas. While the West Indian manatee has been recently sighted in the Port Mansfield Harbor and occasionally in the Laguna Madre, such occurrences are extremely rare. Given its rarity and lack of sightings near the project area, this species is not likely to occur within the project or mitigation areas.

2.2.3 Presence in Proposed Action Area

No manatees have been recorded from the study area (NPS, 2007), largely because of the lack of suitable habitat. It is possible but extremely unlikely that this species would occur within the study area. In the event a manatee is encountered during the construction processes, further coordination with the Coastal Ecological Services Field Office (281) 286-8282 is necessary.

2.5 Green Sea Turtle

2.5.1 Habitat

The green 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).

Terrestrial habitat is typically limited to nesting activities, although in some areas, such as Hawaii and the Galápagos Islands, they will bask on beaches. 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), although an individual might switch to a different nesting beach within a single nesting season.

2.5.2 Range

The green turtle is a circum-global species in tropical and subtropical waters. In U.S. Atlantic waters, it occurs around the U.S. Virgin Islands, Puerto Rico, and 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, 1991a).

2.5.3 Distribution in Texas

The green 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 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. By 1900, however, the fishery had virtually ceased to exist. Turtles continued to be hunted sporadically for awhile, 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 turtles still occur in these same bays today but in much-reduced numbers (Hildebrand, 1982). While green turtles prefer to inhabit bays with seagrass meadows, they may also be found in bays that are devoid of seagrasses. The green 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 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 (National Park Service [NPS], 2006). Between 2001 and 2005, up to five nests per year were recorded from the Texas coast (Shaver, 2006). Two green turtle nests were recorded each year at Padre Island National Seashore during 2006 and 2007 (NPS, 2007). Green turtles, however, nest more frequently in Florida and in Mexico. Since long migrations of green turtles from their nesting beaches to distant feedings grounds are well documented (Meylan, 1982), the adult green 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.

2.5.4 Presence in Proposed Action Area

While the green turtle occasionally occurs along the Texas coast and juveniles can be found in inshore waters, the species more frequently occurs along the South Texas coast. No green turtle nests have been recorded from the study area (NPS, 2007), largely because of the lack of suitable nesting habitat. It is possible but unlikely that this species would occur within the study area. The species would not be present within the project area.

2.6 Kemp's Ridley Sea Turtle

2.6.1 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 (Campbell, 1995).

2.6.2 Range

Adults are primarily restricted to the Gulf, although juveniles may range throughout the Atlantic Ocean, as 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 headstarting 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 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).

2.6.3 Distribution in Texas

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); 2005 (51 nests); and 2006 (102 nests) (NPS, 2007). As noted above, some of these nests were from headstarted ridleys. Of the 102 Kemp's ridley nests recorded for Texas in 2006, 64 were at the Padre Island National Seashore (NPS, 2007). In 2007, 128 Kemp's ridley nests have been recorded on Texas beaches, including 73 at Padre Island National Seashore (NPS, 2008). 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), 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.

2.6.4 Presence in Proposed Action Area

No Kemp's ridley nests have been recorded from the study area (NPS, 2007), largely due to lack of suitable nesting habitat; however, 7 of the 128 Kemp's ridley nests recorded to date in 2007 are from Galveston Island (NPS, 2007). Kemp's ridley inhabits shallow coastal and estuarine waters and is the most likely of these species to occur in the study area. It is possible, but unlikely, that this species would occur within the project area. No suitable nesting habitat for this species exists within the project area.

2.7 Leatherback Sea Turtle

2.7.1 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, 2007b), 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.

2.7.2 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 waterbodies 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, 2012).

The leatherback migrates farther and ventures into colder water more 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 5,900 kilometers 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.

2.7.3 Distribution in Texas

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: cabbagehead (*Stomolophus sp.)* and moon (Aurelia sp.) (NMFS and USFWS, 1992). According to the USFWS (1981), leatherbacks have never been common in Texas waters. No nests of this species have been recorded in Texas for at least 70 years (NPS, 2007). The last two, one from the late 1920s and one from the mid-
1930s, were both from Padre Island (Hildebrand, 1982).

2.7.4 Presence in Proposed Action Area

No leatherback nests have been recorded from the study area (NPS, 2007), largely because of the lack of suitable nesting habitat. The leatherback is primarily a pelagic species that rarely occurs
in Texas's coastal waters (USFWS, 1995). It is possible, but unlikely, that this species would occur within the study area. The species would not occur within the project area.

2.8 Loggerhead Sea Turtle

2.8.1 Habitat

The loggerhead sea turtle occurs in the open seas as far as 500 miles from shore, but mainly over the continental shelf, and in bays, estuaries, lagoons, 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, 1991b).

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; 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).

2.8.2 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 (Ross, 1982). 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, 2012).

2.8.3 Distribution in Texas

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. 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). Between 2001 and 2005, up to five loggerhead nests per year were recorded from the Texas coast (Shaver, 2006). Two loggerhead nests were recorded in 2006: one at Padre Island National Seashore and the other on South Padre Island, and six loggerhead nests, four at Padre Island National Seashore, and two at South Padre Island have been recorded on Texas beaches in 2007 (NPS, 2007). 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.

2.8.4 Presence in Proposed Action Area

The loggerhead occasionally nests on the Texas coast and is common in the Gulf; however, no loggerhead nests have been recorded from the study area (NPS, 2007) largely because of the lack of suitable nesting habitat. It is possible, but unlikely, that this species occurs within the study area. No suitable habitat exists within the project area.

2.9 Hawksbill Sea Turtle

2.9.1 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 re-enter coastal waters when they reach a carapace length of approximately 20 to 25 centimeters. 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, 2012).

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 (Mortimer, 1982; Musick, 1979). 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 several meters 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 (National Research Council [NRC], 1990).

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, 2012). In the continental U.S., the hawksbill largely nests in Florida where it is sporadic at best (NFWL, 1980). 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).

2.9.3 Distribution in Texas

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,
2012). 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, 2007).

2.9.4 Presence in Proposed Action Area

No documented records of hawksbills exist from Chambers County, and no hawksbills nests have been recorded from the study area (NPS, 2007), largely because of the lack of suitable nesting habitat. Nonetheless, this species is of potential occurrence in the study area. However, no potential nesting habitat exists for this species within the project area.

2.10 Texas Prairie Dawn-Flower

2.10.1 Habitat

The Texas prairie dawn-flower occurs on poorly drained, sparsely vegetated areas at the base of pimple (mima) mounds or other barren areas on slightly saline soils in coastal prairie grasslands (USFWS, 1989). Sometimes it is associated with other Texas Gulf Coastal Plain endemics such as the Texas windmill-grass (*Chloris texensis*) and Houston machaeranthera (*Machaeranthera aurea*).

Texas prairie dawn-flower historically occurred within and around Houston in Fort Bend and Harris counties, and has been recently discovered in Trinity County (USFWS, 2007). An additional specimen was collected around 1879–1880 from southwest Texas between the Nueces and Frio rivers on the Old San Antonio Road; however, recent field research has been unsuccessful in relocating this population.

2.10.3 Distribution in Texas

Texas prairie dawn-flower is endemic only in the state of Texas. A large population of this species is informally protected by the USACE within Addicks and Barker reservoirs USFWS, 1989). Originally limited to western and northwestern portions of Harris County, populations of this species have been newly discovered in northeastern and southeastern Harris County, and in Trinity County (USFWS 2007). Additionally, the largest known population of this species was recently discovered on a 100-acre tract of land owned by the Katy Prairie Conservancy (USFWS, 2007).

2.10.4 Presence in Proposed Action Area

A review of historic and recent aerial photography for the project area has not identified any areas that could support potential habitat for the Texas prairie dawn-flower. Although official surveys for the plant were not conducted, USACE has determined that the project area is not likely to support habitat appropriate for the Texas prairie dawn-flower.

2.11 Whales

NMFS identified five whale species of potential occurrence in the Gulf (see Table 1). These species are generally restricted to offshore marine waters and their presence in Galveston Bay is extremely unlikely. Therefore, it is unlikely that any of these five species would occur within the project area. These species would not occur within the project area because no suitable habitat exists within the project area.

3.0 EFFECTS ANALYSIS AND AVOIDANCE, MINIMIZATION, AND CONSERVATION MEASURES

The following sections provide the findings of the Galveston District and species-specific avoidance, minimization, and conservation measures that support the effect determination. Effect determinations are presented using the language of the ESA.

- *No Effect* – The proposed action will not affect a federally listed species or critical habitat.

- *May Affect, but not likely to adversely affect* – The project may affect listed species and/or critical habitat; however, the effects are expected to be discountable, insignificant, or completely beneficial.

• *Likely to adversely affect* – Adverse effects to listed species and/or critical habitat may occur as a direct result of the proposed action or its interrelated or independent actions and the effect is not discountable, insignificant, or completely beneficial. Under this determination, an additional determination is made whether the action is likely to jeopardize the continued survival and eventual recovery of the species.

3.1 Piping Plover

No nesting or foraging sites are known to occur within the proposed project area. No occurrences of piping plover were documented within the proposed action area. Proposed project activities would have no effect on this species.

3.2 West Indian Manatee

No occurrences of West Indian Manatee have been documented within the proposed action area. Proposed project activities would have no effect on this species

3.3 Sea Turtles

While there is no nesting habitat for any of the five species of sea turtles within the proposed project areas, sea turtles are known to frequent Galveston Bay during the spring, summer, and fall months. Continued maintenance dredging of the Cedar Bayou channel would be accomplished by hydraulic pipeline dredge, as opposed to hopper dredges that have the potential to impact sea turtles. Construct of the proposed confined upland placement area (PA 7) would be accomplished mechanical excavation of material within the upland areas of the project site. Therefore, proposed project activities would have no effect on sea turtle species

3.8 Texas Prairie Dawn-Flower

No occurrences of Texas prairie dawn-flower were documented within the proposed action area. Proposed project activities would have no effect on this species.

4.0 SUMMARY

Although several threatened or endangered species occur within the project vicinity, the overall conclusion is that the proposed project would have no effect on the following listed species: piping plover, West Indian manatee, green sea turtle, Kemp’s Ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, hawksbill sea turtle, and Texas prairie dawn-flower.

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Appendix C

Section 404(b)(1) analysis

EVALUATION OF SECTION 404(b)(1) GUIDELINES
(SHORT FORM)

PROPOSED PROJECT: Cedar Bayou Dredged Material Management Plan.

The proposed Cedar Bayou Dredged Material Management Plan (CBDMMP) would include the construction of a new confined upland Placement Area (PA) on an approximately 110-acre property previously developed for a RV park. The proposed upland site is located approximately two miles north-northwest of the mouth of Cedar Bayou on the southwest bank just across the Cedar Bayou from existing PA 6. The property is generally rectangular in shape with the long sides running in an approximately northeast to southwest direction. The site is bounded by Tri-Cities Beach Road to the southwest, Houston Light and Power (HL&P) canal to the northwest, Cedar Bayou to the east and north, and vacant property to the southeast. The upland site was determined to meet reasonable size, location, cost, and environmental criteria. Dredged material would also continue to be placed in the existing confined upland PA 6. No modifications to PA 6 are being proposed beyond normal levee raises to bring the PA to its optimal height for capacity which is considered routine maintenance.

	Yes	**No***
1. Review of Compliance (230.10(a)-(d))		
A review of the proposed project indicates that:		
a. The placement represents the least environmentally damaging practicable alternative and, if in a special aquatic site, the activity associated with the placement must have direct access or proximity to, or be located in the aquatic ecosystem, to fulfill its basic purpose (if no, see section 2 and information gathered for EA alternative).	**X**	
b. The activity does not appear to:		
1) Violate applicable state water quality standards or effluent standards prohibited under Section 307 of the Clean Water Act;	**X**	
2) Jeopardize the existence of Federally-listed endangered or threatened species or their habitat; and	**X**	
3) Violate requirements of any Federally-designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies).	**X**	
c. The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, an economic values (if no, see values, Section 2)	**X**	
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see Section 5)	**X**	

	Not Applicable	Not Significant	Significant*
2. Technical Evaluation Factors (Subparts C-F) (where a 'Significant' category is checked, add explanation below.)			
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			
1) Substrate impacts		**X**	
2) Suspended particulates/turbidity impacts		**X**	
3) Water column impacts		**X**	
4) Alteration of current patterns and water circulation		**X**	
5) Alteration of normal water fluctuation/hydroperiod	**X**		
6) Alteration of salinity gradients	**X**		
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D)			
1) Effect on threatened/endangered species and their habitat		**X**	
2) Effect on the aquatic food web		**X**	
3) Effect on other wildlife (mammals, birds, reptiles and amphibians)		**X**	
	Not Applicable	**Not Significant**	**Significant***
2. Technical Evaluation Factors (Subparts C-F) (where a 'Significant' category is checked, add explanation below.)			
c. Special Aquatic Sites (Subpart E)			
1) Sanctuaries and refuges	**X**		
2) Wetlands		**X**	
3) Mud flats	**X**		
4) Vegetated shallows	**X**		
5) Coral reefs	**X**		
6) Riffle and pool complexes	**X**		
d. Human Use Characteristics (Subpart F)			
1) Effects on municipal and private water supplies	**X**		
2) Recreational and Commercial fisheries impacts	**X**		
3) Effects on water-related recreation	**X**		
4) Aesthetic impacts		**X**	
5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves	**X**		

	Yes
3. Evaluation of Dredged or Fill Material (Subpart G)	
a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material (check only those appropriate)	**N/A**
1) Physical characteristics	
2) Hydrography in relation to known or anticipated sources of contaminants	
3) Results from previous testing of the material or similar material in the vicinity of the project	
4) Known, significant sources of persistent pesticides from land runoff or percolation	
5) Spill records for petroleum products or designated (Section 311 of Clean Water Act) hazardous substances	
6) Otherpublic records of significant introduction of contaminants from industries, municipalities or other sources	
7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	

List appropriate references: N/A

	Yes	No
b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredged or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and placement sites and not likely to degrade the placement sites, or the material meets the testing exclusion criteria.	**X**	

	Yes
4. Placement Site Delineation (230.11(f))	
a. The following factors as appropriate, have been considered in evaluating the placement site:	**N/A**
1) Depth of water at placement site	
2) Current velocity, direction, and variability at placement site	
3) Degree of turbulence	
4) Water column stratification	
5) Discharge vessel speed and direction	
6) Rate of discharge	
7) Fill material characteristics (constituents, amount, and type of material, settling velocities)	
8) Number of discharges per unit of time	
9) Other factors affecting rates and patterns of mixing (specify)	

List appropriate references: N/A

	Yes	No
b. An evaluation of the appropriate factors in 4a above indicates that the placement site and/or size of mixing zone are acceptable.	**N/A**	

	Yes	No
5. Actions to Minimize Adverse Effects (Subpart H)		
All appropriate and practicable steps have been taken, through application of recommendations of 230.70-230.77 to ensure minimal adverse effects of the proposed discharge.	X	

List actions taken:

1) The PA would be located within a primarily upland site, and confined with dikes to minimize smothering of organisms during events when discharges of maintenance dredged material are occurring in the PA.
2. The PA would be confined with containment dikes to reduce the potential for erosion, slumping or leaching of materials into the surrounding aquatic ecosystem.

	Yes	No*
6. Factual Determination (230.11)		
A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:		
a. Physical substrate at the placement site (review Sections 2a. 3, 4, and 5 above)	X	
b. Water circulation, fluctuation and salinity (review Sections 2a. 3, 4, and 5)	X	
c. Suspended particulates/turbidity (review Sections 2a. 3, 4, and 5)	X	
d. Contaminant availability (review Sections 2a. 3, and 4)	X	
e. Aquatic ecosystem structure and function (review Sections 2b and c, 3, and 5)	X	
f. Placement site (review Sections 2, 4, and 5)	X	
g. Cumulative impacts on the aquatic ecosystem	X	
h. Secondary impacts on the aquatic ecosystem	X	

7. Evaluation Responsibility	
a. This evaluation was prepared by:	**Andrea Catanzaro**
Position:	**Environmental Lead**

8. Findings	**Yes**
a. The proposed placement site for discharge of or fill material complies with the Section 404(b)(1) Guidelines.	X
b. The proposed placement site for discharge of dredged or fill material complies with the Section 404(b)(1) Guidelines with the inclusion of the following conditions:	

List of conditions: N/A

c. The proposed placement site for discharge of dredged or fill material does not comply with the Section 404(b)(1) Guidelines for the following reason(s):	
1) There is a less damaging practicable alternative	
2) The proposed discharge will result in significant degradation of the aquatic ecosystem	
3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem	

Date	MURPHY.CAROLYN.E.1230989296 Digitally signed by MURPHY.CAROLYN.E.1230989296 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=MURPHY.CAROLYN.E.1230989296 Date: 2014.03.21 10:15:42 -05'00' CAROLYN MURPHY Chief, Section

NOTES:

* A negative, significant, or unknown response indicates that the permit application may not be in compliance with the Section 404(b)(1) Guidelines.

Negative responses to three or more of the compliance criteria at the preliminary stage indicate that the proposed projects may not be evaluated using this “short form” procedure. Care should be used in assessing pertinent portions of the technical information of items 2a-e before completing the final review of compliance.

Negative response to one of the compliance criteria at the final stage indicates that the proposed project does not comply with the Guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the “short form” evaluation process is inappropriate.

Appendix D

Air Emissions

Cedar Bayou DMMP Air Quality Analysis

1.0 Introduction

The purpose of the Cedar Bayou DMMP Project is to establish 20 years of dredged material capacity for the lower reach of Cedar Bayou by construction of a new upland placement area (PA) using the most cost effective and environmentally acceptable approach practicable. Cedar Bayou is located east of the City of Baytown and the bayou acts as a dividing line between Chambers and Harris Counties, Texas (Figure 1).

Figure 1. Project Location

This document presents the air quality analysis performed by the USACE, Galveston District, pursuant to the Clean Air Act (CAA) to document that air contaminant emissions that would result from the USACE action in approving the proposed project are below *de minimus* and that a General Conformity Determination is not required.

2.0 Background

The construction activities associated with this project will be located within Harris County. Harris County is located within the Houston-Galveston-Brazoria (HGB) ozone nonattainment area. The U.S. Environmental Protection Agency (EPA) has classified the HGB as being in attainment or unclassified with the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants except ozone. Under the recently promulgated 2012 8-hour ozone standard, the HGB is classified as a "marginal" nonattainment area. Prior to the 2012 rules, the HGB was designated as a "severe" nonattainment area. 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). The *de minimus* thresholds (both severe and marginal) for the HGB attainment area are presented in table 2.

Table 2. *De minimus* thresholds for the HGB attainment area

	Severe	Marginal
NO_X	25 tons/year	100 tons/year
VOC	25 tons/year	100 tons/year

Best available information was used to prepare this draft determination. However, in the event that the construction schedule is modified, a revised determination will be submitted to TCEQ and EPA for review.

3.0 Methods and Analysis

The land-based emission sources for the proposed project includes both off-road equipment such as bulldozers, crawlers, cranes, etc. and on-road construction vehicles such as dump trucks and haul trucks. The off-road and on-road construction equipment would consist primarily of diesel-powered engines. Emissions of NO_x and VOC were estimated by type for each piece of equipment based on the equipment horsepower, fuel type, and expected operating hours for construction. The basis for emissions included the following:

- Preliminary project description and other information, as developed by the USACE for the proposed project.
- The EPA NONROAD emission factor model, Final 2005 Version, was used to predict emissions resulting from landside, off-road construction equipment with inputs for assumed equipment usage developed for this alternative. This model may be used to predict air emissions for off-road construction equipment based on information including geographic location, equipment type, and fuel use for specific years that may be selected. It provides an estimate of emissions for different equipment based on equipment population, load factor, available horsepower, deterioration, and applicable standards.

A list of equipment needed for construction of the proposed project was developed by the Cost Engineering Section of the USACE, Galveston District (Table 1). This list also included estimated operating hours.

The equipment was grouped based on the type of equipment, horse power, load factor, and NO_X and VOC emissions. The operating hours for the equipment groups were then totaled and the following equations were used to calculate NO_X and VOC emissions:

Emission Factor (g/hp-hr) = (a*(Load Factor) - x + b) * 0.7457

Where a = coefficient, b = intercept, x = exponent

For NO_X a = 0.1255, b = 10.4496, x = 1.5

For VOC (HC) a = 0.0667, b = 0, x = 1.5

Emission Rate (tons/hr) = (Engine horsepower x Engine Load Factor x Emission Factor (g/hp-hr))/453.59 grams per pound/2,000 pounds per ton

Emission Amount (tons/yr) = Emission Rage x Hours of Operation (hrs/year)

4.0 Results

The results of the analysis are presented in Table 3.

Table 3. Results of the air quality analysis

Equipment	Hours	HP	Load Factor	NO_X	VOC	NO_X Emissions	VOC Emissions
Apshalt Paver	116	165	59%	3.7275103	0.3038857	0.0464	0.0038
Asphalt Profiler	116	165	59%	3.7275103	0.3038857	0.0464	0.0038
Backhoe	932	200	21%	6.0061466	0.9490323	0.2592	0.0409
Brush Chipper	310	125	43%	5.5854924	0.5494683	0.1026	0.0101
Bucket	4,773	350	43%	4.0891554	0.2871882	3.2379	0.2274
Chainsaw	620	6	78%	0.9099999	62.807919	0.0029	0.2009
Chip Spreader	1	125	43%	5.5854924	0.549683	0.0003	0.0000
Crane	4,773	350	43%	4.2905919	0.3223134	3.3974	0.2552
Crusher	116	400	21%	3.3473836	0.1862279	0.0360	0.0020
Dump Truck	2,209	400	21%	3.3473836	0.1862279	0.6847	0.0381
Excavator	628	150	59%	3.5462134	0.2925814	0.2173	0.0179
Grader	1	165	59%	3.7275103	0.3038857	0.0004	0.0000
Helicopter	2	350	43%	4.2905719	0.3223134	0.0014	0.0001
Hydroseeder	48	350	59%	5.1855796	0.6284272	0.0567	0.0069

Table 3. Results of the air quality analysis							
Equipment	**Hours**	**HP**	**Load Factor**	**NO_X**	**VOC**	**NO_X Emissions**	**VOC Emissions**
Loader, Front End	1,047	200	21%	6.0061466	0.9490323	0.2911	0.0460
Roller	116	5	48%	0.09099999	62.807919	0.0000	0.0193
Roller, Vibratory	7	5	48%	0.09099999	62.807919	0.0000	0.0012
Tractor, Agricultural	1	350	59%	5.1855796	0.6284272	0.0012	0.0001
Tractor, Dozer	5,689	200	21%	6.0061466	0.9490323	1.5819	0.2500
Truck, Highway	4,138	230	59%	2.9597069	0.0228783	1.8320	0.0142
Truck, Off-Highway	8	330	59%	3.3473836	0.1862279	0.0057	0.0003
Water Pump	1,792	21	43%	4.6668262	0.535964	0.0832	0.0096
Water Truck	17	330	59%	3.3473836	0.1862279	0.0122	0.0007
					Tons	11.8970	1.1484

Air emissions from the proposed project fall below the *de minimus* threshold for the current "marginal" HGB nonattainment classification and the previous "severe" HGB nonattainment classification (Table 4). Since the project falls below the *de minimus* classification, a General Conformity Determination is not required.

Table 4. Air emission for the proposed project and d*e minimus* thresholds for the HGB attainment area			
	Project Emissions	Severe	Marginal
NO_X	11.8970 tons/year	25 tons/year	100 tons/year
VOC	1.1484 tons/year	25 tons/year	100 tons/year

Table 1. Cedar Bayou DMMP Full Equipment List			
Description **Equipment by Contractor, Report**	**Condition**	**Manufacturer** **Total:**	**EQ Hours** **28,314**
AF CODTE Backfill	Average	TE TEREX CORPORATION	16
CIV APTSD Sandblast Metal	Average	SD SIOUX STEAM CLEANER CORPORATION	120
EP R50CA010 ROLLER, VIBRATORY, SELF-PROPELLED, SINGLE DRUM, PAD FOOT, 12.5 TON, 84" WIDE, 3X2 SOIL COMPACTOR	Average	CA CATERPILLAR INC. (MACHINE DIVISION)	3
EP T25JD012 TRACTOR, AGRICULTURAL, WHEEL, 325 HP, 4X4, PTO, 3 POINT HITCH	Average	JD DEERE & COMPANY	1
EP T50XX011 TRUCK, HIGHWAY, CREW, 3/4 TON PICKUP, 4X4	Average	XX NO SPECIFIC MANUFACTURER	643
EP T50XX020 TRUCK, HIGHWAY, CREW, 3/4 TON PICKUP 4X4	Average	XX NO SPECIFIC MANUFACTURER	1,920
EP T55CA009 TRUCK, OFF-HIGHWAY, ARTICULATED FRAME, 22 CY, 30 TON, 4X4, REAR DUMP	Average	CA CATERPILLAR INC. (MACHINE DIVISION)	8
GEN A10Z0044 CHIP SPREADER, TOWED, 8' (2.4 M) WIDE, (ADD 35,000 LB (15,876 KG) GVW TRUCK)	Average	ZZ GENERIC EQUIPMENT	1
GEN A30Z0645 ASPHALT/RCC PAVER, 32.8' (10 M) WIDE, SELF PROPELLED, CRAWLER, W/DUAL TAMPER SCREED	Average	ZZ GENERIC EQUIPMENT	116
GEN A40Z0760 ASPHALT PROFILER, 10.0' (3.1M) WIDE x 10" (254 MM) DEEP, CRAWLER (ADD CUTTING TEETH COSTS)	Average	ZZ GENERIC EQUIPMENT	116
GEN B20Z0890 BRUSH CHIPPER, 12" (305 MM) DIA LOG DISC TYPE CUTTER, TRAILER MOUNTED	Average	ZZ GENERIC EQUIPMENT	310
GEN B35Z1120 BUCKET, DRAGLINE, 1.5 CY (1.2 M3) MEDIUM WEIGHT (ADD TEETH WEAR COST)	Average	ZZ GENERIC EQUIPMENT	35
GEN B35Z1140 BUCKET, DRAGLINE, 3.0 CY (2.3 M3) MEDIUM WEIGHT (ADD TEETH WEAR COST)	Average	ZZ GENERIC EQUIPMENT	4,738
GEN C05Z1210 CHAINSAW, 24" - 42" (610-1,067 MM) BAR	Average	ZZ GENERIC EQUIPMENT	620
GEN C85Z2398 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 2.5 CY (1.9 M3), 60 TON (54 MT), 50' (15.2 M) BOOM (ADD BUCKET)	Average	ZZ GENERIC EQUIPMENT	35
GEN C85Z2400 CRANE, MECHANICAL, LATTICE BOOM, CRAWLER, DRAGLINE/CLAMSHELL, 3.0 CY (2.3 M3), 75 TON (68 MT), 100' (30.5 M) BOOM (ADD BUCKET)	Average	ZZ GENERIC EQUIPMENT	4,738
GEN G15Z3080 GRADER, MOTOR, ARTICULATED, 135 HP (101 KW), 12' (3.6 M) BLADE WIDTH	Average	ZZ GENERIC EQUIPMENT	1
GEN H25Z3680 HYDRAULIC EXCAVATOR, ATTACHMENT, MATERIAL HANDLING, BUCKET, 36" (914 MM) PAVEMENT REMOVAL (ADD TO 75,000 LB (34,019 KG) HYDRAULIC EXCAVATOR)	Average	ZZ GENERIC EQUIPMENT	314
GEN H25Z3685 HYDRAULIC EXCAVATOR, ATTACHMENT, CONCRETE PULVERIZER, 3,000 LB (1360 KG) W/POINT (ADD TO 26,000-36,000 LB (11,793-16,329 KG) HYDRAULIC EXCAVATOR)	Average	ZZ GENERIC EQUIPMENT	314
GEN L15Z3880 LANDSCAPING EQUIPMENT, HYDROSEEDER, 3,000 GAL (11,356 L) TRUCK MOUNTED	Average	ZZ GENERIC EQUIPMENT	48
GEN L35Z4260 LOADER, FRONT END, CRAWLER, 2.60 CY (2.0 M3) BUCKET	Average	ZZ GENERIC EQUIPMENT	310
GEN L40Z4395 LOADER, FRONT END, WHEEL, ARTICULATED, 2.75 CY (2.1 M3) BUCKET, 4X4,	Average	ZZ GENERIC EQUIPMENT	403

GEN L40Z4400 LOADER, FRONT END, WHEEL, ARTICULATED, 3.50 CY (2.7 M3) BUCKET, 4X4	Average	ZZ GENERIC EQUIPMENT	334
GEN L50Z4640 LOADER/BACKHOE, WHEEL, 0.80 CY (0.6 M3) FRONT END BUCKET, 9.8' (3.0 M) DEPTH OF HOE, 24" (0.61 M) DIPPER, 4X4	Average	ZZ GENERIC EQUIPMENT	930
GEN P50Z5086 PUMP, WATER, CENTRIFUGAL, TRASH, HOSE, SUCTION/DISCH, 3" (76 MM) DIA x 20' (6.1 M) LENGTH, W/COUPLING/SECTION	Average	ZZ GENERIC EQUIPMENT	448
GEN P50Z5097 PUMP, WATER, CENTRIFUGAL, TRASH, HOSE, SUCTION/DISCH, 3" (75 MM) DIA X 50' (15 M) WITH COUPLING (PER SECTION)	Average	ZZ GENERIC EQUIPMENT	896
GEN P60Z5400 PUMP, WATER, CENTRIFUGAL, DEWATERING, SKID MOUNTED, ENGINE DRIVE, 3" (76 MM) DIA, 17,600 GPM (66,623 LPM) @ 20' (6.1 M) HEAD (ADD HOSES)	Average	ZZ GENERIC EQUIPMENT	448
GEN R45Z5670 ROLLER, VIBRATORY, SELF-PROPELLED, DOUBLE DRUM, SMOOTH, 2.7 TON (2.5 MT), 47"(3.8 M) WIDE, ASPHALT COMPACTOR	Average	ZZ GENERIC EQUIPMENT	1
GEN S30Z6050 SCREENING & CRUSHING PLANTS, CRUSHER - SHAFT IMPACTOR, 36" (0.8 M) X54" (1.4 M), SINGLE ROTOR, 250 TPH (225 MTPH), W/3' (0.9M) X 16' (4.9M) FEEDER/ 4' (1.2M)GRIZZLY/ 24" (0.6M) REJECT CONVEYOR/ & 36" (0.9M) DISCHRG CONVEYOR, TRAILER MTD (ADD 250 KW GEN)	Average	ZZ GENERIC EQUIPMENT	116
GEN T15Z6500 TRACTOR, CRAWLER (DOZER), 136-180 HP (101-134 KW), POWERSHIFT, W/UNIVERSAL BLADE	Average	ZZ GENERIC EQUIPMENT	77
GEN T15Z6520 TRACTOR, CRAWLER (DOZER), 181-250 HP (135-186 KW), POWERSHIFT, LGP, W/UNIVERSAL BLADE	Average	ZZ GENERIC EQUIPMENT	4,954
GEN T15Z6560 TRACTOR, CRAWLER (DOZER), 251-300 HP (187-224 KW), POWERSHIFT, W/UNIVERSAL BLADE	Average	ZZ GENERIC EQUIPMENT	153
GEN T40Z7090 TRUCK OPTION, DUMP BODY, REAR, 12 CY (9.2 M3) (ADD 45,000 LB (20,412 KG) GVW TRUCK)	Average	ZZ GENERIC EQUIPMENT	1,509
GEN T45Z7280 TRUCK TRAILER, WATER TANKER, 5,000 GAL (18,927 L) (ADD 50,000 LB (22,680 KG) GVW TRUCK)	Average	ZZ GENERIC EQUIPMENT	17
GEN T50Z7320 TRUCK, HIGHWAY, CONVENTIONAL, 8,800 LB (3,992 KG) GVW, 4X4, 2 AXLE, 3/4 TON (0.68 MT) - PICKUP	Average	ZZ GENERIC EQUIPMENT	1
GEN T50Z7420 TRUCK, HIGHWAY, 45,000 LB (20,412 KG) GVW, 6X4, 3 AXLE (ADD ACCESSORIES)	Average	ZZ GENERIC EQUIPMENT	1,509
GEN T50Z7520 TRUCK, HIGHWAY, 55,000 LB (24,948 KG) GVW, 6X4, 3 AXLE (ADD ACCESSORIES)	Average	ZZ GENERIC EQUIPMENT	17
GEN T50Z7580 TRUCK, HIGHWAY, 45,000 LB (20,412 KG) GVW, 6X4, 3 AXLE (ADD ACCESSORIES)	Average	ZZ GENERIC EQUIPMENT	48
GEN T50Z7700 DUMP TRUCK, HIGHWAY, 10 - 13 CY (7.6 - 9.9 M3) DUMP BODY, 35,000 LBS (15,900 KG) GVW, 2 AXLE, 4X2	Average	ZZ GENERIC EQUIPMENT	626
GEN T50Z7710 DUMP TRUCK, HIGHWAY, 16 - 20 CY (12.2 - 15.3 M3) DUMP BODY, 75,000 LBS (34,000 KG) GVW, 2 AXLE, 6X4	Average	ZZ GENERIC EQUIPMENT	74
MAP L50JC001 LOADER / BACKHOE, WHEEL, 0.80 CY FRONT END BUCKET, 24" DIP, 4.3 CF, 12' DIGGING DEPTH, 4X4	Average	JC JCB INC.	2
MAP T15CA008 TRACTOR, CRAWLER (DOZER), 145 HP, POWERSHIFT, W/5.60 CY SEMI-U BLADE (ADD ATTACHMENTS)	Average	CA CATERPILLAR INC. (MACHINE DIVISION)	501
MAP T15CA014 TRACTOR, CRAWLER (DOZER), 240 HP, LOW GROUND PRESSURE, W/7.70 CY STRAIGHT BLADE (ADD ATTACHMENTS)	Average	CA CATERPILLAR INC. (MACHINE DIVISION)	4
MAP XMEZ0025 HELICOPTER, 1250 LB. LIFT CAP, 206L4	Average	ZZ GENERIC EQUIPMENT	2
MIL ALABG Concrete	Average	BG BARBER-GREENE COMPANY	30
MIL C75GV002 CRANE,HYD,S/P,RT,4WD,20T/70'BOOM	Average	GV GROVE CRANES	291

MIL CPIDC W8 X 8 Wide Flange Piles	Average	DC	44
MIL CPIDV Piling	Average	DV	13
MIL SIWSC Field Welding for Steel Items	Average	SC SCHWING AMERICA INC.	20
PTC A30Z0680 ASPHALT WINDROW ELEVATOR, SELF PROPELLED, 60" (18 M) WIDE (ADD ASPHALT PAVER UNIT)	Average	ZZ GENERIC EQUIPMENT	116
UPB XMIXX020 SMALL TOOLS	Average	XX NO SPECIFIC MANUFACTURER	175
USR CODES Excavation with Hyd. Excavator	Average	ES ESCO CORPORATION	26

Appendix E

Habitat Evaluation Procedures Report

1.0 Background Information

1.1 Project Description

The U.S. Army Corps of Engineers (USACE) proposes to build a new Placement Area (PA) for the placement of dredged material from the Cedar Bayou Navigation Channel in Chambers and Harris Counties, Texas. The PA will be located approximately two miles from the mouth of Cedar Bayou on an approximately 110-acre property that was previously developed for a RV park but has since been abandoned (Figure 1). The property is generally rectangular in shape with the long sides running in an approximately northeast to southwest direction. The site is bounded by Tri-Cities Beach Road to the southwest, HL&P canal to the northwest, Cedar Bayou to the northeast, and vacant property to the southeast. Existing infrastructure within the site includes asphalt surfaced roads, and underground utilities including storm and sanitary sewers, sanitary pump station, and water distribution pipes.

Figure 1. Project Area and Existing Tidal Wetlands.

The proposed PA would be constructed with containment dikes having an elevation of +32 feet (NAVD 88) with a 10-foot crown width, and side slopes of 1 vertical to 3 horizontal. Actual levee heights relative to existing elevations would vary from about 12 feet at the southwest side of the PA to over 20 feet where dike alignment crosses over the existing canals located along the northeast side of the site. The containment dike footprint would be cleared of vegetation and existing infrastructure. The resulting exposed ends of storm sewers that were installed as a part of the planned RV park would be grouted and the sanitary sewer and water pipes will be capped prior to containment dike construction. Asphalt materials from demolition of the existing roads within the site would be collected and buried within the interior of the PA in areas where the drainage/sewer infrastructure will have been removed. Debris from demolition of drainage and sewer consisting of concrete rubble and cast iron piping would be buried in the canals only after the exterior containment dike has been constructed in order to isolate the debris from Cedar Bayou. Construction would impact a portion of each of the canals and would include elimination of approximately 2.56 acres of wetlands located along the shorelines of the affected areas of the canals.

The initial construction of the containment dike would be performed by excavating material from the interior of the PA. The containment dike would be constructed using the semi-compacted technique by compacting the borrow material in 12-inch lifts using a bull dozer of minimum specified size. The final crown and outside slope of the containment dikes would be seeded using the hydro-mulch method. Depending on the location of suitable fill soils within the site, material may be placed by side-casting excavated material along the inside perimeter of the proposed dike, or it may be excavated from the interior of the site and hauled to the dike construction area. The location of suitable dike constriction soils within the site would be determined during the preconstruction engineering and design phase.

An effluent drop-outlet structure would be constructed at the northeast end of the PA with discharge into Cedar Bayou. The structure would be positioned far enough away from the containment dike to allow future levee raisings as required over the life of the PA.

1.2 HEP Overview

The Habitat Evaluation Procedure (HEP), developed by the U.S. Fish and Wildlife Service (USFWS), is a method used to quantify the impacts of a proposed project by evaluating the ability of the wildlife habitat within a study area to provide key components necessary for specific wildlife species (USFWS 1980). HEP is a species-habitat approach to impact assessment that quantifies habitat quality for selected evaluation species through the use of a habitat suitability index (HSI). The HSI value is derived from an evaluation of the ability of key habitat components to provide the life requisites of selected species of wildlife (USFWS 1980). HEP is based on the assumption that habitat for selected species can be described at a specified point in time by an HSI. The species HSI is multiplied by the area of available habitat at that time to determine the total habitat units (HU) for the species for particular cover types in the study area. The first step of the HEP analysis, the baseline assessment, describes the existing habitat conditions in terms of HUs for the study area. The next step involves projecting future habitat conditions in the defined project area in terms of HUs and comparing the future habitat conditions with the proposed project to the future habitat conditions without the proposed project. To do so, the HUs are integrated over time for each scenario and then annualized by the life of the project to derive an Average Annual Habitat Unit (AAHU) for each scenario. The impact of the proposed project is equal to the difference between the future without-project AAHUs and the future with-project AAHUs. The quantitative project impact value is then used to determine the mitigation required to compensate for the habitat lost as a result of the proposed project.

2.0 HEP Baseline Assessment

The HEP baseline assessment was conducted in July of 2013. The baseline assessment determined cover types present within the proposed project area and evaluated the habitat quality of such cover types to which impact is anticipated and mitigation would be necessary. The objective of the baseline assessment was to record and quantify the habitat quality of cover types in terms of HUs prior to construction. Delineation of the project area was based on conceptual design drawings and preliminary plans (Figure 1).

2.1 Cover Type Descriptions

The site is bound by Cedar Bayou on the northeast side and the Cedar Bayou Intake Channel on the northwest side. Most of the interior of the site is dominated by uplands, with the exception of four canals cut into the site along Cedar Bayou. The canals were excavated in the late 1980s during the initial construction of the proposed RV park. Estuarine intertidal emergent marsh dominated by smooth cordgrass (*Spartina alterniflora*) occurs as a narrow fringe along the shoreline of these canals as well as along the shorelines of the Cedar Bayou and Cedar Bayou Intake Channels. Open waters adjacent to the site are characterized as estuarine subtidal shallow bay bottom. Based on data from field investigations and aerial photos, it is estimated that the project site contains approximately 5.44 acres of estuarine intertidal emergent wetlands. Construction of the proposed project would impact a portion of each of the canals. Based on these calculations, approximately 2.56 acres of wetlands within the canals would be impacted by construction of the proposed project (Figure 2).

2.1 HSI Model Selection

Red drum (*Sciaenops ocellatus*) is an estuarine-dependent species found along the Atlantic coast and in the Gulf of Mexico. The red drum HSI model was selected to be incorporated into the HEP analysis for this project because of this species' importance to commercial and recreational fisheries. The red drum HSI is designed for use throughout their range and can be used to assess habitat suitability for both their larval or juvenile life stages. No model was developed for the adult

Figure 2. Proposed Placement Area and Resulting Tidal Wetland Impacts.

stage because adults are highly mobile and tolerate a wide range of environmental conditions. Of the two models developed for the larval and juvenile red drum, one is designed for use in estuaries with naturally vegetated substrates and the other for use in estuaries that cannot support bottom vegetation because of natural factors such as high turbidity. Each model utilizes different variables. These HSI models are applicable in the estuarine intertidal and subtidal habitat classes of Cowardin et al. (1979). The naturally nonvegetated substrate HSI model for the red drum was utilized for this project area because the area contains no submerged aquatic vegetation and habitats within the project site include estuarine intertidal emergent marsh and estuarine subtidal unconsolidated bottom habitats.

Brown shrimp (*Penaeus setiferus*) occur in both marine and estuarine habitats, depending on life stage. Adult shrimp spawn offshore in marine waters. Post-larval shrimp enter estuaries where they are highly dependent on coastal wetlands for food and habitat cover. Juvenile shrimp leave the estuary and move offshore to mature into adults. Brown shrimp HSI models should be used to evaluate areas with salt and brackish marshes with alternately flooding and receding waters, which is representative of the estuarine intertidal emergent marsh cover type. The brown shrimp HSI model was selected to be incorporated into the HEP analysis for this project due to the importance of this species to commercial and recreational fisheries.

2.2 Baseline Assessment Results

A HEP baseline assessment was conducted for each evaluation species. Data were applied to species specific HSI models over one cover type to obtain HSI scores for red drum and brown shrimp. Observed data was referenced to suitability index (SI) graphs, found in the species-specific HSI model reports, to obtain suitability indices based on graph-derived mathematical equations, where applicable, and on categorical values. Suitability indices were then used in model-defined HSI equations to complete the HSI analysis. Subsequent sections describe the derivation of HSIs for each species.

<u>Red drum HSI Model</u>

The HSI model for the red drum in estuaries with no naturally submerged vegetation is based on four habitat variables and aggregated into two life requisites (water quality and food/cover) for larval and juvenile red drum. Optimal water quality conditions are assumed to occur when: (1) the mean water temperature is between 25 and 30°C and (2) the mean salinity is between 25 and 30 parts per thousand (ppt). Optimal feeding conditions are assumed to occur when 100 percent of open water is fringed by persistent emergent vegetation. Optimal cover conditions are assumed to occur when the substrate is predominately mud and mean water depths are between 1.5 and 2.5 meters at low tide.

The mathematical equations used to determine HSI for red drum in estuaries with no naturally submerged vegetation are as follows:

- Water quality = $(V1^2 \text{ x } V2)1/3$
- Food = V3
- Cover = (V5xV6)1/2
- HSI = water quality, food or cover, whichever is lowest

<u>Brown shrimp HSI Model</u>

The HSI model for the brown shrimp in estuarine habitats is based on four habitat variables that are aggregated into two life requisites (food/cover and water quality). Optimal food/cover conditions are assumed to occur in estuaries that: (1) Are covered by 100 percent cover of vegetation (marsh and seagrass) and (2) Have substrate composition comprised of a soft bottom with peaty silts and/or organic mud with decaying vegetation and organic material. Optimal water quality conditions are assumed to occur when: (1) The mean summer salinity is between 10 and 20 ppt and (2) The mean summer water temperature is between 20 and 30°C.

The mathematical equations used to determine HSI for brown shrimp in estuarine habitats are as follows:

- Food/cover = (V1 x V2b)1/3
- Water quality = (V3b x V4)1/2
- HSI = water quality or food/cover, whichever is lower

3.0 Impact HEP Analysis

Habitat impact assessments are performed by quantifying habitat conditions using HUs at several points in time throughout some defined period of analysis. Points in time, or target years (TYs), are used in HEP, and allow users to anticipate and identify significant changes (in area or quality) within the project (or site). This approach is consistent with the evaluation period for Federal Projects that is referred to as the "period of analysis" and includes a baseline and the "life of the project" as defined by the HEP Manual (USFWS, 1980). The life of the project is defined as that period between the times the project becomes operational (end of construction period) and the end of the project life, as determined by the lead agency, which is a 20-year period for this project. As a rule, the baseline TY is always TY=0, where the baseline year is defined as a point in time before proposed changes would be implemented. As a second rule, there must always be at least a TY=1 and a TY=X2. TY1 is the first year land- and water-use conditions are expected to deviate from baseline conditions. This is usually the first year the project becomes operational. TYX2 designates the ending target year or the span of the project's life. For Federal Projects, the ending target year (TYX2) is often tied to the economic period of analysis for the project. For the purposes of the Cedar Bayou DMMP study, the baseline year (TY0) is 2013; TY1 or the first year changes are anticipated is 2014, and the ending target year is 2034. Thus, the life of the project spans from 2014 through 2034.

3.1 Without Project Conditions and Analysis

This project site lies within fairly shallow water in an area of low wind and wave energy. As such, the area of estuarine intertidal emergent marsh along shorelines has remained fairly stable over time. Without project implementation, the habitat area and site conditions, and the related habitat quality (HSI values) for red drum and brown shrimp are assumed to stay fairly constant, maintaining HSIs of 0.26 and 0.46, respectively, over the period of analysis. The without-project variable trends and calculation of HSIs for red drum and brown shrimp are presented in Appendix A, Tables A-1 and A-2.

Habitat Units (HUs) for Red drum were calculated for each target year by multiplying the area by the HSI value water quality, food, or cover – whichever is lowest. HU's for brown shrimp were calculated for each target year by multiplying the area by the HSI values for food/cover or water quality – whichever is lowest. The cumulative HUs are calculated for the changes between in all target years and averaged based on the number of years in the period of analysis to provide the Average Annual Habitat Units (AAHUs) (Table 1). Since the habitat area and quality would be assumed to remain relatively unchanged over the period of analysis, the without-project AAUHs for both evaluation species would also remain fairly constant, maintaining baseline levels through the period of analysis. Without-project, the AAHUs for red drum and brown shrimp would be 1.40 AAHUs and 2.49 AAHUs, respectively. Based on the results in Table 1, the composite or average AAHU value for the species for the project area under the without-project scenario would be 1.95 AAHUs.

Table 1. Without-Project AAHUs for red drum and brown shrimp
Placement Area Impact Analysis

RED DRUM						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.26	0.26	5.44	5.44	1.40
1	**2**	0.26	0.26	5.44	5.44	1.40
2	**6**	0.26	0.26	5.44	5.44	5.62
6	**21**	0.26	0.26	5.44	5.44	21.07
Cumulative HUs						29.50
Without-Project AAHUs						1.40
BROWN SHRIMP						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.46	0.46	5.44	5.44	2.49
1	**2**	0.46	0.46	5.44	5.44	2.49
2	**6**	0.46	0.46	5.44	5.44	9.97
6	**21**	0.46	0.46	5.44	5.44	37.38
Cumulative HUs						52.33
Without-Project AAHUs						2.49
SITE AVERAGE						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.36	0.36	5.44	5.44	1.95
1	**2**	0.36	0.36	5.44	5.44	1.95
2	**6**	0.36	0.36	5.44	5.44	7.79
6	**21**	0.36	0.36	5.44	5.44	29.22
Cumulative HUs						40.91
Without-Project AAHUs						1.95

3.2 With-Project Conditions and Analysis

Construction of the proposed project would impact approximately 2.56 of the 5.44 acres of estuarine intertidal emergent wetlands dominated by smooth cordgrass present in the project area. The impacted wetlands are located along the shorelines of the canals located within the interior of the proposed PA (Figure 2). With-project, the overall habitat quality of the remaining 2.88 acres of wetlands provide about the same habitat quality (HSI) for red drum, as the percentage of available open water edge fringed with persistent emergent vegetation would remain relatively unchanged despite the loss of marsh area. Mean temperature, salinity and water depth would also remain unchanged. The HSI for brown shrimp would be lowered slightly (0.14 HSI) from the without-project condition, though the percentage of the remaining area of estuary that is not occupied by the PA footprint would still have about the same percentage of vegetative cover for the species. Overall, however, HUs for both species would decrease as a result of the overall decrease in wetland acreage. The with-project variable trends and calculation of HSIs for red drum and brown shrimp are presented in Appendix A, Tables A-3 and A-4.

The net average annual impact of the proposed project is equal to the difference between the without-project AAHUs and the with-project AAHUs. With-project, the AAHUs for red drum and brown shrimp would be reduced to 0.76 AAHUs and 1.32 AAHUs, respectively, while the overall site average would be reduced to 1.04 AAHUs (Table 2). Based on the without- and with-project results, the net average annual impact due to construction of the proposed PA would be a loss of 0.64 AAHUs and 1.17 AAHUs, for the red drum and brown shrimp, respectively. Overall, this would amount to an average loss of 0.91 AAHUs for the project site (Table 3).

4.0 Mitigation HEP Analysis

The mitigation requirements for the project are determined based on the net average annual impact of the proposed project compared to such value for mitigation activities within the proposed mitigation area from similar analysis. The mitigation alternatives analysis evaluates the habitat associated with the proposed mitigation alternative plans using the HSI models for the same two evaluation species. Whether the required mitigation for the proposed project is likely to be achieved through proposed mitigation activities is determined based on the predicted net average annual benefit (in AAHUs) for the mitigation area, which is equal to the difference between the without-project" AAHUs and the with-project AAHUs.

Table 2. With-Project AAHUs for red drum and brown shrimp
Placement Area Impact Analysis

RED DRUM						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.26	0.26	5.44	2.88	1.07
1	**2**	0.26	0.26	2.88	2.88	0.74
2	**6**	0.26	0.26	2.88	2.88	2.97
6	**21**	0.26	0.26	2.88	2.88	11.15
Cumulative HUs						15.95
With-Project AAHUs						0.76
BROWN SHRIMP						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.59	0.45	5.44	2.88	1.89
1	**2**	0.45	0.45	2.88	2.88	1.29
2	**6**	0.45	0.45	2.88	2.88	5.16
6	**21**	0.45	0.45	2.88	2.88	19.36
Cumulative HUs						27.70
With-Project AAHUs						1.32
SITE AVERAGE						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.36	0.35	5.44	2.88	1.48
1	**2**	0.35	0.35	2.88	2.88	1.02
2	**6**	0.35	0.35	2.88	2.88	4.07
6	**21**	0.35	0.35	2.88	2.88	15.26
Cumulative HUs						21.82
With-Project AAHUs						**1.04**

Table 3. Comparison of Without- and With-Project AAHUs for red drum, brown shrimp
Placement Area Impact Analysis

	WITHOUT-PROJECT AAHUs	**WITH-PROJECT AAHUs**	**CHANGE AAHUs**
RED DRUM	1.40	0.76	-0.64
BROWN SHRIMP	2.49	1.32	-1.17
SITE AVERAGE	1.95	1.04	-0.91

4.1 Mitigation Alternatives

All proposed mitigation alternative plans are located on the project site for which the proposed PA is to be constructed.

Mitigation Alternative Plan 1

This alternative would create 2.64 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 5.52 acres of wetlands at the project site, resulting in a "no net loss" of wetland area. To create the 2.64 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 3). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

Mitigation Alternative Plan 2

This alternative would create 2.73 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 5.29 acres of wetlands at the project site, resulting in a "no net loss" of wetland area. To create the 2.73 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 4). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction, by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

Figure 3. Mitigation Alternative Plan 1

Figure 4. Mitigation Alternative Plan 2

Mitigation Alternative Plan 3

This alternative would create 3.01 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 5.57 acres of wetlands at the project site, resulting in a "no net loss" of wetland area. To create the 3.01 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 5). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction, by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

Mitigation Alternative Plan 4

This alternative would create 3.61 acres of estuarine intertidal emergent marsh dominated by smooth cordgrass to compensate for the loss of 2.56 acres of wetlands due to construction of the proposed PA. Overall, this would result in 6.17 acres of wetlands at the project site, resulting in a "no net loss" of wetland area. To create the 3.61 acres of wetlands, the USACE would excavate and contour two upland areas located in the southeast portion of the site (Figure 6). The site would be contoured to a maximum target elevation of approximately 1.16 feet MLT, which is the estimated upper limit of the elevation growing range for smooth cordgrass growing in the vicinity. The actual target elevation range would be determined prior to construction, by surveying nearby existing marsh in areas adjacent to the project site. After excavation and grading of the site, the mitigation area would be planted with smooth cordgrass, with sprigs planted on a 3 foot centers.

4.2 Mitigation Without-Project Conditions and Analysis

The purpose of the mitigation analysis is to determine the mitigation requirements based on the net impact of the project. A mitigation analysis was conducted for the same evaluation species, red drum and brown shrimp, assessed for the project area. Since all mitigation alternative scenarios are located onsite, the

Figure 5. Mitigation Alternative Plan 3

Figure 6. Mitigation Alternative Plan 4

without-project conditions for the mitigation assessment are assumed to be the same as presented in Section 3.1 and Table 1. Without-project, the AAHUs for red drum and brown shrimp would be 1.40 AAHUs and 2.49 AAHUs, respectively. The site composite score or average AAHU value for the species for the project area under the without-project scenario would be 1.95 AAHUs.

4.3 Mitigation With-Project Conditions and Analysis

Construction of the proposed project would impact approximately 2.56 of the existing 5.44 acres of estuarine intertidal emergent wetlands dominated by smooth cordgrass located at the project site. Each of the proposed mitigation alternative plans would more than replace the habitat acres lost from construction activities, by creating 2.64, 2.73, 3.01 or 3.61 acres of wetlands, resulting overall in approximately 5.52, 5.61, 5.89 or 6.49 acres of wetlands at the project site. Implementation of any of the mitigation plans in addition to the project impacts, would provide about the same habitat quality (HSI) for red drum, as the percentage of available open water edge fringed with persistent emergent vegetation would remain relatively unchanged despite the overall gain in marsh area. Mean temperature, salinity and water depth would also remain unchanged. Likewise, the HSI for brown shrimp, would remain relatively unchanged from the without project condition as the area of estuary that is vegetated, though somewhat larger, would still have about the same percent cover for the species. For all mitigation alternatives, AHHUs for both species and the site average would increase as a result of the overall increase in wetland acreage. The project variable trends and calculation of HSIs for red drum and brown shrimp are presented in Attachment A, Tables A-5 and A-16, for each of the four mitigation alternatives plans implemented concurrent with PA impacts.

The net average annual impact (adverse or beneficial) of the proposed project is equal to the difference between the without-project AAHUs and the with-project AAHUs. The with-project AAHUs for red drum and brown shrimp post-project implementation, including project impacts plus mitigation for all mitigation alternatives under consideration are presented in Table 4. Overall, post-project implementation, including project impacts and mitigation, this project site would yield an average of 2.30, 2.34, 2.5 and 2.81 AAHUs. These results reflect a very slight net gain in the overall site average of 0.35, 0.39, 0.55, and 0.86 AAHUs above the without-project condition of implementing no project at all, demonstrating full compensation for impacts.

Table 4. Comparison of Without-Project and With-Project Plus Mitigation AAHUs

MITIGATION ALTERNATIVE	EVALUATION SPECIES	WITHOUT-PROJECT AAHUS	WITH-PROJECT (IMPACT) PLUS MITIGATION AAHUS	CHANGE AAHUs
PLAN 1	red drum	1.40	1.42	0.02
	brown shrimp	2.49	3.18	0.69
	Site Average	1.95	2.30	0.35
PLAN 2	red drum	1.40	1.45	0.05
	brown shrimp	2.49	3.23	0.74
	Site Average	1.95	2.34	0.39
PLAN 3	red drum	1.40	1.52	0.12
	brown shrimp	2.49	3.49	1.00
	Site Average	1.95	2.50	0.55
PLAN 4	red drum	1.40	1.67	0.27
	brown shrimp	2.49	3.94	1.45
	Site Average	1.95	2.81	0.86

Table 5 represents the net change between with-project conditions for the impacts scenario alone and for the impact scenario plus each of the four proposed mitigation alternative plans. It is important to note that 0.64. AAHHUs for red drum and 1.17 AAHUs for brown shrimp (0.91 AAHUs for site average) were needed to fully compensate for the loss of AAHUs as a result of the construction of the proposed PA (see Table 3). Based on the results presented in Table 5, any of the proposed mitigation alternative plans would provide full replacement for the predicted losses.

5.0 Cost-Effectiveness and Incremental Cost Analysis

The identification of suitable mitigation measures centered upon the cost analyses comparisons of the proposed measures. The following sections detail the HEP and CE/ICA analyses that evaluated the productivity of the proposed mitigation alternative plans for the study. The analysis was performed using the IWR-Planning Suite 1.0.11.0 (USACE Certified, 24 September 2008).

Annualized costs for the proposed mitigation alternative plans were developed using a 3.75% interest rate and a 0. 0.071962 amortization factor for construction (amortized over the 20-year project life) (Table 6). The costs took into consideration both mitigation plan construction costs, monitoring the year of construction and annual monitoring for the first five-years after construction.

Table 5. Comparison of Net Change between in AAHUs for the Impact and Impact Plus Mitigation With-Project Scenarios

MITIGATION ALTERNATIVE	EVALUATION SPECIES	IMPACT WITH-PROJECT AAHUS	IMPACT + MITIGATION WITH-PROJECT AAHUS	NET CHANGE AAHUs
PLAN 1 (create 2.64 acres)	red drum	0.76	1.42	0.66
	brown shrimp	1.32	3.18	1.86
	Site Average	1.04	2.30	1.26
PLAN 2 (create 2.73 acres)	red drum	0.76	1.45	0.69
	brown shrimp	1.32	3.23	1.91
	Site Average	1.04	2.34	1.3
PLAN 3 (create 3.01 acres)	red drum	0.76	1.52	0.76
	brown shrimp	1.32	3.49	2.17
	Site Average	1.04	2.50	1.46
PLAN 4 (create 3.61 acres)	red drum	0.76	1.67	0.91
	brown shrimp	1.32	3.94	2.62
	Site Average	1.04	2.81	1.77

Table 6. Annualized Cost of Proposed Mitigation Plans
(October 2012 Price Levels; $1.12 fuel cost; 3.75 %)

Plan	Mitigation Alternative Plan 1	Mitigation Alternative Plan 2	Mitigation Alternative Plan 3	Mitigation Alternative Plan 4
Annualized First Cost	$ 30,704	$ 31,547	$ 34,382	$ 39,693
Annualized O&M (Monitoring)	$ 2,481	$ 2,481	$ 2,481	$ 2,481
Total Annualized Costs	$ 33,185	$ 34,029	$ 36,863	$ 42,174

Cost effective analyses identified the least-costly plans for each level of output. The three criteria used for identifying non-cost effective plans or combinations include: (1) The same level of output could be produced by another plan at less cost; (2) A larger output level could be produced at the same cost; or (3) A larger output level could be produced at the least cost.

Table 7 details the results of the cost effectiveness and incremental cost analyses for the mitigation alternative plans. All four plans were considered cost-effective, with Plans 1 and 4 being best buy plans. Average annual costs ranged between $33,185 and $42,174 and produced a net increase of between 2.30 and 2.81 AAHUS. Average costs per AAHU for each of the plans ranged from $14,428.26 (Plan 4) to $15,008.54 (Plan 1). All mitigation alternatives plans generated enough AAHUs to satisfy the minimum average mitigation requirement (0.91 AAHUs).

Incremental Cost Analysis was performed to compare the incremental costs for each additional unit of output. In CE/ICA, the plan with the lowest incremental cost per unit over the No Action Alternative was the first incremental Best Buy plan. Plans having higher incremental costs per unit for a lower level of output are typically eliminated from further consideration, while plans having lower incremental costs per unit for a higher level of output are carried forward as "Best Buy" plans. The intent of incremental analysis is to identify large increases in cost relative to output. Based on the results of the analysis (Table 7 and Figure 7), Mitigation Alternative Plan 1 was identified as most cost-effective, incrementally effective solution proposed, providing 2.30 AAHUs at an average annual cost of $33,185, and incremental cost of $14,428.26 per AAHU over the No Action Plan. Therefore, Mitigation Alternative Plan 1 is the recommended mitigation plan.

Table 7. Cost Effectiveness and Incremental Cost Analysis
(October 2012 Prices, 3.75% Interest)

Plan	Net increase in AAHUs	Total Costs (Construction plus monitoring)	Average Annual Cost	Average Annual Cost per AAHU	COST EFFECTIVE	Incremental Cost per Output
No Action	0.0	$0	$ 0.00	---	BEST BUY	---
Plan 1	2.30	$ 464,421	$ 33,185	$ 14,428.26	BEST BUY	---
Plan 2	2.34	$ 476,140	$ 34,029	$ 14,542.31	YES	---
Plan 3	2.50	$ 515,525	$ 36,863	$ 14,745.20	YES	---
Plan 4	2.81	$ 589,326	$ 42,174	$ 15,008.54	BEST BUY	$ 17,355.56

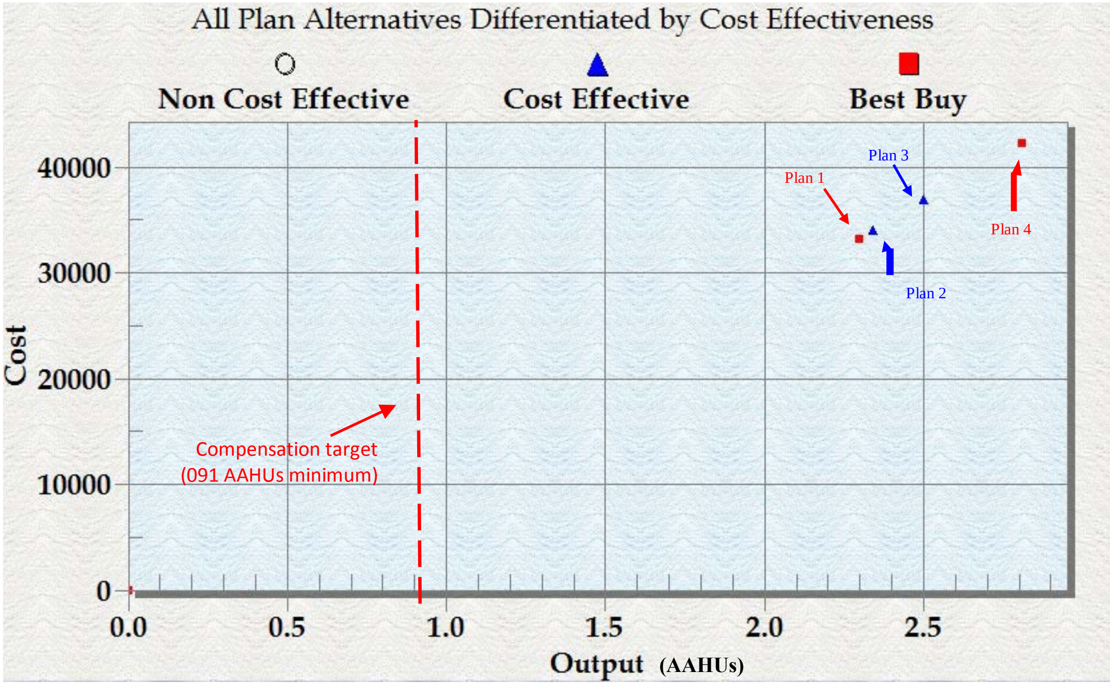

Figure 7. Cost Effective and Best Buy Plans.

6.0 Summary and Conclusions

The proposed construction of a new PA for the placement of dredged material from the Cedar Bayou Navigation Channel would impact approximately 2.56 acres of estuarine intertidal emergent wetlands dominated by smooth cordgrass. These wetlands provide cover and feeding habitat for important fisheries species such as red drum and brown shrimp. Based on the HEP analysis described in this report, the project impacts would result in the loss of 0.64 AAHHUs for red drum and 1.17 AAHUs for brown shrimp, for an average of loss 0.91 AAHUs for the site.

Four mitigation alternative plans were similarly analyzed using HEP, and the habitat outputs (AAHUs) and costs were compared using CE/ICA. Based on the results of the mitigation analysis, Mitigation Alternative Plan 1 was selected as the recommended mitigation plan. This plan had the lowest incremental cost per unit of output, and it is a cost effective solution and the least expensive alternative plan with a total cost of $464,421. The 2.30 AAHUs (site average) that would be generated from the 2.64 acres of estuarine intertidal emergent wetlands created under Mitigation Alternative Plan 1 would provide an net increase in 1.26 AAHUs (see Table 5) over the impact with-project conditions and an overall increase of 0.35 (see Table 4) AAHUs above the No Action Plan. Thus, Mitigation Alternative Plan 1 would result in "no net loss" of wetland function and area and would fully compensate the loss of 0.91 AAHUs as a result of the construction of the proposed PA.

7.0 References

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ATTACHMENT A

HABITAT EVALUATION PROCEDURES

HSI AND AAHU CALCULATIONS

Table A-1. Without-Project Conditions and HSI Calculations for red drum

red drum			Without-Project									
Variables	Description	Optimal Condition	TY0[1] 2013 (baseline)	SI	TY1 2014	SI	TY2 2015	SI	TY6 2019	SI	TY21 2034	SI
V1	Mean Water Temp (Celsius)	25-35°C	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68
V2	Mean Salinity (ppt)	25-30 ppt	20	0.67	20	0.67	20	0.67	20	0.67	20	0.67
V3	Percent of open water edge fringed with persistent emergent vegetation	100%	97%	0.97	97%	0.97	97%	0.97	97%	0.97	97%	0.97
V5	Substrate Composition	Mud	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00
V6	Mean depth (m)	1.5-2.5 m	0.1	0.07	0.1	0.07	0.1	0.07	0.1	0.07	0.1	0.07
Water Quality = ($V1^2$ x V2)1/3			0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Food = V3			0.97	0.97		0.97		0.97		0.97		0.97
Cover = (V5xV6)1/2			0.63	0.26		0.26		0.26		0.26		0.26
HSI = water quality, food or cover, whichever is lower				0.26		0.26		0.26		0.26		0.26
Acres				5.44		5.44		5.44		5.44		5.44
Habitat Units (HUs)				1.04		1.04		1.04		1.04		1.04

Table A-2. Without-Project Conditions and HSI Calculations for brown shrimp

brown shrimp			Without-Project									
Variables	Description	Optimal Condition	TY0[1]		TY1		TY2		TY6		TY21	
			2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Percent Estuary covered by vegetation	100%	31%	0.31	31%	0.31	31%	0.31	31%	0.31	31%	0.31
V2	Substrate Composition	Soft Bottom[2]	1	1	1	1	1	1	1	1	1	1
V3	Mean Spring Salinity (ppt)	10-20 ppt	20	1.0	20	1.0	20	1.0	20	1.0	20	1.0
V4	Mean Spring Water Temp (Celsius)	20-30 °C	21.8	1	21.8	1	21.8	1	21.8	1	21.8	1
Food/Cover = (V1 x V2b)1/3			0.59	0.46		0.46		0.46		0.46		0.46
Water Quality = (V3b x V4)1/2				1.00		1.00		1.00		1.00		1.00
HSI = water quality or food/cover, whichever is lower				0.46		0.46		0.46		0.46		0.46
Acres				5.44		5.44		5.44		5.44		5.44
Habitat Units (HUs)				2.49		2.49		2.49		2.49		2.49

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-3. With-Project Conditions and HSI Calculations for red drum

red drum			With-Project									
			TY0[1]		TY1		TY2		TY6		TY21	
Variables	Description	Optimal Condition	2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Mean Water Temp (Celsius)	25-35°C	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68
V2	Mean Salinity (ppt)	25-30 ppt	20	0.67	20	0.67	20	0.67	20	0.67	20	0.67
V3	Percent of open water edge fringed with persistent emergent vegetation	100%	97%	0.97	88%	0.90	88%	0.90	88%	0.90	88%	0.90
V5	Substrate Composition	Mud	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00
V6	Mean depth (m)	1.5-2.5 m	0.1	0.07	0.1	0.07	0.1	0.07	0.1	0.07	0.1	0.07
Water Quality = ($V1^2$ x V2)1/3			0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Food = V3			0.97	0.97		0.90		0.90		0.90		0.90
Cover = (V5xV6)1/2				0.26		0.26		0.26		0.26		0.26
HSI = water quality, food or cover, whichever is lower				0.26		0.26		0.26		0.26		0.26
Acres				5.44		2.88		2.88		2.88		2.88
Habitat Units (HUs)				1.04		0.74		0.74		0.74		0.74

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-4. With-Project Conditions and HSI Calculations for brown shrimp

brown shrimp			With-Project									
Variables	Description	Optimal Condition	TY0[1]		TY1		TY2		TY6		TY21	
			2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Percent Estuary covered by vegetation	100%	31%	0.31	30%	0.30	30%	0.30	30%	0.30	30%	0.30
V2	Substrate Composition	Soft Bottom[2]	1	1	1	1	1	1	1	1	1	1
V3	Mean Spring Salinity (ppt)	10-20 ppt	20	1.0	20	1.0	20	1.0	20	1.0	20	1.0
V4	Mean Spring Water Temp (Celsius)	20-30 °C	21.8	1	21.8	1	21.8	1	21.8	1	21.8	1
Food/Cover = (V1 x V2)1/3			0.59	0.46	0.46	0.45		0.45		0.45		0.45
Water Quality = (V3 x V4)1/2				1.00	1.00	1.00		1.00		1.00		1.00
HSI = water quality or food/cover, whichever is lower				0.46		0.45		0.45		0.45		0.45
Acres				5.44		2.88		2.88		2.88		2.88
Habitat Units (HUs)				2.49		1.29		1.29		1.29		1.29

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-5. With-Project Conditions and HSI Calculations for red drum
Mitigation Alternative 1

red drum			With-Project									
			TY0[1]		TY1		TY2		TY6		TY21	
Variables	Description	Optimal Condition	2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Mean Water Temp (Celsius)	25-35°C	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68
V2	Mean Salinity (ppt)	25-30 ppt	20	0.67	20	0.67	20	0.67	20	0.67	20	0.67
V3	Percent of open water edge fringed with persistent emergent vegetation	100%	97%	0.97	95%	0.96	95%	0.96	95%	0.96	95%	0.96
V5	Substrate Composition	Mud	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00
V6	Mean depth (m)	1.5-2.5 m	0.1	0.07	0.1	0.07	0.1	0.07	0.1	0.07	0.1	0.07
Water Quality = $(V1^2$ x V2)1/3			0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Food = V3			0.97	0.97		0.96		0.96		0.96		0.96
Cover = (V5xV6)1/2				0.26		0.26		0.26		0.26		0.26
HSI = water quality, food or cover, whichever is lower				0.26		0.26		0.26		0.26		0.26
Acres				5.44		5.52		5.52		5.52		552
Habitat Units (HUs)				1.40		1.43		1.43		1.43		1.43

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-6. With-Project Conditions and HSI Calculations for brown shrimp
Mitigation Alternative 1

brown shrimp			With-Project									
			TY0[1]		TY1		TY2		TY6		TY21	
Variables	Description	Optimal Condition	2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Percent Estuary covered by vegetation	100%	31%	0.31	44%	0.44	44%	0.44	44%	0.44	44%	0.44
V2	Substrate Composition	Soft Bottom[2]	1	1	1	1	1	1	1	1	1	1
V3	Mean Spring Salinity (ppt)	10-20 ppt	20	1.0	20	1.0	20	1.0	20	1.0	20	1.0
V4	Mean Spring Water Temp (Celsius)	20-30 °C	21.8	1	21.8	1	21.8	1	21.8	1	21.8	1
Food/Cover = (V1 x V2)1/3			0.59	0.46		0.58		0.58		0.58		0.58
Water Quality = (V3 x V4)1/2				1.00		1.00		1.00		1.00		1.00
HSI = water quality or food/cover, whichever is lower				0.46		0.58		0.58		0.58		0.58
Acres				5.44		5.52		5.52		5.52		552
Habitat Units (HUs)				2.49		3.19		3.19		3.19		3.19

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-7. With-Project AAHUs for red drum and brown shrimp, and the Site Average Mitigation Alternative Plan 1

RED DRUM						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.26	0.26	5.44	5.52	1.41
1	**2**	0.26	0.26	5.52	5.52	1.43
2	**6**	0.26	0.26	5.52	5.52	5.70
6	**21**	0.26	0.26	5.52	5.52	21.38
Cumulative HUs						29.92
With-Project AAHUs						1.42
BROWN SHRIMP						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.46	0.58	5.44	5.52	2.84
1	**2**	0.58	0.58	5.52	5.52	3.19
2	**6**	0.58	0.58	5.52	5.52	12.77
6	**21**	0.58	0.58	5.52	5.52	47.90
Cumulative HUs						66.71
With-Project AAHUs						3.18
SITE AVERAGE						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.36	0.42	5.44	5.52	2.13
1	**2**	0.42	0.42	5.52	5.52	2.31
2	**6**	0.42	0.42	5.52	5.52	9.24
6	**21**	0.42	0.42	5.52	5.52	34.64
Cumulative HUs						48.31
With-Project AAHUs						2.30

Table A-8. With-Project Conditions and HSI Calculations for red drum
Mitigation Alternative 2

red drum			With-Project									
Variables	Description	Optimal Condition	TY0[1] 2013 (baseline)	SI	TY1 2014	SI	TY2 2015	SI	TY6 2019	SI	TY21 2034	SI
V1	Mean Water Temp (Celsius)	25-35°C	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68
V2	Mean Salinity (ppt)	25-30 ppt	20	0.67	20	0.67	20	0.67	20	0.67	20	0.67
V3	Percent of open water edge fringed with persistent emergent vegetation	100%	97%	0.97	94%	0.95	94%	0.95	94%	0.95	94%	0.95
V5	Substrate Composition	Mud	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00
V6	Mean depth (m)	1.5-2.5 m	0.6	0.40	0.6	0.40	0.6	0.40	0.6	0.40	0.6	0.40
Water Quality = ($V1^2$ x V2)1/3			0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Food = V3			0.97	0.97		0.95		0.95		0.95		0.95
Cover = (V5xV6)1/2			0.63	0.26		0.26		0.26		0.26		0.26
HSI = water quality, food or cover, whichever is lower				0.26		0.26		0.26		0.26		0.26
Acres				5.44		5.61		5.61		5.61		5.61
Habitat Units (HUs)				1.40		1.45		1.45		1.45		1.45

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-9. With-Project Conditions and HSI Calculations for brown shrimp
Mitigation Alternative 2

brown shrimp			With-Project									
Variables	Description	Optimal Condition	TY0[1]		TY1		TY2		TY6		TY21	
			2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Percent Estuary covered by vegetation	100%	31%	0.31	44%	0.44	44%	0.44	44%	0.44	44%	0.44
V2	Substrate Composition	Soft Bottom[2]	1	1	1	1	1	1	1	1	1	1
V3	Mean Spring Salinity (ppt)	10-20 ppt	20	1.0	20	1.0	20	1.0	20	1.0	20	1.0
V4	Mean Spring Water Temp (Celsius)	20-30 °C	21.8	1	21.8	1	21.8	1	21.8	1	21.8	1
Food/Cover = (V1 x V2)1/3			0.59	0.46		0.58		0.58		0.58		0.58
Water Quality = (V3 x V4)1/2				1.00		1.00		1.00		1.00		1.00
HSI = water quality or food/cover, whichever is lower				0.46		0.58		0.58		0.58		0.58
Acres				5.44		5.61		5.61		5.61		5.61
Habitat Units (HUs)				2.49		3.25		3.25		3.25		3.25

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-10. With-Project AAHUs for red drum and brown shrimp, and the Site Average Mitigation Alternative Plan 2

RED DRUM						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.26	0.26	5.44	5.61	1.43
1	**2**	0.26	0.26	5.61	5.61	1.45
2	**6**	0.26	0.26	5.61	5.61	5.79
6	**21**	0.26	0.26	5.61	5.61	21.73
Cumulative HUs						30.40
With-Project AAHUs						1.45
BROWN SHRIMP						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.46	0.58	5.44	5.61	2.87
1	**2**	0.58	0.58	5.61	5.61	3.25
2	**6**	0.58	0.58	5.61	5.61	12.98
6	**21**	0.58	0.58	5.61	5.61	48.68
Cumulative HUs						67.77
With-Project AAHUs						3.23
SITE AVERAGE						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.36	0.42	5.44	5.61	2.15
1	**2**	0.42	0.42	5.61	5.61	2.35
2	**6**	0.42	0.42	5.61	5.61	9.39
6	**21**	0.42	0.42	5.61	5.61	35.20
Cumulative HUs						49.08
With-Project AAHUs						2.34

Table A-11. With-Project Conditions and HSI Calculations for red drum
Mitigation Alternative Plan 3

red drum			With-Project									
Variables	Description	Optimal Condition	TY0[1] 2013 (baseline)	SI	TY1 2014	SI	TY2 2015	SI	TY6 2019	SI	TY21 2034	SI
V1	Mean Water Temp (Celsius)	25-35°C	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68
V2	Mean Salinity (ppt)	25-30 ppt	20	0.67	20	0.67	20	0.67	20	0.67	20	0.67
V3	Percent of open water edge fringed with persistent emergent vegetation	100%	97%	0.97	95%	0.96	95%	0.96	95%	0.96	95%	0.96
V5	Substrate Composition	Mud	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00
V6	Mean depth (m)	1.5-2.5 m	0.6	0.40	0.6	0.40	0.6	0.40	0.6	0.40	0.6	0.40
Water Quality = $(V1^{2} \times V2)1/3$			0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Food = V3			0.97	0.97		0.96		0.96		0.96		0.96
Cover = (V5xV6)1/2			0.63	0.26		0.26		0.26		0.26		0.26
HSI = water quality, food or cover, whichever is lower				0.26		0.26		0.26		0.26		0.26
Acres				5.44		5.89		5.89		5.89		5.89
Habitat Units (HUs)				1.40		1.52		1.52		1.52		1.52

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-12. With-Project Conditions and HSI Calculations for brown shrimp
Mitigation Alternative Plan 3

brown shrimp			With-Project									
Variables	Description	Optimal Condition	TY0[1]		TY1		TY2		TY6		TY21	
			2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Percent Estuary covered by vegetation	100%	31%	0.31	46%	0.44	46%	0.46	46%	0.46	46%	0.46
V2	Substrate Composition	Soft Bottom[2]	1	1	1	1	1	1	1	1	1	1
V3	Mean Spring Salinity (ppt)	10-20 ppt	20	1.0	20	1.0	20	1.0	20	1.0	20	1.0
V4	Mean Spring Water Temp (Celsius)	20-30 °C	21.8	1	21.8	1	21.8	1	21.8	1	21.8	1
Food/Cover = (V1 x V2)1/3			0.59	0.46		0.60		0.60		0.60		0.60
Water Quality = (V3 x V4)1/2				1.00		1.00		1.00		1.00		1.00
HSI = water quality or food/cover, whichever is lower				0.46		0.60		0.60		0.60		0.60
Acres				5.44		5.89		5.89		5.89		5.89
Habitat Units (HUs)				2.49		3.51		3.51		3.51		3.51

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-13. With-Project AAHUs for red drum and brown shrimp, and the Site Average Mitigation Alternative Plan 3

RED DRUM						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.26	0.26	5.44	5.89	1.46
1	**2**	0.26	0.26	5.89	5.89	1.52
2	**6**	0.26	0.26	5.89	5.89	6.08
6	**21**	0.26	0.26	5.89	5.89	22.81
Cumulative HUs						31.88
With-Project AAHUs						1.52
BROWN SHRIMP						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.46	0.60	5.44	5.89	2.99
1	**2**	0.60	0.60	5.89	5.89	3.51
2	**6**	0.60	0.60	5.89	5.89	14.04
6	**21**	0.60	0.60	5.89	5.89	52.65
Cumulative HUs						73.19
With-Project AAHUs						3.49
SITE AVERAGE						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.36	0.43	5.44	5.89	2.23
1	**2**	0.43	0.43	5.89	5.89	2.52
2	**6**	0.43	0.43	5.89	5.89	10.06
6	**21**	0.43	0.43	5.89	5.89	37.73
Cumulative HUs						52.53
With-Project AAHUs						2.50

Table A-14. With-Project Conditions and HSI Calculations for red drum
Mitigation Alternative Plan 4

red drum			With-Project									
			TY0[1]		TY1		TY2		TY6		TY21	
Variables	Description	Optimal Condition	2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Mean Water Temp (Celsius)	25-35°C	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68	21.8	0.68
V2	Mean Salinity (ppt)	25-30 ppt	20	0.67	20	0.67	20	0.67	20	0.67	20	0.67
V3	Percent of open water edge fringed with persistent emergent vegetation	100%	97%	0.97	95%	0.96	95%	0.96	95%	0.96	95%	0.96
V5	Substrate Composition	Mud	1	1.00	1	1.00	1	1.00	1	1.00	1	1.00
V6	Mean depth (m)	1.5-2.5 m	0.6	0.40	0.6	0.40	0.6	0.40	0.6	0.40	0.6	0.40
Water Quality = ($V1^2$ x V2)1/3			0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Food = V3			0.97	0.97		0.96		0.96		0.96		0.96
Cover = (V5xV6)1/2			0.63	0.26		0.26		0.26		0.26		0.26
HSI = water quality, food or cover, whichever is lower				0.26		0.26		0.26		0.26		0.26
Acres				5.44		6.49		6.49		6.49		6.49
Habitat Units (HUs)				1.40		1.68		1.68		1.68		1.68

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-15. With-Project Conditions and HSI Calculations for brown shrimp
Mitigation Alternative Plan 4

brown shrimp			With-Project									
			TY0[1]		TY1		TY2		TY6		TY21	
Variables	Description	Optimal Condition	2013 (baseline)	SI	2014	SI	2015	SI	2019	SI	2034	SI
V1	Percent Estuary covered by vegetation	100%	31%	0.31	48%	0.48	48%	0.48	48%	0.48	48%	0.48
V2	Substrate Composition	Soft Bottom[2]	1	1	1	1	1	1	1	1	1	1
V3	Mean Spring Salinity (ppt)	10-20 ppt	20	1.0	20	1.0	20	1.0	20	1.0	20	1.0
V4	Mean Spring Water Temp (Celsius)	20-30 °C	21.8	1	21.8	1	21.8	1	21.8	1	21.8	1
Food/Cover = (V1 x V2)1/3			0.59	0.46		0.61		0.61		0.61		0.61
Water Quality = (V3 x V4)1/2				1.00		1.00		1.00		1.00		1.00
HSI = water quality or food/cover, whichever is lower				0.46		0.61		0.61		0.61		0.61
Acres				5.44		6.49		6.49		6.49		6.49
Habitat Units (HUs)				2.49		3.98		3.98		3.98		3.98

[2]Soft Bottom with peaty silts, organic muds, decaying vegetation

Table A-16. With-Project AAHUs for red drum and brown shrimp, and the Site Average Mitigation Alternative Plan 4

RED DRUM						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.26	0.26	5.44	6.49	1.54
1	**2**	0.26	0.26	6.49	6.49	1.68
2	**6**	0.26	0.26	6.49	6.49	6.70
6	**21**	0.26	0.26	6.49	6.49	25.14
Cumulative HUs						35.05
With-Project AAHUs						1.67
BROWN SHRIMP						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.46	0.61	5.44	5.89	3.21
1	**2**	0.61	0.61	5.89	5.89	3.98
2	**6**	0.61	0.61	5.89	5.89	15.91
6	**21**	0.61	0.61	5.89	5.89	59.68
Cumulative HUs						82.78
With-Project AAHUs						3.94
SITE AVERAGE						
TY1	**TY2**	**HSI1**	**HSI2**	**Acres1**	**Acres2**	**Cumulative HUs**
0	**1**	0.36	0.44	5.44	5.89	2.37
1	**2**	0.44	0.44	5.89	5.89	2.83
2	**6**	0.44	0.44	5.89	5.89	11.31
6	**21**	0.44	0.44	5.89	5.89	42.41
Cumulative HUs						58.92
With-Project AAHUs						2.81

Appendix F

Coastal Consistency Determination

COMPLIANCE WITH GOALS AND POLICIES – SECTION 501.25(a)-(f) DREDGING AND DREDGED MATERIAL DISPOSAL AND PLACEMENT TEXAS COASTAL MANAGEMENT PROGRAM CEDAR BAYOU DREDGED MATERIAL MANAGEMENT PLAN

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 subsection are supplemental to any further restrictions or requirements relating to the beach access and use rights of the public. In implementing this subsection, 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: The proposed project involves the construction of a new upland confined placement area (PA). Effects to coastal waters, submerged lands, critical areas, coastal shore areas and Gulf beaches have been mimimized to the maximum extent practicable by locating the proposed PA in a predominantly upland site that has been disturbed and modified by past development activities, and restricting unavoidable impacts to the interior portions of tidal man made canals.

(1) Dredging and dredged material disposal and placement shall not cause or contribute, after consideration of dilution and dispersions, to violation of any applicable surface water quality standards established under §501.21 of this title.

Compliance: There are no contaminants in the project area based analysis of water and sediment quality data as presented in Sections 3.13 and 4.8 of the Environmental Assessment for this project. No water quality standards will be violated by this project.

(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.

Compliance: Approximately 2.56 acres of estuarine marsh habitat would be impacted by the proposed project. Mitigation for project specific impacts would be performed immediately adjacent to the impacted area. Approximately 2.64 acres of estuarine marsh habitat would be created to complensate for unavoidable project related impacts.

(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;

Compliance: No practicable alternative exists that would have fewer adverse effects on coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf Beaches.

(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

Compliance: All practicable steps have been taken to minimize adverse affects on these resources. The project impact area is situated in an area that was already subject to development, thereby avoiding impact to locations with no prior environmental impacts.

(C) significant degradation of critical areas under §501.23(a)(7)(E) of this title would result.

Compliance: No significant degradation of critical areas would result from this project. Approximately 2.54 acres of estuarine marsh would be impacted. Resource impacts are offset by the proposed mitigation, which would create approximately 2.64 acres of estuarine marsh habitat adjacent to the impacted area.

(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.

Compliance: The project has overriding importance to the public and national interest because it is needed to keep the Cedar Bayou Navigation Channel open.

(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 paragraph where appropriate and practicable.

Compliance: Adverse effects of dredging as described in this EA have been minimized as described under "Compliance" for paragraph (a2) of this section. The project has been cited and sized to optimize performance while minimizing environmental impacts and cost.

(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;

Compliance: Discharge from dredging will be limited to the upland confined placement area. Dredged material will be held in the placement area until sediments have separated from the water, at which point the water will be released back into Cedar Bayou.

(B) locating and designing projects to avoid adverse disruption of water inundation patterns, water circulation, erosion and accretion processes, and other hydrodynamic processes;

Compliance: The project is not anticipated to have adverse effects to water inundation patterns, water circulation, erosion and accretion processes, or 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;

Compliance: Cedar Bayou maintenance materials would be discharged into an upland confined placement area constructed on land that has been previously disturbed by construction.

(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;

Compliance: The proposed project has been sized to maximize PA capacity, while minimizing environmental impacts. The construction of the placement area has avoided and minimized adverse effects to coastal waters, submerged lands, critical areas, coastal shore areas and Gulf beaches by placing material in an area that has historically been impacted by construction.

(E) discharging materials at sites where the substrate is composed of material similar to that being discharged;

Compliance: No open water placement is proposed.

(F) locating and designing discharges to minimize the extent of any plume and otherwise control dispersion of material; and

Compliance: No open water placement is proposed.

(G) avoiding the impoundment or drainage of critical areas.

Compliance: There would be no impoundment or drainage of critical areas.

(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 physicochemical 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 (iv) adding chemical flocculants to enhance the deposition of suspended particulates in confined disposal areas,

Compliance: Material to be dredged complies with applicable standards for sediment toxicity and will be place in an upland confined placement area.

(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.

Compliance: Dredged material will be placed in an upland confined placement area, with properly maintained containment dikes.

(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: Dredged material will be placed in a confined placement area with properly maintained containment dikes. Training dikes will be used to ensure the material is dispersed

evenly within the site.

(5) Adverse effects from dredging and dredged material disposal or placement operations can be minimized by adopting 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.

Compliance: Materials would be pumped by pipeline and hydraulic pipeline dredge to the placement area. Personnel familiar with the equipment that would ensure avoidance and minimization requirement would be adhered to.

(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;

Compliance: Changes to water current and circulation patterns would be localized, minimal, and would not adversely 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;

Compliance: The project would not introduce new invasive species to the area.

(C) avoiding sites having unique habitat or other values including habitat of endangered species;

Compliance:

(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;

Compliance: Impacts resulting from construction of the proposed project would be fully mitigated

by the creation of estuarine marsh habitat adjacent to the project area. Habitat Evaluation Procedure (HEP) Analysis has been conducted to assess environmental impacts associated with construction of the proposed project and to plan for appropriate mitigation.

(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;

Compliance: Discharge would be confined to an upland confined placement area, and impacts resulting from construction of the proposed project would be fully mitigated by the creation of estuarine marsh habitat.

(F) timing dredging and dredged material disposal or placement activities to avoid spawning or migration seasons and other biologically critical time periods; and

Compliance: There are no known biologically critical time periods (e.g. sea turtle or nesting birds) that would be affected by construction of the proposed PA 7 or continued use of pipeline dredging to maintain the lower Cedar Bayou Navigation Channel. Additional resource agency coordination during construction and futuremaintenance activities would be undertaken as necessary should new inforamtion warrant it.

(G) avoiding the destruction of remnant natural sites within areas already affected by development.

Compliance: The proposed PA 7 would be located in a previousely disturbed area.

(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;

Compliance: The placement area would be constructed on primarily on land already impacted by previous development. Release of water during disposal would be controlled to ensure compliance with TCEQ regulations

(B) selecting sites which are not valuable as natural aquatic areas;

Compliance: The creation of 2.64 acres of estuarine marsh habitat onsite and adjacent to the project area compensates for all project impacts.

(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

Compliance: There are no recreational activities associated with the site.

(D) selecting sites that will not increase incompatible human activity or require frequent dredge or fill maintenance activity in remote fish and wildlife areas.

Compliance: The project would not increase incompatible human activity or require frequent dredge or fill maintenance activities in remote fish and wildlife areas.

(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 subparagraph if such data and information is produced and evaluated in compliance with §501.15(b)(1) of this title (relating to Policy for Major Actions).

Compliance: No new channels or basins would be constructed as part of the proposed project.

(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 paragraph (1) of this subsection unless modified in design, size, use, or function.

Compliance: N/A – The proposed placement area is new construction.

(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.

Compliance: There are no cost effective opportunities for beneficial use of dredged material.

(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.

Compliance: There are no cost effective opportunities for beneficial use of dredged material.

(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.

Compliance: There are no cost effective opportunities for beneficial use of dredged material.

(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 paragraph (a) of this subsection, 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.

Compliance: Dredged material placement would be in a contained upland placement area.

(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.

Compliance: This project would be constructed as a confined upland placement area.

Appendix G

Relative Sea Level Rise

Relative Sea Level Rise for Cedar Bayou, TX: Addressing the Most Recent Corps Guidance

Corps of Engineers guidance (EC 1165-2-212, October 2011) specifies the following procedures for incorporating relative sea level rise into the project impacts. This analysis addresses the Cedar Bayou DMMP project area.

Evaluate alternatives using “low”, “intermediate”, and “high” rates of future sea-level change:

- Use the historic rate of local mean sea-level change as the “low” rate. (The guidance further states that historic rates of sea level rise are best determined by local tide records (preferably with at least a 40 year data record.)

- Estimate the “intermediate” rate of local mean sea-level change using the modified NRC Curve I. Consider both the most recent IPCC projections and the NRC projections and add those to the local rate of vertical land movement.

- Estimate the “high” rate of local mean sea-level change using the modified NRC Curve III. Consider both the most recent IPCC projections and the NRC projections and add those to the local rate of vertical land movement.

The Modified NRC curves are based on the curves published by the National Research Council in 1987 (NRC 1987) with modifications of the coefficients suggested in the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report (AR4) (IPCC, 2007).

The Modified NRC equation is given below:

$$\eta(t) = (0.0017 + M)t + bt^2 \quad (1)$$

Where

$\eta(t)$	=	the relative sea level rise for year t (meters)
t	=	the elapsed time since the baseline year of 1992 (years)
M	=	the local rate of subsidence (+) or uplift (-) (meters/year)
b	=	the rate of acceleration of eustatic sea level rise (meters/year^2)

The values of b are chosen such that the sea level due to eustatic rise at year 2100 is equal to 0.5, 1.0, and 1.5 m respectively. These values as provided in the guidance are given in Table 1.

The following equation results from manipulating equation (1) to account for eustatic sea level rise starting in 1992.

$$E(t_2)-E(t_1) = 0.0017(t_2-t_1)+b(t_2^2-t_1^2) \quad (2)$$

Where,

$E(t_2)-E(t_1)$ = Eustatic mean sea level trend meters/year
b = the rate of acceleration of eustatic sea level rise (meters/year^2)
t1 = time between construction date and 1992 (years)
t2 = time between end of design life and 1992 (years)

Table 1:
Rate of acceleration of eustatic sea level rise for each Modified NRC curve

NRC Curve	b (meters/year^2)
NRC I	2.71E-05
NRC II	7.00-05
NRC III	1.13 E-04

Historic RSLR

The recent historic rate of local relative sea level rise can be obtained from local tide records with reasonably high confidence. The nearest tide gauge with over 40 years of record is located at Galveston Pier 21, Texas. The NOAA mean sea level trend at this site (from 1908 to 2011) is equal to 6.35±0.26 mm /yr (0.0208 ± 0.0009 ft/yr) with a 95% confidence interval.

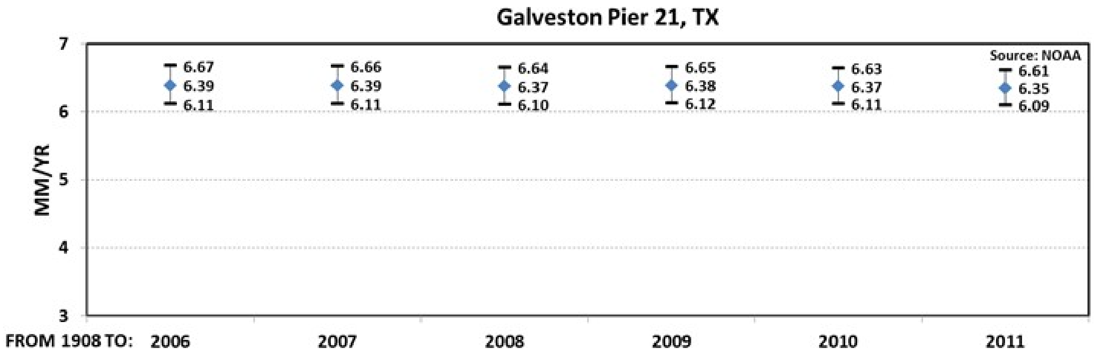


Figure 1:
Relative Sea Level Rise Trend from NOAA, Galveston Pier 21, Texas
(http://tidesandcurrents.noaa.gov/sltrends/sltrends_update.shtml?stnid=8771450)

If we assume a historic eustatic rate equal to the globally averaged rate given for the Modified NRC curves (= 1.7 mm /yr (0.0056 ft/yr)), this results in an estimated observed subsidence rate of 6.61 – 1.7 = 4.91mm /yr (0.0161 ft/yr).

Subsidence Discussion

To date, there is no scientific consensus on what the local subsidence rate should be for future projections. The relative influence of historic anthropogenic activities, such as oil extraction and groundwater withdrawal, are difficult to quantify. The Harris-Galveston Coastal Subsidence District was established by the Texas Legislature in 1975 in order to provide groundwater withdrawal regulation throughout Harris and Galveston counties. Since establishment, subsidence rates have dramatically decreased although they are still higher than long term historical rates.

Since the cessation of most of these anthropogenic activities occurred in the Houston-Galveston vicinity within the last 20 to 30 years, there is not yet sufficient tide gage date since to determine whether or not the local rate of subsidence has decelerated. The land subsidence rates in the area have been monitored using extensometers and more recently GPS, with some benchmarks established as early as 1906. Within the area of interest, the subsidence rate from 1906 to 1987 was approximately 6 to 7 ft (.074 to .086 ft/yr). However, published 2001 rates are much lower: PAM sites observations 1999 – 2001 indicate approximately 14.4 mm/yr (.047 ft/yr) and inland extensometers in Pasadena, TX in 2000 are on the order of 12.19 mm/yr (.04 ft/yr). Because these measured rates of land subsidence are higher than those calculated using the recent Corps guidance, the sea level rise rates utilizing this accelerated land subsidence for the low, medium, and high rates are also examined.

Several studies of basal peat layers have been conducted in the Texas and Louisiana coastal region to determine estimates of the long term average rates of subsidence. These rates are generally on the order to 0.5 mm/yr (0.0016 ft/yr) (Tornqvist et al (2006)). This rate is significantly lower than the observed tide gage rates or the monitored recent subsidence rates. Therefore, basal peat rates were not reviewed in light of the higher observed subsidence in the last century within the study location.

Figure 2 below shows the monitored subsidence rates within Harris-Galveston counties from 1906 to 2000.

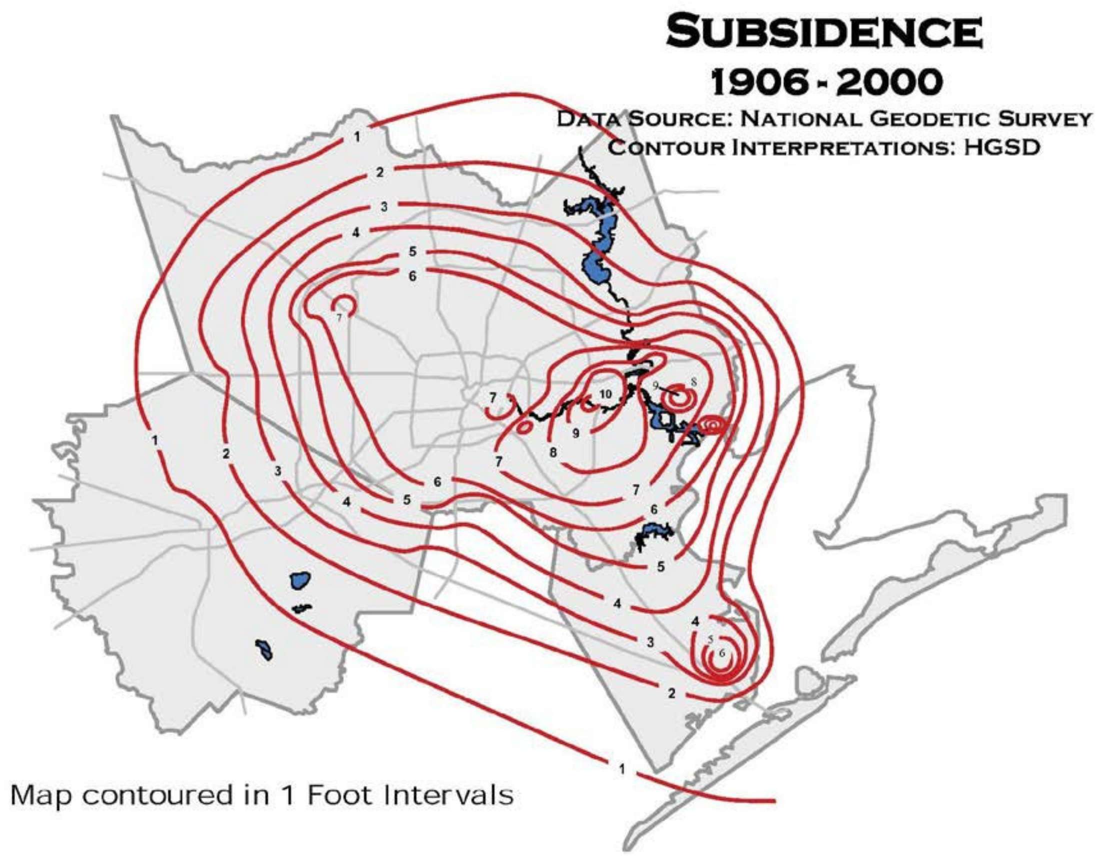
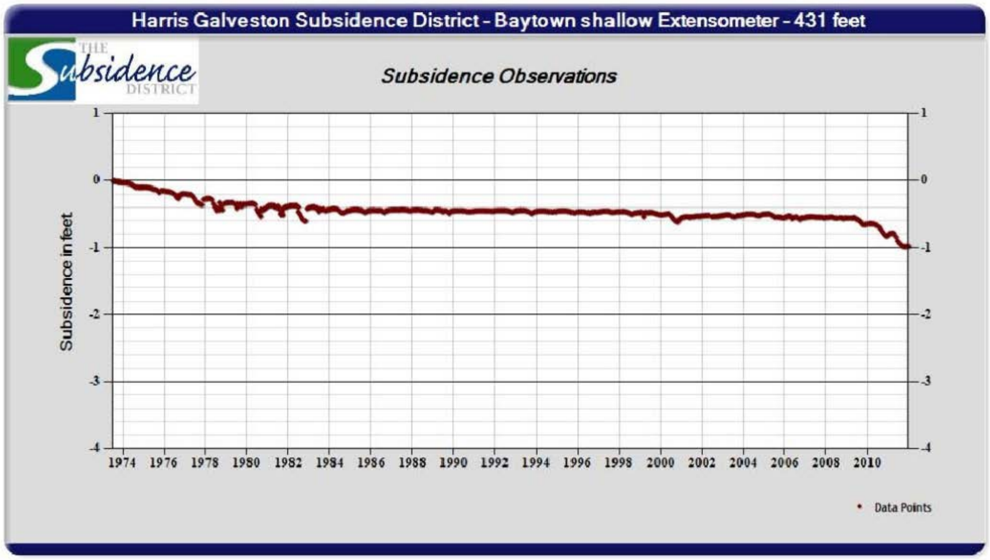
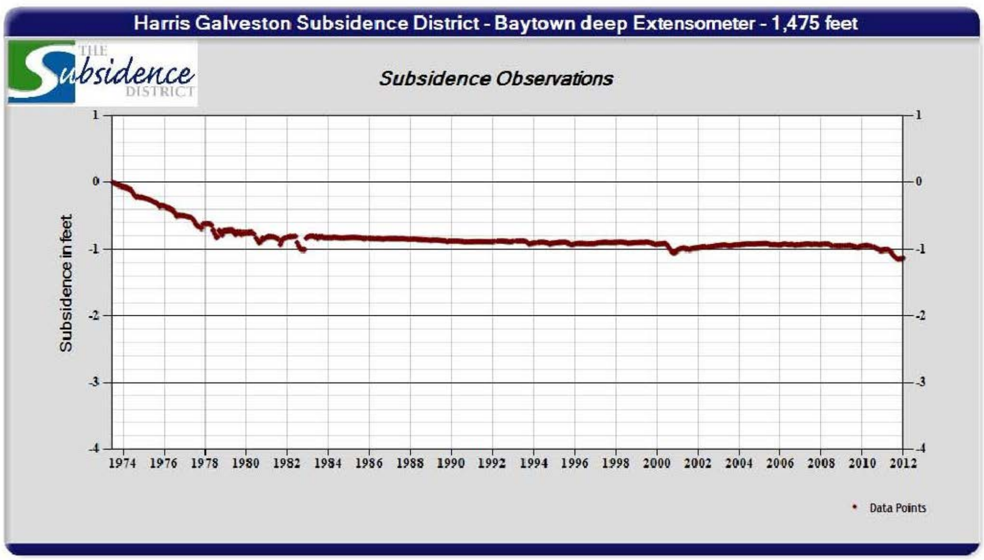


Figure 2:
Subsidence from 1906 to 2000 in Harris and Galveston counties.
(Image courtesy of Harris-Galveston Subsidence District).

Figures 3 and 4 show extensometer data from Baytown, close to the project site. The extensometers indicate that once the Subsidence District began regulating water withdrawal in the mid 1970's, the subsidence rate reduced. However, both extensometers indicate higher rates of subsidence in the last few years. In the project vicinity, there was an uncharacteristic increase in subsidence seen in the extensometer record around Baytown between 2009 and 2011 of about 0.5ft over a two year period. It is not known what the cause for this upswing in subsidence is. Since the approximate 0.25ft/yr subsidence rate seems dramatic compared to the entire record and is only seen in the last two years this trend not be used in this sea level rise analysis. The rapid acceleration of subsidence indicated by the local extensometers since 2009 should be monitored. If subsidence endangers the project as constructed during its design life measures should be implemented to protect the project.





Figures 3 & 4: Extensometer Data at Baytown

New RLSR analysis as per the Updated Corps Guidance

According to the most recent 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 local monitored subsidence rates should also be considered.

Figures 5 and 6 display the computed sea level rise based on the new guidance for the low (historic) rate, the intermediate (Modified NRC Curve I) rate, and the high (Modified NRC Curve III) rate. The sea level rise rates based on local monitored subsidence rates are also shown for the three NRC curves. The computed sea level rise given here assumes a 20 year project life, and gives the predicted rise for the years 2015-2035. The rates are given for subsidence values that correspond to both the observed tidal gage values (moderate subsidence), and the monitored subsidence values (higher subsidence).

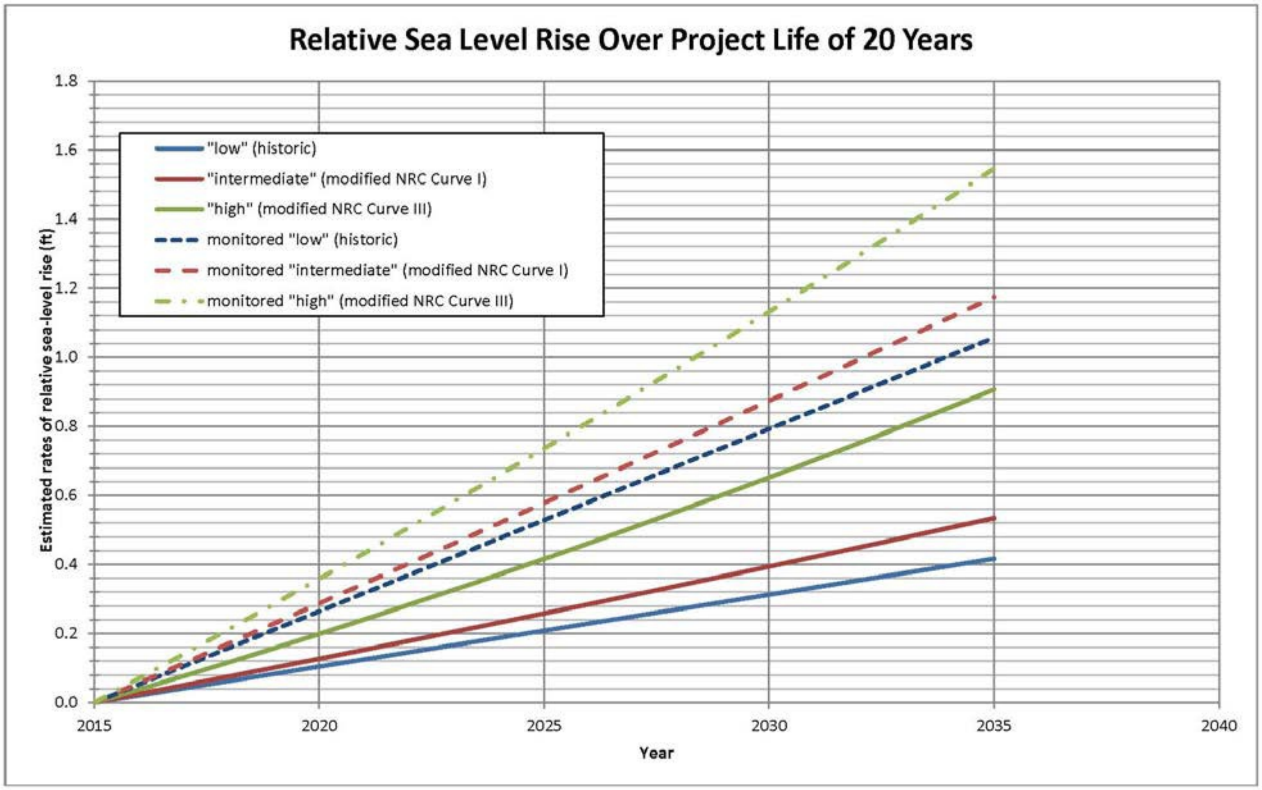


Figure 5: Relative Sea Level Rise Projections Over Project Life

The relative sea level rise values for the 20 year project life are summarized in Table 2.

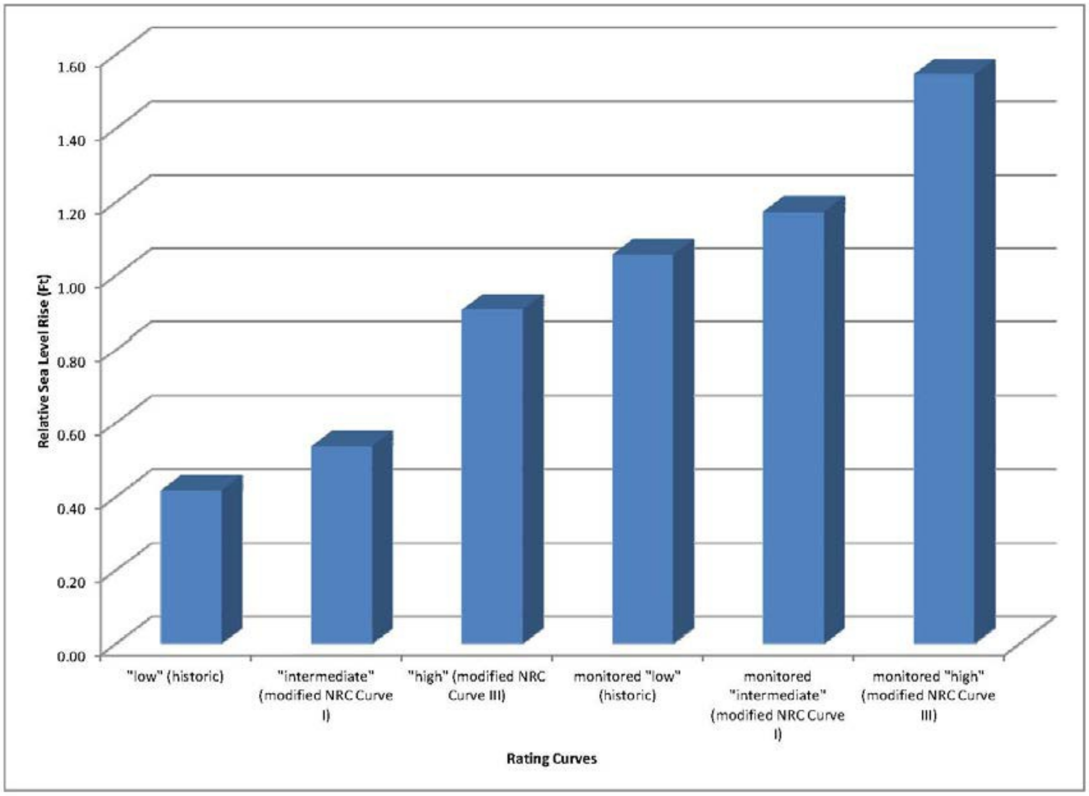


Figure 6: Various Predicted Rates of Relative Sea Level Rise for 2015-2035.

Table 2: Estimates of Future Relative Sea Level Rise (2015-2035)

Subsidence Rate	Low (ft (cm))	Intermediate (ft (cm))	High (ft (cm))
Monitored Rate (0.0472 ft/yr or 14.4 mm/yr)	1.056 (32.20)	1.174 (35.78)	1.546 (47.12)
Tide gage (0.01611 ft/yr or 4.91 mm/yr)	0.417 (12.70)	0.534 (16.28)	0.906 (27.62)

Project Related RSLR Impacts in Cedar Bayou, TX

The potential for RSLR impacts on the Cedar Bayou DMMP is minimal. The calculated worst case using tide gauges is under a foot (0.906ft) and the worst case using monitored subsidence is 1.546 ft.

The existing placement areas in the vicinity currently do not have any type of armored protection and any new placement areas will be constructed in a similar manner using typical construction methods. Sea level rise will not have any impact on the armoring requirements for the placement areas. Finally, impacts on surge levels due to the project, with and without RSLR, are expected to be extremely minimal and insignificant.

References

Harris-Galveston Coastal Subsidence District National Geodetic Survey Automated Global Positioning System Subsidence Monitoring Project. Zilkoski, Hall, Mitchell, Kammula, Singh, Chrismer, and Neighbors.

NOAA. Sea Level Trends Online. http://tidesandcurrents.noaa.gov/sltrends/sltrends_update.shtml?stnid=8771450

US Army Corps of Engineers. Sea-Level Change Considerations for Civil Works Programs. EC 1165-2-212. Oct 2011.

Excel Calculations

Relative Sea Level Rise (RSLR) addressing the most recent Corps guidance (EC 1165-2-212 dated October 1, 2011)

Year Constructed (start date):	2015	(between 1992 and 2100)
Project Life:	20	years
Relative SLR:	6.35	mm/yr
Monitored Subsidence:	14.4	mm/yr
Global Mean SLR (default 1.7 mm/yr):	1.7	mm/yr

Variables used in SLR equations:

NRC Curve	b (meters/year^2)
NRC I	2.71E-05
NRC II	7.00E-05
NRC III	1.13E-04

Relative Sea Level Rise,	Local rate of subsidence, M	Monitored rate of subsidence	Global Mean Sea-Level Change
6.35 mm/yr	4.65 mm/yr	14.40 mm/yr	1.70 mm/yr
0.00635 m/yr	0.00465 m/yr	0.014400 m/yr	0.00170 m/yr
0.02083 ft/yr	0.01526 ft/yr	0.047244 ft/yr	0.00558 ft/yr

"low" (historic)	0.417 feet	0.1270 meters
"intermediate" (modified NRC Curve I)	0.534 feet	0.1628 meters
"high" (modified NRC Curve III)	0.906 feet	0.2762 meters
monitored "low" (historic)	1.056 feet	0.3220 meters
monitored "intermediate" (modified NRC Curve I)	1.174 feet	0.3578 meters
monitored "high" (modified NRC Curve III)	1.546 feet	0.4712 meters

Appendix H

Water and Sediment Quality

SOL Engineering Services, LLC

106 South President Street, Suite 400
Jackson, MS 39201

July 20, 2012

Ms. Lisa M. Finn
U.S. Army Corps of Engineers
Environmental Section
P.O. Box 1229
Galveston, Texas 77553-1229

Dear Ms. Finn:

Re: Cedar Bayou Channel Sampling and Chemical Analysis
Contract W912HY-11-D-003, Task Order 0009

SOL Engineering, Anacon, TestAmerica, and Atkins ("The SOL Team") were contracted by the U.S Army Corps of Engineers Galveston District, to provide assistance with the sampling, analysis, and reporting for the maintenance dredging of the Cedar Bayou Channel to comply with requirements of the Clean Water Act. The lead review agency for this project is the U.S. Environmental Protection Agency (EPA), Region 6, Dallas, Texas. This project was completed under Contract W912HY-11-D-003, Task Order (TO) 0009.

Please consider this draft letter report as partially satisfying the requirements of the above-noted TO. After the Galveston District review, we will make necessary modifications and submit a final letter report, plus a hard copy and CD containing all raw chemistry data, water quality data sheets, and Excel and Word files, as required by the TO.

METHODS

Samples from all sampling stations (Attachment A) noted in the Sampling and Analysis Plan (SAP) attached to TO 0009 for the Cedar Bayou Channel Project have been collected according to the requirements of the SAP by Atkins.

Sediment samples were collected using a stainless steel Ponar dredge deposited into a clean stainless steel pan, composited with a clean stainless steel spoon, and placed into appropriate sample containers. All sediment handling equipment was cleaned and rinsed between sampling stations using Standard Operating Procedures (Attachment B).

Water samples were collected using non-contaminating, metal-free pumps with food-grade hoses and suitable pre-cleaned bottles. All metal samples except mercury and selenium were filtered using a 0.45 µm filter. All samples were stored at a temperature between 2 and 4 degrees Celsius.

All chemical analyses were performed by Anacon, Inc., Houston, Texas, except for the dioxin and furan analyses, which were performed by TestAmerica, Knoxville, Tennessee. All chemical analyses required by the TO009 have been completed according to the SAP.

RESULTS

The water quality parameters taken at the time of collection are presented in Table 1 (Attachment C), as are the coordinates at which samples were collected. Included in Tables 2–5 (Attachment C) are a list of the parameters for which analysis was required under the TO and the concentrations of detected parameters in the various media. Also included in the tables are appropriate standards, criteria, or screening values to which the detected parameters can be compared.

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There are a few consistent trends in the standard parameter data (see Table 1). Salinity is highest at Station CB-12-01 and decreases away from the Houston Ship Channel. Dissolved oxygen is good at all stations but increases away from the Houston Ship Channel, except for Station CB-12-07. There is essentially no change in any of the other parameters.

The results of chemical analyses for compounds detected in water and elutriate samples are presented in Tables 3 and 4. Also included in Tables 3 and 4 are the Texas Surface Water Quality Standards (TWQS), provided by the Texas Commission on Environmental Quality (TCEQ) for the protection of aquatic life. Since the sediment and water samples used to prepare the elutriates are from grab samples from a marine environment and thus are a snapshot in time, not from a series of samples taken over time (e.g., a seven-day average like chronic TWQS), the acute marine TWQS are more appropriate for comparison. An examination of Table 3 indicates that there are no exceedances of any acute TWQS for the Cedar Bayou Channel stations.

Elutriates were prepared from test sediment and channel water, filtered to remove suspended material for trace metal analysis (except mercury and selenium) or centrifuged, and submitted for chemical analysis. Therefore, the elutriates provide information on those constituents that are dissolved into the water column during dredging and open-water placement. A comparison of the elutriate results with the channel water results indicates no definitive increases in constituent concentrations upon elutriate preparation. Nickel and selenium were detected once or twice in the elutriates but not in any water samples. For the other constituents, there was essentially no change or the changes varied in directionality. An examination of Table 4 indicates that there are no exceedances of any acute TWQS for the channel stations.

Sediment concentrations of detected compounds are presented in Table 5. Concentrations of metals, except mercury, were always highest at Station CB-12-06, while polyaromatic hydrocarbons (PAH) were generally highest at Station CB-12-07 or its duplicate. All of the stations with generally higher constituent concentrations were fine-grained.

There are no enforceable sediment quality criteria or standards with which to compare concentrations in the sediment. However, there are several different guidelines that are used to look for a cause for concern in sediment samples, one of which is the Effects Range Low, or ERL. No ERLs were exceeded, except for the ERL for mercury (0.15 mg/kg). The mercury ERL was exceeded at every station with concentrations ranging from 0.21 to 0.30 mg/kg. The Effect Range Medium (ERM) for mercury is 0.71 mg/kg, well above the values noted above. The sediments at Stations CB-12-01 through CB-12-03 are loams, but all others are generally fine, with a sand content below 10 percent.

Dioxin and furan analyses on sediment samples were conducted for those stations so designated in the SAP. The results, both raw data and data normalized to total organic content of the individual sediments, are included in Table 5. The range of values, 6.1 to 9.2 picograms/gram (pg/g) dry weight total toxic equivalent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TEQ), is similar to that found in the Houston Ship Channel and Galveston Channel recently (0.5 pg/g to 5.4 pg/g), which were considered not to "reflect significant point source contributions of dioxins/furans to the project area but rather reflect the low level dioxin/furan contamination that is ubiquitous in environmental media throughout the United States, including coastal areas" [Statement of Finding for Galveston Harbor and Channel and Houston Ship Channel Dredging Project, January 10, 2012].

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No samples exceeded the acute TWQS. Results for all sample stations exceeded the ERL for mercury but were well below the ERM. Results for all other analytes were below the ERL. There is nothing in the chemical analyses that would indicate a concern with the placement of these sediments, under the guidance provided by the Regional Implementation Agreement (RIA) and/or the Inland Testing Manual.

Very truly yours,

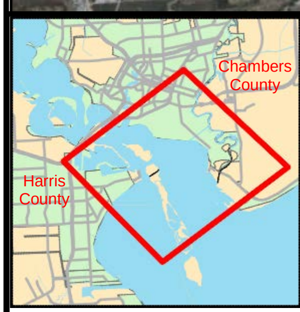
SOL ENGINEERING SERVICES, LLC

Derek Starling, P.E., C.Q.E.
Principal

DS:SC

c: Martin Arhelger - Atkins
Marisa Weber - Atkins

Phone: (601) 961-1415 Fax: (601) 940-0420



Sampling Location

Projection: State Plane
Datum: NAD 83
Zone: South Central
Units: Feet
Source: Bing Aerial Map

0 1.5 3 Miles

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Jackson, Mississippi 39201
Phone: (601) 961-1415
Fax: (601) 960-0420

Figure 1
Sampling and Chemical Analysis
Cedar Bayou Channel
Harris and Chambers County, Texas

USGS Quads: Morgans Point

Prepared By: SOL	Scale: 1" = 1.5 miles
Job No: 1120	Date: 05/18/2012

File: S:\GIS\Cedar Bayou\Figure 1 - CB Sampling.mxd

WATER QUALITY DATA

Project: **Cedar Bayou Channel** Task Order #:

Date(s) Collected: 5/8/2012 Tide, MLT: - 0.22 Feet @ 04:12

Wind Direction: Northeast Wind Speed: 5 to 10 mph

Weather and Water Conditions: Mostly sunny with seas less than a foot

Sample Number	CB-12-01A	CB-12-01B	CB-12-01C	CB-12-02A	CB-12-02B	CB-12-02C	CB-12-03A	CB-12-03B	CB-12-03B
Station	0+00	0+00	0+00	50+00	50+00	50+00	100+00	100+00	100+00
Distance From C_L (Ft.)	40 N	0	40 S	40 N	0	40 S	40 NE	0	40 SW
Water Depth MLT (Ft.)	20	21	21	13	13	12	11	12	12
DO (mg/L)	7.47	7.30	7.12	8.39	8.48	8.62	9.72	9.43	9.46
pH	7.69	7.66	7.64	7.80	7.81	7.82	8.03	8.00	8.01
Salinity ($^{o}/_{oo}$)	10.86	10.37	10.90	9.71	9.60	9.50	9.29	9.30	9.27
Water Temp. (°C)	25.57	25.22	24.50	24.99	25.06	25.18	24.92	24.78	24.87
Air Temp. (°C)	26.1	26.1	26.1	26.6	26.6	27.2	27.2	27.2	27.2
Lat.	N29 41 02.9	N29 41 02.5	N29 41 02.2	N29 41 20.9	N29 41 20.5	N29 41 20.1	N29 40 58.3	N29 40 58.0	N29 40 57.6
Long.	W94 58 50.0	W94 58 49.9	W94 58 49.7	W94 57 57.9	W94 57 58.0	W94 57 58.0	W94 57 07.5	W94 57 07.7	W94 57 07.9
Time	12:35	12:30	12:40	13:00	13:10	13:20	13:23	13:28	13:34
Comment									

REMARKS:

WATER QUALITY DATA

Project: **Cedar Bayou Channel** Task Order #:

Date(s) Collected: 5/8/2012 Tide, MLT: - 0.22 Feet @ 04:12

Wind Direction: Northeast Wind Speed: 5 to 10 mph

Weather and Water Conditions: Mostly sunny with seas less than a foot

Sample Number	CB-12-04A	CB-12-04B	CB-12-04C	CB-12-05A	CB-12-05B	CB-12-05C	CB-12-06A	CB-12-06B	CB-12-06C
Station	150+00	150+00	150+00	200+00	200+00	200+00	250+00	250+00	250+00
Distance From C_L (Ft.)	40 NE	0	40 SW	40 W	0	40 E	40 W	0	40 E
Water Depth MLT (Ft.)	8	8	9	12	12	13	13	12	13
DO (mg/L)	8.90	8.94	9.06	9.10	9.10	9.08	8.00	9.90	9.95
pH	7.99	7.98	7.99	8.00	7.99	7.99	7.95	7.90	7.97
Salinity ($^o/_{oo}$)	8.81	8.77	8.76	8.20	8.19	8.18	8.13	8.08	8.02
Water Temp. (°C)	24.71	24.82	24.88	25.60	25.35	25.36	24.31	24.46	24.59
Air Temp. (°C)	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.3	28.8
Lat.	N29 40 32.9	N29 40 32.7	N29 40 32.4	N29 40 39.8	N29 40 39.8	N29 40 39.7	N29 41 16.3	N29 41 16.3	N29 41 16.4
Long.	W94 56 19.2	W94 56 19.5	W94 56 19.8	W94 55 44.6	W94 55 44.2	W94 55 43.8	W94 55 11.0	W94 55 10.6	W94 55 10.1
Time	13:46	13:51	13:59	14:02	14:07	14:13	14:15	14:20	14:26
Comment									

REMARKS:

WATER QUALITY DATA

Project: **Cedar Bayou Channel** Task Order #:

Date(s) Collected: 5/8/2012 Tide, MLT: - 0.22 Feet @ 04:12

Wind Direction: Northeast Wind Speed: 5 to 10 mph

Weather and Water Conditions: Mostly sunny with seas less than a foot

Sample Number	CB-12-07A	CB-12-07B	CB-12-07C						
Station	300+00	300+00	300+00						
Distance From C_L (Ft.)	40 W	0	40 E						
Water Depth MLT (Ft.)	12	12	13						
DO (mg/L)	7.57	8.54	8.48						
pH	7.99	7.97	7.97						
Salinity ($^{o}/_{oo}$)	7.78	7.74	7.77						
Water Temp. (°C)	25.50	25.55	25.41						
Air Temp. (°C)	28.3	28.8	28.8						
Lat.	N29 41 53.8	N29 41 53.8	N29 41 53.8						
Long.	W94 54 56.8	W94 54 56.3	W94 54 55.9						
Time	14:31	14:36	14:42						
Comment	DUP	DUP	DUP						

REMARKS:

TABLE 2

PARAMETERS DETERMINED BY CHEMICAL ANALYSIS

METALS	
Antimony	Lead
Arsenic	Mercury
Beryllium	Nickel
Cadmium	Selenium
Chromium, Total	Silver
Chromium, Trivalent	Thallium
Chromium. Hexavalent	Zinc
Copper	
PESTICIDES AND PCBs	
Aldrin	Dieldrin
Alpha-BHC	Endosulfan I
Beta-BHC	Endosulfan II
Gamma-BHC (Lindane)	Endosulfan sulfate
Delta-BHC	Endrin
Chlordane	Endrin aldehyde
Alpha-Chlordane	Heptachlor
Gamma- Chlordane	Heptachlor epoxide
4,4'-DDD	Toxaphene
4,4'-DDE	Total PCBs
4,4'-DDT	
SEMIVOLATILES	
Acenaphthene	Dimethyl phthalate
Acenaphthylene	Di-n-butyl phthalate
Anthracene	2,4-Dinitrotoluene
Benzidine	2,6-Dinitrotoluene
Benzo(a)anthracene	Di-n-octyl phthalate
Benzo(a)pyrene	1,2-Diphenylhydrazine
Benzo(ghi)perylene	Fluoranthene
Benzo(b&k)fluoranthene	Fluorene
Bis(2-chloroethyoxy)methane	Hexachlorobenzene
Bis(2-chloroethyl)ether	Hexachlorobutadiene
Bis(2-chloroisoproply)ether	Hexachlorocyclopentadiene
Bis(2-ethylhexyl)phthalate	Hexachloroethane
4-Bromophenyl phenyl ether	Indeno(123-CD)pyrene
Butyl benzyl phthalate	Isophorone
4-chloro-3-methylphenol	2-Methyl-4,6-dinitrophenol (4,6-dinitro-o-cresol)
2-Chloronapthalene	Naphthalene
2-Chlorophenol	Nitrobenzene
4-Chlorophenyl phenyl ether	2-Nitrophenol Chrysene
	4-Nitrophenol
Dibenzo(ah)anthracene	N-nitrosodimethylamine
1,2-Dichlorobenzene	N-nitrosodi-n-propylamine
1,3-Dichlorobenzene	N-nitrosodiphenylamine
1,4-Dichlorobenzene	Phenanthrene
3,3'-Dichlorobenzidine	Phenol
2,4-Dichlorophenol	Pentachlorophenol
2,4-Dinitrophenol	Pryene
Diethyl phthalate	1,2,4-Trichlorobenzene
2,4-Dimethylphenol	2,4,6-Trichlorophenol

TABLE 2 (Concluded)

PARAMETERS DETERMINED BY CHEMICAL ANALYSIS

CONVENTIONAL PARAMETERS	
Ammonia	Total Petroleum Hydrocarbons
Cyanide	% Solids*
Total Organic Carbon	
DIOXIN/FURAN CONGENERS	
2,3,7,8 - Tetrachloro Dibenzo-p -Dioxin	
1,2,3,7,8 - Pentachloro Dibenzo-p-Dioxin	1,2,3,7,8,9 - Hexachloro Dibenzo-p-Dioxin
1,2,3,4,7,8 - Hexachloro Dibenzo-p-Dioxin	1,2,3,4,6,7,8 - Heptachloro Dibenzo-p-Dioxin
1,2,3,6,7,8 - Hexachloro Dibenzo-p-Dioxin	Octachloro Dibenzo-p-Dioxin
2,3,7,8 - Tetrachloro Dibenzo-p-Furan	2,3,4,6,7,8 - Hexachloro Dibenzo-p-Furan
1,2,3,7,8 - Pentachloro Dibenzo-p-Furan	1,2,3,7,8,9 - Hexachloro Dibenzo-p-Furan
2,3,4,7,8 - Pentachloro Dibenzo-p-Furan	1,2,3,4,6,7,8 - Heptachloro Dibenzo-p-Furan
1,2,3,4,7,8 - Hexachloro Dibenzo-p-Furan	1,2,3,4,7,8,9 - Heptachloro Dibenzo-p-Furan
1,2,3,6,7,8 - Hexachloro Dibenzo-p-Furan	Octachloro Dibenzo-p-Furan

* sediment only

TABLE 3

CONCENTRATIONS OF DETECTED COMPOUNDS (ug/L)

WATER

CEDAR BAYOU CHANNEL

Date Sampled: MaY 8, 2012

	TWQS		Detection	CB-12-									
Parameter	Chronic	Acute	Limit	01	02	03	04	05	06	07	07 Dup	Field Blank1	Field Blank2
Arsenic	78	149	1.00	1.50	5.02	4.80	4.00	4.10	3.80	4.10	4.40	BDL	BDL
Copper	3.6	13.5	1.00	2.20	2.40	2.10	2.00	2.00	BDL	1.90	1.80	BDL	0.41 J
Nickel	13.1	118	1.00	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.32 J
Selenium	136	564	2.00	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Thalium	N/A	N/A	1.00	0.62 J	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	84.2	92.7	1.00	1.60	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.68 J	1.01
Ammonia*	N/A	N/A	0.03	0.21	0.25	0.11	0.51	0.37	0.42	0.23	0.22	N/A	N/A
TOC*	N/A	N/A	0.10	7.66	7.86	8.53	9.00	8.53	9.00	9.00	8.53	N/A	N/A

Dup = Duplicate Sample

BDL = Below Detection Limits

* mg/L

J Compound detected value below Quantitation Limits

Metals Blank 1 is a straight pour of milliQ deionized water to the sample container

Metals Blank 2 is milliQ deionized water pumped through the filter into the sample container

TABLE 4

CONCENTRATIONS OF DETECTED COMPOUNDS (ug/L)
ELUTRIATE
CEDAR BAYOU CHANNEL

Date Sampled: MaY 8, 2012

	TWQS		Detection	CB-12-							
Parameter	Chronic	Acute	Limit	01	02	03	04	05	06	07	07 Dup
Arsenic	78	149	1.00	3.50	4.30	2.90	3.40	3.30	3.60	3.20	3.00
Chromium, Total	N/A	N/A	1.00	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium III	N/A	N/A	1.00	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Copper	3.6	13.5	1.00	1.90	3.40	BDL	1.90	BDL	BDL	BDL	BDL
Nickel	13.1	118	1.00	1.50	1.30	BDL	BDL	BDL	BDL	BDL	BDL
Selenium	136	564	2.00	BDL	BDL	BDL	1.90 J	BDL	BDL	BDL	BDL
Thalium	N/A	N/A	1.00	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Zinc	84.2	92.7	1.00	7.49	3.10	BDL	BDL	BDL	5.12	6.96	BDL
Ammonia*	N/A	N/A	0.03	0.26	0.31	0.18	0.25	0.13	0.11	0.24	0.68
TOC*	N/A	N/A	0.10	10.0	8.93	9.20	9.26	9.00	9.93	8.80	8.80

Dup = Duplicate Sample
BDL = Below Detection Limits
* mg/L
J Compound detected value below Quantitation Limits
Silver was found only in the Station TC-12-08 elutirate at 1.70 ug/L.

TABLE 5

CONCENTRATIONS OF DETECTED COMPOUNDS (dry weight)
SEDIMENT
CEDAR BAYOU CHANNEL

Date Sampled: MaY 8, 2012

				CB-12-							
Parameter	Units	Detection Limit	NOAA ERL	01	02	03	04	05	06	07	07 Dup
Arsenic	mg/kg	0.30	8.2	3.52	4.86	5.45	5.27	5.78	6.41	5.32	5.91
Beryllium	mg/kg	1.00	N/A	0.63 J	0.85 J	1.20	1.05	1.08	1.29	0.99 J	1.16
Cadmium	mg/kg	0.10	1.2	BDL	BDL	BDL	BDL	0.20	0.26	0.19	0.24
Chromium, Total	mg/kg	1.00	81.0	12.9	18.5	24.8	22.7	23.8	30.5	21.7	27.7
Chromium III	mg/kg	1.00	N/A	12.9	18.5	24.8	22.7	23.8	30.5	21.7	27.7
Copper	mg/kg	1.00	34.0	6.61	9.59	10.8	10.5	11.7	15.4	10.9	13.6
Lead	mg/kg	0.30	46.7	12.6	18.9	21.2	19.8	20.0	23.2	16.8	21.1
Mercury	mg/kg	0.20	0.15	0.21	0.22	0.25	0.23	0.30	0.27	0.21	0.24
Nickel	mg/kg	0.50	20.9	8.57	11.8	15.4	13.6	13.6	15.5	13.0	14.5
Selenium	mg/kg	0.50	N/A	0.19 J	0.29 J	0.35 J	0.28 J	0.37 J	0.51	0.29 J	0.32 J
Silver	mg/kg	0.20	1.00	0.08 J	0.07 J	0.08 J	0.07 J	0.07 J	0.12 J	0.06 J	0.08 J
Thallium	mg/kg	0.20	N/A	0.13 J	0.20	0.25	0.23	0.25	0.30	0.23	0.26
Zinc	mg/kg	2.00	150	33.4	50.0	60.3	57.8	61.0	79.2	50.1	92.9
Phenanthracene	ug/kg	20.0	240	28.6	BDL	BDL	BDL	BDL	BDL	37.8	43.9
Anthracene	ug/kg	20.0	N/A	BDL	36.0	BDL	BDL	BDL	BDL	BDL	BDL
Fluoranthene	ug/kg	20.0	600	37.0	46.6	42.5	42.1	43.2	58.6	71.7	63.6
Pyrene	ug/kg	20.0	665	38.6	47.3	43.9	43.4	45.2	60.3	70.4	62.6
Chrysene	ug/kg	20.0	384	BDL	34.4	31.3	31.1	32.6	43.3	42.0	71.8
Benzo(a)anthracene	ug/kg	20.0	261	BDL	BDL	BDL	BDL	BDL	BDL	BDL	37.4
Benzo(b)Fluoranthene	ug/kg	20.0	N/A	BDL	BDL	BDL	BDL	BDL	BDL	30.7	51.8
Benzo(k)Fluoranthene	ug/kg	20.0	N/A	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(a)Pyrene	ug/kg	20.0	430	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Indeno(1,2,3-c,d)Pyren	ug/kg	20.0	N/A	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Benzo(ghi)Perylene	ug/kg	20.0	N/A	23.4	26.2	25.6	23.6	25.9	33.1	26.2	33.5
Bis (2-Ethylhexyl) Phthalate	ug/kg	20.0	N/A	948	407	BDL	BDL	BDL	BDL	BDL	BDL
Dibutyl Phthalate	ug/kg	20.0	N/A	BDL	BDL	BDL	BDL	BDL	BDL	160	BDL
Ammonia	mg/kg	0.10	N/A	73.5	104	145.0	135.0	112	158	158	122
TOC	%	0.10	N/A	0.75	1.19	1.84	1.68	2.02	2.02	1.92	1.44
Percent Solids	%	N/A	N/A	52.5	44.6	40.0	42.7	40.6	33.5	48.2	37.9
Gravel	%	N/A		0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
Sand	%	N/A		36.1	32.1	18.2	3.1	5.2	6.0	7.1	9.1
Silt	%	N/A		35.6	28.9	28.5	47.3	41.5	29.6	49.4	35.2
Clay	%	N/A		28.3	39.0	53.3	49.6	53.3	64.0	43.5	55.7
D50	mm	N/A		0.0424	0.0248	0.0038	0.0053	0.0027	0.0000	0.0117	0.0025

Mercury ERM = 0.710mg/kg.

TABLE 5

CONCENTRATIONS OF DETECTED COMPOUNDS (dry weight)
SEDIMENT
CEDAR BAYOU CHANNEL

Parameter	Units	Detection Limit	NOAA ERL	CB-12- 01	02	03	04	05	06	07	07 Dup
UN-NORMALIZED DATA as TEQs											
2,3,7,8-TCDD	pg/g		N/A	1.6 B	2.2 QB	2.0 B	2.0 QB	1.3 B	1.7 B	0.92 B	
1,2,3,7,8-PeCDD	pg/g		N/A	0.67 QBJ	0.72 QBJ	0.98 BJ	1.2 QBJ	0.99 BJ	1.4 BJ	0.91 BJ	
1,2,3,4,7,8-HxCDD	pg/g		N/A	0.18 QBJ	0.22 BJ	0.22 BJ	0.31 BJ	0.25 BJ	0.33 BJ	0.23 BJ	
1,2,3,6,7,8-HxCDD	pg/g		N/A	0.34 B	0.35 B	0.35 B	0.47 B	0.37 B	0.51 B	0.33 B	
1,2,3,7,8,9-HxCDD	pg/g		N/A	0.91 CB	0.87 CB	0.93 CB	1.0 CB	0.92 CB	1.2 CB	0.79 CB	
1,2,3,4,6,7,8-HpCDD	pg/g		N/A	1.3 B	1.3 B	1.2 B	1.7 B	1.2 B	1.8 B	1.2 B	
OCDD	pg/g		N/A	0.99 BE	0.96 BE	0.84 BE	1.2 BE	0.84 BE	1.6 BE	1.0 BE	
2,3,7,8-TCDF	pg/g		N/A	0.47 B	0.61 B	0.52 B	0.64 SB	0.38 BX	0.40 SB	0.26 SB	
1,2,3,7,8-PeCDF	pg/g		N/A	0.014 QBJ	0.018 BJ	0.020 BJ	0.022 QBJ	0.018 BJ	0.020 BJ	0.011 BJ	
2,3,4,7,8-PeCDF	pg/g		N/A	0.12 BJ	0.11 QBJ	0.15 BJ	0.24 QBJ	0.14 BJ	0.18 BJ	0.11 BJ	
1,2,3,4,7,8-HxCDF	pg/g		N/A	0.10	0.13 QBJ	0.10 QBJ	0.14 QBJ	0.097	0.13	0.081	
1,2,3,6,7,8-HxCDF	pg/g		N/A	0.073 BJ	0.091 QBJ	0.098 QBJ	0.12 QBJ	0.093 QBJ	0.13 QBJ	0.086 QBJ	
2,3,4,6,7,8-HxCDF	pg/g		N/A	0.032 QBJ	0.035 QBJ	0.041 QBJ	0.043 QBJ	0.048 BJ	0.058 QBJ	0.034 BJ	
1,2,3,7,8,9-HxCDF	pg/g		N/A	0.022 BJ	0.024 BJ	0.024 QBJ	0.016 QBJ	0.021 QBJ	0.029 QBJ	0.012 QBJ	
1,2,3,4,6,7,8-HpCDF	pg/g		N/A	0.075 B	0.089 QB	0.054 B	0.098 QB	0.061 B	0.09 B	0.060 B	
1,2,3,4,7,8,9-HpCDF	pg/g		N/A	0.0087 BJ	0.0099 BJ	0.0074 QBJ	0.010 QBJ	0.0063 QBJ	0.0089 QBJ	0.0067 BJ	
OCDF	pg/g		N/A	0.0042 B	0.0045 QB	0.0057 B	0.0042 QB	0.0051 SB	0.0069 SB	0.0042 B	
Total TEQ	pg/g		N/A	6.9	7.7	7.5	9.2	6.7	9.6	6.1	
NORMALIZED DATA as TEQs per 1% Organic Carbon											
2,3,7,8-TCDD	pg/g		N/A	213.3 B	185 QB	109 B	119 QB	64.4 B	84.2 B	48 B	
1,2,3,7,8-PeCDD	pg/g		N/A	89.3 QBJ	60.5 QBJ	53.3 BJ	71.4 QBJ	49.0 BJ	69.3 BJ	47.4 BJ	
1,2,3,4,7,8-HxCDD	pg/g		N/A	24.0 QBJ	18.5 BJ	12.0 BJ	18.5 BJ	12.4 BJ	16.3 BJ	12.0 BJ	
1,2,3,6,7,8-HxCDD	pg/g		N/A	45.3 B	29.4 B	19.0 B	28.0 B	18.3 B	25.2 B	17.2 B	
1,2,3,7,8,9-HxCDD	pg/g		N/A	121 CB	73.1 CB	50.5 CB	59.5 CB	45.5 CB	59.4 CB	41.1 CB	
1,2,3,4,6,7,8-HpCDD	pg/g		N/A	173 B	109 B	65.2 B	101 B	59.4 B	89.1 B	62.5 B	
OCDD	pg/g		N/A	132 BE	80.7 BE	45.7 BE	71.4 BE	41.6 BE	79.2 BE	52.1 BE	
2,3,7,8-TCDF	pg/g		N/A	62.7 B	51.3 B	28.3 B	38.1 SB	18.8 BX	19.8 SB	13.5 SB	
1,2,3,7,8-PeCDF	pg/g		N/A	1.9 QBJ	1.5 BJ	1.1 BJ	1.3 QBJ	0.9 BJ	1.0 BJ	0.6 BJ	
2,3,4,7,8-PeCDF	pg/g		N/A	16.0 BJ	9.2 QBJ	8.2 BJ	14.3 QBJ	6.9 BJ	8.9 BJ	5.7 BJ	
1,2,3,4,7,8-HxCDF	pg/g		N/A	13.3 0.0	10.9 QBJ	5.4 QBJ	8.3 QBJ	4.8 0.0	6.4 0.0	4.2 0.0	
1,2,3,6,7,8-HxCDF	pg/g		N/A	9.7 BJ	7.6 QBJ	5.3 QBJ	7.1 QBJ	4.6 QBJ	6.4 QBJ	4.5 QBJ	
2,3,4,6,7,8-HxCDF	pg/g		N/A	4.3 QBJ	2.9 QBJ	2.2 QBJ	2.6 QBJ	2.4 BJ	2.9 QBJ	1.8 BJ	
1,2,3,7,8,9-HxCDF	pg/g		N/A	2.9 BJ	2.0 BJ	1.3 QBJ	1.0 QBJ	1.0 QBJ	1.4 QBJ	0.6 QBJ	
1,2,3,4,6,7,8-HpCDF	pg/g		N/A	10.0 B	7.5 QB	2.9 B	5.8 QB	3.0 B	4.5 B	3.1 B	
1,2,3,4,7,8,9-HpCDF	pg/g		N/A	1.2 BJ	0.8 BJ	0.4 QBJ	0.6 QBJ	0.3 QBJ	0.4 QBJ	0.3 BJ	
OCDF	pg/g		N/A	0.6 B	0.4 QB	0.3 B	0.3 QB	0.3 SB	0.3 SB	0.2 B	
Total TEQ	pg/g		N/A	920	647	408	548	332	475	318	

Dup = Duplicate Sample
BDL = Below Detection Limit
N/A = Not Applicable
J Estimated result. Analyte detected below Quantitation Limits
Q Extimated maximum possible concentration.
C Co-eluting isomer
B Method blank contamination. The associated method blank contains the target analyte at a reportable level.
E Estimated result. Result concentration exceeds the calibration range.
S Ion Suppression
X See Project Narative