US Army Corps
of Engineers ®
Galveston District

FINAL

ENVIRONMENTAL ASSESSMENT

for

Houston Ship Channel Project Deficiency Report, Houston-Galveston Navigation Channels, Texas

(Flare at the Intersection of the Houston Ship Channel and Bayport Ship Channel)

Chambers County, Texas

March 2015

March 7, 2016

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STATEMENT OF FINDINGS
AND
FINDING OF NO SIGNIFICANT IMPACT
FOR
HOUSTON SHIP CHANNEL PROJECT DEFICIENCY REPORT
(Flare at the Intersection of the Houston Ship Channel and Bayport Ship Channel)
HOUSTON-GALVESTON NAVIGATION CHANNELS, TEXAS

1. Purpose. The Houston Ship Channel (HSC) contains a deficiency inherent in the design in the *Houston-Galveston Navigation Channels, Texas, Limited Reevaluation Report and Final Supplemental Environmental Impact Statement* completed in November 1995 (1995 LRR/SEIS). The Houston-Galveston Navigation Channels, Texas, Project (HGNC) was authorized in the Water Resources Development Act of 1996 (WRDA 1996), Section 101(a)(30), P.L. 104-303. The channel design for the HGNC did not fully account for impacts of the channel improvements within the HSC in the vicinity of the Bayport Ship Channel (BSC). A hazardous and unacceptable navigation condition has resulted. Increased traffic and vessel size afforded by the channel improvements authorized by WRDA 1996 has increased the potential for collisions and accidents within this section of the HSC. The intersection of the HSC and Bayport Ship Channel (BSC) has been a major safety concern for over a decade.

The purpose of the proposed project is to correct a design deficiency and conduct a corrective action through a channel modification required to make the project function on an interim basis as initially intended in a safe, viable, and reliable manner.

All elevations in the Project Deficiency Report (PDR) have been converted to the Mean Lower-Low Water (MLLW) datum, but for continuity with previous project documents and approvals, values in the MLT datum have also been retained for reference. The MLLW datum adjustment in the project vicinity is 1.47 feet below MLT at the Texas Coastal Ocean Observation Network (TCOON) gage at Morgans Point, Texas, located roughly five miles north of the BSC. This elevation difference varies along the length of the HSC. For additional information on datum conversions reference Engineer Manual (EM) 1110-2-6056.

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.
The location of the identified deficiency is situated along the HSC segment that crosses Galveston Bay between Redfish Reef to the south and Morgans Point to the North. Specifically, it is located northwest of the Mid Bay Placement Area (PA) in the vicinity of the intersection between the HSC (between HSC Station 30+000 and HSC Station 23+000) and the BSC.

2. Proposed Action.
Alternative 3, the recommended deficiency corrective action, consists of increasing the existing 3,000 feet southern radius of the Flare to 4,000 feet, and widened the HSC by a maximum of 235 feet to the east between about HSC Station 26+484 and HSC Station 30+090 (and relocating the

existing barge lanes to accommodate the widened HSC. The barge lanes will be relocated to the east of the HSC widening and consistent with the original design.

The work would be accomplished using a hydraulic cutterhead dredge and pumping the dredged new work materials to PA 14, located in close proximity and northeast of the project. The resulting about 1.94 MCY of new work materials would be stacked along the interior slope of the existing perimeter dike to form a berm and used for future dike raising construction. In the event that PA 14 is not available at the time of construction approval of the proposed project, the new work dredged materials may be placed at the Mid Bay Upland PA. Since the time of the Draft FONSI, other existing PAs and Beneficial Use (BU) marsh cells have been identified as possible contingencies for the use of new work dredged materials to add flexibility to the use of the placement system and respond to changing priorities. This includes use of the material to raise dikes at PA 15, to continue dike construction of the already-planned and approved connection between PAs 14 and 15, or to repair deteriorated dikes at Atkinson Island BU Marsh Cells M7/8/9, and M10. Therefore, these sites have been included in the consideration of environmental impacts under this FONSI. The use of the material to raise dikes at the existing upland confined PA 15 would have the same impact as use for dike raising at PA 14 or MidBay PA. Impacts of initial construction of the PA 14/15 connection and at Atkinson Island BU Marsh Cells M7/8/9, and M10 were evaluated and documented in the *Final Environmental Assessment Expansion of Placement Areas 14 and 15, Houston Ship Channel, Chambers County, Texas*, dated January 2010 (hereafter referred to as the "Expansion of PAs 14 and 15 EA"). Use of the new work material to repair or continue dike construction of the PA 14/15 connection and marsh cells would just continue the previously approved proposed action and would avoid impacts from any separate clay mining activity needed to continue constructing or repair the earthen portion of the dike. In accordance with Engineer Regulation (ER) 200-2-2, *Procedures for Implementing NEPA*, use of the new work material to repair deteriorated dikes is a categorically excluded activity involving repair, rehabilitation, and replacement of existing structures such as levees at a completed Corps project which carries out the authorized project purpose.

The total maintenance quantity for the next 20 years would be approximately 4.26 MCY, which is due to the incremental increase in channel depth and width beyond existing conditions. The maintenance materials would be placed in nearby HSC PAs and BU sites, including existing PA 15, PA 14, Mid Bay PA, Atkinson Island BU Marsh Cells M7/8/9, and M10, as well as any other existing Atkinson Island BU Marsh Cells requiring renourishment. The future PA 15/PA 14 connection would also be utilized for maintenance. The project area would be dredged for routine maintenance at the same times and frequencies as the associated channels. Proposed project construction would begin in September 2016, and the construction period for the new work dredging and placement would be approximately 10 months.

3. Coordination. A Notice of Availability was issued to interested parties including Federal and state agencies on September 14, 2015, which described the proposed action and announced the availability of the Draft EA. Comments on the Notice of Availability and Draft EA and the District's responses, have been included in Appendix 3 of the Final EA.

4. 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 including placement of new work and maintenance dredged material have been identified and assessed and can be found in Sections 4, 5 and 7 of the Final EA.

- The proposed action will impact 29.9 acres of oyster reef and a conversion of approximately 26.8 acres of shallow and deep unvegetated bay bottom to deeper, navigation channel bottom. Compensatory mitigation would consist of the restoration of 30.1 acres of oyster reef at the San Leon Reef, which was impacted by Hurricane Ike induced sedimentation in 2008. Section 4.4 of the EA provides additional information regarding site selection and the USFW Habitat Suitability Index (HSI) modeling to determine the mitigation.
- The proposed action does not change the current land use.
- Project related air quality impacts were evaluated using the worst case emissions for construction of the proposed action (Appendix 4 of the Final EA). Air contaminant emissions from construction would not be considered *de minimus.* It is anticipated that approximately 304.7 tons of NOx and 12.4 tons of VOCs would be generated during the 2016 timeframe and 4.2 tons of NOx and 0.6 tons of VOCs would be generated during 2017 from the construction of the proposed action. Per 40 CFR 93.158(a)(5)(i)(A), the proposed action was coordinated with TCEQ to seek concurrence that the emissions conform to the applicable State Implementation Plan (SIP) for purposes of determining general conformity. Concurrence was obtained via a TCEQ letter dated November 4, 2015.
- No other special aquatic sites would be impacted by the proposed project. Only minor, temporary increases in turbidity, noise and navigation traffic are anticipated during project construction. These affected resources are expected to recover to pre-project conditions after the work is completed. The proposed project is expected to contribute beneficially to navigation safety and is not expected to contribute negative cumulative impacts to the area.
- Potential impacts to water quality associated with the construction of the recommended deficiency corrective action consist of sedimentation during construction. During construction, dredging of the proposed correction actions to the channel could potentially result in temporary increases in Total Suspended Solids (TSS). These impacts would be temporary in duration and minimal in extent as the proposed dredged method will employ a hydraulic dredging with a suction cutterhead, and dredged material placement would go into an existing, diked, upland confined dredged material PA. The USACE would require the construction contractor to implement 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 1 of this Final EA. The USACE acquired 401 Water Quality Certification from Texas Commission on Environmental Quality (TCEQ) during preparation of the Draft EA for placement of new work material at PA 14 and MidBay PA, and maintenance material at the aforementioned PAs. The USACE is coordinating the contingent use of

new work material at PA 15, Atkinson Island BU Marsh Cells M7/8/9, and M10, and the PA 14/15 connection, and use at these PAs would be pending completion of this coordination. State 401 Water Quality Certification was previously obtained during the development of the Expansion of PAs 14 and 15 EA for initial construction of the Atkinson Island BU Marsh Cells and the PA 14/15 connection using similar material mined from adjacent sections of the HSC.

- No impacts to prime or unique farmlands are anticipated.
- Implementation of the proposed action is not anticipated to directly affect any historical properties, structures, objects, sites included in or eligible for inclusion in the Nation Registry of Historic Places.
- Implementation of the proposed action is not anticipated to impact aesthetic resources in the project area.
- Implementation of the proposed action would have no effect any federally threatened or endangered species or their habitat.
- Implementation of the proposed action would not disproportionately impact minority or low-income populations. Permanent adverse impacts to socioeconomic resources and environmental justice populations within the project area are not anticipated.

Thus, it is concluded that no significant impacts on the environment or to the surrounding human population are expected to occur as a result of the proposed action.

5. Determinations. The proposed corrective actions to the HSC were determined to be compliant with the following Federal legislation: NEPA, Endangered Species Act, Clean Water Act, Fish and Wildlife Coordination Act, Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) as amended through 2006, Marine Mammal Protection Act (MMPA) of 1972 as amended through 2007, National Historic Preservation Act, Coastal Zone Management 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), Executive Order 13045 (Protection of Children from Environmental Health Risks and Safety Risks), Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act of 1986, Executive Order 13112 (Invasive Species), Migratory Bird Treaty Act (MBTA), the U.S. Army, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, and the U.S. Department of Agricultural 2002 Memorandum of Agreement with the Federal Aviation Administration (FAA) to Address Aircraft-Wildlife Strikes, Protection of Environment, Executive Order 11514, and Executive Order 13186 (Migratory Bird Habitat Protection).

6. Findings. Based on my analysis of the Final EA for the HSC Project Design Deficiency Report and other information pertaining to the proposed project, I find that the BSC Project will not have a significant effect on the quality of the human environment. Galveston District reviewed the project for consistency with the goals and policies of the TCMP. Based on this analysis, I find that the proposed plan is consistent with the goals and policies of the TCMP. After consideration of the information presented in the Final 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 action may be constructed.

22 MARCH 2016
(date)

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

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List of Appendices

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List of Acronyms

ACHP	Advisory Council on Historic Preservation
APE	Areas of Potential Effect
BA	Biological Assessment
B.C.	Before Christ
BSC	Bayport Ship Channel
BSCCT	Bayport Ship Channel Container Terminal
BU	Beneficial Use
BUG	Beneficial Uses Group
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CCMP	Comprehensive Conservation and Management Plan
CCC	Coastal Coordination Council
CY	Cubic Yard
CNRA	Coastal Natural Resource Areas
CZMA	Coastal Zone Management Act
dB	Decibels
dBA	Decibels, A-Weighted
DOD	Department of Defense
EA	Environmental Assessment
EFH	Essential Fish Habitat
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	Engineer Regulation
ERDC	U. S. Army Engineer Research and Development Center

ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FMP	Fishery Management Plan
GBEP	Galveston Bay Estuary Program
GCD	General Conformity Determination
GMSL	Global Mean Sea Level
GMFMC	Gulf of Mexico Fisheries Management Council
HGAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Brazoria area
HGNC	Houston-Galveston Navigation Channel Project
HPA	Houston Pilots Association
HSC	Houston Ship Channel
HSI	Habitat Suitability Index
HUD	U.S. Department of Housing and Urban Development
HYC	Houston Yacht Club
Leq	Equivalent Continuous Noise Level
Ldn	Day-Night Average Sound Level
LOE	Lines of Evidence
MCY	Million Cubic Yards
MLT	Mean Low Tide
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level

NAA	Nonattainment Area
NAAQS	National Ambient Air Quality Standards
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOx	Nitrogen Oxides
NRCS	Natural Resources Conservation Service
PA	Placement Area
PGN	Planning Guidance Notebook
PHA	Port of Houston Authority
ppb	parts per billion
ppt	parts per trillion
ppth	parts per thousand
RCRA	Resource Conservation and Recovery Act
RFMC	Regional Fishery Management Councils
RSLC	Relative Sea Level Change
SHPO	State Historic Preservation Officer
SRCC	Southern Regional Climate Center
SSC	Seabrook Sailing Club
SVOCs	Semi-Volatile Organic Compounds
TB	Turning Basin
TCEQ	Texas Commission on Environmental Quality
TEU	Twenty-Foot Equivalent Unit

THC	Texas Historical Commission
TCMP	Texas Coastal Management Program
TNRC	Texas Natural Resources Code
tpd	Tons per Day
TPWD	Texas Parks and Wildlife Department
TRCC	Texas Railroad Commission
TxGLO	Texas General Land Office
U. S.	United States of America
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WMA	Wildlife Management Area
WOE	Weight of Evidence
WRDA	Water Resources Development Act

1.0 INTRODUCTION, PURPOSE AND NEED

1.1 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Galveston District, hereafter referred to as "the District", has prepared a Project Deficiency Report (PDR) for the Houston-Galveston Navigation Channels, Texas, Project (HGNC) to address deficiencies in the Houston Ship Channel (HSC) in the vicinity of the Bayport Ship Channel (BSC). In accordance with the National Environmental Policy Act (NEPA), this Environmental Assessment (EA) has been prepared to analyze and document the potential impacts of the proposed project and reasonable alternatives to the natural and human environment.

1.1.1 Proposed Action and Location

The location of the identified deficiency is situated along the HSC segment that crosses Galveston Bay between Redfish Reef to the south and Morgans Point to the North. A vicinity map showing the general location of the proposed action is provided in Exhibit 1.1.1-1. Specifically, it is located northwest of the Mid Bay Placement Area (PA) in the vicinity of the intersection between the HSC (between HSC Station 30+000 and HSC Station 23+000) and the BSC. The recommended corrective action to the deficiency consists of increasing the existing southern radius of the existing Flare to 4,000 feet, widening the HSC by a maximum 235 feet to the east between about HSC Station 26+484 and HSC Station 30+090, and relocating the existing barge lanes to accommodate the widened HSC (Exhibit 1.1.1-2). The existing barge lanes must be relocated to replace a congressionally-approved feature of the HGNC Project. The barge lanes will be relocated to the east of the HSC widening and consistent with the original design.

The work would be accomplished using a hydraulic dredge with cutterhead and pumping the dredged new work materials to PA 14, located in close proximity and northeast of the project. The resulting approximate 1.94 million cubic yards (MCY) of new work materials would be stacked along the interior slope of the existing perimeter dike to form a berm and used for future dike raising construction. The new work from the project would be hydraulically placed in PA 14 in a berm along the interior of the perimeter dike. The berm would provide increased future dike foundation strength by displacing and consolidating some of the existing softer materials beneath the berm, provide a base upon which to build future dike raises, and provide desirable clay soils for future dike raises.

To provide flexibility for placement should PA 14 become unavailable, new work materials may also be beneficially used to repair or raise dikes in nearby existing HSC PAs and BU marsh cells, including existing PA 15, Mid Bay PA, Atkinson Island BU Marsh Cells M7/8/9, and M10, or for the continued construction of the already-planned and approved connection between PAs 14 and 15, to create maintenance material placement capacity. The NEPA documentation for impacts from the construction of the existing marsh cells and PA 14/15 connection was provided in the Final EA, Expansion of PAs 14 and 15, Houston Ship Channel, Chambers County, Texas. For repairs to the existing marsh cell dikes, Engineer Regulation (ER) 200-2-2, Procedures for Implementing NEPA, categorically excludes activities at completed Corps projects which carry out the authorized project purposes including as examples, repair, rehabilitation, and replacement of existing structures and facilities such as buildings, roads, groins, and levees. Dikes are the same type of structure as levees, except a levee protects normally dry land from occasional floodwaters, and a dike impounds normally present water (or dredged material in this case) from adjacent dry land (or the Bay's open waters in this case). The use of the new work material to repair the marsh cell dikes within their existing extent is therefore categorically excluded. The use the new work material from the corrective action for marsh cell repairs or continued PA 14/15connection construction is being coordinated with TCEQ and EPA, and use would be pending the completion of this coordination. For placement at the adjacent marsh cells, new work material would be hydraulically placed in deteriorated sections of the existing levee to recreate a stable dike cross section. Shore protection to remaining and repaired dikes would be considered and could be added, pending final construction design. For continued construction of the PA 14/15 connection, new work material would be hydraulically placed behind the existing rock dikes to continue construction of planned containment dikes.

1.1.2 Project Background

The HGNC Project was authorized in Water Resources Development Act (WRDA) 1996, Section 101(a)(30), Public Law 104-303. The HGNC Project is a multipurpose project with two separable elements. The two original project purposes were to provide navigation improvements to the ports of Houston and Galveston, and to provide environmental restoration for the Houston portion of the Project through the beneficial use (BU) of dredged material. The project is located in the Galveston Bay system in Harris and Galveston Counties, Texas. The HGNC Project provides for -46.5 Mean Low Lower Water (MLLW) [-45-foot mean low tide (MLT)] Houston and Galveston Channels by extending the Entrance Channel an additional 3.9 miles to the -48.5-foot MLLW (-47-foot MLT) contour in the Gulf of Mexico along the existing alignment, deepening the Entrance Channel to the -48.5-foot MLLW (-47 feet MLT) over its 800-foot width and 10.5 mile length, enlarging the HSC to a depth of -46.5 feet MLLW (-45 feet MLT) (plus 2 feet of advanced maintenance and 2 feet of allowable overdepth) and a width of 530 feet from Bolivar Roads to Boggy Bayou, plus wideners on curves, and enlarging the Galveston Channel (excluding the last 2,571 feet at the most westward end) to a depth of -46.5 feet MLLW (-45 feet MLT) and a width varying between 650 and 1,112 feet. The HGNC Project also allowed for up to 4,250 acres of marsh located in mid and upper Galveston Bay, and a 12-acre bird island located in East Galveston Bay (Evia Island). Of the 4,250 acres of marsh restoration, 690 acres were constructed as part of the initial navigation channel improvements and the remaining acres were deferred for future channel maintenance dredging cycles. Mitigation features include construction of 172 acres of oyster reef and planting of 0.86 acres of trees for a bird rookery adjacent to Alexander Island PA. The BSC is a Federally-maintained channel, originally constructed as a 10-foot deep, 100-foot wide barge in 1964 through agreements between Humble Oil and Refining Company and the Harris County HSC Navigation District (now the Port of Houston Authority [PHA]). It was then widened and deepened in the 1970's by the PHA to the depth of -41.5 feet MLLW (-40 feet MLT) and width of 300 feet, authorized for Federal assumption of maintenance (AOM) by the USACE in 1993. The PHA was permitted by Department of the Army permit SWG-2011-1183 in April 2014 to deepen the channel to -46.5 feet MLLW (-45 feet MLT), plus 2 feet of advanced maintenance and 2 feet of allowable overdepth, and widen the channel by 100 feet outside the land cut (400 feet total width), and 50 feet inside the land cut (350 total width) under the BSC Improvements Project. The BSC Improvements Project was also approved for Federal AOM in May 2014. The construction of these improvements is underway, and once accepted by the USACE, will be federally maintained. The existing Flare connecting the HSC with the BSC was constructed at the time the BSC was improved to the -41.5 feet MLLW (-40 feet MLT) depth approved for Federal Maintenance. It is currently maintained at a depth of -41.5 feet MLLW (-40 feet MLT) plus 7 feet of advanced maintenance and 2 feet of allowable overdepth dredging from the confluence of the Flare and HSC to approximately BSC Station 214+00.

GENERAL NOTES
1. Project limits & features are shown for illustrative purposes only.
2. Proposed project extent shown is to toe line.

Legend

Proposed Project Footprint

- Flare Easing
- Channel Widener and Barge Lane Relocation

Proposed Dredged Material Placement

- New Work
- Maintenance
- Existing Channel Alignment

HSC PDR FLARE AT BAYPORT ENVIRONMENTAL ASSESSMENT

Project Vicinity Map

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date March 2016	Job No. 60345436	Exhibit 1.1.1-1

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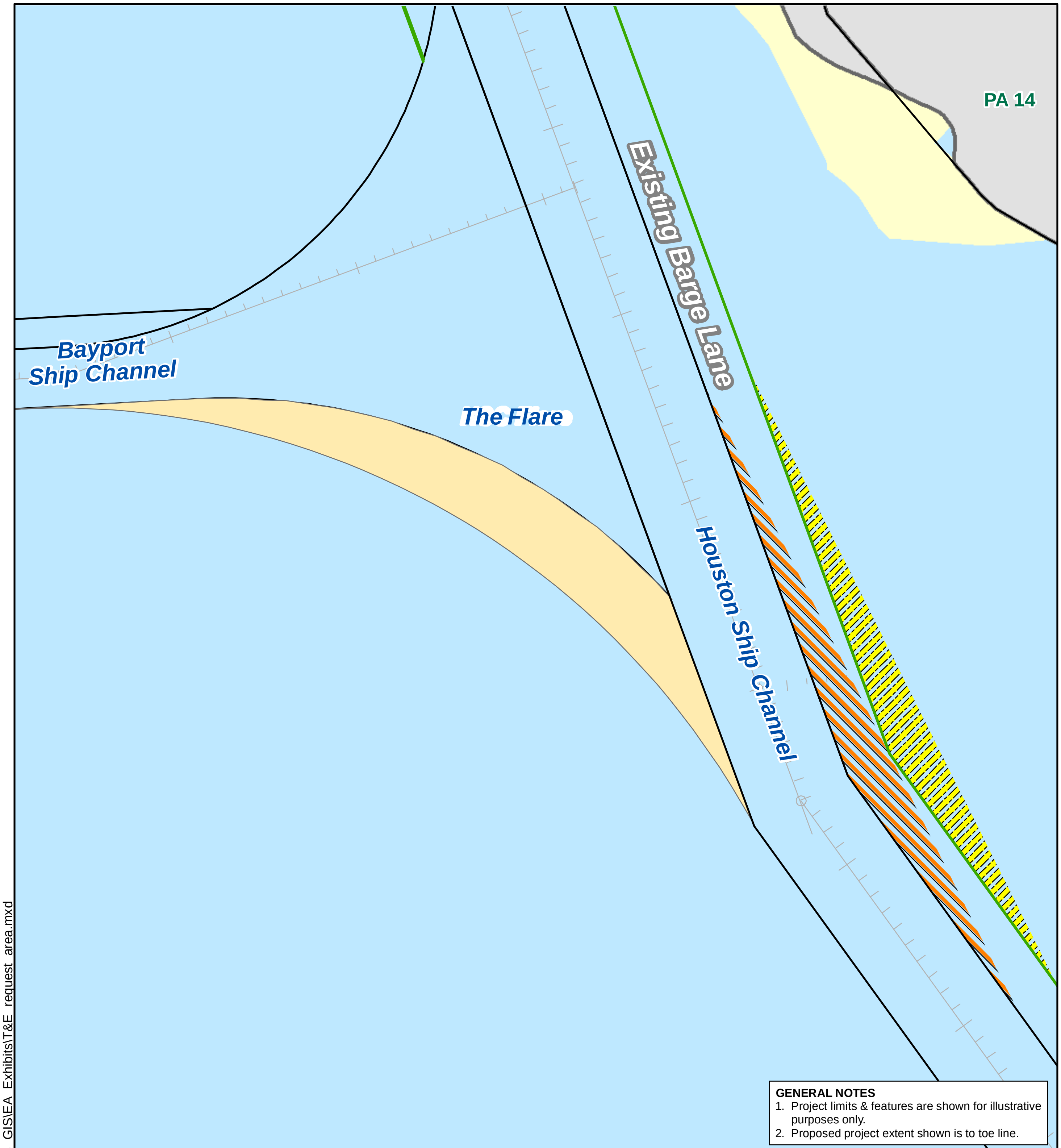

Legend

- Existing Barge Lane Toe
- Existing Main Channel Toe
- Barge Lane Relocation
- Main Channel Widener
- Flare Easing

N S W E

0 500

Feet

HSC PDR FLARE AT BAYPORT ENVIRONMENTAL ASSESSMENT

Project Area and Proposed Project

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date March 2016	Job No. 60345436	Exhibit 1.1.1-2

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1.2 PURPOSE

The purpose of the proposed project is to correct a design deficiency and conduct a corrective action through a channel modification required to make the project function on an interim basis as initially intended in a safe, viable, and reliable manner.

The ultimate fix will require a study of the HSC within Galveston Bay to address potential channel widening, passing lanes, and anchorage areas. The study will be conducted under the authority of section 216 of the Flood Control Act of 1970, Review of Completed Projects. In the interim, the recommendation is to prepare this PDR to document the scope of the plan to alleviate the navigation safety concerns in the vicinity of the intersection of the HSC and BSC.

The HSC contains a deficiency inherent in the design in the *Houston-Galveston Navigation Channels, Texas, Limited Reevaluation Report and Final Supplemental Environmental Impact Statemen*t completed in November 1995 (1995 LRR/SEIS). The HGNC Project was authorized in the Water Resources Development Act of 1996 (WRDA 1996), Section 101(a)(30), Public Law 104-303. The channel design for the HGNC did not fully account for impacts of the channel improvements within the HSC in the vicinity of the BSC. A hazardous and unacceptable navigation condition has resulted. Increased traffic and vessel size afforded by the channel improvements authorized by WRDA 1996 has increased the potential for collisions and accidents within this section of the HSC. The intersection of the HSC and BSC has been a major safety concern for over a decade.

1.3 NEED

The need for the project is demonstrated by satisfaction of the five project deficiency criteria from Engineer Regulation (ER) 1165-2-119, *Modifications To Completed Projects*. These are synopsized as follows:

1) It is required to make the project function as initially intended by the designer in a safe, viable and reliable manner.

In 1987, the Galveston District proposed a phased improvement plan for the HSC. The Phase I channel was proposed to be 530 feet wide and 45 feet deep. The intent of the improvement plan was to allow for safe two-way traffic in order to ease congestion in the channel. Towards this end, ship simulations were conducted at WES to test various combinations of vessel sizes to determine the types of vessels that could safely meet and pass in the HSC. At the time of the ship simulation study, USACE guidance for the design of deep-draft navigation channels for two-way traffic specified that vessels meeting and passing should have a minimum ship-to-ship clearance of 80 feet and a minimum ship-to-bank clearance of 60 feet for both vessels. The WES study concluded that the Phase I channel could safely handle two-way traffic for vessels having a combined beam width of 280 feet or less. Based on the WES study's recommendations, the Phase I project was designed, authorized, and constructed with the intention to accommodate the meeting and passing of vessels whose combined beam width is 280 feet or less.

Construction of the Phase I channel was completed in 2005. Since then, several accidents and near miss events have been recorded or reported (discussed in Section 2.4.2 of the PDR). These incidents involve vessels meeting and passing in the HSC, especially the channel reach just north of the turn at Five Mile Cut, in the vicinity of the BSC confluence. These incidents led to concerns surrounding the adequacy of the channel to safely handle two-way traffic, as intended.

To better understand these navigational safety concerns, an expert elicitation survey was conducted by ERDC (2015 EE Report referenced in PDR Executive Summary, Page 5). The study involved 13 subject matter experts (ship pilots, navigation engineers/scientists, and USACE staff) who had recently worked on or had knowledge about the HSC and similar projects. Among the concerns raised by the expert elicitation, a key safety concern raised was that the vast majority of incidents of two-way traffic, i.e., vessels meeting and passing each other in the vicinity of the Bayport Flare, could be classified by industry standards as near-miss events.

To ascertain that the high incidence of near-miss events identified in the expert elicitation was a result of a design deficiency, a quantitative analysis of project performance was conducted by SWG (2016 AIS Report referenced in PDR Executive Summary, Page 6). Using AIS data, the statistics of ship and bank clearances were analyzed for instances where two vessels with a combined beam width of 280-feet or less (the vessel classes for which the project was designed) met and passed each other in the project area (the intended project function). The results from the AIS data analysis show that at least 80 percent of the time, the passing vessels violated the minimum clearances stipulated for safe navigation. In other words, the project does not function as intended 80 percent of the time.

2) It is not required because of changed conditions.

The Phase I Project was designed to allow for safe two-way passage for vessels having a combined beam width of 280 feet. The design guidance at the time of the study specified that vessels meeting and passing should have a minimum ship-to-ship clearance of 80 feet and a minimum ship-to-bank clearance of 60 feet for both vessels. The AIS data analysis focused solely on the class of vessels the channel was designed for and the design guidance in place at the time of the study. The project deficiencies identified by the AIS report are therefore not the result of changed conditions.

3) It is generally limited to the existing project features.

The recommended corrective action in the area of concern includes a bend easing (widening) on the east side of the HSC and increasing the radius of the Flare at the intersection of the HSC and BSC. While the Flare was not specifically a feature of the WRDA 1996 authorized project and was not designed by USACE, infringement upon the BSC by the authorized project has caused the HSC project to fail at the intersection. Coordination through Division Counsel verified that though not typical, activities can incorporate areas outside of the original footprint. The key test is that remedial measures must not change the scope of function of the authorized project .

4) It is justified by safety or economic considerations.

The corrective action addresses navigation safety concerns within the HSC, both for vessels turning into the BSC and vessels continuing along the HSC. Vessels turning must reduce their vessel speed which reduces control of the vessel. Other vessels within the HSC must in turn reduce their speed to respond to the turning vessels. Corrective action will improve vessel maneuverability through the area, reduce the required zigzag turn into the BSC, lessen the tendency of vessels to veer from intended and safe course, and reduce the congestion on the HSC. Therefore, this reduces the risk of collisions and groundings from the vessels reducing speed and losing maneuverability during meeting/passing maneuver, which was considered the most critical navigation concern in the bay section.

5) It is not required because of inadequate local maintenance.

The Galveston District performs routine maintenance of the HSC as required. As such, this criterion is not applicable.

In summary, the needs behind the purpose of the project are a requirement to make the project function as initially intended by the designer in a safe, viable and reliable manner, the need to address deficiencies associated with the current (and not changed) conditions, a need to correct deficiencies of existing project features, justification by safety considerations, and the project is required, not due to inadequate maintenance, whether by local or Federal interests, but by deficiencies inherent in the design of the existing channel.

1.4 PROJECT DATUM

All elevations in this report are in the MLT datum unless otherwise specified. However, the Galveston District did convert the area to the Mean Lower-Low Water (MLLW) datum recently, and for all future dredging contracts the MLLW datum will be used. The MLLW datum adjustment in the project vicinity is 1.47 feet below MLT at the Texas Coastal Ocean Observation Network (TCOON) gage at Morgans Point, Texas, located roughly five miles north of the BSC. This elevation difference varies along the length of the HSC. For additional information on datum conversions reference Engineer Manual (EM) 1110-2-6056.

Tides in the study area range from an ebb tide of -1.2 feet MLLW to a high flood tide of 1.7 feet MLLW (at National Oceanic and Atmospheric Administration (NOAA) Station 8770613, Morgans Point, Texas)). The mean tide range at Morgan’s Point is 1.13 feet, and the diurnal range is 1.31 feet.

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2.0 ALTERNATIVES ANALYSIS

2.1 INTRODUCTION

The Preferred Alternative for the Proposed Project was determined by the District using the applicable Civil Works planning process in ER 1105-2-100, *Planning Guidance Notebook* (PGN) and requirements for project justification under ER 1165-2-119, *Modifications to Completed Projects*. The plan formulation and alternative evaluation is fully documented in the Section 5 of the PDR, and is presented for NEPA purposes here, to present the rational for selecting the Preferred Alternative for evaluation of environmental impacts.

2.1.1 Planning Criteria

The District identified opportunities, objectives, and constraints to guide the plan formulation and evaluation of alternatives considered for the corrective action. The following summarizes them.

- Opportunities included the following.
  - The opportunity to perform corrective action to correct a design deficiency and make the project function as intended in a safe, viable, and reliable manner
  - Opportunity to provide virgin borrow material for PA 14 major dike raising to further support the O&M dredging plan for the HSC
- Objective – Identify a safe, cost effective, environmentally acceptable corrective action to address a design deficiency on the HSC in the vicinity of the Bayport and HSC intersection in Chambers Counties, Texas.
- Constraints – The corrective action must be environmentally acceptable, economically feasible and use sound engineering practices and methodologies. As such, the project must have minimal negative impacts on the environment and utilize efficient means for construction of the site(s) and for placement of the dredged material. Specific constraints consisted of the following:
  1. The process and plans must comply with Federal and State laws and policies.
  2. The corrective action must not have any unmitigated significant adverse impact to fish and wildlife.
  3. Unconfined open water placement of new work is not acceptable for this corrective action.
  4. Placement of new work material limited to existing confined upland PAs for this corrective action.

Criteria numbers 3 and 4 are included because the ERDC Lines of Evidence (LOE)/Weight of Evidence (WOE) evaluation of the proposed dredged material and placement specifically evaluated the new work dredged material with the placement location defined as confined upland PA 14. This is the PA located immediately adjacent to the area of safety concern.

2.1.2 Plan Formulation Process

The planning objectives and constraints form the basis for subsequent plan formulation, alternative screening and the identification of the recommended corrective action. The expected Future Without-Project Condition (synonymous to the "No-Action Plan") was developed for comparison with other alternatives. Additionally, structural and non-structural alternatives were developed. For the structural plans, two flare radii and three bend wideners were simulated. The maximum flood and ebb velocity fields for each alternative and the base condition were provided for use in the ERDC Ship/Tow Simulator as discussed in the Engineering Appendix Section 2.2.2. Because this is a corrective action for an engineering deficiency, the placement of the new work material was designated for the existing PA in closest proximity to the area of safety concern. The corrective actions were evaluated and screened using the simulation process.

2.2 CORRECTIVE ACTION ALTERNATIVES

A variety of nonstructural and structural alternatives were considered. The No Action Alternative was also considered in accordance with NEPA evaluation guidance.

2.2.1 No Action

USACE is required to consider the option of "No Action" as one of the study alternatives in order to comply with the requirements of NEPA. With the No Action Plan (i.e. the Future Without Project Condition or FWOP), it is assumed that no project would be implemented by the Federal Government or by local interests to achieve these particular planning objectives. However, normal operation and maintenance activities, along with other probable channel improvements, are assumed to be performed as currently performed. The No Action alternative would be to continue to maintain the HSC and BSC and Flare in their present configuration. The recommended corrective action would not be constructed. Safety challenges for vessel operators passing the BSC and the HSC Bend, or negotiating the turnout between the HSC and BSC would not change. The significant risk of collisions between vessels while navigating the turn would remain the same. USACE would continue to perform annual maintenance dredging of the Flare; otherwise, navigation could be impeded due to the high shoaling in this area, resulting in reduced shipping volumes at the Port of Bayport. The Flare at the intersection of the HSC and BSC requires dredging annually. The BSC is dredged every two years, and the HSC is dredged every three years.

Under the No Action alternative there would not be any new work dredging. Therefore, under the No Action alternative there would not be any impacts to additional open water or oyster habitat. However, the significant risks of collision, and the associated potential environmental impacts which could include vessel spills, would remain.

2.2.2 Non-Structural Alternatives

The following non-structural measures to reduce or avoid hazards are already in use as the existing condition:

1. The area of safety concern has been designation by the USCG as a precautionary zone under 33 CFR 161.35 - "Navigation and Navigable Waterways, Vessel Traffic Management, Vessel Traffic Service Houston/Galveston".

2. Currently the situation is managed by traffic management systems and pilot-to–pilot coordination to facilitate movement of the vessels through the intersections. Aside from basic traffic "rules of the road", there is no legal control over the barge traffic.

3. Vessels leaving the HSC to enter the BSC typically do so with tug assistance due to the reduction in speed and sharp turn necessary to safely enter the channel. The tugs assist the vessel in turning into the BSC and escort the vessel to the docks.

The Port of Houston is the third largest port in the U.S. As such, operational restrictions such as increasing distances between transiting and passing vessels or one-way traffic are not considered viable options because it would significantly increase the costs of shipping on this busy waterway and significantly reduce transportation cost savings. The available non-structural corrective actions do not alleviate the safety concerns. Even with the aforementioned non-structural safety measures, the risk of a catastrophic collision occurring remains significantly high.

2.2.3 Structural Alternatives

Structural alternatives were modeled by ERDC through vessel simulations to determine their performance in reducing the identified navigation risks. The purpose of this modeling was to determine through ship maneuvering simulations whether the proposed channel dimensions of each alternative would be safe and efficient for each of the ships specified and if there would be operational limitations and special tug requirements for movements of these ships through these alternative plans. Design depths were -48.5 feet MLLW (-47 feet MLT) in the Flare and -44.5 feet MLLW (-43 feet MLT) in the BSC. The primary ship model tested was the Susan Maersk, an 1,140 feet x 140 feet containership, drafting 40 feet. More details of the ship simulation are provided in Section 5.7 of the PDR. The structural alternatives evaluated, and their performance in the ship simulations are summarized in the following subsections.

2.2.3.1. Alternative 1 – Increase existing 3,000-foot flare radius to 4,000-foot radius combined with 60-foot bend easing on eastern side of the HSC

Alternative Tested – This alternative would increase the existing flare radius from 3,000 feet to 4,000 feet combined with a 60-foot wide bend easing (channel widener) on the eastern side of the HSC. This alternative would not require any deepening of the authorized BSC. The channel widener would be constructed to a depth of -46.5 feet MLLW (-45 feet MLT) to match the authorized depth of the HSC. This alternative represents the least amount of channel modification (dredging) in terms of dredged material.

Testing Result – This simulation failed on the transit during the inbound transit on an ebb tide where the simulated ship encroached on the HSC on the eastern side by 75 feet.

2.2.3.2. Alternative 2 – Increase existing 3,000-foot flare radius to 4,000-foot radius combined with 300-foot bend easing on eastern side of the HSC

Alternative Tested – This alternative would increase the existing flare radius from 3,000 feet to 4,000 feet (same as Alternative 1) combined with a 300-foot wide bend easing (channel widener) on the eastern side of the HSC. This alternative would not require any deepening of the authorized BSC. The channel widener would be constructed to a depth of -46.5 feet MLLW (-45 feet MLT) to match the authorized depth of the HSC. Alternative 2 was considered to allow pilots more flexibility in setting up for the turn into the BSC or entering the HSC.

Testing Result – All inbound and outbound runs under ebb and flood tide were successful.

2.2.3.3. Alternative 3 – Increase existing 3,000-foot flare radius to 4,000-foot radius combined with a 235-foot bend easing on eastern side of the HSC

Alternative Tested – This alternative would increase the existing flare radius from 3,000 feet to 4,000 feet (same as Alternative 1) combined with a 235-foot wide bend easing (channel widener) on the eastern side of the HSC. This alternative would not require any deepening of the authorized BSC. The channel widener would be constructed to a depth of -46.5 feet MLLW (-45 feet MLT) to match the authorized depth of the HSC. The easing in Alternative 3 is smaller than the easing in Alternative 2 and helps give an idea of how much of an easing may be necessary for safe navigation between the two ship channels.

Testing Result – All inbound and outbound runs under ebb and flood tide were successful. The tracks show no vessels encroaching on the proposed channel lines.

2.2.3.4. Alternative 4 – Increase the existing 3,000-foot flare radius to a 5,375-foot radius with no channel widener on the eastern side of the HSC

Alternative Tested – This alternative would increase the existing flare radius from 3,000 feet to 5,375 feet with no channel widener.

Testing Result – Two of the runs failed. Both the inbound and outbound flood tide runs were unsuccessful. The inbound vessel encroached on the northern side of the BSC by about 10 feet. The outbound vessel encroached on the eastern side of the HSC by about 190 feet.

2.2.3.5. Alternative 5 – Increase existing 3,000-foot flare radius to 5,375-foot radius combined with a 300-foot bend easing on eastern side of the HSC

Alternative Tested – This alternative would increase the existing flare radius from 3,000 feet to 5,275 feet (same as Alternative 4) combined with a 300-foot wide bend easing (channel widener) on the eastern side of the HSC. This alternative represents the greatest amount of channel modification in terms of dredged material. The channel widener would be constructed to a depth of -46.5 feet MLLW (-45 feet MLT) to match the authorized depth of the HSC.

Testing Result – All inbound and outbound runs under ebb and flood tide were successful. The tracks show no vessels encroaching on the proposed channel lines.

2.2.3.6. Alternative 6 – Increase existing 3,000-foot flare radius to 5,375 foot radius combined with a 235-foot bend easing on eastern side of the HSC

Alternative Tested – This alternative would increase the existing flare radius from 3,000 feet to 5,375 feet (same as Alternative 4) combined with a 235-foot wide bend easing (channel widener) on the eastern side of the HSC. This channel widener is smaller than the one proposed in Alternative 5. The channel widener would be constructed to a depth of -46.5 feet MLLW (-45 feet MLT) to match the authorized depth of the HSC.

Testing Result – All inbound and outbound runs under ebb and flood tide were successful. The tracks show no vessels encroaching on the proposed channel lines.

2.3 EVALUATION AND COMPARISON OF ALTERNATIVE CORRECTIVE ACTIONS

Regarding the ship simulations of structural alternatives, in summary, the HPA determined that with a design depth of -48.5 MLLW (47-feet MLT), the 4000-foot flare radius allowed pilots to maintain sufficient speed for safely turning into and out of the BSC. Additional room allowed by the 5,375-foot radius compared to the 4,000-foot radius showed no added benefit. This was reiterated through pilot comments suggesting the 5375-foot flare radius is too large and could even cause problems trying to enter the respective channel. They further commented that the 235-foot HSC bend easing was all that was necessary at this time. Therefore, Alternative 3 is the preferred simulated alternative. The structural alternatives were then evaluated with screening criteria.

2.3.1 Screening of Alternative Corrective Actions

Project-specific criteria related to the purpose of the project were used to screen the alternative corrective actions. The following screening criteria were used in the evaluation of the recommended corrective action.

1. **Improve navigation safety** – In the initial stage of screening, key factors that affected navigability of vessels constrained by the current channel configurations were considered. This included navigability transiting the HSC Bend and the Flare, USACE channel design criteria, minimum widening identified by the HPA to provide navigation efficiency through ship simulations, and effects of widening on the channel alignment.

2. **Cost effectiveness** – Total project costs and cost effectiveness considerations were used for initial screening. Preliminary project construction costs were developed considering cost factors such as dredging, dike construction, engineering design, potential mitigation, and construction management.

3. **Minimize environmental impacts** – The project footprint is located in the open waters of upper Galveston Bay. Therefore, environmental impacts would be limited to open water marine habitat and would not involve terrestrial, wetland, or near-shore (tidal flats, beach, dunes etc.) impacts. Environmental marine field surveys provided geospatial data useful to gauging the marine habitat impacts, and confirmed that oyster reef and unvegetated, featureless bay bottom would be impacted by channel widening. Therefore, oyster reef acreage impacts were the primary measure of environmental impact used in the screening. For detail on the nature of the oyster reef habitat and quantities see Chapter 3, Affected Environment in the EA.

4. **Dredged material quantity** – The quantity of new work dredged material required for placement will have a cost impact; more dredging and more material will be higher cost. The larger the project footprint, the higher the quantity of new work requiring placement. The new work material will go to PA 14 and used for dike raising. This is the closest existing upland confined PA to the project site.

The six structural alternatives and the No Action alternative were then evaluated using the screening criteria. Table 2.3.1-1 summarizes the performance of the alternatives against the criteria. As shown in Table 2.3.1-1, of the alternatives that improved the navigation safety issue, the one with the least amount of environmental impact and the least amount of dredging (and therefore cost) is Alternative 3.

2.3.2 Selection of Recommended Corrective Action

The ERDC ship simulation study identified the corrective action which will make the project function as initially intended by the designers in a safe, viable, and reliable manner as Alternative 3. This design virtually eliminates the zigzag turns required by the existing condition; i.e., making a 15-degree turn to starboard (right) and then within a ship length or two (depending on the size of the ship) making almost a 90-degree turn to port (left). The recommended design change allows a ship entering the BSC to make a smooth turn to the starboard beginning near the HSC Bend.

Placement of the new work dredged material will be placed into PA 14. Not only is PA 14 situated in closest proximity to the area of safety concern, the material is needed for future dike raises at PA 14.

Any environmental impacts that could not be avoided will be minimized to the greatest extent possible and the plan would include compensation for any impacts that could not be avoided. The mitigation plan is addressed in the PDR under Section 6.8.3 Mitigation Plan and Section 4.4 in the EA.

Table 2.3.2-1 Alternative Corrective Action Screening Results

Alternative	Proposed Flare Radius (Existing 3,000 feet)	Proposed Bend easing on east side of HSC (feet)	Improve Navigation Safety?	Preliminary Cost (Dredging)	Dredged Material Quantity (cy)	Environmental Impacts	
						Bay Bottom (Acres)[1]	Oyster Habitat (Acres)[2]
No Action (FWOP)	No change	0	Failed	0	-	0	0
Alternative 1	4,000 feet	60	Failed	$13.2M	1,534,834	36.17	22..8
Alternative 2	4,000 feet	300	Improved	$19.5M	2,319,022	63.18	40.6
Alternative 3	4,000 feet	235	Most Improved	$16.4M	1,942,838	56.67	29.9
Alternative 4	5,375 feet	0	Failed	$19.8M	2,410,987	49.45	34.4
Alternative 5	5,375 feet	300	Too large[3]	$26.3M	3,206,658	80.38	53.7
Alternative 6	5,375 feet	235	Too large[3]	$23.3M	2,830,474	73.87	43.0

[1]Bay bottom is the sum of non-overlapping area of the features comprising the alternative; additionally, bay bottom acreage encompasses the oyster acreage. They are not two separate areas.
[2]Oyster impact acreage excludes acreage in existing barge lane, which has been mitigated for under the HGNC Barge Lanes project.
[3]Pilot comments suggested 5,375-foot radius too large and could even cause problems trying to enter channel.

2.4 ALTERNATIVES CARRIED FORWARD

As a result of the screening and evaluation process described in the preceding sections, Alternative 3 was selected, is recommended for implementation, and carried through for evaluation in this EA. The No Action Alternative is also carried through for evaluation.

2.4.1.1. No Action Alternative

The No Action alternative was describe in detail in Section 2.2.1, but basically consists of taking no corrective action to address the deficiencies in the current channel design. The navigation issues detailed in Section 1.3 would continue to occur, such as loss of maneuverability resulting from vessel slow-down due to congestion, and the continuation of the need to make two significant course changes in about a ship length to navigate the HSC Bend and turn into the BSC. The resultant congestion and increased risks for vessel collision would continue. Although the associated environmental impacts associated with structural alternatives would not occur, the increased risk of collision from taking no action would have its own environmental impact risks from vessel content releases which could include refined and petrochemical products.

2.4.1.2. Preferred Alternative

The Preferred Alternative consists of the proposed corrective actions to the HSC of Alternative 3, and proposed placement for new work and maintenance dredged materials as described below.

Proposed Corrective Actions to the HSC

Alternative 3, the recommended deficiency corrective action, consists of increasing the existing southern radius of the Flare to 4,000 feet, widening the HSC by a maximum 235 feet to the east between about HSC Station 26+484 and HSC Station 30+090, and relocating the existing barge lanes to accommodate the widened HSC (Figure 6-1, Plate C-02). The barge lanes will be relocated to the east of the HSC widening and consistent with the original design.

The work would be accomplished using a hydraulic dredge with cutterhead and pumping the dredged new work materials to PA 14, located in close proximity and northeast of the project. The resulting about 1.94 MCY of new work materials would be stacked along the interior slope of the existing perimeter dike to form a berm and used for future dike raising construction.

Proposed Dredged Material Placement

HSC PAs available for this project include existing PA 15, PA 14, and Mid Bay PA (all upland confined PAs). Also available are the Atkinson Island BU Marsh Cells M7/8/9, and M10. PA 14 is the PA in closest proximity to the project and will be used for the placement of new work material. The future PA 15/PA 14 Connection (upland confined PA) was also assumed available for future maintenance material storage. Of these available PAs and marsh cells, PA 14 is closest to the dredging and an existing operational PA. PA 14 was selected for new work material placement. The new work from the project would be hydraulically placed in PA 14 in a berm along the interior of the perimeter dike. Prior to dredging, the PA 14 containment dike would be mechanically raised three feet to the interior of the existing dike crest by borrowing material from the existing interior berm area located just interior of the existing dike. Once dredged, the new work would be pumped to PA 14 to form a berm along the interior of the raised dike. The berm would provide increased future dike foundation strength by displacing and consolidating some of the existing softer materials beneath the berm, provide a base upon which to build future dike raises, and provide desirable clay soils for future dike raises.

The upland confined Mid Bay PA would be considered an alternate location for new work placement for this project should unforeseen circumstances occur prior to construction precluding the use of or limiting the capacity of PA 14, provided the material is similarly placed within the upland confined Mid Bay PA on the interior slope of the existing perimeter dike to form a berm, whereupon it may also be used for future dike raising construction. To provide flexibility for placement should PA 14 become unavailable, new work materials is also proposed to be beneficially used to repair or raise dikes in nearby existing HSC PAs and BU marsh cells, including existing PA 15, Mid Bay PA, Atkinson Island BU Marsh Cells M7/8/9, and M10, or for the continued construction of the already-planned and approved connection between PAs 14 and 15, to create maintenance material placement capacity, as discussed in Section 1.1.1.

The project would result in increased maintenance volumes on the order of about 205,000 CY annually from the Flare and 23,000 CY annually from the HSC Widener. The resulting 20-year maintenance increment, taking into account dredging cycle lengths and number of cycles anticipated, would be about 4.58 MCY. The maintenance materials would be placed in nearby HSC PAs and BU site, including existing PA 15, PA 14, Mid Bay PA, Atkinson Island BU Marsh Cells M7/8/9, and M10, as well as any other existing Atkinson Island BU Marsh Cells requiring renourishment. The future PA 15/PA 14 connection would also be utilized for maintenance. The project area would be dredged for routine maintenance at the same times and frequencies as the associated channels.

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3.0 AFFECTED ENVIRONMENT

The segment of the HSC in the project area is a navigation channel that was constructed in the early 1900's and last improved in the 2000's by dredging the existing Galveston Bay. This segment of the HSC is in unpopulated, open water of Galveston Bay. The HSC intersects with the BSC in the project area. The BSC is a navigation channel constructed in the late 1960's to the mid 1970's, and is currently being improved under the PHA BSC Improvements Project, which was documented in the BSC Improvements Project 33 USC Section 408 and Section 204(f) of WRDA 86 EA. This EA contains local and regional information applicable to the project area since the BSC intersects the HSC in the project area and is in the same local open water environment. The Bayport Ship Channel Container Terminal Final Environmental Impact Statement (BSCCT FEIS) also contains local information applicable to the mainland adjacent to the project area, as well as regional information applicable to the project area, with regard to the affected environment. Finally, the Final EA, Expansion of PAs 14 and 15, documents more localized information around the PAs being proposed for use in this project. Therefore, these NEPA documents have been referenced in this EA. The following subsections describe the conditions and resources of the affected environment in the project area.

3.1 PHYSICAL ENVIRONMENT

This section provides general information on the non-living resources of the physical environment of the project area. General information is provided for the project setting, climate, geology, topography, soils, physical oceanography, and water and sediment quality.

3.1.1 Project Area and Climate

The project area is located in Galveston Bay. Galveston Bay is an estuary where freshwater flows mix with the salt water of the Gulf of Mexico. The surface area of Galveston Bay is approximately 600 square-miles. Galveston Bay is characterized by generally shallow water depths, generally ranging from 5 to 12 feet. Dredged navigation channels, with permitted or authorized depths ranging from -13.5 to -46.5 MLLW (-12 to -45 feet MLT) that with advanced maintenance and allowable overdepths have maximum depths ranging from -14.5 to -50.5 feet MLLW (-13 to -49 feet MLT), are located throughout the bay system. Galveston Bay consists of several subsystems: Trinity Bay, East Bay, and the confined portion of the HSC above Morgan's Point, San Jacinto Bay, upper Galveston Bay, and West Bay. The proposed project is located in Upper Galveston Bay.

The climate for the Greater Houston area is classified as humid subtropical. Temperatures on average range from a low of 45º Fahrenheit (F) in January to a high of 94º F in July with an average yearly precipitation of 55 inches (NOAA Southern Regional Climate Center [SRCC], 2015). The prevailing wind in Galveston Bay is from the southeast. The Greater Houston area and Galveston Bay region in general are susceptible to tropical cyclones during hurricane season (June through November). Storm tide heights recorded near the City of Galveston have ranged from 6.29 to 15.69 feet above MLLW (5.7 to 15.1 feet above mean sea level [MSL]). The last major hurricane to impact the area was Hurricane Ike in 2008.

As discussed in Engineering Circular (EC) 1165-2-212, *Sea-Level Change Considerations for Civil Works Programs*, recent climate research by the Intergovernmental Panel on Climate Change (IPCC) predicts continued or accelerated global warming for the 21st Century and possibly beyond, which will cause a continued or accelerated rise in global mean sea-level. Therefore, impacts to coastal and estuarine zones caused by sea-level change must be considered in all phases of Civil Works programs. The analysis of sea-level change and impacts on the proposed project are discussed in Sections 3.1.4 and 4.1.4, respectively.

3.1.2 Topography and Soils

The project is entirely in open water, or dredged material PAs constructed in formerly open water within Galveston Bay. The topography of land adjacent to the general area of the project is relatively flat and is located on the Gulf Coastal Plain of Texas which consists of flat low-lands. Elevation in the vicinity of the project, according to a review of U.S. Geological Survey topographic maps, ranges from sea level within Galveston Bay to approximately 30 feet on the nearby PAs.

Soil survey data for Chambers County, Texas was reviewed to determine the existing soils of land within the County adjacent to the project area (Natural Resources Conservation Service [NRCS] 1976, and 1994). The soils of the nearest mapped units on adjacent land are listed and described below in Table 3.1.2-1, and consist of Harris, Dylan, and Beaumont series. The project area itself does not have a soil classification assigned and is classified as "Water" (W) because it is submerged by the estuarine waters of the bay. Placement areas, including the proposed PA 14 are classified as Ijam series soils that reflect their dredged material origins. However, since Galveston Bay was formed by some of the same geological processes and events as the adjacent coastal land, as discussed in the next Section 3.1.3 Geology, some of the same formations, most importantly, the Beaumont Clay, form the bottom of Galveston Bay.

Table 3.1.2-1 Soil Types and Characteristics

Soil Type	Soil Characteristics
Beaumont Clay (BeaA)	The Beaumont series consists of very deep, poorly drained, very slowly permeable soils on low uplands. They formed in clayey sediments of the Pleistocene Age. These nearly level soils are on the Coast Prairie. Slopes range from 0 to 1 percent. Beaumont soils are poorly drained and very slowly permeable.
Dylan Clay (DylC)	The Dylan series consists of very deep, moderately well drained soils. These gently sloping to sloping soils formed in clayey alluvium. Slope ranges from 3 to 5 percent. Mean annual air temperature is about 20.6 degrees C (69 degrees F), and mean annual precipitation is about 1397 mm (55 in).
Harris Clay (HarA)	The Harris series consists of very deep, very poorly drained soils. These soils formed in saline clay derived from Holocene age coastal sediments. Slope is less than 1 percent. Mean annual air temperature is about 21 degrees C (70 degrees F), and mean annual precipitation is about 1270 mm (50 in).
Ijam Soils (IjmB)	The Ijam series consists of very deep, poorly drained, very slowly permeable soils that formed from materials dredged from rivers, bays, and canals. These gently sloping soils occur on flats in coastal areas. Slope ranges from 0 to 2 percent. Mean annual precipitation is about 1397 mm (55 in), and mean annual air temperature is about 20.5 degrees C (70 degrees F).

Prime farmland soils are defined by the NRCS as those soils that have the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. The NRCS identifies soil series meeting this definition for each county. Prime farmland soils, as defined by NRCS, are limited to the mainland surrounding the project area. There are no prime farmland soils in the project area, because it consists of the open waters of Galveston Bay, and the majority of the dredged material PAs are man-made.

The predominant sediment types in Galveston Bay are silt and clay muds, muddy sand, and sandy mud. The silt and clay muds are widely distributed in the northwest portion of Galveston Bay, where the project area is located. Muddy sands and sandy mud are associated with sandy shore margins and other areas of high wind/wave energy.

3.1.3 Geology

The geology within the project area is of the Quaternary Period. The geology of the mainland adjacent to the proposed project is mapped as Beaumont formation. The Beaumont formation is the youngest formation of the Pleistocene age. The origin of the Beaumont formation is primarily fluvial and deltaic; however some small areas might have originated as coastal marsh and lagoonal deposits. In the project area, the Beaumont formation is dominantly clay and mud of low permeability, high water-holding capacity, high compressibility, high to very-high shrink-swell potential, poor drainage, low shear strength, and high plasticity. The existing dredged material PAs in the project area are mapped as fill and areas containing dredged material (Fisher et al., 1982). Modern geology of Galveston Bay results from interaction between marine and fluvial environments, with the bay, having formed by estuarine flooding during post-glacial sea level rise, and barrier islands forming after sea level still stand was reached (Lankford and Rehkemper, 1969). The top-most sediments of the bay bottom overlying the geologic formations in the project area are primarily the result of deposition from modern fluvial and coastal erosion processes, and sediment transport from currents and tides. Historic dredging of oyster shell for road construction in the 20th century has created voids filled in by this deposition, resulting in deeper pockets of unconsolidated sediment deposits in some parts of the bay bottom in the general project area, while other areas have less depth of unconsolidated sediments overlying the stiffer materials of the Beaumont formation.

3.1.4 Physical Oceanography

Galveston Bay is characterized as a relatively large shallow bay with an extensive interconnected system of deeper navigational ship channels. With the exception of ship navigation channels and the Mid Bay constriction caused by Redfish Bar, both natural and anthropogenic oyster reefs constitute the largest physiographic feature in Galveston Bay as remaining portions are comprised of shell, sand, mud, silt and clay particles with little bottom relief. A description of the Galveston Bay bathymetry is provided in Section 3.1.1. The physical oceanography in Galveston Bay is dominated by tidal mixing and, to a lesser degree, freshwater input and wind driven circulation.

3.1.4.1. Tides, Currents, and Water Level

The proposed project area experiences semi-diurnal tides encompassing two high and two low tidal periods each daily tidal cycle, with an average mean tidal range of approximately 1 feet. Elevated tidal surge is experienced in Galveston Bay during storm conditions and high spring tide events. From May to September the Galveston Bay experiences increased precipitation driven freshwater input from the two largest river drainages, the Trinity and San Jacinto Rivers, and Buffalo Bayou. These increased freshwater inputs typically result in the formation of a fresh/saltwater wedge concentrated in the deeper areas of the Galveston Bay as well as navigational channels such as the HSC and BSC.

Water circulation and currents in Galveston Bay can also be affected by prevailing wind conditions, especially within the relatively shallower areas. The prevailing south and southeastern winds, typically experienced from spring through fall, force water against the mainland and create countercurrent eddies within the nearshore areas while north and northwest winds in the winter months cause bay water to push against the barrier islands of Galveston and Bolivar. Due to the low capacity to inflow ratio and small tidal range, water entering Galveston

Bay has a relatively long residence time, with flushing times ranging from 75 to 280 days for the entire bay and from 16 to 28 days in the HSC (Sparr et al., 2010).

Although Galveston Bay is typically a low energy environment protected on the seaward side by a chain of barrier islands with limited inlets, the area experiences a high level of storm activity. Multiple hurricanes and tropical storms in recent years have had a dramatic effect on the location, composition, and function of shorelines throughout the bay. Coastal flooding from hurricanes occurs when the effects of storm surge, driven by cyclonic winds and low pressure, cause water to pile up at levels higher than normal ocean water surface levels. Storm surge levels are highest when storm surge coincides with the astronomical high tide to result in storm tide. Storm surge effects are greatest in shallower offshore waters. Therefore, the bathymetry that tends to exacerbate storm surge effects are those that result in shallower water.

3.1.4.2. Salinity

The HGNC Entrance Channel and Jetties depth and width generally control the saltwater inflows and outflows of the Galveston and Trinity Bay Systems. The BSC is a tributary channel to the HSC with a closed terminus that runs east-west essentially along the same isohaline (contour with the same salinity). Freshwater inflows are generally controlled by the San Jacinto and Trinity River as well as various local flood control district outflows and surface runoff.

The HSC project deficiency repair area does not control or connect areas of higher ocean salinity with the estuarine salinity of Galveston Bay. The project area that will be addressed by the proposed project is a short segment of the HSC that does not connect areas of disparate salinity.

3.1.4.3. Relative Sea Level Change (RSLC)

Changes in local or relative sea level reflect the integrated changes in global or eustatic sea level plus changes due to vertical land movement, or subsidence. Based on 100 years of tide gauge data recorded locally at Galveston Pier 21 (National Oceanic and Atmospheric Administration [NOAA], 2015), the historic rate of relative MSL is estimated at 0.021 ± 0.00092 feet/year. In accordance with EC 1165-2-212, Sea-level Change Considerations for Civil Works Programs, the local subsidence rate may be estimated from tidal analysis by subtracting the rate of global mean sea level (GMSL) change from the historic rate of relative mean sea level (RMSL) change. Assuming the historic rate of GMSL change is equal to the globally averaged rate of 0.0056 feet/year, the resulting estimated observed subsidence rate for the project area would be 0.0153 feet/year. Using this estimated local subsidence rate for the project area, changes in relative MSL in the project area over the 50-year period of analysis would be 1.37 feet using the historic rate of GMSL change, 1.80 feet using the medium rate of accelerated GMSL change, and 3.18 feet using the high or accelerated rate of GMSL change.

Figure 1 displays the computed sea level change 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 change rates based on local monitored subsidence rates are also shown for the three NRC curves. The computed sea level change given here assumes a 50 year project life, and gives the predicted rise for the years 2016-2066.

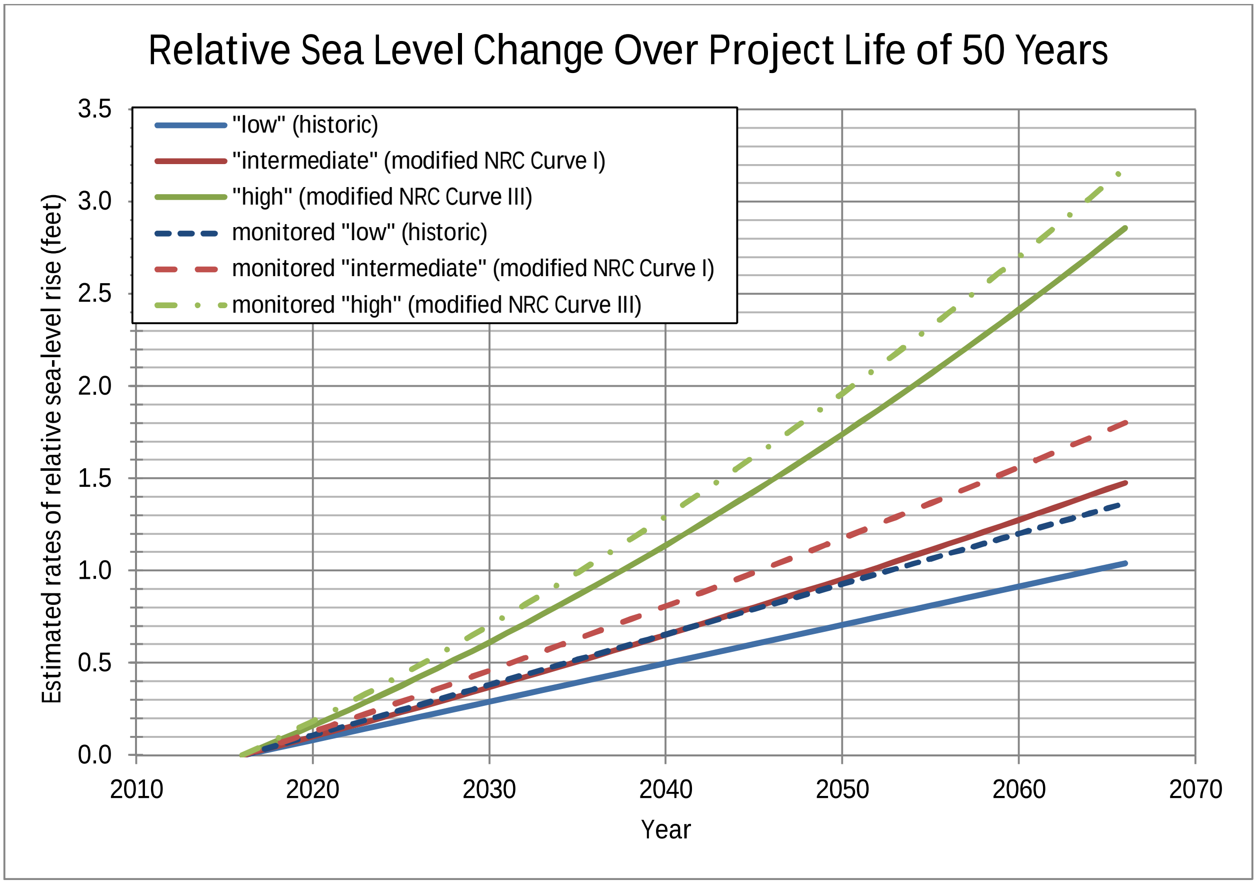

Figure 3.1.4-1: Relative Sea Level Change over the 50 Year Project Life

3.1.5 Water and Sediment Quality

The Clean Water Act (CWA), Section 303(c), requires states to review, establish, and revise water quality standards for all surface waters within the state. The major surface waters of the State are classified by the Texas Commission on Environmental Quality (TCEQ) into segments for purposes of water quality management and for the designation of site-specific uses and criteria. Classification supports the operation of the State's programs to assure compliance with State and Federal requirements (TCEQ, 2004). The proposed project is identified as water quality Segment 2421 (Upper Galveston Bay) and Segment 2421 Open Water (OW) by the TCEQ and is located in designated Bays and Estuaries Basin 24.

3.1.5.1. Water Quality

The project area is located in a sub segment of Segment 2421 described as the Western Portion of the Bay (2421_02). For areas assessed by the TCEQ, water quality Segment 2421_02; primarily has no concerns or fully supports Aquatic Life use; for Recreational use, this water quality segment is currently listed as fully supported. For the General use, parameters such as water temperature, and PH are fully supported and nutrient screening levels for Orthophosphorus, and Ammonia have no concerns; other nutrients screened such as Nitrate, Chlorophyll-a, and Total Phosphorus have a concern for water quality based on screening levels. The concern for screening levels means that the parameter of concern exceeds the TCEQ's current screening values, but a water quality standard has not been established for the segment. As described below, fish consumption is not supported due to Polychlorinated biphenyl (PCB) and dioxin in edible fish tissues (TCEQ, 2012a and b). TCEQ Monitoring sites in close proximity to the proposed project include Station IDs 14560, 14562 and 16507, with the last sampling data collected in November of 2010.

Site-specific uses and supporting numerical criteria for each segment of classified water bodies are listed in Section 307.10, Title 30, Chapter 307 of Texas Administrative Code (TAC). Classified segments are designated for primary contact recreation unless sufficient site-specific information demonstrates that elevated concentrations of indicator bacteria frequently occur due to sources of pollution that cannot be reasonably controlled by existing regulations, wildlife sources of bacteria are unavoidably high and there is limited aquatic recreational potential, or primary or secondary contact recreation is considered unsafe for other reasons such as ship or barge traffic. In a classified segment where contact recreation is considered unsafe for reasons unrelated to water quality, a designated use of noncontact recreation may be assigned either noncontact recreation criteria or criteria normally associated with primary contact recreation.

Biennially, each state is required, under Section 305(b), to submit a report to the U.S. Environmental Protection Agency (EPA) describing the status of surface waters in the state. A use is said to be "impaired" when it is only partially supported or not supported at all. A list of waters that are impaired is required by Section 303(d) and included in the 305(b) Water Quality Inventory Reports. Regulation (40 CFR 130.7) requires that each 303(d) list be prioritized and identify waters targeted for Total Maximum Daily Load (TMDL) development, with the goal to restore the full use of the water body. The TMDL defines an environmental target by determining the extent to which a certain pollutant must be reduced in order to attain and maintain the affected use. Based on this environmental target, the State develops an implementation plan to mitigate sources of pollution within the watershed and restore full use of the water body (TCEQ, 2015).

Segment 2421_02 was listed on the TCEQ's 2012 Texas Water Quality Inventory and 303(d) list (also referred to as the Section 303(d) list) for Polychlorinated biphenyl (PCBs) (first listed in 2004) and dioxins (first listed in 1996) in edible tissue (TCEQ, 2012b). In response to these conditions, two TMDL projects have been initiated, one for PCBs and one for dioxin (H-GAC 2015). Of note, PCBs in sediments have been below screening levels in all samples for this segment, as discussed under sediment quality. The Texas Department of State Health Services (TDSHS) advises that consumers restrict their consumption of catfish, spotted seatrout, and blue crab caught in the area because dioxin concentrations found in them pose a risk to consumers (TCEQ, 2015c).

3.1.5.2. Sediment Quality

<u>State and Regional Data</u>

In compliance with Section 305(b), each state is required to submit a report to the EPA describing the status of the surface waters of the state. In addition to water quality monitoring, sediment in Segment 2421_02 was assessed over nine years (2001-2010) and presented in the 2012 Texas Integrated Report. The data collected was metals. No parameters monitored in sediment exceeded the Aquatic Life Use criteria within the nine year assessment period. Other entities such as University of Houston (UH) also monitor water and sediment in Galveston Bay in support of development of area TMDLs or the Texas Clean Rivers program, a partnering of State and regional water authorities. TMDL sediment sampling results for total PCBs by UH between 2008 and 2012 at the station nearest the project (14560, within 1 mile) indicated levels more than an order of magnitude below the TCEQ marine aquatic life use screening criterion of 180 µg/kg (Rifai 2012 and 2014). The results also indicated dioxin toxicity equivalent (TEQ) levels were in the same lowest result interval of 3.5 parts per trillion (ppt) to 17 ppt TEQ that results for the rest of the lower Bay was in, which is reflective of background levels of dioxin in Galveston Bay. Individual results from earlier sampling between 2002 and 2004 indicated a range of 0.49 ppt to 8.87 ppt TEQ, with all but one result less than 1 ppt. Dioxin concentrations are usually expressed in TEQ, which is a toxicity-weighted average of all dioxin compounds, weighted relative to the most toxic dioxin compound 2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). No national marine or State screening sediment guidelines for dioxin exist.

The USACE routinely samples areas where maintenance dredging occurs for sediment and elutriate analysis. Elutriate analysis involves analyzing water under conditions simulating agitation by dredging and subsequent leaching from sediment. Past sediment testing data for the HSC and Flare from the maintenance dredging sampling by the USACE close to the proposed project, were reviewed to summarize sediment quality close to the proposed project. This data involved a wide array of compounds in sediment and elutriate.

Water and sediment samples were collected by USACE from the Federally-maintained Bayport navigation channel for the purpose of conducting testing to characterize the shoaled material that would be excavated during routine maintenance dredging (USACE, 2012). The material was evaluated to determine whether unacceptable adverse impacts would result from dredging and dredged material placement operations. The evaluation consisted of chemical analyses of sediment, water, and elutriates samples, and grain-size analyses. Four composite sediment samples were taken along with surface water from the BSC, and included one location at the existing Flare, composited from points ranging approximately from 180 to 1200 feet from the proposed project (Sample Point H-BF-12). Each composite sediment sample, water and elutriate were analyzed for metals, pesticides, PCBs, semi volatiles (including PAHs), gross parameters (ammonia, total petroleum hydrocarbons etc.), and dioxins/furans. Sediment sample data was reported as dry weight. For the sample point at the Flare, no organic chemicals were detected in the sediments, and none of the detected metals exceeded NOAA effects range low (ERL) screening guidelines. The elutriate test results showed that all organic chemical (e.g., pesticides, PCBs, and PAHs) were below their respective detection limits. None of the 15 metals evaluated at this sample point exceeded the Texas Surface Water Quality Standards (SWQS) saltwater acute or chronic criteria.

Sedimentology in Galveston Bay

The results discussed in the previous paragraphs typically involved manual core or clamshell-type grab samples of the top layer of sediments, usually between 1 and 3 feet. This layer typically consists of the unconsolidated sediments that are deposited from streams and runoff into the Bay, and some littoral sources. Because it includes land-based runoff and stream outflow sources, and is closest to the surface, it is the sediment layer most prone to human impact, especially from spills. If there are no impacts in this layer, underlying sediments, especially native geological formations, would not be expected to exhibit impacts either.

Deposition rate data from sedimentology and sediment transport studies in Galveston Bay indicate that sediments from the beginning of the 20^{th} Century, which is well before industrial impact in this area, occur within the first 4 feet, at undisturbed locations (i.e. those that have not been dredged). One sediment contamination study that included Galveston Bay involving core sampling, radio-dating, and stratified contaminant analysis of PAHs, PCBs, DDTs and metals, demonstrates that industrial impacts peaked approximately within the 1960s-1980s timeframe, showed little impact before this era, and that levels have sharply declined since (Santschi et al. 2001). The analysis, done on an un-dredged part of Upper Galveston Bay in Trinity Bay, shows the peaks of the expected anthropogenic contaminants (the organics [PAH, PCB etc.] and most metals) within the first foot of the core, and the average sediment deposition rate estimated or the core-aging in this study indicate turn-of-the-20th century sediment is captured within the first 1.5 feet. The ERDC conducted a sediment transport study for the HSC that included modeled deposition rates in Upper Galveston Bay (Tate et al. 2008). The modeled deposition rate for the high flow year for the location on the HSC just north of the BSC, would equate to a sediment depth less than 4 feet going back to 1900. The rate at this location was considered in this discussion because it would be expected to be higher than the location of the sedimentology study, due to closer proximity to the San Jacinto River mouth. In reality, the average rate at this location would be less than the high-flow year rate, because of intervening low-flow year conditions, and therefore, turn-of-the-20th century sediment would be expected at shallower depth. Nevertheless, these studies would indicate that sediments impacted by industrial activity would be expected within the first 4 feet of deposition in un-dredged areas, and therefore, deeper native geological strata would not be expected to have been subject to industrial impact before they were dredged. Therefore, in the absence of surficial impact, new work material dredged from the native geological layers underlying maintenance material would also not be expected to be impacted.

Local Project Data

New work material proposed to be dredged by the PHA for the BSC Improvements Project was extensively sampled and analyzed at locations along the BSC from February through April 2014, including one location (BSC08) directly adjacent to the start of the Flare Easing of the proposed project. The sampling involved undisturbed cores drilled to the same depths as the proposed project (-46.5 feet MLLW [-45 feet MLT]), and captured the underlying native, stiff clay and sand layers constituting the geological layers that new work dredging for the proposed project would encounter. In the instance that native, stiff clays indicative of the Beaumont Formation, were encountered in a core, this material was separated and analyzed apart from other material in the core. A total of 26 sediment samples were collected and analyzed over two phases. In the first phase, ten composite sediment samples were created from three individual samples spread across the width of the channel at each of ten dredge units (DU) which represented 10 locations along the channel. Also, nine discrete sediment samples from nine locations along the north edge of the proposed channel widening (including BSC08A, closest to the proposed project) were collected to better characterize the largely un-dredged new work material outside of the active channel. The first sampling event utilized Vibracore samplers for collection. Second phase sampling was done with a sonic drilling rig at locations (including BSC08A) where the full depth of the proposed dredged template was not reached due to clay layers too stiff for the Vibracore to penetrate further, a clear indicator that native geological strata had been encountered.

Bulk sediment, modified elutriate, and surface water samples were analyzed for Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs), pesticides, PCBs, metals, mercury, dioxins, and total petroleum hydrocarbons diesel range organics (TPH-DRO). Surface water samples were collected primarily to support interpretation of elutriate results. Other general quality parameters like ammonia, cyanide, TOC, total sulfide, and dissolved organic carbon were also measured. VOC analysis was limited to sediment and surface water samples within the land cut of the BSC. Results were compared to screening thresholds consisting of a variety of State water, EPA Region 6, and NOAA ERL and effects range median (ERM) sediment screening guidelines. Tables 3.5.1-1 and 3.1.5-2 summarize the results:

Table 3.1.5-1 Sediment Results Summary for 2014 New Work Material Testing Near Project Area

	Compounds		Sample Results					BSC08 Result		
Testing[5] Group	# Tested	# Detected	Total[1] Results	Range[2] of # Detects	# Loc. with Detects	# Threshold exceeded[3]	# ND > Threshold (#Comp./ # Results)[4]	Detects (#Comp./ # Results)	# >Threshold	Notes
VOCs	40	3	16	4-10	6	0	0	0	0	
SVOCs	41	3	26	1-8	6	0	1	1/2	0	
PAHs	16	9	26	1-8	7	0	0	0/0	0	
TPH-DRO	1	1	26	8	10*	N/A	N/A	1/1	N/A	*Only 3 locations in Phase 2
Pesticides	20	1	26	2	2	0	6/26*	0/0	0	*Includes BSC08; chronic thresholds only
PCBs	209	128	26	1-24	10	0	0	9-97*/3	0	*High number in Phase 1
Dioxins	17	17	26	5-26	10	N/A	N/A	5-15*/3	N/A	*Low number in native sample
Metals	14	14	26	9-26	10	9*	0	16/3	1**	*ERL for As, Ni;**ERL for Ni

1. Number of results for each compound tested
2. There are different numbers of detects for different compounds
3. N/A = no threshold available for group or compound
4. ND = Non-Detect; # of Compounds/# of Results where non-detects exceeded a threshold
5. Abbreviations: VOC = volatile organic compound; SVOC = semi- volatile organic compound; PAH = polycyclic aromatic hydrocarbon; TPH-DRO = Total Petroleum Hydrocarbons – Diesel Range Organics; PCB = Polychlorinated biphenyl; ERL = Effects Range Low; As = arsenic, Ni = nickel

Table 3.1.5-2 Elutriate Results Summary for 2014 New Work Material Testing Near Project Area

	Compounds		Sample Results					BSC08 Result		
Testing[5] Group	# Tested	# Detected	Total[1] Results	Range[2] of # Detects	# Loc. with Detects	# Threshold exceeded[3]	# ND > Threshold (#Comp./ # Results)[4]	Detects (#Comp./ # Results)	# > Threshold	Notes
SVOCs	41	2	17	1-6	7	0	0	1/1	0	
PAHs	16	12	17	15-17	5	0	0	1/1	0	
TPH-DRO	1	1	17	14	10	N/A	N/A	1/1	N/A	
TPH-GRO	1	1	17	2	2	N/A	N/A	0/0	N/A	
Pesticides	20	4	17	2-5	6	0	7/22*	0/0	0	*Includes BSC08; chronic thresholds only
PCBs	209	33	17	1-15	10	0	0	15/2*	0	*Phase 2 only 1 compound detected
Dioxins	17	7	17	2-15	10	N/A	N/A	4/1*	N/A	*No detects in Phase 2
Metals	14	9	17	1-17	10	0	2*/7	6/2	0	*EPA Acute WQC for Cu, Ag

1. Number of results for each compound tested
2. There are different numbers of detects for different compounds
3. N/A = no threshold available for group or compound
4. ND = Non-Detect; # of Compounds/# of Results where non-detects exceeded a threshold
5. Abbreviations: VOC = volatile organic compound; SVOC = semi- volatile organic compound; PAH = polycyclic aromatic hydrocarbon; TPH-DRO = Total Petroleum Hydrocarbons – Diesel Range Organics; GRH = Gasoline Range Hydrocarbons; PCB = Polychlorinated biphenyl; Comp. = Compounds; ERL = Effects Range Low; Cu = copper, Ag = silver

Sediment

As shown for sediment, only 3 compounds out of 40 were detected with none exceeding thresholds, and no VOCs detected in BSC08 samples. For SVOCs, only 3 of 41 compounds were detected with none exceeding thresholds, and only one compound detected in BSC08 samples, with none exceeding thresholds. Only one of the 26 samples in which the compound was not detected had a detection limit above the benchmark, resulting from the dilution required for analysis. However, this does not impact the overall interpretation of the data given the preponderance of samples with no detection, including BSC08. Therefore, it is not likely that this compound or any of the other SVOCs are present in these sediments at ecologically meaningful concentrations. For the nine PAHs detected, none exceeded thresholds, and were at least 64 times lower than the lowest screening benchmark for total PAHS in all project samples. None were detected in the BSC08 samples.

There are no ERL and ERM values and Region 6 marine sediment screening benchmarks for TPH-DRO. Concentrations of DRO in all of the sediment samples ranged from not detected to 23.3 milligrams per kilogram (mg/kg) with most (20) in the single-digit range (<10 mg/kg). The BSC08 results ranged from 3.05 mg/kg to 7.11 mg/kg and were estimated values. Various State land-based cleanup levels for the diesel range fraction for land-based soil can range from 50 mg/kg in Oklahoma for residential surface soil, to 99 mg/kg in Texas for the most conservative Tier 1 residential Protective Concentration Level (PCL), to 100 mg/kg in Oregon for diesel petroleum (ORDEQ, 2008; ODEQ, 2012; TCEQ, 2014). These states and others use generic levels as conservative, first-tier concentrations, and allow more site specific risk-based levels to be calculated that can result in thresholds one to three orders of magnitude larger. Massachusetts developed chronic risk-based aquatic sediment benchmarks for petroleum hydrocarbon fractions (Batelle 2007) based on the aromatic and aliphatic fractions, with options to normalize (divide) values by the sediment organic fraction (e.g. total organic carbon). For the fractions associated with diesel, the benchmark for aliphatics, which typically comprise 80% of diesel (EPA, 2000; Geosphere, Inc. and CH2M Hill, 2006), ranges from 2,722 to 9,883 mg/kg un-normalized (with 5,543 mg/kg the value for the largest fraction present in diesel). The normalized benchmarks range from 11 mg/kg to 43.5 mg/kg (22.4 mg/kg for the largest fraction present in diesel), normalized using the mean total organic content in the BSC samples. Direct comparison of BSC results would require analyzing samples to fractionate results into the specific carbon range groups. However, all BSC results were well below the un-normalized benchmarks, and most results (including BSC08) were single digit values below all fractions' normalized benchmarks, indicating they would not exceed them. For results above the normalized benchmarks, since the BSC results represent the sum of all DRO fractions, considering the typical percent-by-mass composition for the fractions (Geosphere, Inc. and CH2M Hill, 2006), individual fraction results would be expected to be below all of the normalized benchmarks. In the absence of regulatory marine sediment screening thresholds, considering the various states' land-based cleanup levels and chronic aquatic sediment benchmark discussed, the TPH-DRO levels detected in the BSC sediments, including the sample closest to the proposed project, do not indicate a concern.

Only one of 20 pesticides was detected at only two locations, with none exceeding any threshold, including BSC08 samples. The reporting limits for six pesticides not detected – DDT and derivatives, chlordane, dieldrin, and lindane – were slightly elevated above the ERLs and Region 6 screening levels (ex. 2.4 µg/kg result vs a 2.2 µg/kg ERL). However, method detection limits (MDL) for each of these pesticides except chlordane were below the target detection limit (TDL). The fact that many of the TDLs are higher than the screening levels indicates limitations of current analytical methods to consistently achieve detection below low marine screening thresholds. Because all of the subject results were non-detection of these pesticides that actually occurs at the MDLs, which are well below the TDLs and screening values, any concentrations of these pesticides below detection would be limited to the MDL. Therefore, the slightly elevated RLs do not impact the interpretation and usability of the data, and it is not likely that these pesticides are present in the BSC sediment at a concentration that is ecologically significant. Of 209 PCB congeners tested, 60 percent were detected. For BSC08, the number of congeners detected was low in Phase 2 samples, which would be expected in deeper, native material samples. None of the total PCB concentrations exceeded ERL and ERM values or the Region 6 sediment screening benchmarks. These concentrations were at least 8 times lower than the lowest screening benchmark (22,700 ng/kg) for all project samples. Therefore, PCBs are not a concern in BSC sediments. For Dioxins and Furans, TEQs ranged from 0.542 to 5.72 ng/kg. Because there were no marine sediment screening benchmarks for dioxins, dioxin TEQs were compared to the background TEQs developed as part of the San Jacinto River Waste Pits Remedial Investigation (Integral Consulting Inc. and Anchor QEA, LLC 2013). The background value in the SJRWP RI was determined to be 7.21 ng/kg (Integral 2013). The range of TEQs measured for all BSC sediments (including BSC08) was below the background value. Therefore, dioxin TEQs for the BSC sediments are within the range of background and do not indicate a concern for contaminated sediment.

Each of the tested metals was detected, but only arsenic and nickel exceeded screening benchmarks. Nickel, detected in seven samples, ranged from 22.1 to 28.3 mg/kg, only marginally (~6%) exceeding the lowest ERL and Region 6 chronic threshold of 20.9 mg/kg. These values are within the range of concentrations found in bulk sediment throughout the upper bay (NOAA, 2003). Arsenic only exceeded screening criteria at one location and sample in the second phase, with a value of 8.5 mg/kg. This is only marginally (~4%) above the ERL value and Region 6 marine sediment benchmark of 8.2 mg/kg, is within 50% of the Texas Specific Background median value (5.9 mg/kg) used in the Texas Risk Reduction Program (TRRP), and is within the range of concentrations of bulk sediment found in the upper bay (NOAA, 2003). The marginal excursion above the threshold was isolated, limited only to this location and this sample, suggesting natural variability. More importantly, the corresponding elutriate and surface water results for nickel and arsenic, although some were estimated concentrations, were well below the EPA marine acute screening threshold. Therefore, this does not indicate that the isolated, low exceedance of the nickel and arsenic sediment guidelines would result in water quality impairment. For both nickel and arsenic, mean sediment concentrations (4.57 and 18.2 mg/kg, respectively) were below the ERL values, and none of the nickel or arsenic concentrations exceeded ERM values. Given the limited and infrequent exceedances of the ERL and Region 6 benchmarks, levels consistent with ambient concentrations on land and in the Bay, and that none of the metals were detected at concentrations that exceeded the ERM, no adverse ecological impacts associated with the BSC material are anticipated, and the data does not indicate a concern.

Elutriate

As shown for elutriate, only 2 of 41 SVOCs were detected with none exceeding thresholds, and only one compound detected in BSC08 samples, with none exceeding thresholds. Concentrations of the detected compounds in the elutriates were consistent with those detected in the surface water samples; therefore, detected di-n-butylphthalate and bis(2-ethylhexyl)phthalate concentrations indicate background concentrations in the surface water and not release of these compounds attributable to BSC sediments. There are no EPA or Texas water quality screening criteria for the protection of aquatic life for di-n-butylphthalate. Of the twelve PAHs detected, no EPA or Texas water quality screening criteria are available, except for phenanthrene, which has a State standard of 7.7 µg/L, and which was not exceeded. Concentrations of PAHs and the total PAH were low and generally consistent with surface water PAH concentrations. The sample locations in which compounds were detected in elutriate largely did not coincide with the ones in which those compounds were detected in sediment. Considering these factors, elutriate results likely represent background surface water concentrations, indicating that BSC sediments would not present a water quality concern during dredging and placement.

There are no EPA or Texas water quality screening criteria for the protection of aquatic life for DRO or GRO. TPH-DRO was detected in 14 of the 17 samples. This is essentially the same frequency of detection in the companion water samples. TPH Gasoline Range Organics (GRO) was detected at a low concentration estimated below the RL in only one first phase sample and one second phase sample. Because TPH-DRO and TPH-GRO were only detected only at low concentrations and the concentrations detected in the elutriates were consistent with levels and the frequency with which they were detected in the surface water, a concern for TPH impact on water quality from BSC sediments is not indicated. Of twenty pesticides tested, only four were detected at low concentrations below thresholds. Similar to bulk sediment, the TDLs for many of the pesticides, including the detected compounds are higher than some screening levels, representing limitations with current analytical methods to consistently achieve detection below low marine screening thresholds. However, except for chlordane, none of the seven compounds were detected in bulk sediments at RLs below applicable screening thresholds. For chlordane, the two constituent isomers, alpha- and beta-chlordane were not detected in bulk sediment at much lower RLs. Also, these compounds are insoluble in water. Considering the few detections, no exceedances of screening criteria, the bulk sediment results, and insolubility, a concern for water quality impact from pesticides in BSC sediments is not indicated.

Of 209 PCB congeners tested, only 33 congeners were detected at low concentrations that are at least five orders of magnitude below the Texas marine acute WQS of 10,000 ng/L. Results were also consistent with surface water PCB congener concentrations. Therefore, PCB congeners detected in elutriates likely represent background surface water concentrations. Also, the bulk sediment concentrations were low and not of concern, and PCBs have very low water solubility. Therefore, a concern for water quality impact from PCBs in BSC sediments is not indicated. For dioxins, low concentrations of seven PCDD/PCDF congeners were detected, with the majority at concentrations estimated below the RL. The dioxin TEQ ranged from not detected to 0.004 ng/L (parts per trillion). There are no EPA or Texas water quality aquatic screening criteria for individual PCDD and PCDF congeners or for dioxin TEQ. The dioxin TEQ results in elutriates were comparable to results in the surface water samples and compounds detected generally coincided between elutriate and surface water; therefore PCDD and PCDF congeners detected in the elutriates likely represent background surface water concentrations. Considering this, the low bulk sediment results, and the very low water solubility of dioxins, a concern for water quality impact from dioxins in BSC sediments is not indicated.

Of the 14 metals tested, nine were detected at concentrations well below the EPA and Texas marine acute saltwater quality standards. Six metals were detected in BSC08 samples. Mean concentrations of all samples were below the Texas chronic saltwater screening criteria, and were comparable to surface water sample concentrations; therefore, the concentrations in the modified elutriates likely represent background surface water concentrations and indicate that release of metals would not be attributable to BSC sediments. Similar to the surface water samples, two metals – copper and silver – were not detected at RLs above the TDLs and lowest screening levels. For copper, this was limited to one sample at one location (BSC06) during the second phase. TCEQ dissolved copper data for this bay segment (2421), ranges from 3-6 μg/L compared to the non-detection at 5 μg/L of the elutriate. Also, the elutriate result at this location in the first phase, was a detection well below the chronic threshold. More importantly, the bulk sediment 1) does not exceed the low NOAA ERL, 2) is right near the Texas Specific Background median value (15 mg/kg) used in the TRRP, and 3) is well within the range of ambient concentrations measured in the upper bay during the 2002 NOAA study. None of this indicates that ambient water quality would be impaired by sediment for copper. For silver, this was limited to second phase samples that included BSC08. First phase samples were qualified estimated detections ranging from 0.34 μg/L to 1.1 μg/L, which are below the EPA and State screening marine acute criteria of 1.9 μg/L and 2 μg/L, respectively. More importantly, in bulk sediment, although concentrations were estimated, silver was detected at a limit well below the NOAA ERL. This does not indicate water quality impairment due to silver from sediment. Considering the metals data, a concern for water quality impact from BSC sediments is not indicated.

Summary

None of the sediment or elutriate results indicated a concern for contaminated sediments or water quality impacts from sediment. The information from the BSC Improvements Project was reviewed, because sample locations included a location close to the proposed project, and included locations closer to the main channel of the BSC, the mainland, and associated industrial activity than the proposed project. Consistent with the requirements in 40 CFR 230.60 and USACE Regulatory Guidance Letter (RGL) 06-02, *Guidance on Dredged Material Testing for Purposes of Section 404 of the Clean Water Act, Section 10 of the Rivers and Harbors Act, and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972,* dredged material testing under the CWA is based on a reason to believe that contaminants are present in the material proposed for discharge and have the potential to cause an unacceptable adverse impact. This evaluation should consider several factors, including prior results, potential sources of contamination, contaminant routes and transport, and project location to determine the need for further testing. The evaluation to establish a reason to believe that proposed dredged material will not contain contaminants at levels with the potential to cause an unacceptable adverse impact, and therefore not require further testing, is discussed in Section 4.1.4, under the Preferred Alternative.

Conclusion

In summary, for substances with a numerical standard or screening threshold, the sediment quality data in the area of the proposed project do not indicate a contamination concern for sediments. Metals, organics, pesticides, and PCBs have been below screening thresholds, with the majority of samples having no detection for the majority of these parameters in the available individual results reviewed. Dioxins have no national guidelines, but are low and commensurate with ambient levels in the Bay.

3.2 BIOLOGICAL RESOURCES

The following sections describe the biological resources found within the project area. This includes descriptions of habitat, flora, and fauna typically found in the aquatic and terrestrial portions of the project area.

3.2.1 Vegetation and Habitats

3.2.1.1. Terrestrial

The project area is in the open water of Galveston Bay located adjacent to the mainland within the Gulf Coast Prairies and Marshes Natural Region as mapped by the Texas Parks and Wildlife Department (TPWD, 2011). The Upper Coastal Prairie of Texas (approximately 21,000 square-miles) is a narrow strip of land, approximately 50 miles wide, that borders the coastal marshes from Matagorda Bay to the Sabine River and corresponds to the wetter side of the Texas Coastal Prairie. The region includes barrier islands on the coastline, estuarine marshes, remnant tall grass prairies (most converted to agricultural and/or developed lands), oak parklands, and oak mottes. Forested wetlands and riparian woodlands occur in the river bottomlands. According to the 1984 TPWD's Vegetation Types of Texas, landside portions nearest to the project area are mapped as grassland and marsh/barrier island vegetation types (McMahan et al., 1984). The grassland vegetation is typically found inland from direct tidal influences of Galveston Bay. Examples of vegetation found in the grassland habitat include Bermuda grass (*Cynodon dactylon*), smutgrass (*Sporablus indicus*), live oak (*Quercus virgininiana*), and windmill grass (*Cholris canteri*). The marsh/barrier island habitat occurs more in the brackish and saline areas that are tidally influenced. Typical vegetation types include: big cordgrass (*Spartina cynosuroides*), black rush (*Juncus roemerianus*), glassworts (*Salicornia* spp), and smooth cordgrass (*Spartina alterniflora*). The modifications to the channel for the proposed project would be constructed in the marine environment where no terrestrial habitat is present. The dredged material placement portion of the project would take place on the dikes of existing active upland confined PAs which are mapped as a marsh/barrier island vegetation type, or constructed beneficial use marsh cells. Though some PAs may be mapped as marsh/barrier island vegetation type, this is limited to areas on the exterior fringes of the PA complex, outside of the containment dike and actual area of material placement.

3.2.1.2. Wetlands

The main type of wetland found in the project vicinity is estuarine wetlands. These types of wetlands are typically saline and are located in a transitional area between freshwater and saltwater marshes. Common species that occur in the estuarine wetlands include glasswort, salt marsh bulrush (*Scirpus maritimus*), smooth cordgrass, seashore saltgrass (*Distichlis spicata*), and sea-oxeye (*Borrichia frutescens*). The immediate vicinity of the channel improvement portion of the project is open water. Therefore, there are no wetlands within the corrective actions portion of the project.

Information from the PA 14/15 Expansion EA indicates salt water marsh habitats are found adjacent to and between PAs 14 and 15. The constructed demonstration marsh, Gorini Marsh, located immediately north of PA 15, is approximately 200 acres (USACE, 2010). Also, narrow bands of salt marsh and intertidal sand flats are found around the fringe of the existing PAs 14 and 15. The narrow bands of salt marsh gently slopes downward from the PA 14 dike, and based on surveys performed for the PA 15 fringe marsh, should be a mixture of high marsh dominated by more salt tolerant species such as sea oxeye and some brackish-condition species such as marsh hay cordgrass (*Spartina patens*) closer towards the dike, low marsh with species such as marshhay cordgrass, seashore saltgrass, and smooth cordgrass farther away from the dike, and Salicornia flats dominated by dwarf saltwort (*Salicornia bigelovii*) on relatively bare dredge deposits interspersed among the low marsh. Marsh cells in the surrounding area, including those that would receive maintenance material from the proposed project such as Cells M1 through M6, are in various stages of filling to planned marsh elevations. Once these have been filled over an anticipated 20-year period and consolidated to the target elevations, they would be graded to provide a diversity of elevations to support high, low and transitional tidal marsh, and open water features such as tidal creeks and ponds to provide circulation and water edge habitat. The developing marsh would be seeded or transplanted from harvested vegetation with plant species such as smooth cordgrass, marshhay cordgrass, sea oxeye, dwarf spikerush (*Eleocharis parvula*) according to the elevation regime. Open water features would be potentially transplanted with seagrass vegetation such as turtlegrass (*Thalasia testudinum*), and shoalgrass (*Halodule beaudettei*). Currently, Cells M1 through M4 are the most developed, with approximately one-quarter to one-half of the cells filled.

3.2.2 Wildlife

The wildlife in the project area includes species typical of the Gulf Coast Plain and the Galveston Bay system. The following sections describe the terrestrial and aquatic wildlife found in and around the project area.

3.2.2.1. Terrestrial

The Gulf Coast region provides habitat for numerous species of terrestrial wildlife. Some common species of terrestrial wildlife that occur in the vicinity of the project include: raccoon (*Procyon lotor*), Virginia opossum

(*Didelphis virginiana*), black rat (*Rattus rattus*), killdeer (*Charadrius vociferus*), rock dove (*Columba livia*), red-winged blackbird (*Agelaius phoeniceus*), northern mockingbird (*Mimus polyglottos*), western ribbon snake (*Thamnophis proximus*), western cottonmouth (*Agkistrodon piscivorous*), cricket frog (*Acris crepitans*), and five-line skink (*Eumeces fasciatus*), among many others. No terrestrial habitat is present within the channel improvement portion of proposed project.

The project area includes the existing dredged material PA 14. PA 14 is considered for this project for new work placement, with the upland Mid Bay PA identified as a contingency, and maintenance dredged material placement may be placed in PAs 14, 15, other Atkinson Island PA cells (M7/8/9, M10 etc.) and Mid Bay. The northern end of Atkinson Island contains the Atkinson Island Wildlife Management Area (WMA) managed by the TPWD. Habitat in the WMA includes a 40-acre woodlot primarily composed of hackberry and yaupon, approximately 90 acres of brackish marsh, and 20 acres of dredged material from HSC maintenance (TPWD, 2009). Wildlife documented here includes shore and wading birds, raccoons, and rattlesnakes (TPWD, 2009). Coyotes (*Canis latrans*) and nutria (*Myocaster coypus*) can also be found within the WMA, which includes PA 15 (USACE, 2010). Atkinson Island, north of PA 14, has been a historical nesting site for colonial water birds and is identified and mapped by the U.S. Fish and Wildlife Service (USFWS) as a colonial waterbird rookery; colony#600-181 (USACE, 2010).

Information from the last available waterbird census contained in the PA 14/15 Expansion EA indicates the following bird species have been observed nesting on Atkinson Island since 1974: anhinga (*Anhinga anhinga*), black skimmers (*Rynchops niger*), black-crowned night heron (*Nycticorax nycticorax*), Caspian tern (*Sterna caspia*), cattle egret (*Bubulcus ibis*), Forster's tern (*Sterna forsteri*), great blue heron (*Andea erodias*), great egret (*Casmerodius albus*), gull-billed tern (*Gelochelidon nilotica*), laughing gull (*Larus atricilla*), least tern (*Sternula antillarum*), little blue heron (*Egretta caerulea*), neotropic cormorant (*Phalacrocorax brasilianus*), reddish egret (*Egretta rufescens*), roseate spoonbill (*Ajaia ajaia*), royal tern (*Sterna maxima*), sandwich tern (*Sterna sandvicensis*), snowy egret (*Egretta thula*), tricolored heron (*Hydranassa tricolor*), white ibis (*Eudocimus albus*), white-faced ibis (*Plegadis falcinellus*), and yellow-crowned night heron (*Nyctanassa violacea*) (USACE, 2010). Other bird species observed on the sand flats between PAs 14 and 15 during field work conducted in October 2009 for the PA 14/15 Expansion EA included brown pelican (*Pelecanus occidentalis*), white pelican (*Pelecanus erythrorhynchos*), sandpiper species, and seagull species. Apart from the WMA area, Atkinson Island, and its extensions (PAs 14, 15 etc.) consists of active upland dredged material PAs, and with the exception of the completed Gorini Marsh (discussed in Section 3.2.1.2), also consists of BU marsh cells that are currently partially filled with intertidal salt marsh or open water transitioning to salt marsh as they are filled and planted. These are BU marsh cells that have been requested for maintenance material use and are currently either diked sections of open water or are in the process of filling. Some are partially filled with areas at intertidal marsh elevation with marsh vegetation, and other areas approaching the intended elevation that may have volunteer vegetation developing that would get disturbed by fill activity needed to bring it to the design elevation for permanent marsh vegetation establishment. The Mid Bay PA is an upland PA consisting of cells that have mostly been filled to above sea level, and are in the process of being filled to their design upland elevation. As the elevation transitions past intertidal level and the dewatering process continues, pioneer emergent and submerged vegetation species may periodically develop in between filling cycles, and volunteer terrestrial species are expected for areas above intertidal elevation. Smaller areas of the cell are currently open water.

3.2.2.2. Aquatic

A description of the aquatic habitat types and wildlife present within Galveston Bay and the proposed project area is provided below.

3.2.2.2.1. Benthic

Estuary-wide surveys of benthic invertebrates have been conducted within Galveston Bay and a list of the common assemblages that occur is provided in Table 3.2.2-1. Typically, few species of polychaetes, molluscs, and crustaceans dominate Galveston Bay's benthic community. Silty clay (or muddy) sediments tend to support a polychaete dominated community, while the benthic community in more sandy (or coarse) sediments is primarily composed of crustaceans (Galveston Bay Estuary Program [GBEP], 2002). The assemblage within the proposed project area is most likely a combination of the Open Bay and Deep Channel assemblages.

Table 3.2.2-1 Soft Bottom Assemblages in Galveston Bay

Assemblage	Predominant Species
River Influenced, Low Salinity Assemblages (Salinity < 10 ppth)	*Rangia cuneata, Rangia flexuosa, Macoma mitchelli, Texadina, Vioscalba louisianea, Streblospio benedicti, Mediomastus ambista, Hobsonia florida, Tubificoides heterochaetus, Peloscolex gabriellae, Macrobrachium spp., Chironomidae*
Enclosed Bay or Inter-reef Assemblage (Salinity variable)	*Nuculana acuta, Nuculana concentrica, Mulinia lateralis, Tagelus pebius, Ensis minor, Acteocina caniculata, Streblospio benedicti, Mediomastus ambiseta, Microphiopholis atra*
Open Bay Assemblage (Salinity Range 10-35 ppth)	*Abra aequalis, Corbula contracta, Mulinia lateralis, Nuculana concentrica, Pandora trilineata, Periploma orbicularis, Acteocina canaliculata, Paraprionospio pinnata*
Bay Margin Assemblage	*Ensis minor, Heteromastus filiformis, Streblospio benedicti, Mediomastus ambiseta, Capitella capitata, Ampelisca abdita, Corophium louisianum, Hargeria rapax*
Inlet and Deep Channel Assemblage (Salinity Near-Gulf)	*Nassarius acutus, Tellina texana, Owenia fusiformis, Onuphis eremita oculata*

Source: Parker, 1960 and White et. al, 1985 as noted in GBEP, 1992

Benthic invertebrate abundance generally increases in a north to south direction from the Trinity Bay-Upper Bay region to the Lower Galveston-West Bay region. A seasonal trend also occurs, with peak benthos abundance in the spring, between February and May, and lower abundances in October and November. Macrofaunal diversity within Galveston Bay is considered to be low or moderate compared to other estuaries in the Gulf of Mexico (GOM), with the highest diversity in areas with stable salinity regimes (e.g., near inlets such as Bolivar Roads and Rollover Pass). The general HSC area, which would include the proposed project area, generally has a lower species diversity compared to the more open bay stations (GBEP, 2002).

As part of the Environmental Monitoring and Assessment Program (EMAP), benthos data was collected in Galveston Bay in 1993. The EMAP study concluded that Galveston Bay in general has a similar macrofaunal density and species richness as other sampled estuaries along the Louisianan Province. In addition, marina sites, one of which was sampled included Bayport, had much lower values than the rest of the Galveston Bay.

A summary of data from the three closest EMAP stations to the proposed project area is provided in Table 3.2.2-2which show that polychaetes were dominant. Of note, the samples were all collected during a single season. A more general description of the invertebrate community within the proposed project area is provided below.

Table 3.2.2-2 A Summary of the EMAP Data for Galveston Bay (1993) – Stations GB1, GB2, & GB3

Species (or Family)	Taxonomic Group	Mean Abundance when Present[1]	No. of Documented Occurrences (Maximum of 3)[2]
Bivalve		1	1
Callinectes sabidus	Decapoda	1	1
Mediomastus ambiseta	Polychaete	3.3 (+/-0.3)	3
Nemertean		1.3 (+/-0.3	3
Parandalia spp.	Polychaete	13.7 (+/-5.7)	3
Paraprionospio pinnata	Polychaete	2 (+/- 1)	3
Petricola pholadiformis	Bivalve	1	1
Xanthidae	Decapoda	1	1

[1]Samples were taken using a Van Veen Grab with a 440 cm2 surface area, no depth of grab penetration is provided

[2]Only one sample was collected at Stations GB1,GB2, and GB3

Note: The EPA has required that the following disclaimer be placed upon use of the EMAP data set - "Although the data described in this article have been funded wholly or in part by the U.S. Environmental Protection Agency through its EMAP Estuaries Program, it has not been subjected to Agency review, and therefore does not necessarily reflect the views of the Agency and no official endorsement should be inferred."

Open Bay Habitat

Results from studies conducted within the open habitat of Upper Galveston and Trinity Bays indicate macrofaunal abundance is typically less than 4,000 individuals per square-meter (m^2). Two polychaete species, *Mediomastus ambiseta* and *Streblospio benedicti*, have been commonly noted as being the dominant macrofaunal species present. The population of these species can be so large in areas that it significantly influences abundance trends for the entire assemblage. Other species occasionally reported as dominant, depending upon season, include *Vioscalba louisianae* (Gastropod), *Peloscolex gabriellae* (Oligochaetea), and *Mulinia lateralis* (Mussel) (GBEP, 1992).

M. ambiseta is a small, opportunistic capitellid polychaete that responds to disturbance and has the potential for rapid population increase (Starczak et al., 1992).

S. benedicti is a small, segmented, tube-dwelling Spionidae polychaete which is also an opportunistic species colonizing stressed or organically enriched sediments (Levin, 1984).

Hard-Bottom Habitat

Hard-bottom habitats such as rocky outcrops or coral reefs do not exist in Galveston Bay; however oyster reef habitat (*Crassostrea virginica*) is common within the bay. The environmental cues used by larval oysters to detect preferred settling points include the presence of a hard substrate (preferably the shell of an adult oyster) water movement, salinity and food supply. Thus the presence of living and historic reefs is important for the continued settling of oyster larvae. Additional information concerning the location of oyster reefs within the project area is provided in Section 3.2.2.2.3.

Within the oyster reef system, significant predators are present including crabs (e.g., green porcelain crab [*Petrolisthes armatus*], mud crabs [*Panopeus herbstii*, *Eurypanopeus depressus*]) and an oyster drill, *Thais haemastoma*. Mussel competitors are also present and include species such as *Brachidontes spp*. Oyster surveys have found that the presence of crab predators and mussel competitors within oyster reefs is related more to the salinity of the region than oyster abundance, per se. Also common within the oyster reef habitat are bryozoans, barnacles, and polychaetes (GBEP, 1997).

3.2.2.2.2. Fish and Other Pelagic Fauna

Pelagic fauna are those organisms that primarily live in the water column of the Bay. The open bay habitat contains nekton species comprised mostly of crustaceans and finfish species. The diversity and distribution of the fish species can be affected at any time during the year by migrations and spawning cycles (Armstrong, 1987). Newly spawned fish species begin migrating in to Galveston Bay in winter and early spring, with the maximum biomass observed during the summer months (Armstrong et al., 1978; Parker, 1965). Dominant finfish species inhabiting the open waters of Galveston Bay include Atlantic croaker (*Micropogonias undulates*), Gulf menhaden (*Brevoortia patronus*), bay anchovy (*Anchoa mitchilli*), sand seatrout (*Cynoscion arenarius*), gizzard shad (*Dorosoma cepedianum*), spot (*Leiostomus xanthurus*), and hardhead catfish (*Arius felis*) (Chambers and Spark, 1959; Parker, 1965). The Galveston Bay system also maintains important recreational and commercial fisheries for shrimps, crabs, and fishes. Additional information associated with commercial and recreational species is further referenced in Section 3.2.3.

The nekton species depend on the food web provided by planktonic species. Phytoplankton in the Bay is dominated by diatoms which constitute over 40 percent of all phytoplankton, and includes species such as *Skeletonema costatum*, *Thalassionema nitzschoides*, and *Navicula abunda*, all of which exhibit peak abundance in the early spring months. Blue-green algae *Oscillatoria* species dominate this community in the summer, while green algae *Ankistrodesmus* species dominate in the late summer and early fall months (Texas Department of Water Resources, 1981). Zooplankton (not including meroplankton) in the Bay is primarily comprised of copepods, cladocerans, and chaetognaths, with species such as *Acartia tonsa, Oithona* sp. and *Labidocera aestiva*, and *Noctiluca scintillans*. Meroplankton are organisms such as fish and benthic invertebrates which are only planktonic for early life history stages. In Galveston Bay, zooplankton abundance is closely linked to water temperatures and inversely related to salinity levels (Armstrong, 1987). Peaks in standing crop abundance have been identified in April and late summer, and are correlated with high freshwater input into the bay and elevated water temperatures, respectively. The increased zooplankton populations observed in the warmer summer months have the capacity to severely limit phytoplankton abundance through intensive grazing and leave the less palatable cyanobacteria (blue green algae) as the dominant phytoplankton group (Ornolfsdottir, 2003).

3.2.2.2.3. Oyster Reefs

Oyster reefs are present in many areas of the Galveston Bay system and provide ecologically important functions. Two species inhabit Texas coastal waters. Eastern oysters (Crassostrea virginica) are the dominant bivalve species in shallow saltwater bays, lagoons and estuaries, in water 8 to 25 feet (2.5 to 7.5 meters) deep and between 28 and 90 degrees F. Crested oyster (*Ostrea equestris*) is less common in Texas and limited to higher salinity waters. Therefore, it is not expected to be abundant in the project area.

Oyster habitat surveys were conducted within the potential project footprint using sonar side-scan data and ground-truthing by diver for the Flare easing portion in 2011. The results of an oyster reef survey performed March 7-11 for the BSC, 2011 suggested that high substrate density and consolidated oyster reef habitats were identified within the deeper waters adjacent to the existing Flare, the area where ships turn to enter into the BSC. A side-scan sonar survey of the area of the proposed main channel widener, plus a 500-foot buffer east of the main channel widener, was performed in December 2011. This area covered the footprint of the proposed barge lane relocation. Though this reef was not groundtruthed by diver, the sonar signature was extensive and dense, similar to that in the proposed Flare easing, directly opposite of the main channel widener, and clearly indicative of the historically mapped reef directly lining the HSC. Therefore, it was assumed that the reef within the proposed main channel widener was at minimum high substrate density reef, if not consolidated reef. There are approximately 21.3 acres of oyster reef within the proposed Flare easing, 7.4 acres of reef within the proposed main channel widener, and 8.6 acres of reef within the proposed barge lane relocation. The main channel widener is wholly within the existing barge lane of the HSC. The oyster reef impacts within the existing barge lanes (including those within the proposed main channel widener) were mitigated for permanent impact with approximately 54 acres of oyster reef pad construction by the USACE in 2004, when the barge lanes were dredged as part of the HGNC Project. The existing barge lanes are to be perpetually maintained. The existing barge lane oyster reef impact and mitigation were documented under the *2005 Record of Environmental Considerations for Houston - Galveston Navigation Channels, Texas Project - Upper Bay Barge Lanes*. Therefore, the 7.4 acres of reef within the proposed main channel widener, which represents regrowth into the existing barge lanes which get periodically dredged for maintenance, has already been mitigated. A map delineating areas of consolidated oyster reef, and areas with high densities of shell hash (i.e. shell-in-mud or shell-on-mud) with or without oysters around the proposed project area, is provided in Exhibit 3.2.2-1. In summary, approximately 37.3 acres of oyster reef habitat were found to occur within the footprint of the proposed action, of which 7.4 acres were already previously mitigated, resulting in 29.9 acres of reef impact to mitigate.

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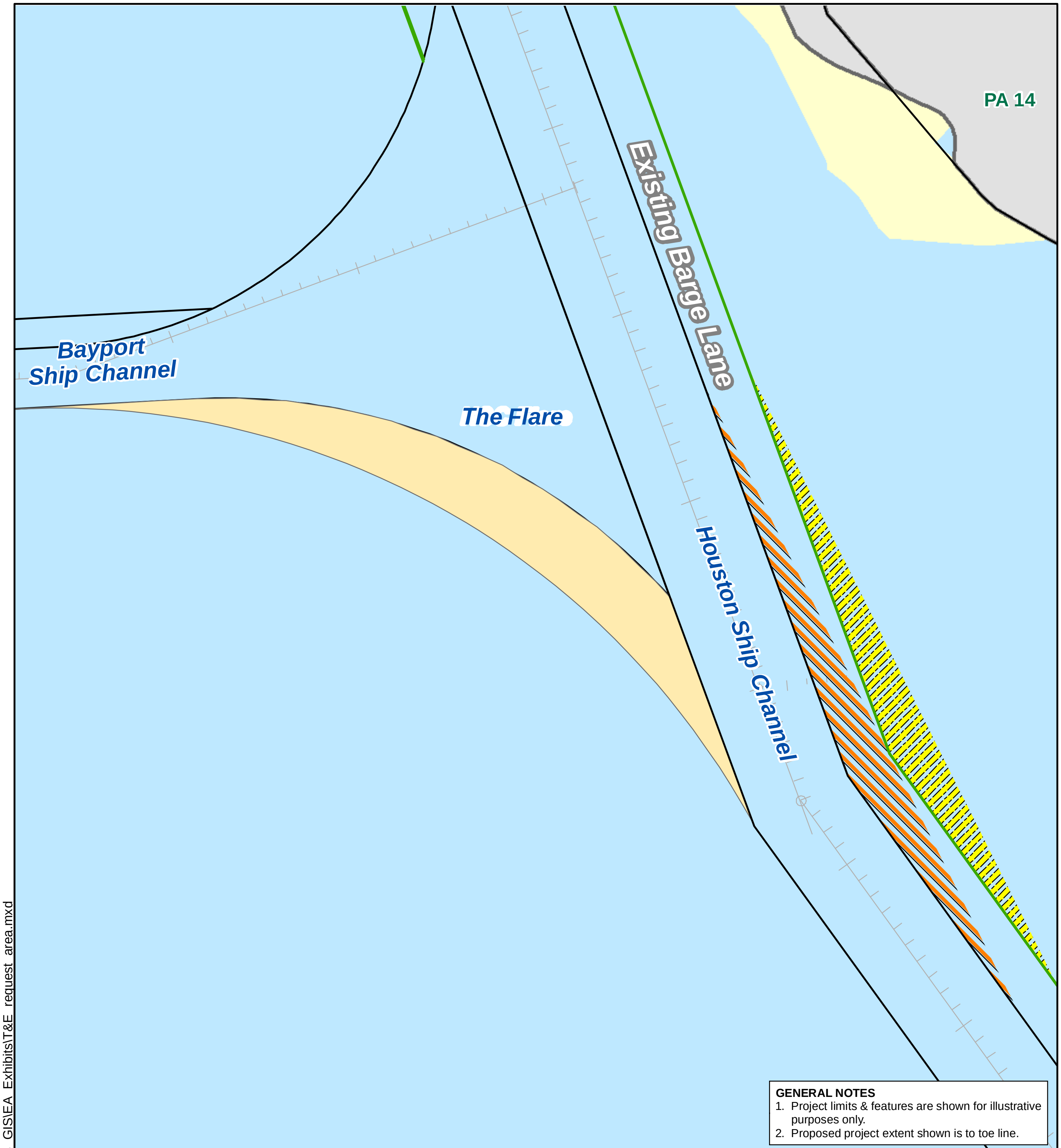

Legend

- Existing Barge Lane Toe
- Existing Main Channel Toe
- Barge Lane Relocation
- Main Channel Widener
- Flare Easing

HSC PDR FLARE AT BAYPORT ENVIRONMENTAL ASSESSMENT

Project Area and Proposed Project

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date March 2016 | Job No. 60345436 | Exhibit 1.1.1-2

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3.2.3 Essential Fish Habitat

3.2.3.1. Introduction to Essential Fish Habitat (EFH)

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) set forth a new mandate for the National Marine Fisheries Service (NMFS), regional Fishery Management Councils (FMC), and other Federal agencies to identify and protect important marine and anadromous fisheries habitat, referred to as EFH. To achieve this goal, it was recognized by NMFS that suitable marine fishery habitat needed to be maintained. The NMFS and the regional FMCs were required to delineate EFH in Fishery Management Plans (FMP) for all federally managed fisheries. The 1996 amendments to the MSFCMA also required that EFH consultation be conducted for any activity that may affect important habitats of federally managed marine and anadromous fish species.

EFH has been defined in MSFCMA § 3(10) as those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. The EFH interim final rule summarizing EFH regulations (62 CFR 66551) further specified the EFH definition as waters and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; substrate including sediment, hard-bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle.

NOAA Fisheries Gulf of Mexico Fishery Management Council (GMFMC) is responsible for the creation of FMPs in Federal waters off Texas, Louisiana, Mississippi, Alabama, and Florida. GMFMC defines six FMPs for the Gulf of Mexico [GOM] (for shrimp, red drum, reef fish, coastal migratory pelagics, corals, and spiny lobster). There are 54 species managed, excluding the coral complex. EFH consists of areas of higher species density, based on the NOAA Atlas (NOAA, 1985) and functional relationships analysis for the Red Drum, Reef Fish, Coastal Migratory Pelagics, Shrimp, and Spiny Lobster FMPs; and on known distributions for the Coral FMP.

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.

Informal consultation with NMFS was initiated regarding EFH in the project area as detailed in Section 6.3. Per the recommendation of NMFS and in addition to the EFH information provided in Section 3.2.3, a separate EFH Assessment for this project was prepared that contains all of the elements outlined by the final rules for the MSFCMA under 50 CFR Part 600. The EFH assessment includes (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, the managed species, and associated species by life history stage; (3) the Federal agency's views regarding the effects of the action on EFH; and (4) proposed mitigation, if applicable. The assessment includes the results of an on-site inspection, the views of recognized experts on the habitat or species affects, a literature review, an analysis of alternatives to the proposed action, and any other relevant information. Given the scale of the proposed action, the proportion and type of habitat being impacted and mitigated for, and the current presence of shipping activity, the assessment does not result in identifying further mitigation actions. The EFH Assessment is available upon request. The following paragraphs describe the general impacts that would occur to EFH and the managed species.

3.2.3.2. Project Area EFH Determination by FMPs

EFH for the Gulf of Mexico is identified by the GMFMC as Ecoregion 4 and determined as the composite of EFH for various species and life stages in the fishery management units (FMU) of the Gulf of Mexico. General EFH information presented was derived from the EFH mapping tool provided by NOAA. Details on EFH for specific species and life stages in each FMU are provided in Section 3 of the EFH FEIS (GMFMC, 2004). Additionally, the Draft EFH Assessment is available upon request. A more detailed discussion of usage of habitat in the specific project area for the various individual or groups of species and their life stages is also included in the Draft EFH Assessment. This information is summarized in this section to provide a description of what EFH and managed species is defined for the project area. Additionally, informal consultation with NMFS has been initiated.

Information from the habitat descriptions from the GNFMC FMPs and the EFH FEIS were used to provide the following summary of what EFH and managed species (and associated life stages) are present in the project area (GMFMC 2004 and 2005).

Red Drum FMP EFH: All estuaries in the GOM, which would include Galveston Bay, are defined as EFH for the Red drum (*Sciaenops ocellatus*). The area of Galveston Bay where the proposed project is planned is considered to be EFH for larval to early juvenile stages of the Red drum.

Reef Fish and Coastal Migratory Pelagics FMPs EFH: All estuaries in the GOM, which would include Galveston Bay, are defined as EFH for Reef Fish and Coastal Migratory Pelagics. Of the species listed in the Reef Fish FMP, only the Gray snapper (*Lutjanus griseus*) has habitat descriptions associated with Galveston Bay. Of the species listed in the Coastal Migratory Pelagics FMP, only the Spanish mackerel (*S. maculates*) has habitat descriptions associated with Galveston Bay. The area of Galveston Bay where the proposed project is planned is considered to be EFH for post larval through adult life stages of the grey snapper, and for early to late juvenile and, occasionally, adult stages of the Spanish mackerel.

Shrimp FMP EFH: All estuaries in the GOM, which would include Galveston Bay, are defined as EFH for shrimp. Of the species listed in the Shrimp FMP, only brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*) have habitat descriptions associated with Galveston Bay. The area of Galveston Bay where the proposed project is planned is determined to be EFH for late post-larval to sub-adult life stages for brown, white and pink shrimp (GMFMC, 2004).

Galveston Bay does not have habitat defined as EFH for the other GMFMC FMPs, which are the Spiny Lobster FMP and Coral FMP. The absence of EFH for the species not found in Galveston Bay is generally attributable to life stage requirements for oceanic salinity, continental shelf or reef structure, and seagrass, but also may be due to natural range, offshore spawning habits, and other causes.

In addition to the species discussed above, the highly migratory species are managed by the NOAA Fisheries Highly Migratory Species Management Unit, Office of Sustainable Fisheries and an FMP was developed for the Atlantic species of sharks, tunas, and swordfish, and Atlantic billfishes (NMFS, 2006). EFH has been mapped for 39 of the species managed by this FMP, and are listed in and discussed in more detail in the Draft EFH Assessment which is available upon request. Of the 39 highly migratory species for which EFH has been mapped, only the following have EFH within the area in Galveston Bay where the proposed project is planned: Atlantic sharpnose shark neonates only (*Rhizoprionodon terraenovae*), Blacktip shark adult and neonates

(*Carcharinus limbatus*), Bonnethead shark juveniles and neonates (*Sphyrna tiburo*), Bull shark juveniles and neonates (*Carcharhinus leucas*), and the Scalloped hammerhead shark neonates only (*Sphyrna lewini*).

The proposed project area is located within Ecoregion 4 as identified by the GMFMC. The categories of EFH in the project area include estuarine emergent marsh, estuarine shell substrate, estuarine mud substrate, and estuarine water column. In addition to being designated as EFH, these habitats provide nursery, foraging, and refuge habitats that support various economically important marine fishery species, such as spotted seatrout (*Cynoscion nebulosus*), flounder (*Paralichthys spp.*), Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), gulf menhaden (*Brevoortia patronus*), striped mullet (*Mugil cephalus*), and blue crab (*Callinectes sapidus*). Such estuarine-dependent organisms serve as prey for other fisheries managed under the Magnuson-Stevens Act by the GMFMC (e.g., red drum, mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks). These habitats also provide other essential estuarine support functions, including: (1) providing a physically recognizable structure and substrate for refuge and attachment above and below the sediment surface; (2) binding sediments; (3) preventing erosion; (4) collecting organic and inorganic material by slowing currents; and (5) providing nutrients and detrital matter to the Galveston Bay estuary.

3.2.3.3. Description of Project Area EFH Identified by the GMFMC

Open Water Column: Zooplankton and phytoplankton are the dominant organisms in this habitat and serve as the foundation of the estuarine and marine food webs. Phytoplanktons are major contributors to primary production, which is directly linked to production of biomass of species managed under the MSFCMA. In addition to supplying food for animals, phytoplankton plays a central role in nutrient cycling in Galveston Bay.

Open-Bay Bottom: The open-bay bottoms in the project area include flat areas consisting of mixtures of mud and mud/shell hash. Benthic epifauna and infauna are the primary organisms that utilize this habitat by adhering to the surface or burrowing into the sediment. These organisms feed by filter feeding particles from the water column or by ingesting sediments and extracting nutrients. Many of the epifauna and infauna feed on plankton, and are then directly fed upon by some of the species managed under the MSFCMA, such as shrimp.

Submerged Aquatic Vegetation (SAV): Seagrass areas provide nursery grounds for many species of fish support a tremendously complex ecosystem and are extremely productive. Seagrass areas are considered EFH for many species of fish. Surveys performed March 7-11, 2011 confirmed that there is no seagrass present within or adjacent to the proposed project area. Project site conditions are not conducive to seagrass growth.

Oyster Reefs: Oyster reefs provide structural complexity in soft sediment environments by increasing available surface area for use by other organisms. Oyster reefs serve as fish habitat by providing structure, protection and trophic support to juveniles and adults (SAFMC, 1998). In the northern Gulf of Mexico (north of Galveston Bay, Texas, to northwestern Florida) spotted seatrout and red drum appear to favor oysters reefs as foraging areas in much the same way they use seagrass meadows in areas where seagrasses are abundant. Oyster reefs of various sizes are present in all Texas estuaries, but are best developed between Galveston Bay and Corpus Christi Bay (Diener, 1975).

Oyster reef habitat is found in the area of the project. The majority of the oyster fishery as well as the oyster reefs in Texas are located within the Galveston Bay area (80-90 percent) with some additional areas in the Corpus Christi-Aransas Bay area (Kilgen and Dugas, 1989). Project-area specific oyster habitat description and delineation is provided within Section 3.2.2.2.3.

Estuarine Emergent Marsh: Estuarine wetlands exist in the Galveston Bay system across a salinity gradient and are classified into salt marshes and brackish marshes. In addition to the marshes found near the shoreline, several dredged material PAs are and have been beneficially used for creation of emergent marsh. This type of habitat is discussed further in Section 3.2.1. Specifically within the proposed project footprint, no marsh is found within the area of the channel improvements. Salt marsh is located directly adjacent eastward of PA 14, and a salt marsh is located between PAs 14 and 15, where a connection planned by the USACE will be expanding these PAs. The marsh impacts of the connection area are already mitigated for under that project.

Coral Areas: There are no coral areas within Galveston Bay.

3.2.3.4. Priority Habitats and Other Fisheries Concerns

3.2.3.4.1. Habitat Areas of Particular Concern (HAPC)

Habitat Areas of Particular Concern (HAPC) are a subset of the EFH information. They are areas that provide extremely important ecological functions or are especially vulnerable to degradation. The EFH regulations require that designation of specific HAPC's be based on one or more of the following considerations:

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether and to what extent development activities are or will be stressing the habitat; and
- The rarity of the habitat type.

The GMFMC designated HAPC's in the Gulf of Mexico Generic EFH Amendment (1998; Amendment). In the Final Generic Amendment Number 3 for Addressing HAPC (GMFMC 2005), the Council identified several HAPC's to benefit all FMP-managed species under Council jurisdiction. The proposed project is not in or near any of these areas identified as HAPC. These areas are all offshore and not close to Galveston Bay. The Draft EFH Assessment, available upon request, discusses the details and lists the locations of the areas designated as HAPC under the Final Amendment Number 3.

3.2.3.5. State Managed

Texas recreational and commercial fishermen fishing less than 9 nautical miles off the coast of Texas are considered to be in State regulated waters, and must comply with the rules and regulations for each type of fishing that have been published by the TPWD. The TPWD provides electronic access to the rules and regulations for coastal fishing on its website at http://www.tpwd.state.tx.us/fishboat/, as accessed on May 21, 2015. The former Texas Parks and Wildlife Commission adopted management plans for only the shrimp, oyster and crab fisheries. The remaining species which are regulated by the State of Texas are regulated only through written rules and regulations, not through FMPs.

3.2.3.6. Commercial and Recreational Fisheries

The finfish and shellfish resources in Galveston Bay support the most lucrative commercial and recreational fisheries of all the major ports in Texas and annually constitute approximately 33 percent of the total commercial revenue and 50 percent of the total recreational revenue for the entire State (Lester, 2002). The annual commercial finfish catch within Galveston Bay between 1997 and 2001 averaged approximately 209,065 lbs, and the annual ex-value of finfish averaged $211,770 (GBEP 2011 and Culbertson et al. 2004). While the majority of recreational revenue is generated through the collection of finfish, the commercial catch is predominantly comprised of shellfish. Large scale commercial fishing in Galveston Bay dates back to the 1870's as a result of increasingly efficient processing and refrigerated shipping techniques. Since that time, considerable advancements in fishing gear has allowed the commercial fishing industry to flourish, as evidenced by 2009 landings in the Galveston Bay worth approximately $35 million (all values given are in U.S. dollars (USD)) (NMFS, 2011). From 1997 to 2001, landings of white shrimp (*Penaeus setiferus*) from Galveston Bay comprised 62 percent of the landings from Texas bay systems and were valued at $5.7 million in 1999, while brown (*Panaeus aztecus*) and pink (*Panaeus duorarum*) shrimp comprised the majority of landings (36 percent) for these species in Texas bays, with Galveston Bay landings worth an estimated $2.5 million in 1999 (Culbertson et. al., 2004). In addition, Galveston Bay supports a robust live and dead bait shrimp fishery and is responsible for over 50 percent of coastal Texas landings worth $1.6 million in 2001 (Culbertson et. al., 2004).

Although trawl based shrimp landings account for nearly half of Galveston Bay's commercial harvest, other shellfish landed relatively frequently from the bay include blue crab (*Callinectes sapidus*), accounting for 28 percent of coastal Texas landings from 1997-2001 and worth $1.6 million in 1998, and eastern oyster (*Crassostrea virginica*), which accounts for 91 percent of Texas landings from 1997-2001 worth an estimated $13.2 million in 1999. Galveston Bay commercial finfish landings ($234,000 in 1999) pale in comparison to shellfish landings and typically only account for about 7 percent of annual coastal Texas finfish landings (Robinson et. al. 1998). Commercial finfish landings in the bay are primarily comprised of mullet (*Mugil cephalus*) at 26 percent, southern flounder (*Paralichthys lethostigma*) at 13 percent, black drum (*Pogonias cromis*) at 11 percent, and sheepshead (*Archosargus probatocephalus)* at 10 percent, in order of decreasing pounds landed from 1991 to 2001.

The Texas recreational fishery is an economically important segment of the total coastal fishery industry with resultant direct expenditures translating to over $2 billion annually to the State's economy (Texas Water Development Board, 1987). Recreational fishing in the Galveston Bay system accounts for almost 40 percent of this coastal fishing and 35 percent of the landings, and is accomplished through the issuance of over 262,000 fishing licenses and caught by anglers using primarily hook and line equipment (TPWD, 2000). The primary species targeted and landed by recreational fisherman include Atlantic croaker, sand sea trout, southern flounder, red drum, and spotted seatrout. Galveston Bay yielded the most recreational marine fish landed (40% of the state total) when compared to other Texas Bays between 1993 and 2003 (GBEP 2011). Annual private-boat fishing pressure and landings average at least three times greater in Galveston Bay than in any other Texas bay system during the 1998-2008 timeframe (Green and Campbell 2010)..

Although commercial and recreational fishing is important in the Galveston Bay area, much of the bay is subject to fishing restrictions and consumption advisories. The entire area of Galveston Bay where the proposed project is planned is currently within an area restricted for shellfishing. This designation means the area is closed to the harvesting of shellfish for direct marketing.

The Upper Galveston Bay area north of a line drawn from Red Bluff Point to Five-Mile cut marker to Houston Point is also within a consumption advisory area for blue crabs, catfish and spotted seatrout. It is recommended that adults limit consumption of blue crab, catfish and spotted seatrout from this area to no more than one (1) eight ounce (8 oz) meal per month; and that women who are nursing, pregnant, or who may become pregnant and children under twelve (12) years old should not consume blue crab, catfish or spotted seatrout from this area. All of Galveston Bay is within a consumption advisory area by the TDSHS for all catfish species due to PCBs and dioxins in edible tissue.

3.2.4 Threatened and Endangered Species

A Biological Assessment (BA) of the study area describing the federally-listed threatened and endangered species likely to occur and the potential impact associated with the proposed Federal actions has been prepared and is attached as Appendix 5. The BA accounts for any species that have been added to or deleted from the USFWS and NMFS Federal lists of endangered and threatened species, presents any new information regarding the previously assessed species, and provides an effects determination based on habitats available that may be affected by the proposed action. The BA includes a list of federally-listed species under the jurisdiction of USFWS and/or NMFS. Of these species, only the bald eagle and sea turtles are likely to occur in areas adjacent to the project.

The bald eagle has been delisted from the Federal list of endangered and threatened species, but receives Federal protection under the Bald Eagle Protection Act and the Migratory Bird Treaty Act. There is no designated critical habitat for any species located within or adjacent to the project area. Refer to the BA in Appendix 5 for more details regarding the federally listed species that may be affected by the proposed project.

In addition to the federally protected species, the TPWD maintains a separate county-specific list of threatened and endangered species that may potentially occur as a resident or migrant in the project area. The TPWD protected species is also listed in Table 3.2.4-1. Of the State-listed species that are not also listed on the Federal list of protected species, only the reddish egret and white-faced ibis are likely to occur in the areas around the project. Those species with only a State-listed status were not considered in further detail in the BA. All species listed in were compiled from USFWS and TPWD county-specific lists for Chambers County. State-listed species with “Species of Greatest Conservation Need” designation were also not considered due to their non-regulatory status under the Endangered Species Act.

Table 3.2.4-1 Federally-Listed Threatened and Endangered Species in Chambers County

Common Name	Scientific Name	Listing Status		
		USFWS[1] County by County List	TPWD[2]	NMFS[3] List for State of Texas
Birds				
American peregrine falcon	*Falco peregrinus anatum*	NL	T	NL
Bald eagle	*Haliaeetus leucocephalus*	NL	T	NA
Piping plover[#]	*Charadrius melodus*	T, CH[4]	T	NA
Red Knot	*Calidris canutus rufa*	T	NL	NA
Reddish egret	*Egretta rufescens*	NL	T	NL
Sprague's pipit	*Anthus spragueii*	C	NL	NA
Swallow-tailed kite	*Elanoides forficatus*	NL	T	NL
White-faced Ibis	*Plegadis chihi*	NL	T	NL
Wood stork	*Mycteria americana*	NL	T	NL
Fishes				
Smalltooth sawfish	*Pristis pectinata*	NL	E	E
Invertebrates				
Lobed star coral	*Orbicella annularis*	NA	NL	T
Mountainous star coral	*Orbicella faveolata*	NA	NL	T
Boulder star coral	*Orbicella franksi*	NA	NL	T
Elkhorn coral	*Acropora palmata*	NA	NL	T, CH[4]
Mammals				
Blue whale	*Balaenoptera musculus*	NL	NL	E
Finback whale	*Balaenoptera physalus*	NL	NL	E
Humpback whale	*Megaptera novaeanglaie*	NL	NL	E
Sei whale	*Balaenoptera borealis*	NL	NL	E
Sperm whale	*Physeter macrocephalus*	NL	NL	E
West Indian Manatee	*Trichechus manatus*	E	NL	NL
Louisiana black bear	*Ursus americanus luteolus*	NL	T	NL
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	NL	T	NL
Red wolf	*Canis rufus*	NL	E	NL
Mollusks				
Louisiana pigtoe	*Pleurobema riddellii*	NL	T	NL
Reptiles				
Alligator snapping turtle	*Macrochelys temminckii*	NL	T	NA
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E, CH[4]	E	E
Green sea turtle[#]	*Chelonia mydas*	T, CH[4]	T	T
Kemp's Ridley sea turtle[#]	*Lepidochelys kempii*	E	E	E
Leatherback sea turtle	*Dermochelys coriacea*	E	E	E
Loggerhead sea turtle[#]	*Caretta caretta*	NL	T	T
Northern scarlet snake	*Cemophora coccinea copei*	NL	T	NL
Smooth green snake	*Liochlorophis vernalis*	NL	T	NL
Texas horned lizard	*Phrynosoma cornutum*	NL	T	NL
Timber/Canebrake rattlesnake	*Crotalus horridus*	NL	T	NL

[1] USFWS 2015,
[2] TPWD 2015; [3] NOAA/NMFS 2015; [4] Critical Habitat is listed, but not present within the project study area
[5] E = Endangered; T = Threatened; CH = Critical Habitat has been designated NL = Not Listed; NA = Not Applicable
[#]Federal- listed species likely to be found in the project area.

Only those species with a federally endangered or threatened status were considered in further detail in the attached BA. Species with a Federal status of threatened or endangered that are likely to be present within the project area include the Kemp's Ridley sea turtle, loggerhead sea turtle, and green sea turtle. All other species listed in Table 3.2.4-1 are not likely to be found within the project area.

3.2.5 Invasive Species

An invasive species is defined as a species that is non-native or "alien" to the ecosystem or habitat under consideration and may cause economic, environmental, or human health harm (Executive Order [EO] 13112, February 1999). Marine invasive species can be spread by a number of different methods including ballast water and boat hulls, through human-built canals, and from human travel. Dumping aquarium exotic fish and unwanted exotics into the water or wild are other common ways invasive species spread (TexasInvasives.org, 2010).

Two invasive species - Australian spotted jellyfish (*Phyllorhiza punctata)* and sauerkrautgrass (*Zoobotryon verticillatum*) - have been identified as having the potential to occur near or within the upper Galveston Bay area. General information on the distribution of these species is provided below.

Australian spotted jellyfish were first reported in the U.S. off the coast of California in 1981. A cryptic (i.e. isolated, genetically distinct) population may have existed in the northern Gulf of Mexico since 1993 (Graham et al., 2003). In the spring and summer of 2000, millions were found in coastal regions of Mississippi and Louisiana in the northern Gulf of Mexico (Graham et al., 2003; Johnson et al., 2005). One juvenile was collected in West Galveston Bay in June 2006 (GBEP, 2010a).

Sauerkrautgrass, spaghetti bryozoans are believed by researchers to have a worldwide distribution in tropical and warm temperate seas (Hill, 2001). *Z. verticillatum* is known to occur in Galveston Bay (GBEP, 2010b).

Grass carp are able to invade new habitats due to their ability to produce many eggs, grow quickly, and produce more eggs as they mature. Unlike the other carps, grass carp prefer to spawn in large rivers instead of lakes or slower-moving water (however, grass carp has the potential to breed in slower-moving water if need be). Breeding populations have been established by escapees from legal experiments in Lake Conroe and illegal stockings. These fish are known to reproduce in the Trinity River-Galveston Bay area (GBF 2002, GBEP 2010c).

3.2.6 Coastal Zone Management Resources

The Texas General Land Office (TxGLO) is responsible for administering the Texas Coastal Management Program (TCMP) within the State to manage the Coastal Natural Resource Areas (CNRA) under the Coastal Zone Management Act (CZMA). The project area is located within the TCMP Coastal Zone Boundary. Of the sixteen types of CNRAs listed in the governing rules in Texas Natural Resources Code (TNRC) Chapter 33, Paragraph §33.203, the following CNRAs are found in the vicinity of the project:

- Coastal preserves – Atkinson Island WMA discussed in Section 3.2.2.
- Coastal shore areas – Areas that are 100 feet landward of the high-water mark on submerged lands, which includes existing PAs, such as PA 14.
- Coastal wetlands – Estuarine wetlands (salt water marsh etc.) discussed in Section 3.2.1.
- Critical erosion areas – Galveston Bay shoreline in general is listed as eroding per latest Texas Bureau of Economic Geology data.
- Hard substrate reefs and oyster reefs – Hard-bottom habitat and oyster reef discussed in Section 3.2.2.

- Submerged land – Galveston Bay bottom in the project area.
- Tidal sand or mud flats – Tidal sand flats located between and around the fringes of PAs 14 and 15 as discussed in Section 3.2.1.
- Water under tidal influence – Galveston Bay waters

These resources are subject to the requirements of the CZMA and TCMP discussed in Section 6.7.

3.3 HUMAN ENVIRONMENT

3.3.1 Socioeconomics

The socioeconomic analysis was conducted for Chambers County and the adjacent Census tracts, block groups, and block within the project area. The Harris-Galveston shoreline in the County border and the proposed project is approximately 10,500 feet (2 miles) from the shoreline. The proposed project is expected to have minimal impacts to the human environment because all work will be located in the open water (Galveston Bay) and an uninhabited man-made dredge sediment placement island in Galveston Bay.

3.3.1.1. Population and Employment

The proposed project is located in Chambers County but is not located in within any city limits because it is located on the open water. The 1990, 2000, and preliminary 2010 Census population counts for Chambers County are shown in Table 3.3.1-1. The population for Chamber County between 1990 and 2010 had a 75 percent increase.

Table 3.3.1-1 Population Statistics for Chambers County and

Geographic Area	Population		
	1990	2000	2010
Chambers County	20,088	26,031	35,096

U.S. Census 1990, 2000, and 2010

There is a civilian labor force of 178,866 in Chambers County, with an unemployment rate of 5.3 percent as of April 2015, according to the Texas Workforce Commission (TWC 2015). As shown in Table 3.3.2-1, the 2009-2013 5-year American Community Survey average median household income for the Chambers County was $76,781. There are Census Tracts, Block Groups, and Blocks in Galveston bay, but in the area of the project, currently there is zero population.

3.3.1.2. Social Characteristics

3.3.1.2.1. Population by Race and Ethnicity

As shown in Table 3.3.2-1, there are Census Tracts, Block Groups, and Blocks in Galveston Bay. However, in the area of the project, currently there is zero population. The demographic breakdown for Chambers County is 70.6 percent White (Caucasian), 18.8 percent Hispanic, 8.1 percent Black or African American, 0.9 percent Asian, and

1.6 other. The surroundings small communities, such as Shoreacres, El Lago, and Taylor Lake Village are predominantly White race/ethnicity, while Pasadena and La Porte have higher minority populations.

The median age of residents in the Chambers County was 37.3. Median ages and the average household size of 2.9 people per household (ACS, 2009-2013).

3.3.2 Environmental Justice and Protection of Children from Environmental Health Risks and Safety Risks

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, mandates that Federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of programs on minority and low-income populations (59 *Federal Register* 7629-7633, February 1994). A minority population is defined as a group of people and/or a community experiencing common conditions of exposure or impact, consisting of persons classified by the U.S. Census Bureau as Black, Asian, American Indian or Alaska Native, Hispanic, or other non-white persons including those persons of two or more races. A low-income population is defined as a group of people and/or a community that, as a whole, live below the national poverty level. The poverty guideline for a family of four, as defined by the U.S. Department of Health and Human Services is a total annual household income of $24,250 in 2015. Disproportionate environmental impact occurs when the risk or rate for a minority population or low-income population from exposure to an environmental hazard exceeds the risk or rate of the general population and, where available, to another appropriate comparison group(s) (U.S. Department of Defense [DOD], 1995; EPA, 1998).

Census Tract Analysis

The data used to determine the potential for disproportionate effects to low-income and/or minority (EJ) populations within the vicinity of the project area are also presented.

In order to determine the affected environment for this EA, updated demographic data the project area was analyzed. The project area is completely located on open water and is not located in any city limits, shown in Table 3.3.2-1. The proposed project for this EA is located within Chambers County. The county border lies along the shoreline (Exhibit 1.1.2-1). Currently, the 2010 Census is available for race/ethnicity and population. The latest income characteristics are available for the geographies of interest from the Census Bureau are through the 2009-2013, 5-year American Community Survey (ACS). Due to the fact that none of the Census geographies in the project area have a population, EJ impacts are not anticipated. The nearest populated Census geographies are approximately no closer than 1.8 miles away in El Jardin del Mar. Demographic data reviewed from the BSC Improvements Project EA did not identify ethnicity or income indicators of EJ populations in the Census tracts around the BSC, including those in El Jardin del Mar. Therefore, even considering the nearest populated Census geographies, based on the demographic data, EJ impacts are not anticipated.

Protection of Children from Environmental Health and Safety Risks

E.O. 13045, Protection of Children from Environmental Health Risks and Safety Risks, mandates federal agencies to identify and address disproportionate environmental health and safety risks to children. "Environmental health risks and safety risks" are defined as risks to health or safety that are attributable to products or substances that the child is likely to come in contact with or ingest, such as air, food, drinking or recreational use of water, soil children may live on, and products they use or are exposed to. Because the project area consists of the open water of Galveston Bay, at closest 1.3 miles from the mainland, and PA 14, an uninhabited dredged material placement island at minimum 2 miles from the mainland, there are no populations of children, or facilities geared towards children (e.g. schools, playgrounds) in the project area.

Table 3.3.2-1 Percent Race/Ethnicity and Median Household Income for the Study Area

Geographic Area	2010 Population	Race/Ethnicity (Percent)					Percent Minority	Median* Household Income	Percent Families Living Below Poverty Threshold
		White	Hispanic/ Latino	Black/ African American	Asian	Other			
Counties									
Chambers	35,096	70.6	18.8	8.1	0.9	1.6	29.4	$72,489	9.7

Source: U.S. Census Bureau 2010 and 2009-2013 ACS sample/estimate data.

3.3.3 Community and Recreational Resources

Galveston Bay assets contribute billions of dollars to the region's economy and supports employment of tens of thousands of people through several key water-based industries including recreational and commercial fishing, shellfish harvesting, and tourism (TCEQ, 2007). Among recreational opportunities, sportfishing is a major attraction, representing about half of all sportfishing expenditures in Texas (TCEQ, 2007).

Along the shoreline, west and north of the project area, are the cities, towns, and communities of Morgan’s Point, La Porte, and Shoreacres, and along the shoreline to the south are Pasadena and Seabrook.

Chambers and Harris Counties (located on the shoreline closest to the project area) has developed infrastructure to provide health, police, fire, emergency, and social services to the communities surrounding the project area in addition to a wide range of public facilities, including education facilities, places of worship, cemeteries and many recreation resources.

3.3.3.1. Community Facilities

Police, Fire Protection and Emergency Services

Port of Houston Fire Department provides emergency response along the ship channel, and the USCG provides security and emergency response services for open water areas in the project area.

Education Facilities

As the proposed project is in the middle of open water of Upper Galveston Bay, there are no educational facilities near the proposed project. The closest schools in the communities on the mainland surrounding the project area include La Porte High School, Beacon School, Seabrook Intermediate School, and Bay Elementary.

Cemeteries and Places of Worship

As the proposed project is in the middle of open water of Upper Galveston Bay, there are no cemeteries or places of worship near the proposed project. In the communities on the mainland surrounding the project area, there are numerous places of worship. The closest cemeteries to the proposed project area are the La Porte and Seabrook cemeteries.

3.3.3.2. Recreational Facilities

Recreational activities in the project area and the communities to the west of the project area include duck hunting, saltwater fishing, swimming, sailing, nature viewing, pleasure boating, camping, picnicking, and sightseeing. Ecotourism, or tourism that is based on nature rather than man-made attractions, is the tourist industry's most rapidly expanding sector.

Within Galveston Bay, more than 20 percent of the region's population participates in saltwater fishing and the use of open space and about 15 percent enjoys saltwater boating (GBEP 2011). A 1993 study found that the proportion of area residents expected to annually participate in walking, saltwater swimming, and picnicking is well over 40 percent (GBEP 2011). Approximately 34 percent of Houston-Galveston Bay households were likely to use the bay at least once a year for recreational purposes including swimming, picnicking, shoreline walks, bird or wildlife watching, and fishing (GBNEP, 1994b). A general recreational activity summary indicated that 27 percent of Texas travel destination in the Gulf Coast Region, defined by the Texas Department of Economic Development (TDED) as the Houston, Galveston-Texas City, and Brazoria Metropolitan Statistical Areas, include nature or outdoor sports activities (TDED, 1999).

Tourism in the Gulf Coast Region creates notable economic benefit to the community and provides employment. In 1999, overall recreation-related travel spending in the region contributed over $5 billion to the economy and grew at an average rate of 6.6 percent annually over 4 years. For the same year, TDED reported that recreation-related travel spending for Texas destinations was an estimated $700 million and generated 10,700 jobs (TDED, 1999a).

3.3.3.2.1. Public Parks and Beaches

Approximately 2 miles from the proposed project, along the shoreline, there are a number of public parks, beaches and recreational vehicle campgrounds. North and south of the project, there are five public parks; Sylvan Beach Park, Rex L Meador Park, Miramar Park, El Jardin del Mar Parks; and Sylvan (Public) Beach and El Jardin del Mar (Community) Beach.

3.3.3.2.2. Boating

By law boats, sail boats, motorized boats, and USCG documented vessels, must be registered with TPWD when on Texas public water. About 90,000 pleasure boats are registered in Galveston Bay. Galveston Bay has the 3rd highest concentration of privately-owned marinas in the U. S. (TCEQ, 2007). There are many popular boating and yacht clubs within the Galveston Bay area that utilize the bay for their boating activities, including but not limited to the Houston Yacht Club and Seabrook Sailing Club.

The Houston Yacht Club

The Houston Yacht Club (HYC) is based at Miramar Drive, Shoreacres at Galveston Bay, approximately 2.2 miles northwest of the proposed project. HYC was established in 1897 and has a long tradition of organizing regattas, hosting national and world championships, and promoting Houston as a nationally recognized yacht racing and recreational boating center. The club’s activities include sailing, power boating, cruising, racing, youth sailing, sailing lessons, fishing tournaments and social events. The HYC hosts World or National Championships on an annual basis, with Olympic Trials held by the HYC in Galveston Bay.

Seabrook Sailing Club

Seabrook Sailing Club (SSC) is located at 602 4th Street, Seabrook, approximately 4 miles south of the proposed project. The club sponsors activities to include sailing, youth sailing, sailing lessons, and social events, and utilizes Galveston Bay for sailing lessons and competitions.

3.3.3.2.3. Recreational Fishing

Fishing in Galveston Bay accounts for over half of the State's recreational fishing expenditures and the Galveston Bay area hosts more sports fishermen than any other place on the Texas Coast. Galveston Bay has a wide variety of fish species, including speckled trout, redfish, flounder, golden croaker, drum and Spanish mackerel (TCEQ, 2007).

Anglers take part in fishing from the piers located around Galveston Bay, including Sylvan Beach Fishing Pier, La Porte, approximately 3.8 miles to the north of the proposed project, as well as fishing from boats in the bay. A number of companies located in the Galveston Bay area offer chartered fishing trips, making recreational fishing in the bay also accessible to those who do not own a boat.

3.3.3.2.4. Bird Watching

Birding is a popular outdoor activity along the Texas Coast. The Great Texas Coastal Birding Trail is a State-designated system of trails, bird sanctuaries, and nature preserves along the entire length of the Texas Gulf Coast. As the State of Texas is home to more bird species than any other in the U.S., the birding trail system offers many suggestions for bird-watching locations on the Great Texas Coastal Birding Trail around Galveston Bay.

Water and shore birds, including American avocet, willet, sanderling, western sandpiper, dunlin, dowitchers, piping plover and black-bellied plover are common in the Galveston Bay area throughout the year, while rare species are spotted during fall and spring migration when 75 percent of all North American bird species travel through Galveston during fall and spring migration. Further detail regarding birds within the project area can be found in Section 3.2.2.

The Galveston Bay system has been identified as a regionally significant reserve site for resident and migratory shorebirds, and supports more than five percent of all mid-continental shorebird populations during their annual migrations (TCEQ, 2007).

3.3.4 Visual and Aesthetic Resources

Existing characteristics of the viewsheds for the proposed project area are discussed in this section. A viewshed is defined as the entire area an individual can see from a given point. The study area for visual and aesthetic resources consists of viewsheds of the project area looking out from the existing shoreline in residential areas or public parks.

The viewshed area boundary starts at Sylvan Beach park, continues south to the BSC, and continues along the shoreline of the El Jardin Del Mar neighborhood and El Jardin Beach and ends south at Surf Oaks, as shown in

Exhibit 3.3.4-1. The viewshed area was set based on the location of the proposed project and potential project impacts from the PAs and areas where dredging would take place in the Flare. Representative viewsheds are discussed in two locations. The first existing viewshed is located along the shoreline near Sylvan Beach Park and continues along the shoreline at Shore Acres neighborhood, and the second viewshed is from the residential area and recreational beach area in the El Jardin Del Mar neighborhood, south of the Bayport Cruise Terminal.

In general, the coastline within Galveston Bay is somewhat irregular due to numerous inlets, bays, bayous, bogs, and canals. Within the viewshed area five water bodies touch the shoreline including two unnamed tributaries, Cedar Bayou, BSC, and Pine Gully. In addition, Boggy Bayou is connected to the BSC. The terrain in the viewshed area varies from 0 to 22 feet MSL.

The views vary north of the BSC (Shore Acres neighborhood) to Sylvan Beach Park from the shoreline. From the Sylvan Beach Park, the view directly southeast towards the direction of the proposed project, is open water, with the pier in the foreground and the PA sites in the distance.

The current views from the shoreline of the El Jardin Del Mar neighborhood and beach consist of open water with distant barges or ships in the HSC directly to the east. The viewshed towards the northeast in the direction of the proposed project also includes in the distance, a view of existing land masses of PAs, and the view to the south is the Kemah Bridge and residential areas.

GENERAL NOTE

1. Project limits & features are shown for illustrative purposes only.

Legend

Proposed Project Footprint

- Flare Easing
- Channel Widener and Barge Lane Relocation

Proposed Dredged Material Placement

- New Work
- Maintenance
- Existing Channel Alignment
- City Limits
- Permitted Location
- Dry Hole
- Oil Well
- Plugged Oil Well
- Marinas
- Beach Access Points
- View Shed
- Pipelines

HSC PDR FLARE AT BAYPORT ENVIRONMENTAL ASSESSMENT

Existing Oil and Gas Infrastructure and Aesthetic and Recreation Resources Near Proposed Project

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date March 2016	Job No. 60345436	Exhibit 3.3.4-1

Document Path: P:_PWD\Port of Houston\60345436 - HSC Nav Study\1100 HSC-PDR-Flare\09_GIS\EA_Exhibits\Exhibit 3.3.4-1 Existing OG Infra Aesthet and Rec Near Proj.mxd

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3.3.5 Existing Infrastructure

Resources produced in the proposed project area and vicinity include oil and natural gas, sulfur, brine, sand, clay, and shell for the making of lime and other materials. Sulfur is an important industrial mineral occurring primarily in the cap rock of certain regional salt domes. Oil and gas fields are densely distributed throughout the proposed project vicinity; no wells are within the boundaries of the proposed project footprint of the corrective actions. No active wells are found within footprints of PA 14, which is proposed for new work material placement, and Mid Bay PA which is proposed as a contingency. These PAs, as well as others proposed for maintenance material placement were already planned and have already been, or are planned for construction by the USACE; however, provisions for required access is accounted for by the Expansion of PA 14 and 15 Project managed by the USACE.

3.3.6 Traffic and Transportation

The following sections discuss existing transportation facilities in the proposed project area.

3.3.6.1. Surface Transportation

Road Transportation

The proposed project is entirely within the open water of Galveston Bay, at closest, 1.3 miles from the mainland. There are no roads or bridges within the proposed project footprint or the surrounding water in project area.

Rail Transportation

The proposed project is entirely within the open water of Galveston Bay, at closest, 1.3 miles from the mainland. There are no railroads or railyards within the proposed project footprint or the surrounding water in project area.

3.3.6.2. Marine Transportation

Galveston Bay is a major center of both commercial and recreational navigation. Concentrations of recreational boating facilities and activity exist along the shoreline to the west of the proposed project area and utilize the Galveston Bay. Both activities have traditionally coexisted with deep-draft commercial navigation. Generally this means that recreational boats stay clear of larger commercial vessels that are restricted to navigation in the dredged channels.

Commercial Shipping

The HSC and the BSC are the focal point for commercial marine transport in the Galveston Bay system. Heavy industry, petrochemical plants, container terminals, and bulk cargo terminals are accessed through the HSC, BSC and ancillary channels. Areas adjacent to the BSC are important to commercial transportation destinations. Barges (or tows) and oceangoing vessels, including container ships, general cargo shops, dry and liquid bulk shops, and workboats carry cargo through the Galveston Bay system to cargo terminals and industrial facilities.

Further detail regarding commercial marine transportation in the HSC and BSC can be found in Section 1.3.

3.3.7 Hazardous, Toxic and Radioactive Waste

A Hazardous, Toxic, and Radioactive Waste (HTRW) investigation was conducted to identify indicators of potential hazardous materials or waste issues in the vicinity of the proposed project that have the potential for impacts as result of the proposed project. A regulatory database search was performed in accordance with American Society for Testing and Materials (ASTM) standard: E 1527-13 Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process. A commercial database vendor, BANKS Environmental Data (Banks), prepared a regulatory database report on June 1, 2015 for the geographic area that includes the proposed project and the recommended record search distances from the proposed project footprint (Banks 2015). As discussed, in Section 3.3.5, oil and gas sites, and pipelines were examined in the project area. The regulatory listings are limited and include only those sites that are known to the regulatory agencies to be permitted, contaminated, or in the process of evaluation for potential contamination at the time of publication.

The regulatory database reports included a review of the ASTM and All Appropriate Inquiry (AAI) required databases. The project regulatory database search radius was based on the dredged area footprint of the proposed action, which starts at the HSC and continues to the Bayport Turning Basin (TB) (Exhibit 3.3.4-1). An abbreviated list of ASTM and AAI recommended Federal and State databases and other records that were searched for relevant information is included below. Additional databases were searched but no information was found.

- National Priority List (NPL) and State/Tribal NPL, within 1.00 mile; EPA list of confirmed or proposed Superfund sites
- Delisted National Priority List (DNPL), within 0.5 mile; EPA list of confirmed or proposed Superfund sites deleted from the EPA list
- Comprehensive Environmental Response, Compensation, and Liability Information Service (CERC) and State/Tribal CERC, within 0.50 mile; proposed or possible NPL sites from the EPA database of current and potential Superfund sites currently or previously under investigation. This includes emergency response actions involving hazardous materials, especially those near water.
- CERCLIS No Further Remedial Action Planned (CER NFRAP), within 0.50 mile; proposed or possible NPL sites where no contamination was found, removed quickly or was not serious enough to require Federal Superfund action or NPL consideration
- Resource Conservation and Recovery Act (RCRA), treatment, storage, or disposal (TSD) sites, within 0.50 mile; EPA database of sites that treat, store, dispose, or incinerate hazardous waste
- RCRA Corrective Action Site (RCRA COR), within 1.00 mile; EPA database of Resource Conservation and Recovery Information System (RCRIS) sites (hazardous waste handlers) subject to corrective action activity
- RCRA Generators (RCRA GEN), within 0.25 mile; EPA database of RCRIS sites that create over the minimum specified limit of hazardous waste per month or meet other RCRA requirements including the RCRA Administrative Action Tracking System and Compliance Monitoring and Enforcement List
- State/Tribal Disposal or Landfill (SWLF), within 0.5 mile; TCEQ database lists closed and abandoned municipal solid waste landfills
- Federal Brownfields (FED BROWN) and State/Tribal Brownfield (ST BROWN) within 0.5 mile; listing of sites that EPA is tracking for real property that is either abandoned or underutilized due to real or perceived environmental contamination

- Federal Intuitional (FED IC) and State/Tribal Controls (ST IC) within 0.5 mile; Federal and State/Tribal listed site that have intuitional controls due to remediation or administrative restriction due to risk of environmental exposure
- Federal Engineering (FED EC) and State/Tribal Controls (ST EC) within 0.5 mile; Federal and State/Tribal listed site that have engineering controls due to remediation or administrative restriction due to risk of environmental contamination
- Emergency Response Notification System (ERNS), within 0.25 mile; EPA database of emergency response actions for reported spills or releases of regulated materials
- State/Tribal Storage Tanks (PST), within 0.25 mile; TCEQ database contains information on above and underground petroleum storage tanks, compliance, and releases in the State
- State/Tribal Leaking Storage Tanks (LPST), within 0.5 mile; TCEQ database contains information on above and underground leaking petroleum storage tanks, compliance, and releases in the State
- State/Tribal Voluntary Cleanup Program (VCP) and Innocent Owner/Operator Program (IOP), within 0.50 mile; VCP sites are noted as contaminated sites that private parties have cleaned up through assistance with the State.
- State/Tribal Hazardous Water (HW), within 0.25 mile; TCEQ database contains information about facilities which store, process, or dispose of hazardous waste as maintained by the Industrial and Hazardous Waste permits section of the TCEQ.

According to the regulatory database search, no listings were identified within the ASTM search distances. The search service did provide data for unmapped ERNS records on water associated with this part of Galveston Bay that did not have sufficient information readily map these sites. This information was conservatively included in the search and is designated as orphan sites for ERNS since they have no location data. Approximately 320 water orphan ERNS sites were identified.

Though no ERNS records were initially mapped to within the one-quarter mile ASTM search distance of the proposed project, the environmental database search included ERNS records that were waterborne incidents described as occurring on the HSC, BSC, or otherwise in this upper part of Galveston Bay, with no mapping information available. These were included to supplement the standard search, because other incident description information might be usable to further infer or assert their location. Most of the approximately 320 records had no further usable information and included records that could be at distances many times the ASTM search distance. However, 130 of these records had general location description information such as occurrence on the BSC, or the USCG Aids-to-Navigation (ATON) channel buoy light number that were used in conjunction with geospatial data, such as the ATONS light locations, to further narrow these down to 38 records occurring within 5 miles or 1 mile of the proposed project, or on the BSC. These records spanned from 1989 to 2014, with approximately 14 of them older than 10 years old. The majority of these (26) are releases or loss of ATONS light batteries from vessel collisions with the light buoy. The remaining 12 records were more than a mile away, with most involving reports of an unknown sheen or release of vessel machinery oil (e.g. cooling, hydraulic), one involving an abandoned intact drum of unknown substance, and only one involving diesel release from a barge. Four of those 12 incidents were older than 10 years old. None of these indicated large catastrophic spills. Only 6 records are within 1 mile of the proposed project, with 4 involving ATONS light battery releases or losses, only one involving an unknown sheen, and one a hydraulic oil hose leak from a dredging vessel. Only two of them are less than 10 years old. Of these 6 records, 5 of them are likely within the one-quarter mile ASTM search distance of the proposed project, including the unknown sheen and hydraulic oil hose leak incidents. Only 5 records were listed as occurring on the BSC, with location or incident description information indicating 3 were in the BSC

Turning Basin, 1 elsewhere within the land cut of the BSC, and only 1 potentially in the Bay segment of the BSC. As such, all but one of those is at least 2 miles away from the proposed project on the BSC. The other one was an ATON battery release/loss.

USCG Commandant Instructions (COMDTINST) 16478.10 ATON Battery Release Reporting Requirements, USCG COMDTINST M16500.25A Aids to Navigation Manual, and the USCG 8th District Light List indicate that the ATON light batteries are rechargeable storage/backups for solar panel-powered lights. This information indicates that these are typically either two 12-volt sealed lead acid batteries, or four 6-volt photovoltaic batteries in series for this type of ATON. Both contain dilute (typically 25%-40%) sulfuric acid as the electrolyte and lead oxide terminals. They come in a variety of designs including flooded (liquid electrolyte) and gel-type (gel electrolyte), but at most would be expected to contain 2 to 3 gallons of electrolyte each, which would mean at most 6 to 12 gallons of electrolyte at each light. Given the relatively small size, small dilute acidic electrolyte volume compared to the extremely large volume of seawater, and less-than-annual frequency of individual events, the ATON releases would not be expected to manifest in water quality or sediment impacts. Water and sediment quality information in Section 3.1.5 do not indicate either pH or lead impairment in area water or sediment samples.

Given that only two non-ATON spills were within 1 mile, and involved either an unknown sheen or hydraulic oil hose leak, a hazardous material site concern is not expected, given the relatively small nature of these spill records, and that water and sediment quality information in Section 3.1.5 does not indicate TPH or persistent oil and grease impairment.

One major vessel release incident within Galveston Bay occurred in 2015 after the last update to the ERNS records. The incident involved the collision between the Carla Maersk, a chemical tanker, and the Conti Peridot, a bulk cargo carrier, near Morgan's Point. The collision occurred when the inbound Conti Peridot and outbound Carla Maersk, departed before the suspension of transit along the HSC due to developing fog conditions. After passing a vessel, the Conti Peridot was having trouble returning to the channel center and initiated a port-to-port passing arrangement with the Carla Maersk. Preliminary data show the Conti Peridot moved to the left side of the channel and then back to the right following the arrangement. Maneuvers to correct, execute the passing, and avoid collision under foggy conditions were unsuccessful, and the Conti Peridot, carrying steel rolls, struck the Carla Maersk's portside, penetrating two port wing ballast tanks and the number 4 port cargo tank, which held approximately 15,495 barrels of methyl tert-butyl ether (MTBE), a gasoline additive, releasing MTBE to the water. MTBE is a volatile, flammable and colorless liquid that is very soluble in water. Given its volatility and solubility, the MTBE was expected to readily evaporate or dissipate in water, with limited cleanup response actions. The collision and release occurred approximately 4 miles north of the proposed project area. Given the volatile and soluble nature of MTBE, the limited cleanup response action, and distance, the release would not be anticipated to have substantial impacts to bottom sediments in the proposed project area.

Apart from possible use of existing placement islands with no development, the proposed project would directly impact only underwater bay bottom; therefore, water-related releases in proximity to the proposed dredging locations were examined.

Most releases in water would be expected to dissipate in water with dispersion and tidal exchange, and degrade over time following the spill incident, not posing a permanent water quality impact. This is especially true of the sulfuric acid in ATONs battery losses. Some non-water soluble pollutants released in water might leave more residual contaminants in bay sediments, portions of which would degrade and portions which could be more persistent. Therefore, dredged sediment quality would be the primary HTRW concern. Approximately half of the six water spills that could be located to within a mile of the proposed project are older than 10 years. Of the two non-ATON spills, hydraulic oil from the hydraulic hose leak incident is considered moderately persistent, and would undergo weathering, which would involve spreading, evaporation, emulsification followed by dissolution and dispersion, oxidation, then finally biodegradation to be reduced in the environment. Considering the size, moderate persistence and weathering, this incident would not be expected to manifest in significant impairment of area sediments. In Section 3.1.5, existing sediment quality is discussed in detail, using data from periodic testing of the maintenance dredging of the current BSC. In general, this data has not shown that residual contamination is a problem.

Other potential hazardous materials sites in the project area include pipelines, and oil and gas facilities. Data from the Texas Railroad Commission (TRCC) were reviewed to identify the location of oil and gas sites, and pipelines within the project area. Locations of oil and gas sites and pipelines are shown on Exhibit 3.3.4-1.

3.3.8 Air Quality

The Clean Air Act (CAA), as amended in 1990, regulates air emissions from area, stationary, and mobile sources, and requires the EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. Currently, there are air quality standards for six "criteria" pollutants designated by EPA; carbon monoxide, nitrogen dioxide, ozone, lead, sulfur oxides, and inhalable airborne particulate matter (EPA, 2011). A list of the standards is provided in Table 3.3.8-1.

The Houston-Galveston-Brazoria (HGB) area, consisting of Harris, Montgomery, Liberty, Chambers, Galveston, Brazoria, Fort Bend, and Waller Counties, meets all of the EPA NAAQS, except for ozone. The attainment status of the HGB area is summarized in Table 3.3.8-2.

Table 3.3.8-1 National Ambient Air Quality Standards

Pollutant	Level	Averaging Time	Primary/Secondary
Carbon Monoxide	9 ppm	8-hour	Primary
	35 ppm	1-hour	
Lead	0.15 µg/m3	Rolling 3-Month Average	Prime and Secondary
Nitrogen Dioxide	53 ppb	Annual Mean	Primary and Secondary
	100 ppb	1-hour	Primary
Particulate Matter (PM10)	150 µg/m3	24-hour	Primary and Secondary
Particulate Matter (PM2.5)	12.0 µg/m3	Annual	Primary
	15 µg/m3	24-hour	Secondary
	35 µg/m3	24-hour	Primary and Secondary
Ozone	0.075 ppm	8-hour	Primary and Secondary
Sulfur Dioxide	75 ppb	1-hour	Primary
	0.5 ppm	3-hour	Secondary

Source: EPA 2015c

Table 3.3.8-2 Attainment Status of Houston-Galveston-Brazoria Area

Pollutant	Primary NAAQS	Averaging Period	Designation	Attainment Deadline
Ozone (O_3)*	0.075 ppm (2008 standard)	8-hour	Marginal Nonattainment	July 20, 2015
Lead (Pb)	0.15 µg/m^3 (2008 standard)	Rolling 3-Month Avg.	Attainment/ Unclassifiable	
	1.5 µg/m^3 (1978 standard)	Quarterly Average	Attainment/ Unclassifiable	
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	8-hour	Attainment/ Unclassifiable	
	35 ppm (40 mg/m^3)	1-hour	Attainment/ Unclassifiable	
Nitrogen Dioxide (NO_2)	0.053 ppm (100 µg/m^3)	Annual	Attainment/ Unclassifiable	
	100 ppb	1-hour	Pending	
Particulate Matter (PM10)	150 µg/m^3	24-hour	Attainment/ Unclassifiable	
Particulate Matter (PM2.5)	12.0 µg/m$^{3)}$ (2012 Standard)	Annual (Arith. Mean)	Attainment/ Unclassifiable	
	15 µg/m^3 (1997 Standard)	Annual (Arith. Mean)	Attainment/ Unclassifiable	
	35 µg/m^3	24-hour	Attainment/Unclassifiable	
Sulfur Dioxide (SO_2)	0.03 ppm	Annual (Arith. Mean)	Attainment/ Unclassifiable	
	0.14 ppm	24-hour	Attainment/ Unclassifiable	
	75 ppb	1-hour	Governor's Recommendation Attainment (Harris and Galveston Counties)	

Source: TCEQ 2015

*The U.S. Environmental Protection Agency (EPA) revoked the one-hour ozone standard and the 1997 eight-hour ozone standard in all areas, although some areas have continuing obligations under these standards.

Ozone is a reactive form of oxygen that can occur in two different levels of the atmosphere, the stratosphere and troposphere. Exposure to ground level ozone (troposphere) in high concentrations can result in adverse effects to humans, plants and animals. Ground level ozone is primarily formed by the reaction of sunlight with man-made emissions of nitrogen oxides (NO_x) and VOCs. Urban areas typically have high levels of ground level ozone. On March 27, 2008, the EPA lowered the primary and secondary eight-hour ozone NAAQS to 0.075 parts per million (ppm)[10] [11]. The eight-county HGB area was designated as being in "nonattainment" and classified "marginal" under the 2008 eight-hour ozone NAAQS, effective July 20, 2012. The HGB area includes the same eight counties that were designated "nonattainment" under the 1997 eight-hour ozone standard. Effective April 6, 2015, the EPA revoked the 1997 eight-hour ozone standard, and the associated attainment designations are no longer in effect, except for anti-backsliding purposes (EPA 2015a). EPA also clarified that the general conformity requirements for the 1997 ozone NAAQS end when the NAAQS is revoked, and the general conformity requirements for the 2008 ozone NAAQS become applicable 1 year after the effective date of nonattainment designations for the 2008 NAAQS, making those GC requirements applicable July 20, 2013. The attainment deadline for the HGB marginal nonattainment area is July 20, 2015 (TCEQ 2015d).

3.3.8.1. Greenhouse Gases

Air emissions from equipment powered by internal combustion engines used for constructing a proposed project, or from increased activity of these types of sources resulting indirectly from a project will result in releases of Greenhouse Gas (GHG) emissions that could contribute more than negligibly to global climate change depending the magnitude and duration. To date, regulations with specific thresholds to evaluate adverse impacts pertaining to GHG emissions have not been established by local decision-making agencies, the State, or the Federal government. The Council on Environmental Quality (CEQ) published "Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions," February 10, 2010. This document was issued for the purpose of obtaining public comments, but not to regulate Federal land and resource management actions. The Draft Guidance was revised December 2014, based on comments received on the 2010 draft. The guidance says that it does not establish any legally binding requirements, but constitutes recommendations designed to encourage consistency in the approach Federal agencies take when assessing their proposed actions for GHG impacts under NEPA. The guidance recommends that the level of effort for assessment of GHG impacts be reasonably proportionate to the importance of climate change related considerations to the agency action being evaluated, and that when an agency determines that a quantitative analysis is not appropriate, an agency should complete a qualitative analysis and explain its basis for doing so. The Draft Guidance provides a reference point of 25,000 metric tons or more of carbon dioxide (CO_2)-equivalent (CO_{2e}) GHG emissions on an annual basis below which a GHG emissions quantitative analysis is not warranted, unless quantification below that reference point is easily accomplished. However, the guidance stresses that climate change impacts should be considered on a cumulative level, and should also consider the context and intensity when determining the significance of the proposed action. To this end, proportion and duration of such emissions compared to large scale emissions (e.g. regional and larger) would serve this purpose. Section 4.3.8.3 provides an assessment of the proposed project's potential to emit GHG to a level that would be important in terms of meaningfully contributing to climate change.

3.3.9 Noise

Noise is typically categorized as unwanted sound. Sound is characterized by a number of variables including frequency, duration, and intensity. Sound intensity is measured in decibels (dB), which is a logarithmic measure for which values cannot be simply added arithmetically to calculate the aggregate levels. Environmental sound levels are often expressed in terms of averages over standard durations such as 1-hour, 8-hour, and 24-hour periods. These averages are expressed as an equivalent continuous sound level (L_{eq}) with the same duration. Normal speech has a typical sound level of approximately 60 dB. The human ear typically cannot detect variations of 3 dB or less (U.S. Department of Transportation, 2010; Minnesota Pollution Control Agency, 2008; Nevada Department of Transportation, 2000). Human hearing is less sensitive to low frequencies and extremely high frequencies, and is most sensitive to mid-range frequencies. The most widely accepted method of quantifying sound for human receptors is to measure sound across a wide frequency spectrum and apply a weighting known as "A-weighting" to the individual decibel value of each frequency interval. The logarithmic sum of these values is known as the A-weighted sound level, expressed as dB A-weighted units, or dBA. Another sound measure that compensates for increased sensitivity to noise during quieter nighttime hours is the Day-Night Average Sound Level (L_{dn}). It is a 24-hour averaged sound level with a 10 dBA penalty added to measured nighttime levels (from 10:00 P.M. to 7:00 A.M.) and has been used by several agencies such as the U.S. Department of Housing and Urban Development (HUD) and the U.S. Air Force to determine compatibility of noise with the existing land use.

Noise-sensitive receivers are locations or areas where excessive noise may disrupt normal activity, or cause annoyance or loss of business. Land uses such as residential, religious, educational, recreational, and medical facilities are more sensitive to increased noise levels than are commercial and industrial land uses. The proposed project is located approximately 1.3 miles from the nearest shoreline, well away from any potential sensitive receptors. The nearest residence to the proposed project footprint is approximately 1.5 miles southwest in the El Jardin del Mar community in the City of Pasadena. The closest church to the project area is the Micah Church, located approximately 2.9 miles west-northwest. The closest park to the project area is Goldenacres Park, located approximately 1.3 miles southwest. The closest school to the project area is Bayshore Elementary School, which is located approximately 3.1 miles west-northwest. The closest cemetery is the Seabrook Cemetery, located approximately 2.1 miles southwest. There are no hospitals located in the vicinity of the project study area. Information from the BSCI Section 408 and 204 EA indicates that the mainland adjacent to the project study area is a mixture of suburban residential, open water/undeveloped land, commercial development, and industrial land uses. Development adjacent to Galveston Bay is primarily residential, and includes the communities of Shoreacres, El Jardin del Mar, Bayside Terrace (La Porte), and Morgan's Point. Dense industrial development also exists around the Bayport Ship Channel and Bayport TB. The El Jardin del Mar community in the City of Pasadena, is the nearest residential area to the project area.

The existing sound environment of the area surrounding the proposed project is influenced by numerous waterborne-transportation noise sources, including the operation of ships, barges, commercial fishing vessels, and sport and recreational boats.

3.3.10 Cultural Resources

The cultural resources review for this EA is limited to the proposed project area which consists of the Flare and HSC. The project area is located in Chambers County, Texas which is part of the Southeast Texas Archeological Region of the Eastern Planning Region of Texas (Kenmotsu and Perttula, 1993). The cultural history of the project area has been assigned to four board primary developmental stages: Paleo-Indian (12000 to 8000 BC), Archaic (8000 BC to 100 AD), Ceramic or Woodland (100 AD to 1700 AD), and Historic (1700 AD to the present day). These divisions generally are believed to reflect changes in subsistence as reflected by the material remains and settlement patterns of the people occupying this portion of Texas in prehistoric and early historic times.

The earliest generally accepted culture of the Americas, the Paleondian (10,000–6,500 B.C.), appears to have extended over most, if not all, of North America by the end of the Pleistocene epoch. It has been hypothesized that in Texas the Pleistocene coastline extended as much as 25 miles into the present Gulf of Mexico, and that rivers cut deep canyons into sediments deposited during previous periods of glaciations (Aten, 1983). With the close of the Pleistocene came a period of climatic warming and a consequent rise in sea level as surface water was released from glaciers and polar ice. Paleoindian cultural developments in the Gulf Coastal Plain region, as in most areas of North America, appear to have been intimately related to these gradual but vast changes in the world climate and local environmental conditions.

Occupation of the Texas Gulf Coast during the terminal Pleistocene is evidenced by the recovery of several types of well-made, lanceolate, parallel-flaked projectile points such as Scottsbluff, Clovis, Plainview, Angostura, and possibly San Patrice types. The presence of these distinctive projectile point types along the coastal plain appears to reflect activities that would typically have occurred in areas further inland where the environment is characterized by a mixture of deciduous and pine woodlands (Aten, 1983). According to Aten (1983), this type of habitat typically supports low-density human populations. Archaeological evidence synthesized by Story et al. (1990) from numerous counties comprising the greater Gulf Coastal Plain in Texas, Louisiana, Arkansas and

Oklahoma supports the suggestion that the Paleoindian groups probably existed in small nuclear families or bands which migrated widely in pursuit of seasonal subsistence resources.

When Europeans arrived on the northern Texas coast, they encountered two major native groups, the Atakapa and the Karankawa Indians, who occupied separate territories divided approximately at the western shore of Galveston Bay. The Atakapan, speaking a language of the Tunican family, displayed traits closely related to the natives of southwestern Louisiana. The Karankawan groups spoke a language of the Coahuiltecan family and were more closely related to the Indians further south in Texas and Mexico.

The prehistoric period in the Galveston Bay region lasted until the 18th century when Spanish and French explorers, merchants, and missionaries arrived by using the natural inlets and harbors carved in the Texas coast. Between Galveston Island and neighboring Pelican Island is the Galveston Ship Channel, which formed a natural harbor for sailing vessels and small steamers. The gap between Galveston Island and Bolivar Peninsula offers the principal entrance into Galveston Bay, while San Luis Pass affords a smaller entryway at the Galveston Island's western end.

During the 19th century, Galveston Bay saw massive colonization by European immigrants and the extermination of the indigenous populations through disease and warfare (Aten, 1983; Gadus and Moss, 2000; Story et al., 1990). Many pirates and privateers called Galveston Island home during the 19th century, including the privateer Jean Lafitte. In 1836, four ships of the Texas Navy headquartered on Galveston Island and protected the Texas coast from harassment by Santa Ana and the Mexican Navy (McComb, 1986). Galveston Island was an important harbor during the Civil War. Major General John B. Magruder of the Confederacy recaptured Galveston Island although the Union blockading ships limited commerce in and out of the harbor (Cumberland, 1947). Historical settlement around Galveston Bay originally centered on the Houston area, the northern bay shoreline, and on Galveston Island.

The USS Westfield, a U.S. Navy flagship that ran aground during the Battle of Galveston and scuttled to prevent capture on January 1, 1863, is situated at the merge point of the Texas City Ship Channel and the HSC. USACE undertook several weeks of recovery operations to retrieve artifacts from the USS Westfield in September 2009. During this investigation and recovery Westfield's largest cannon, the 9-inch Dahlgren, was recovered along with five cannonballs from a depth of 48.5 feet below MLLW (47-feet below MLT) near the merge point of the Texas City Ship Channel and the HSC.

From the late 19th century onward, settlement and industry have expanded throughout the area. Most portions of Galveston Bay are in use or have been used by historic settlers within the last 200 years (Gadus and Moss, 2000). Physical modifications associated with excavation and disposal of sediments are the single most obvious manifestation of human impact on Galveston Bay.

By 1900, the Federal government had dredged the HSC, including a 12-foot draft spanning Galveston Bay from the Bolivar Roads, across Red Fish Bar, though the cut at Morgan's Point, and up Buffalo Bayou to Houston. The appearance of oil tankers in the world fleet after WWI resulted in an additional HSC expansion. In close association with the development of the HSC was the creation of a channel to Texas City (Hudson, 1979).

Cultural resource investigation for the proposed project was done in conjunction with investigations accomplished for another local project. In order to identify potential cultural resources within the channel portion of the proposed project, the USACE requested PHA to include the Flare Easing and the then-proposed 250-foot Widener in investigation efforts being performed for the BSC Improvements Project in 2011. HRA Gray & Pape, LLC (HRAGP) of Houston, Texas, conducted a cultural resources survey covering the 4,000-foot radius Flare Easing, the then-proposed 250-foot Widener, and a 500-foot buffer for the Widener, east of that feature. This buffer encompassed the area later proposed for the barge lane relocation. This survey area encompassed the proposed project's Areas of Potential Effects (APE). The investigation consisted of a records review, visual reconnaissance, and an underwater remote-sensing survey of the APE.

Archaeological site files, architectural resource files and previously conducted cultural resource surveys in the vicinity were reviewed in order to identify previously recorded archaeological sites and resources. Since 1991, at least seven marine cultural resource surveys have taken place within 1.6 kilometers (1 mile) of the Preferred Alternative. Aside from a small number of anomalies, no significant cultural resources have been discovered or recorded in the APE. In general, the anomalies encountered were most likely modern debris or naturally occurring bottom features.

Following the literature search, a marine underwater archeological remote sensing survey was conducted in accordance with Federal and local standards. Comprehensive remote sensing survey of the project areas using magnetic and acoustic instrumentation resulted in the identification of 23 magnetic and sonar targets in the APE of the Flare Easing, and 16 magnetic and sonar targets in the APE for the Widener and its buffer. All but two of the targets generated remote sensing signatures suggestive of modern debris or single source isolated objects that were deemed insignificant, and did not warrant further investigation. Two targets (W5, W7) both located in the buffer zone for the Widener, were signatures that were significant enough to warrant either avoidance with a 50-meter avoidance zone around each of the targets in accordance with Title 13 of the Texas Administrative Code (TAC) Chapter 28, Rule 28.2, or further ground-truthing investigations to determine the National Register eligibility if avoidance by the proposed project was not an option.

As documented in the report titled *Remote-Sensing Survey along the Bayport and Houston Ship Channels and Assessment of Two Anomalies for Improvements to the Bayport Ship Channel Project, Chambers County, Texas*, prepared for the USACE by Southeastern Archaeological Research, Inc. (SEARCH) and dated July 2012, the marine remote sensing survey resulted in the identification of three magnetic anomalies that had characteristics similar to that of known shipwrecks. Diver investigations revealed that all three of the anomalies were modern debris. In addition, Target #28/W5, previously identified HRA Gray & Pape in the report titled *Marine Archaeological Survey for the Proposed Bayport Ship Channel Improvement and Flare Projects, Harris and Chambers Counties, Texas*, was also investigated by divers and the source was identified as modern debris. On August 12, 2012, USACE-SWG provided a letter to the Texas State Historic Preservation Officer (SHPO) describing the results of the marine remote sensing survey. Subsequently, the SHPO concurred with these findings on August 22, 2012.

Given the results of the review, survey, and diver investigations, HRAGP recommended that no further archaeological work was required for the remainder of the proposed project's APE and that those portions be cleared to proceed as currently planned. The cultural resource coordination for the area of the existing PAs considered under the proposed project's placement options were previously conducted and documented in the PA 14/15 Expansion EA. This also includes the associated cells proposed for maintenance material. The results of that survey and coordination indicated that no potential for resources is likely and no further investigation was warranted except for one anomaly warranting further investigation was identified at Atkinson Marsh Cell M1.

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4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION

This chapter discusses the impacts to the environment of the alternatives advanced for evaluation in this EA, and any measures proposed to mitigate for impacts to sensitive resources that would be a consequence of project implementation. Since the proposed project consists of new work dredging to implement modifications to an existing navigation channel, and 20 years of operation and maintenance (O&M) of those modifications, any new and initial impacts to ecological resources would occur primarily during the new work dredging to construct the project. Maintenance dredging for the modifications to the channel would only occur in areas initially impacted by new work dredging, and areas of the existing channel already receiving maintenance dredging. Therefore, maintenance dredging for the improved channel would not produce any new impacts, and would consist of the same periodic disturbances experienced during the current maintenance dredging of the HSC and the Flare. The USACE plans to place new work dredged material into PA 14, to raise dikes and create capacity. However, in the event that circumstances arise that make PA 14 unavailable for use during implementation of the proposed project, this chapter also includes evaluation of impacts for using Mid Bay PA. Provisions for using Mid Bay PA as a contingent new work placement area were discussed in Sections 1.1.1 and 2.4.1.2. Also as a contingency, the use of the new work material is proposed for optional use to repair deteriorated dikes at Atkinson Island BU Marsh Cells M7/8/9, and M10, to raise dikes at PA 15, or for the continued construction of the already-planned and approved connection between PAs 14 and 15, as discussed in Sections 1.1.1 and 2.4.1.2. As explained in Section 1.1.1, the repair of existing dikes are categorically excluded according to ER 200-2-2, and the construction of the PA 14/15 connection was documented in the Expansion of PAs 14 and 15 Final EA.

4.1 PHYSICAL ENVIRONMENT IMPACTS

The following subsections describe the potential physical environment impacts of the alternatives advanced for evaluation in this EA.

4.1.1 Topography and Soils

No Action Alternative

The No Action Alternative would continue to result in periodic changes in topography from regular channel maintenance dredged material placement at the PAs proposed for use.

Preferred Alternative

The modifications to the HSC would not impact surface topography, but would have minor bathymetric changes discussed in Section 4.1.3. The total amount of dredged material that would be generated from the construction of the Preferred Alternative is estimated to be approximately 1.94 MCY of new work material. The proposed modifications would result in approximately 228,000 CY of incremental annual maintenance material above what is currently maintained in the existing channel configurations. The preferred placement of new work materials would be in a hydraulic berm along the interior dikes at PA 14. However, project approvals, funding, and timing may result in the strategic placement of new work materials in Mid Bay PA to be used in routine dike raising and repairs. The future incremental maintenance material would be placed in existing PAs including PAs 14, 15, other Atkinson Island PA cells and, Mid Bay when this section of channel is dredged.

While local changes would occur to topography during construction of the Preferred Alternative, these changes would occur on PAs, which are islands located away from the mainland, and would not alter topography or drainage patterns surrounding inhabited areas or land-based agricultural or water resources. Additionally, there are no prime farmland soils in the project area, because it consists of the open waters of Galveston Bay, and the majority of the dredged material PAs are man-made. Considering this, the Preferred Alternative would be expected to have no impacts on the regional physiography and topography of the study area or prime farmland soils and unique farmlands.

Under this alternative, no impacts to native surface soils within the project area would occur. A large portion of the new work material removed from the bay bottom would be clay and some sand. However, this would represent a small percentage of the bay bottom's clay, which is primarily the Beaumont Formation covering much of Galveston Bay. Considering this information, the Preferred Alternative would result in no impacts to topography or soils.

Over the 20-year maintenance period, no impacts would be anticipated as a result of periodic maintenance dredging and placement events, the Draft Dredged Disposal Management Plan (DMMP) indicates that there is sufficient capacity within the existing PAs to maintain the HSC and BSC, including the proposed modification, for the next 20 years.

4.1.2 Geology

No Action Alternative

The No Action Alternative would not impact geology within the study area.

Preferred Alternative

Dredging to construct the modifications to the HSC would minimally impact the local geology by redistributing existing bay bottom clays and sediments, causing potential increases of local shoaling rates within the HSC. Net changes to the local or regional nature of the existing geology of the study area would be minimal. Additionally, there would be no impacts or changes to geologic hazards such as faults and subsidence.

Over the 20 year maintenance period, no new impacts would occur as a result of periodic maintenance dredging and placement events. Maintenance activities would only affect areas previously disturbed during the initial construction of the project.

4.1.3 Bathymetry

No Action Alternative

The No Action Alternative would have the same changes to local bathymetry from maintenance dredging of the existing HSC and Flare over the next 20 years. These would be limited changes within the existing HSC and Flare.

Preferred Alternative

Constructing the corrective actions under the Preferred Alternative would result in local bathymetric changes within and adjacent to the existing BSC. These changes would be small compared to the scale of regional bathymetry. The raising or repair of the dikes on existing PAs would result in no net changes in bathymetry from the No Action Alternative.

While local changes to bathymetry and topography would occur from construction of the proposed modifications to the channel and construction or repair of placement features, these changes would be expected to have minimal impacts on the regional bathymetry of the submerged portions of the study area.

Over the 20 year maintenance period, no new impacts would occur as a result of periodic maintenance dredging and placement events. Maintenance activities would only affect areas previously disturbed during the initial construction of the project.

4.1.4 Physical Oceanography

The following subsections described impacts of the alternatives on physical oceanographic processes in the Bay.

4.1.4.1. Tides, Currents, and Water Level

No Action Alternative

The No Action Alternative would not impact the tides, currents, or water level in the project area.

Preferred Alternative

The proposed action involves deepening and widening existing portions of the Flare and channel that is volumetrically small compared to the volume of Galveston Bay. The proposed action also does not involve putting in new bathymetric features in the Bay that would interfere with tidal exchange, increase shoreline currents, or change the littoral transport in the Bay. The proposed action does not change the freshwater input or wind driven circulation within the project area. Therefore, no impacts to tides, currents, and associated processes, are anticipated.

Although the size of the corrective actions are negligibly small compared to the volume or the tidal prism of the Bay and would have negligible influence on water level, the Preferred Alternative will deepen, and not fill, portions of the current HSC System. Therefore, the bathymetric change would be shallower water to deeper water only over an isolated segment of navigation channel in the middle of open Bay waters. As such, it would not impact storm surge and/or coastal flooding adversely. Since it is not a part of any riverine channel, it has no potential to alter riverine flow or floodplains. Therefore, no impacts to flooding from altering water levels in the Bay during storm conditions are expected.

4.1.4.2. Salinity

No Action Alternative

The No Action Alternative would not impact salinity within the project area.

Preferred Alternative

The proposed action does not involve changing any freshwater inflow related sediment transport and doesn't alter any littoral sediment budget or transport processes in the floodplain. The Preferred Alternative will not alter or change saltwater flows in the HSC System or Galveston Bay as the corrective actions are negligibly small compared to the volume of inflows and outflows of water through the HSC System and Galveston Bay. Also, these modifications do not extend any deepening of the HSC further upstream that would move any salt wedge formation in the water column further upstream.

4.1.4.3. Relative Sea Level Change

No Action Alternative

Under the No Action Alternative, the estimated change in sea level over 50 years discussed in 3.1.4.3 would occur, and range between 1.37 feet and 3.18 feet, depending on the rate of change scenario assumed. There would be no proposed project that would be impacted, but existing projects could experience some impact, and several possible effects to the Bay environment could occur. Existing tidal wetlands could be inundated. New wetlands could develop where the shoreline is not armored or altered by development. Tidal amplitude could increase due to an increase in depth that reduces the effects of bottom friction. The increase in tidal amplitude could in turn increase tidal current velocities and erosion at the shoreline. Given the elevation range of tidal wetlands, and the scale of sea level change predicted, these effects would be expected to occur only under the highest rates of change.

Preferred Alternative

The potential for RSLC impacts on the proposed project is minimal as the increase in RSLC is relatively small. There may be a slight increase in currents and potential increase in shoaling rates; however, these would be minimal and difficult to measure. The calculated low historic rate over the 50-year period of analysis is 1.37 feet and the high rate is 3.18 feet. Nevertheless, increasing RSLC would not impact the function of the corrective actions or purpose of the proposed action, which is to correct navigability problems around the intersection of the HSC and BSC, which would benefit from increase depths of water. A rise in sea level would increase draft and water depth; however, this increase is expected to be small at less than one and one-half foot.

Impacts on surge levels due to the project, with and without RSLC, are expected to be minimal. The lack of effect on storm surge from proposed corrective actions is explained in Section 4.1.5.1. The dredged material would be placed into existing PAs that are well above the elevation where surge would be a factor; therefore, the dredged material placement plan would not impact future RSLC. The PA 14 dikes would be raised from +21.5 feet MLLW (+23 feet MLT) to an elevation of +24.5 feet MLLW (+26 feet MLT) dike. Therefore, the projected increases in sea level are unlikely to require any dike modifications at PAs where material would be used to raise dikes. RSLC might require a review of constructed dike revetments to see if the higher elevations of frequent waves or storm event waves warrant a revision to the location or sizing of stone. None of these considerations would change how material from this project would be used for repairs. Repairs to the current dike sections would still be needed, and material from this project would still be used for those repairs. Therefore, impacts on the Preferred Alternative from RSLC will be minimal.

4.1.5 Water and Sediment Quality

This section describes the effects both alternatives would have on water and sediment quality, in consideration of the existing condition and proposed activities under each alternative.

4.1.5.1. Water Quality

No Action Alternative

No construction would occur under the No Action Alternative. Only the periodic maintenance dredging and dredged material placement already performed for the HSC System occurring over the next 20 years, and the temporary and localized effects due to increases in turbidity associated with those actions, would continue. Because the expansion of PAs 14 and 15 is a project already planned and approved for implementation by the USACE Galveston District, the connection between PAs 14 and 15, and Atkinson Marsh Cell M11, as well as other planned marsh and placement cells, would eventually be built. Therefore the temporary and localized effects due to increases in turbidity associated with those actions would also occur.

Preferred Alternative

Dredging the corrective actions under the Preferred Alternative would result in minimal impacts, but would not be expected to degrade the long-term water quality in or near the HSC and BSC intersection resulting from the dredging activity. These effects would be consistent with those that would occur during normal maintenance dredging operations and planned PA construction occurring in the No Action Alternative. Temperature, salinity, and density distribution patterns would temporarily be affected as a result of water column mixing during dredging and placement activities. These patterns would return to their previous condition following completion of dredging. Any impacts to the distribution patterns for these water quality parameters from dredging would be minimal.

Short-term changes in dissolved oxygen (DO), nutrients, and contaminant levels could occur due to mixing and disturbance of sediments into the water column during dredging and dredged material placement. Temporary decreases in DO concentration could occur during and immediately after dredging due to the movement of anoxic water and sediments through the water column. Temporary DO decreases could occur due to short-term increases in organic material in the water column, and the associated aerobic decomposition. These minimal impacts would be expected to be limited to the immediate vicinity of dredging and dredged material placement. Contaminants present in the surface sediments would be temporarily suspended during dredging and placement activity. However, considering the sediment and elutriate data discussed in Section 3.1.5.2, almost all contaminants detected in more recent results have been below screening thresholds or other thresholds of concern, and detected contaminants are typically of low solubility. Dioxin/furans have been detected in sediment samples, and are low concentrations in the single ppt range. Therefore, levels of sediment contaminants are expected to be predominantly low. Once the dredging activities stop, disturbed material would settle, and DO, nutrient, and contaminant concentrations would return to pre-disturbance levels. These impacts would be minimal and similar to impacts occurring during the periodic maintenance dredge activity and placement that currently takes place in Galveston Bay. Therefore, temporary effects are expected from dredging due to short-term changes in DO, nutrients, and contaminant levels.

Dredging could cause short-term increases in turbidity. However, numerous studies indicate that dredge-induced turbidity plumes are, more often than not, localized, spreading less than a thousand meters from their sources and dissipating to ambient water quality within several hours after dredging is completed (Higgins et al., 2004). A literature review of dredging operation effects on suspended sediments found that in almost all cases, the vast majority of re-suspended sediments resettle close to the dredge within an hour (Anchor Environmental CA L.P., 2003). The anticipated dredging technique for this project would be hydraulic cutterhead dredging, which generally produces small plumes that rapidly decay (USACE ERDC, 2002). Properly operated dredges can confine elevated suspended bottom sediments to several hundred meters from the cutterhead with levels dissipating exponentially towards the surface with little turbidity actually reaching surface waters, and in many cases, at concentrations no greater than those generated by commercial shipping operations or during severe storms (Higgins et al., 2004). Therefore, only temporary, minor effects are expected from dredging due to increased turbidity.

4.1.5.2. Sediment Quality

No Action Alternative

Under the No Action Alternative, sediment quality would continue to reflect the effects of sediment input from San Jacinto River and upstream HSC outflows, which are the main sources sediment in this uppermost part of the Bay (Tate *et al.* 2008), and waterborne spills. The spill records discussed in Section 3.3.7 HTRW has indicated infrequent small-scale liquid spills, and occasional loss of ATON batteries. The existing sediment quality data discussed in Section 3.1.5.2 has not indicated long term impacts or impairment. Therefore, the same general quality trend would be expected to continue. Sediments at the depths of interest for the proposed project are those from the top of the bay bottom to an elevation of -50.5 feet MLLW (-49 feet MLT). These are comprised of unconsolidated deposited sediments located at the top that typically form the maintenance material layer, and underlying native geological layers typically composed of medium to very stiff clays with various lenses or pockets of sand, soft clay, or variations of this (e.g. sandy clay, clayey sand), which typically constitute the new work material. Because of the nature of waterborne spills, which reach top layers first, in the absence of impacts on the top layers, deeper, native layers would not be expected to be impacted, as corroborated by new work material sampling results for the BSC, discussed in Section 3.1.5.2. Therefore, the underlying native geological material would be expected to continue to reflect no contamination problems.

Preferred Alternative

Since the Preferred Alternative will involve excavating the existing new work material, it will not alter the quality of surrounding sediments or underlying native material. With respect to suitability of the new work material proposed to be dredged for the proposed placement, the following subsection discusses this determination.

Determination of Suitability of New Work Dredged Material for Placement

The previous sediment sampling data discussed in Section 3.1.5.2 Sediment Quality was from sampling events in the local area near the Preferred Alternative footprint. Subpart G of 40 CFR 230, which provides the dredged material evaluation and testing procedures in the 404(b)(1) Guidelines, and USACE RGL 06-02, discussed in Section 3.1.5.2, provide policy for determining the need to test dredged material and considerations for using previous testing data to establish whether or not there is a reason to believe that material to be dredged and discharged contains contaminants with the potential to cause an unacceptable adverse impact. The USACE ERDC conducted an extensive analysis of the previous testing information including the recent new work material testing and past maintenance material testing on the HSC, and factors affecting contaminant source, transport, exposure pathways, and receptors, using a LOE and WOE approach. Data collected and reviewed for the analysis, relevant to the factors listed in the 404(b)(1) Guidelines, included database searches of potential contaminant sources, sites, and spill records similar to the AAI database search discussed in Section 3.3.7, locations of wastewater outfalls, mineral activity and infrastructure, site geotechnical and geological data, PA design information, and ecological resources and receptors. These LOE were analyzed in a framework that considered risk-based factors such as pathways, exposure, and receptors, applying a WOE approach to determine whether results show that a stressor, such as contaminants, has caused or could cause a harmful ecological effect. The LOE/WOE analysis concluded that there was no reason to believe that the proposed dredging and placement will mobilize contamination to cause adverse effects, and that further testing of material is not required. This analysis was pursuant to Subpart G of the 404(b)(1) Guidelines, and the USACE RGL 06-02 and is provided in Attachment 6 of this EA.

Maintenance Material

Maintenance dredging to remove unconsolidated sediments on the bay bottom surface during normal maintenance cycles would involve material more subject to environmental contamination, as discussed before. However, the USACE routinely collects water and sediment samples under their maintenance dredging program to ensure there are no causes for concern.

The upper HSC (north of Mid Bay PA) and Flare maintenance materials are routinely placed in PAs 14 and 15, Atkinson Island PA Cells, and Mid Bay. Therefore, these PAs receive maintenance material from the same channel and from the same upper part of the Bay as the proposed action. Therefore, the proposed action would not be expected to alter the nature of the maintenance material already being placed into these PAs. Considering this, maintenance dredging performed over the next 20 years as part of the periodic maintenance of the corrective actions under the Preferred Alternative, would not be expected to result in more suspension and dispersal of sediments as compared to the No Action Alternative, or natural storm, flood, and tidal events.

Conclusion

In summary, the following points from the previous information can be considered:

- There is not a reason to believe new work material used to raise or build dikes would be contaminated and therefore, the Preferred Alternative would not result in adverse impacts from new work material placement.
- Hydraulic dredging produces small, localized, rapidly decaying suspended sediment plumes, which are expected to be considerably smaller and of shorter duration than what storm, floods, and tides already cause.
- The upper HSC main channel and Flare currently receive maintenance dredging, with placement into the PAs identified for use for the proposed action, and the proposed action would not change the nature of the material going into these PAs. The maintenance material is routinely tested by the USACE and PHA to ensure there are no concerns for material placement.

Considering these factors, new work or maintenance dredging under this alternative would not be expected to have adverse impacts.

4.2 BIOLOGICAL RESOURCES IMPACTS

The following sections describe the anticipated impact to biological resources within the project area and the mainland surrounding the project area. New work material placement would occur in PA 14, or Mid Bay as a contingency, and maintenance material placement would occur in PAs 14, 15, and other Atkinson Island PAs and marsh cells, and Mid Bay under the Preferred Alternative. Any associated wetland impacts for their initial construction have already been accounted and mitigated for these existing PAs and marsh cells.

4.2.1 Vegetation

4.2.1.1. Terrestrial

No Action Alternative

No changes to terrestrial vegetation would occur under the No Action Alternative.

Preferred Alternative

The proposed modifications to the HSC would impact no vegetation. Raising and/or repairing the existing PAs would have no impacts on terrestrial vegetation from the construction of this alternative or the associated maintenance over the next 20 years at these established and regularly used PAs,.

4.2.1.2. Wetlands

No Action Alternative

No changes to wetlands would occur under the No Action Alternative other than the continuing construction and development of BU marsh cells at Atkinson Island, which would add estuarine marsh.

Preferred Alternative

No impacts to wetlands would occur as a result of the proposed dredging to implement modifications to the HSC.

No wetland impacts would occur from the associated maintenance over the next 20 years and are similar to the No Action Alternative.

4.2.2 Wildlife

4.2.2.1. Terrestrial

No Action Alternative

No changes to terrestrial habitat would occur under the No Action Alternative.

Preferred Alternative

No loss of upland habitat is anticipated as a result of the proposed new work channel dredging. Dredged maintenance material placement into the existing PAs 14, 15, the PA 14 15 connection, Atkinson PA cells, future M11, and Mid Bay, would not impact native habitat. Any vegetation that may become established between maintenance uses of these active PAs would be temporary in nature at best.

Wildlife (e.g., foraging or nesting avian species, raccoons) may be temporarily displaced during dike construction and PA use. Noise and light associated with the raising and repair of dikes at PA 14, 15, Mid Bay and the Atkinson Island PA cells would be expected to affect wildlife behavior, as would the general increase in human activity. Construction impacts would be considered minimal in these areas that are subjected to routine dredged material placement disturbances. Measures to minimize disruption of nesting and foraging for migratory birds during the appropriate time windows would be implemented.

4.2.2.2. Aquatic

No Action Alternative

Aquatic habitat within the project area includes open-bay water, open-bay bottom, intertidal (e.g., marsh, mudflat), wetlands (salt marsh), and oyster habitat. No new changes to aquatic habitat would occur under the No Action Alternative, and there would be no new impacts beyond what occurs during routine, periodic maintenance for the existing channel. However, continuing construction and development of BU marsh cells at Atkinson Island, would add estuarine marsh, which would benefit the aquatic environment.

Preferred Alternative

Aquatic habitat within the project area and vicinity includes open-bay water, open-bay bottom, intertidal (e.g., marsh, mudflat), wetlands (salt marsh), and oyster habitat. There are no special aquatic sites regulated under 40 CFR 230 such as sanctuaries and refuges, coral reefs, mudflats, vegetated shallows, or riffle and pool complexes present within the project footprint. Portions of the aquatic habitat in the project area would be directly impacted by the proposed modifications to the channel, including impacts to oyster habitat, presented below. Temporary and minimal impacts to aquatic life in the project area and immediate project vicinity similar to what occurs during existing channel maintenance dredging could occur as a result of increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. Turbidity may temporarily affect the respiration, foraging, and/or reproductive capability of some species. Construction vessel traffic could increase wave activity and water uptake/discharge, while construction activity may also result in temporary avoidance of the construction area and a temporary and very localized reduction in marine life production. Dredging activities would be intermittent and localized. These impacts are considered temporary and of short duration.

The raising of the PA 14 dike or Mid Bay PA under the new work dredged material placement plan for this alternative would not permanently impact aquatic habitat. The PA dikes are created containment berms seeded with erosion control turf grass and armored with riprap on their exterior. Repairs to marsh cell dikes would be to previously constructed containment dikes that have eroded or slumped away. The use of new work material to repair marsh cell dikes, and the use of maintenance material from the Preferred Alternative to fill marsh cells would contribute to the continuing construction and development of BU marsh cells at Atkinson Island, which would add estuarine marsh that benefits the aquatic environment. However, no new marsh cell footprints are proposed outside the current 20 year plan under the No Action Alternative.

4.2.2.2.1. Benthic

No Action Alternative

No new impacts to benthic habitat would occur beyond what occurs during routine, periodic maintenance for the existing channel, under the No Action Alternative.

Preferred Alternative

The benthic habitat in the project area and adjacent areas is comprised of featureless soft-bottom substrates likely dominated by benthic infauna, such as polychaetes and amphipods. It can be assumed that dredging the corrective actions would result in 100 percent mortality to benthic infaunal communities present in the dredged material footprint. The resultant turbidity and settling from dredging has the potential for smothering sessile benthic organisms and/or inhibiting filtration functions required for respiration and nutrition. The temporary lower DO concentrations that could result from temporary suspension of organic material during dredging could cause a temporary displacement of mobile organisms and may stress or cause mortality to sessile organisms. As discussed in Section 4.1.4, these effects would be temporary and minor given the nature of hydraulic dredging, as suspended sediments would return to background levels within a short time frame, and would be similar to what occurs during existing channel maintenance dredging. This would also apply to the periodic maintenance dredging over 20 years. Furthermore, it is assumed that marine organisms present in upper Galveston Bay have adapted to the naturally occurring yet highly variable turbidity levels caused by dynamic freshwater and tidal inputs compounded by strong wind driven currents which are typically observed.

As the HSC is already an existing active navigational channel which undergoes routine maintenance dredging, the benthic community that is present is likely adapted to frequent dredging disturbance. The BSCCT FEIS noted that recovery of benthic infauna has been observed as quickly as 18 months following disturbance in experimental dredge plots in upper Galveston Bay. As such, the impact to benthic infauna would be considered a temporary, short-term impact.

Under the Preferred Alternative, new work dredged material placement to raise dikes would be on existing PA dikes well outside of the water column. Therefore, no impacts to benthic habitat from new work material placement would occur, and sediment suspension within open water, and associated effects to sessile organism, would be minimized. Dredged maintenance material placement would occur in interior areas of PAs or constructed marsh cells, within existing dikes, whose impacts have been previously described and accounted for as part of other ongoing USACE dredge projects in Galveston Bay. Maintenance material placement would result in no additional impacts to the benthic marine community. Therefore, over the 20-year maintenance period, no new or additional permanent impacts would occur as a result of periodic maintenance dredging and placement events.

In summary, the dominant infaunal species within Galveston Bay are opportunistic species expected to rapidly recolonize the area following disturbance. Therefore, only temporary impacts to the soft-bottom open-bay community from constructing the proposed modifications to the channel and placing new work and maintenance material under the Preferred Alternative would occur.

4.2.2.2.2. Fish and Other Pelagic Fauna

No Action Alternative

No new impacts to finfish or pelagic fauna, beyond what occurs during routine, periodic maintenance for the existing channel would occur under the No Action Alternative.

Preferred Alternative

During construction, only temporary disturbances and minor, temporary impacts associated with dredging would occur. Disturbances to finfish such as from noise and light during construction dredging would be temporary. Given their high mobility, finfish would be able to readily avoid impacts of the dredging activity. Impacts to free-floating or limited-mobility pelagic fauna, such as phytoplankton, macroalgae, zooplankton, and fish eggs /larvae, would be temporary and minor. These impacts, such as entrainment into cutterheads or vessel cooling water intakes and discharges would be temporary and minor, because the amount of water exchange involved is volumetrically insignificant compared to the Bay, and the ubiquity and high turnover in populations of these types of fauna would quickly replace any impacted organisms. These temporary impacts are the same that occur during maintenance dredging under the No Action Alternative. No permanent or long term impacts on finfish and other pelagic fauna would result from implementing the Preferred Alternative. Considering this, impacts on pelagic fauna would be temporary and minor.

4.2.2.2.3. Oyster Reefs

No Action Alternative

No new impacts to oyster reefs would occur under the No Action Alternative.

Preferred Alternative

The Preferred Alternative dredging to implement modifications to the channel would result in removal of both consolidated oyster reef and shell hash habitat that have been verified within the project footprint. Additional detail regarding the results of extensive habitat mapping and characterizations are available upon request. If not mitigated for, this would be a permanent impact to the local oyster reef habitat; however mitigation of these impacts will include rehabilitation of healthy oyster reefs damaged by Hurricane Ike and construction of reef pads in nearby San Leon Reef. Further detail regarding oyster mitigation is described in Section 4.4.

Geospatial data developed from the side-scan and ground-truthing survey described in Section 3.2.2 was analyzed using the preferred alternative geospatial extent data and a geographic information system (GIS) to determine acreages of direct impact within the footprint of the corrective actions (to the planned proposed channel top-of-banks) (Exhibit 3.2.2-1). Estimates of directly impacted oyster habitat within the area of the correction actions total 29.9 acres of high density and consolidated reef. This constitutes an adverse impact to a significant resource and would be fully mitigated if the project is constructed.

Indirect impacts from turbidity and sedimentation could occur to the oyster habitat down-current from the directly impacted areas, but are expected to be minimal, considering literature reviewed and the extensive presence of reef directly adjacent to the HSC system. Turbidity can inhibit successful filter-feeding and spawning activity while excess sedimentation can prevent efficient settlement and recruitment over existing consolidated reef and shell hash substrates. However, these effects from hydraulic dredge induced turbidity are expected to be minimal, considering the literature discussed in Section 4.1.4. The vast majority of suspended particles would be expected to resettle close to the dredge area and turbidity would be concentrated at the bottom of the water column. In another study of total suspended solid (TSS) around a hydraulic dredge in the vicinity of oyster beds in Calcasieu Lake during maintenance dredging of a navigation channel, results showed no discernible differences in concentrations upstream, parallel to, and downstream of the dredge, indicating the dredging operation had no influence on TSS (USACE New Orleans District, 2007). Results of earlier densitometry surveys from this study indicated silt suspension during maintenance dredging was confined to the deep parts of the channel. These results are expected because hydraulic cutterhead blades are designed to direct loosened material efficiently toward the suction intake.

With the exception of a few smaller complexes, reef within the part of Upper Galveston Bay that the project is located in, is almost exclusively located directly adjacent to the navigation channels of the BSC and HSC. This is clearly observed in the 1991 historical mapping of reef by Texas A&M University at Galveston (TAMUG), and was corroborated in the oyster survey side scan sonar data that was later groundtruthed by diver for this project. The channel margins are covered with extensive reef, and the trend is observed along the HSC south of the project area. The HSC was widened and deepened under the HGNC Project between 1998 and 2008, and extensive HSC adjacent reef was still observed in the sidescan sonar data for this project collected in 2011. Considering the extensive reef coverage directly adjacent to the channels, and considering that these channels are periodically dredged for maintenance (which would involve higher percentages of unconsolidated fines), the new work dredging required for construction of the proposed project and subsequent maintenance dredging would not be expected to result in reef losses due to turbidity effects, and only minimal impacts would occur.

The Preferred Alternative placement would not impact additional oyster habitat as all material would be placed into existing emergent PAs or marsh cells. As a result, no impact upon oyster habitat is expected from the placement of dredged material during initial construction or periodic maintenance dredging events over the 20-year maintenance period.

4.2.3 Essential Fish Habitat

No Action Alternative

No impacts to EFH would occur under the No Action Alternative. Continuing construction and development of BU marsh cells at Atkinson Island, would add estuarine marsh, which would benefit primary productivity for juvenile stages of several managed species, including red drum and shrimp species.

Preferred Alternative

The proposed corrective actions by necessity have to be located adjacent to the current channel and Flare. EFH has been described over broad spatial scales throughout the coastal Gulf of Mexico region; therefore it is difficult to propose any large scale project without impacting EFH for some species.

The majority of impacts to managed species and their associated EFH would be limited to the estuarine benthic environment where the actual dredging would take place, as well as temporary impacts to the water column as a result of increased turbidity. The life stages anticipated to be most impacted are the eggs and larval stages, with those utilizing benthic habitats within the dredged footprint expected to have 100 percent mortality. The majority of the juvenile and adult lives stages present in the project footprint are primarily forage and pelagic species capable of detection and avoidance behavior when exposed to unfavorable conditions. It is expected that construction of the proposed project would not have any direct impacts to juvenile and adult fish other than a temporary displacement, and individuals would re-inhabit temporarily affected areas upon dredging completion. No aquatic vegetation has been identified in the dredged or adjacent buffer zone areas, therefore no impacts to seagrass or the nursery habitat it provides to juvenile fish would occur from the proposed project. Therefore, only minimal impacts to benthic EFH are expected to occur.

The dredging would occur in the estuary of Galveston Bay, which is a nursery area for some species known to inhabit the GOM. The degradation of coastal and estuarine EFH habitats is associated with the following:

- Temporary disturbance and displacement of fish species;
- Increased sediment loads and turbidity in the water column;
- Temporary loss of benthic food items to fisheries;
- Limited disruption or destruction of oyster habitats; and
- Limited sediment transport and re-deposition.

For the purposes of this project, most of the above effects are temporary and likely either offset by environmental protection guidelines, or are negligible considering the localized effect of the actions compared to the proportional area of the Gulf that would be unaffected. In this sense, the coastal and marine environmental degradation from the proposed action would have minor effects on designated EFH or commercial fisheries.

Turbidity generated by the project could affect the foraging behavior of visual predators and the efficiency of filter feeders. The turbidity plume would be expected to migrate only a short distance and cover a small area relative to the total pelagic habitat area available to managed species, and dissipate quickly due to prevailing water circulation and the nature of hydraulic dredging proposed to be used for the Preferred Alternative, which was discussed in Section 4.1.4. The impact to the water column EFH would be considered minor and short-term.

Deposition of suspended sediments could partially or entirely bury shellfish and other sessile organisms. Although existing oyster reefs within the footprint of the dredged areas would be lost, mitigation is proposed as described in Section 4.4. If not mitigated for, this would be a permanent impact. Oyster reefs near the project area may be indirectly affected by the temporary increased turbidity during the dredging operations, but long-term effects to oyster reefs are not expected from the proposed project. In fact, accretion of oyster reefs in areas adjacent to the corrective actions is probable considering the high occurrence of this habitat within close proximity of other anthropogenic activity in Galveston Bay, and extensive reef signature visible along the current channel side slope margins seen in 2011 side scan imagery performed for reef delineation for this project. Regrowth of reef was visible in this imagery in the existing east barge lane, originally dredged in 2004, and would be expected to reoccur in the relocated barge lanes provided by the barge lane relocation. The details of oyster habitat impacted for this alternative are discussed in Section 4.2.2.2.3 above.

The proposed new work dredged material placement will be beneficially used for raising or repair of dikes in existing PAs or marsh cells.

The proposed project is not in or near any of the areas identified as HAPC. These areas are all located offshore. Therefore, no impacts to HAPC are anticipated through the completion or maintenance of the proposed project.

Over the 20-year maintenance period, no new or additional impacts would occur as a result of periodic maintenance dredging and placement events. However, the use of new work material for marsh cell dike repair and filling of marsh cells with maintenance material from the project would enable and contribute to the continuing construction and development of BU marsh cells at Atkinson Island. This would add estuarine marsh, which would benefit primary productivity for juvenile stages of several managed species, including red drum and shrimp species. This would also occur in the No Action Alternative.

4.2.4 Commercial and Recreational Fisheries

No Action Alternative

No new impacts to commercial and recreational fishing would occur under the No Action Alternative.

Preferred Alternative

No commercial or recreational fishing would be allowed to occur within and near the dredging operations. The commercial fishing widely done in Galveston Bay is trawling for shrimp. The trawlers typically avoid active shipping lanes and would be required to avoid the areas of dredging and placement operations. Other shellfish species frequently landed include blue crab and eastern oyster. The area of the proposed project is within an area restricted to shellfishing, and is closed to the harvesting of shellfish for direct marketing. Therefore, the actual dredge operation would have no impacts on any commercial fishing that might be done in the project area.

All recreational fishing would not be allowed within and near the dredging and placement operations. The entire HSC and upper Galveston Bay is within a consumption advisory area for blue crabs, and the entire Galveston Bay is within a consumption advisory area for all catfish species as well as spotted seatrout. The HSC system already supports extensive vessel traffic and is a focal point for commercial marine transport in the Galveston Bay system. While the recreational landings associated with Galveston Bay account for 35 percent of the State total, it is unclear how much of this fishing is actually done within or near the project area. The recreational fishing could resume upon completion of dredge operations. Therefore, no disruption to recreational fishing is expected to occur during the initial construction or periodic maintenance dredging events over the 20-year maintenance period.

4.2.5 Threatened and Endangered Species

No Action Alternative

No new impacts to Federal or State-listed threatened or endangered species would occur under the No Action Alternative.

Preferred Alternative

No federally or State-listed plant species occur within the proposed project area. No impact to listed plant species is anticipated as a result of the proposed project, either from the modifications to the channel, or dredged material placement over the 20-year maintenance period.

Species with a Federal status of threatened or endangered that may be present within the proposed project area include the Kemp’s ridley sea turtle, loggerhead sea turtle, and green sea turtle. Other species listed are not likely to occur in the vicinity of the project due to lack of suitable habitat or the area is beyond their known range limits. There is no designated critical habitat for any of the listed species within the project area. The proposed project area does not involve habitat required for Federally-listed terrestrial (e.g. Sprague’s pipit) or oceanic species (e.g. Blue whale, coral). For species using habitats potentially present in estuaries, the specific habitat required for regular use by most of those species is not present within the proposed project footprint, including those for the Piping plover, Rufa Red knot, and West Indian manatee. The current known range of the Smalltooth sawfish is limited to the Florida peninsula. The effects of the project on Federally-listed species are considered in detail in the BA provided in Appendix 5. Though it is not likely that the listed marine and shorebird species would be encountered within the project area, their presence in the area is possible. USACE contract specifications for this project would contain advisory language for construction contractors to be aware of the possible presence and contact numbers for the USFWS's Houston Coastal Ecological Services Field Office, or the Marine Mammal Stranding Network to call immediately in the event of encountering the species. This is discussed in more detail in Section 6.8, Endangered Species Act, in this EA. Of the Texas State listed species that are not also listed on the Federal list of protected species, the reddish egret and white-faced ibis may also occur within the area. The proposed project area does not include any nesting habitat for any of the species and all of the species are highly mobile and can easily avoid construction activities. Large expanses of similar habitat are located adjacent to the proposed project area for displaced individuals.

The HSC is currently an active commercial shipping channel capable of receiving high frequencies of relatively moderate sized vessels. Cutterhead dredges (non-hopper) are proposed for use on this project for both construction and maintenance. A Regional Biological Opinion (RBO), dated November 19, 2003, by the NMFS for the Galveston, New Orleans, Mobile, and Jacksonville Districts of the USACE concluded that non-hopper dredges are not known to take sea turtles (NMFS 2003). As such, the proposed project would have no effect on any listed sea turtle species within the area.

4.2.6 Invasive Species

No Action Alternative

No new impacts to habitats from the introduction of invasive species would occur under the No Action Alternative. Current commercial and dredge vessel transit and activity would continue.

Preferred Alternative

Channel modifications would not result in increased vessel traffic, and therefore not alter the ballast water discharge that occurs under existing conditions under the No Action Alternative. All vessels are subject to the Ballast Water Management Regulations as applicable in 33 CFR Part 151 Subpart D for the protection to the spread of non-indigenous species, except those meeting exemptions for situations where the risk is reduced or avoided. The additional potential for introduction and spread of invasive marine species due to a one time construction event would be negligible, especially given the ballast water management regulations. The Preferred Alternative would have no impact on propagation of invasive species.

Invasive species typically thrive in disturbed environments like active PAs, which undergo periodic use that destroys or impacts invasive species. Based upon the ubiquity and amount of invasive species already in the region in which the project area is located, the potential for introduction and spread of invasive terrestrial species is considered a minor impact. Over the 20-year maintenance period, no new or additional impacts would occur as result of periodic maintenance dredging and placement events.

4.3 HUMAN ENVIRONMENT IMPACTS

A summary of potential human impacts within the project area as well as the surrounding area is presented in the section below. The scope of this review includes an analysis of the area's socioeconomics, environmental justice, community and recreation resources, air quality, noise and vibration, and cultural resources as well as other categories.

4.3.1 Socioeconomics

No Action Alternative

Under the No Action Alternative, the proposed corrective actions would not be implemented; therefore, improvements to the safety and mobility of the HSC would not be improved. Chambers County would continue to have similar population and socioeconomic trends.

Preferred Alternative

The Harris-Galveston shoreline is the County border; the proposed project is approximately 10,500 feet (2 miles) from the shoreline. Minimal impacts are expected to the human environment because all work will be located in the open water (Galveston Bay) and uninhabited man-made dredged material placement islands in Galveston Bay. The Preferred Alternative would likely have a negligible effect on population growth trends within surrounding cities, and counties in which is located near the project. Most of the construction workers are likely to come from the existing labor force, which already lives within Gulf Coast area; therefore, no change to employment in the region is expected. As a result of this project, a small increase in jobs in the region, associated with construction, is expected, but permanent impacts to local resources are not expected to change. No impacts would be expected as a result of maintenance dredging events over the 20-year maintenance period.

4.3.2 Environmental Justice and Protection of Children from Environmental Health Risks and Safety Risks

No human population currently exists in the mapped Census geographic areas within the project area. As shown in Table 3.3.2-1, Chambers County is 70.6 percent White and the median household income is $72,489, almost three times above the 2015 HHS poverty level; therefore, generally speaking at the County level this area is not considered a high minority or low-income area. Also, there are no populations of children or facilities built for children (e.g. schools, daycare) in the project area.

No Action Alternative

No impacts to environmental justice populations are anticipated to occur under the No Action Alternative.

Preferred Alternative

Minimal impacts to the human environment are expected, because all work will be located in the open water (Galveston Bay) and an uninhabited man-made dredged material placement islands in Galveston Bay. Therefore, impacts to minority and low-income individuals or families living within Chambers County would experience no adverse changes to the demographic, economic, or community cohesion characteristics. Also, as discussed in Section 3.3.2., information from the BSC Improvements Project Section 204 and 408 EA for the populated census tracts nearest to the Preferred Alternative did not identify ethnicity or income indicators of EJ populations. Considering that there are no populated tracts in the project area and that the nearest populated tracts do not have EJ population indicators, the proposed action would not result in disproportionately high and adverse impacts on minority and low-income persons living within the surrounding communities. Over the 20 year maintenance period, no new or additional impacts would result from maintenance dredging and placement events. Because there are no populations of, or facilities built for, children, there will be no direct impact on children from environmental and safety health risks. There will be no indirect environmental or safety impacts either, as dredged material placement will be in PAs that are uninhabited and inaccessible to children due to their location. Therefore, there would be no disproportionate effects to children from health and safety risks.

4.3.3 Community and Recreational Resources

The proposed project is located in the open water and uninhabited man-made dredge sediment placement islands. Impacts to surrounding terrestrial community and recreational resources are not expected. The proposed project will relieve congestion and associated delays around the intersection of the HSC and BSC, increasing the efficiency of transit through this part of the HSC system. Any economic impact would be expected to be positive but small, since it is only a local improvement to vessel travel and not improvement of the rest of the channels or terminal facilities. The positive economic impact to the regional community would be expected to be limited to slight reduction of operational costs to shipper.

No Action Alternative

Under the No Action Alternative, no impacts would occur to community and recreational resources from new construction, and the same existing conditions and pattern of use of these resources as currently happens would continue to occur.

Preferred Alternative

The Preferred Alternative is not expected to have any direct physical impact to land-based community and recreational resources as the alternative would be located in open water and man-made dredged material placement islands. The proposed project would not attract or increase new vessel traffic or lines of cargo, or impact terminal operations. Therefore, indirect impacts on land-based community or recreational resources would not be expected. The proposed modifications to the channel are expected to relieve congestion around the BSC and HSC intersection, improving vessel travel around this intersection. However, given the time and spacing of commercial vessel transit through the channels, the primary use of navigation channels for commercial vessels and general avoidance of recreational vessels during large vessel transit, and that impact on recreational vessel passage across the channels has not been documented to be a problem, any positive impact would be small. As discussed in Section 4.3.7, the reduction in the probability for vessel spills due to the improvement in safety and navigability could reduce any waterborne recreation area closures due to response activities. However, given the relative infrequency of major spill incidents, positive impacts would be minor. Considering this, the Preferred Alternative would not have adverse impacts on community or recreational resources. Periodic maintenance dredging and placement events over the next 20 years would result in similar impacts as all affected areas would be previously disturbed by initial construction activities.

4.3.4 Visual and Aesthetic Resources

No Action Alternative

Existing characteristics of the viewsheds for the proposed project area are discussed in Section 3.3.3. The study area for visual and aesthetic resources consists of viewsheds within the project area looking out from the existing shoreline in residential areas or public parks (Exhibit 3.3.4-1). Under the No Action Alternative, residents with a view of the Bay and the HSC would still primarily have a view of the existing Bay and marine vessels in the distance, and a very distant view of the existing Atkinson Island. Annually or biennially, maintenance dredging along the HSC and BSC is also visible for a few months.

Preferred Alternative

In the short-term, during construction of the proposed project, dredging activities would be visible to shoreline residents, and recreational watercraft users that have a view of the construction activities. The nearest part of the proposed project is approximately 1.3 miles offshore, and the permanent features (which are raised or repaired dikes) is at closest two miles offshore, and would have minimal impacts of views from the shoreline at any vantage point. Views from Sylvan Beach or El Jardin Beach or neighborhoods along the shoreline, as discussed is Section 3.3.4, are limited and it is likely that few residents or recreationalists using Sylvan Beach and the beach located in the El Jardin neighborhood would be impacted from visual and aesthetic changes during construction of the proposed project.

In the long-term, construction of this project is not expected to change surrounding land use. Placement of dredged material would be in existing PAs and would be consistent with existing land use. The addition of dredged new work and maintenance material to PAs 14, 15, Mid Bay, M10 and other Atkinson Island PAs would eventually allow them to become an area for wildlife. The addition of the dredged material to the PAs and marsh cells would help create habitat for different species of shorebirds and other animals. Therefore, these PAs and marsh cells when finished could serve as recreational areas for anglers and birdwatchers. The proposed project is expected to relieve congestion and allow marine vessels to transit the area around the HSC and BSC intersection more efficiently and safely. However, the proposed project would not change the numbers or frequency of vessel transits. Therefore, the view of marine vessels would primarily remain the same. Periodic maintenance dredging and placement events over the next 20 years would result in similar impacts as the No Action alternative, as all affected areas would be previously disturbed by initial construction activities.

4.3.5 Existing Infrastructure

No Action Alternative

Under the No Action Alternative, no impact is anticipated to existing infrastructure, other than those that would occur to existing wells with the planned construction and filling of future PA or marsh cells. As discussed in 3.3.5, the coordination and planning for these impacts were already accomplished as part of the PA 14/15 Expansion EA.

Preferred Alternative

Under the Preferred Alternative, no impact is anticipated to existing infrastructure from the proposed modifications to the channel or new work dredged material placement on the existing PA 14dikes. The PA 14 and Mid Bay PA dikes are already constructed and material would just be added where dikes were already built. The other PAs proposed for maintenance material placement do not have existing infrastructure conflicts (e.g. pipelines, oil and gas production) with the exception of the PA 14/15 connection being constructed and future

M11 marsh cell as part of the USACE's PA 14/15 Expansion Project. Provisions for the existing oil and gas well facility access in these cells are accounted for and discussed in the PA 14/15 Expansion EA.

4.3.6 Traffic and Transportation

4.3.6.1. Surface Transportation

No Action Alternative

Under the No Action Alternative, no impact is anticipated to surface transport, road and rail, since there are no such facilities near the project area as detailed in Section 3.3.6.

Preferred Alternative

Under the Preferred Alternative, no direct impact to surface transport, road and rail will occur since there are no such facilities near the project area as detailed in Section 3.3.6. No indirect impacts to surface transport are expected from the proposed action either, because the proposed action is not expected to have any impacts on terminal activity, and would therefore not increase the related truck or rail activity at terminals. This assumption is made because the capacity (throughput) of the terminal is determined by the terminal facilities (e.g. numbers of cranes berths, acres of storage area) and the proposed action, which only involves local modifications to the navigation channel, will not change any of these facilities. This assumption is explained in detail in Section 4.3.8.

4.3.6.2. Marine Transportation

No Action Alternative

Under the No Action Alternative, no modifications to the HSC would be constructed. Therefore, the current navigation safety, and congestion problems, would continue.

Preferred Alternative

During the construction phase under the Preferred Alternative, dredge vessels and equipment would be required to move out of the active channel to maintain an open shipping lane when vessels are approaching the intersection of the HSC and BSC, and require full channel clearance when entering the BSC or passing the intersection on the HSC. The modifications to the channel of the Preferred Alternative would improve the navigation safety of vessel transit through the HSC-BSC intersection and into the BSC, and reduce congestion, as this is the main purpose of the proposed project. Therefore, marine transportation conditions are expected to improve. With respect to tonnage, the Preferred Alternative would not impact container tonnage, because the Preferred Alternative does not alter the terminal facilities that determine the throughput capacity, as discussed in detail in Section 4.3.8.2, for the Preferred Alternative, Terminal Emissions subsection. Therefore, vessel calls would not increase due to the proposed project. Periodic maintenance dredging and placement events over the next 20 years would not result in any new or additional impacts as all construction activities would preserve the proposed channel conditions.

4.3.7 Hazardous, Toxic and Radioactive Waste (HTRW)

No Action Alternative

The No Action Alternative would have no impact on hazardous materials associated with regulated facilities in the area. Maintenance dredging of the existing HSC and the placement of dredged materials at PAs would continue under the No Action Alternative, which would not impact any HTRW sites.

Preferred Alternative

According to the regulatory database search, no reported HTRW sites were reported within the project footprint or within the ASTM search distances. As discussed in Section 3.3.7, an effort to locate the unmapped ERNS waterborne incident records resulted in only 6 records within one mile of the proposed project, with only 5 of those within the one-quarter mile ASTM distance, and all but two involving small losses of ATONS batteries. Given that the remaining two records involved only an unknown sheen and a hydraulic oil hose leak as discussed in Section 3.3.7, these small-scale incidents did not result in any remaining corrective action site. As discussed in the Determination of Suitability of New Work Dredged Material for Placement subsection for the Preferred Alternative in the Section 4.1.4.2, Sediment Quality, these incidents do not indicate impairment of sediment quality or unsuitability of the new work dredged material to be placed as proposed.

The proposed project is not anticipated to attract or increase new vessel traffic or lines of cargo. The corrective actions are expected to relieve congestion around the BSC and HSC intersection, improving vessel travel through this intersection. The improvement in safety and navigability could decrease the probability for vessel collisions, potentially decreasing the probability of vessel spills in the HSC and BSC.

Regarding pipelines and oil and gas facilities, there are no such facilities in the footprint of the proposed modifications to the channel, and as discussed in Section 3.3.5, conflict and access issues for facilities in proposed PAs were resolved under the Expansion of PAs 14 and 15 Project. All known oil and gas sites and pipelines would be avoided or accommodated with the appropriate access gaps until they are relocated. Therefore, no HTRW impacts arising from these facilities are expected under the Preferred Alternative.

Periodic maintenance dredging and placement events over the next 20 years would not result in any new or additional impacts as all affected areas would be previously disturbed by initial construction activities.

4.3.8 Air Quality

4.3.8.1. Construction Air Emission Analysis

General Conformity is a Federal/state program designed to ensure that actions taken by Federal entities do not hinder states' efforts to meet the national ambient air quality standards (NAAQS). The definition of a Federal action as specified in 40 CFR 93.152 includes "…a permit, license, or other approval for some aspect of a nonfederal undertaking, (and) the relevant activity is the part, portion, or phase of the nonfederal undertaking that required the federal permit, license, or approval." (EPA, 2010a)

With regard to a dredging project such as the Preferred Alternative, the Federal Action is the implementation of the proposed project resulting from the Preferred Alternative, and any activity that the Federal agency supports or finances (i.e. to implement) is subject to General Conformity review.

The EPA has established a series of steps to determine whether a given Federal Action is subject to General Conformity review as follows (EPA, 2010b).

1. Whether the action will occur in a nonattainment or maintenance area;

2. Whether one or more of the specific exemptions apply to the action;

3. Whether the federal agency has included the action on its list of “presumed to conform” actions;

4. Whether the total direct and indirect emissions are below or above the de minimis levels of the criteria pollutant for the standard not attained (see below Table 4.3.8-1 for the de minimis levels); and/or

5. Where the facility has an emission budget approved by the state as part of the SIP, the federal agency determines if the emissions from the proposed action are within the budget.

Regarding the proposed Preferred Alternative,

1. The action would be occurring in the 8-county HGB ozone nonattainment area, which is designated as a severe nonattainment area for the pollutant ozone in the absence of State and Federal decisions to determine the finally attainment status, as discussed in Chapter 3;

2. None of the specific exemptions apply to the action, except for maintenance dredging, which is specifically exempt;

3. The USACE has not included dredging projects on a list of “presumed to conform” actions;

4. Total direct and indirect emissions of NO_x, as currently estimated, would exceed the relevant de minimis levels of 100 tons of NO_x in a marginal nonattainment area. (see Table 4.3.8-1) and;

5. The USACE does not possess an emissions budget approved as part of the HGB area SIP.

Based on the discussion presented above and the emissions presented below, a General Conformity Determination (GCD) is required for both NO_x and VOC emissions from the proposed project. Since the action is required to demonstrate conformity, one or more of the following conditions must be met (EPA, 2010b).

1. Demonstrating that the total direct and indirect emissions are specifically identified and accounted for in the applicable SIP;

2. Obtaining a written statement from the state documenting that the total direct and indirect emissions from the action, along with all other emissions in the area, would not exceed the current SIP emission budget;

3. Obtaining a written commitment from the state to revise the SIP to include the emissions from the action;

4. Obtaining a statement from the Metropolitan Planning Organization (MPO) for the area documenting that any on-road motor vehicle emissions are included in the current regional emission analysis for the Regional Transportation Plan and the Transportation Improvement Program;

5. Fully offsetting the total direct and indirect emissions by reducing emissions of the same pollutant or precursor in the same nonattainment or maintenance area.

A sixth potential demonstration method, conducting air quality modeling that demonstrates that the emissions would not cause or contribute to new violations of the standards, or increase the frequency or severity of any existing violations of the standards, is not available for the proposed project because modeling is not acceptable for ozone nonattainment areas due to the complexity of ozone formation from precursor pollutants and the limitations of current air quality models.

Of the options detailed above, the USACE elected to utilize the second option, obtaining concurrence from TCEQ that the total direct and indirect NO_x and VOC emissions from the action will not exceed the applicable SIP as well as the most recent TCEQ adopted SIP emissions budget, because of the very low level of emissions compared with the SIP budget, and the temporary nature of the emissions.

The project emissions estimates (presented in Table 4.3.8-2) have been based on operational and equipment assumptions developed as part of the detailed project planning process, and on published emission factors and other emission-related operational information. Diesel engines used in dredging and placement work have been assumed to be "Tier 1" level engines while the passenger cars and light duty trucks used in employee commuting have been assumed to be typical of the general fleet, using default settings in the MOVES2014 model.

Table 4.3.8-1 De Minimis Thresholds in Nonattainment Areas

Ambient Pollutant	Nonattainment Status	Tons/year
Ozone (VOC's or NO_x):		
	Serious NAA's	50
	Severe NAA's	25
	Extreme NAA's	10
	Other ozone NAA's outside an ozone transport region	**100**
	Marginal and moderate NAA's inside an ozone transport region	
	VOC	50
	NO_x	100

Source: 40 CFR §93.153 Applicability. (Amended to include PM2.5)

Table 4.3.8-2 Estimated Emissions from Proposed Project Construction (Tons per Year)

Component of Work	2016		2017	
	NO_x	VOCs	NO_x	VOCs
Dredging	186.3	7.4	0.0	0.0
Support Vessels	115.0	4.6	0.0	0.0
Placement Site Work	0.8	0.1	4.1	0.6
Employee Vehicles	0.2	0.04	0.1	0.01
Oyster Mitigation	2.4	0.2	0.0	0.0
Total	**304.7**	**12.4**	**4.2**	**0.6**

In summary, the estimated project construction NO_x emissions require a GCD to be coordinated with the TCEQ to demonstrate that these emissions can be accounted for in HGB SIP emissions budgets. The GCD also requires a public notice and a 30-day public comment period, as well as coordination with EPA Region 6, Houston-

Galveston Area Council (HGAC), the local MPO, and other local air quality agencies as appropriate. A Draft GCD was prepared by the USACE, the lead agency approving the Federal action, with the aforementioned agencies and is included as Appendix 4 to this EA document. The USACE sent a letter summarizing the calculated emissions, containing documentation of the estimate methodology, and requesting a determination of conformity with the SIP to the TCEQ, the agency responsible for the SIP for Texas, via a letter dated August 25, 2015. A copy of this letter is provided in Appendix 2 of this EA. The Draft GCD was publicly coordinated and a public notice of the Draft GCD availability was published concurrent with agency and public review of the Draft PDR and Draft EA, with copies provided to the TCEQ, EPA Region 6, and the HGAC. The TCEQ sent a letter responding to the request dated November 4, 2015, which concluded that the proposed project would conform to the SIP. A copy of this letter is provided in Appendix 2. Details of the concurrence and coordination are summarized in Section 6.6. A copy of the public notice is attached to the Final GCD provided in Appendix 4, and included in Appendix 2 of the this EA.

To support demonstration that the project construction NO_x emissions can be accommodated in the HGB SIP emissions budgets, Table 4.3.8-3 illustrates the minor percentages of the NO_x budgets that the project construction emissions represent. The most recent EPA-approved SIP documents were used: *2010 HGB Attainment Demonstration SIP Revision for 1997 Eight-Hour Ozone* adopted by TCEQ on March 10, 2010 and approved by EPA on January 2, 2014 for marine and non-road mobile sources, and *2013 HGB MVEB Update SIP Revision for the 1997 Eight-Hour Ozone* adopted by TCEQ on April 23, 2013 and approved by EPA on January 2, 2014 for on-road mobile sources. Since the project construction phase is expected to encompass two calendar years, the table compares the higher year of emissions against the emissions budget figures.

Table 4.3.8-3 Comparison of Non-Road Proposed Project Emissions with Modeled SIP Emissions Budgets (Tons per Day)

Project Activities	SIP Inventory Categories	2016 Project NO_x Emissions		HGA SIP 2018 NO_x Emissions Budget	
		(tpy)_	(tpd)	(tpd)	% of Budget
Dredging Activities (dredge, support vessels)	Commercial Marine Vessels	302.3	0.83	39.24	2.1%
Land-side Activities (dredged material placement)	Construction and Mining	2.2	0.006	14.68	0.04%
Total of Non-Road Activities	Total Non-Road Inventory	304.5	0.836	118.60	0.70%

Table 4.3.8-4 Comparison of On-Road Proposed Project Emissions with Modeled SIP Emissions Budgets (Tons per Day)

Project Activities	SIP Inventory Categories	2016 Project NO_x Emissions		HGA SIP 2018 NO_x Emissions Budget	
		(tpy)_	(tpd)	(tpd)	% of Budget
On-road Activities (employee commuting)	On-road Mobile Sources	0.2	0.0005	103.34	0.0005%

Overall, the proposed project construction emissions of NO_x represents represent only 0.7% of non-road emissions from marine, and construction sources, and only 0.0005% of on-road emissions from on-road sources for the emissions modeled in the SIP for 2018. Emissions from the dredging equipment itself, plus support vessels, represents 2.1% of the commercial marine vessel emissions modeled in the SIP, while emissions from construction equipment represent only 0.04% on an average daily basis. As noted earlier, the USACE sought TCEQ concurrence that the NO_x and VOC emissions representing these low percentages would conform to the SIP, and obtained concurrence via letter on November 4, 2015.

Because maintenance dredging is specifically exempt from the General Conformity Rules, maintenance dredging for the proposed improved channel over 20 years will not affect conformity compliance.

4.3.8.2. Operational Air Emission Analysis

Operational air emissions are those emissions resulting from the use of the HSC and BSC, and related terminal facilities. These emissions include those associated with harbor (tugs, refueling barges etc.) and ocean-going vessels (container and bulk liquid vessels etc.), and terminal equipment (cranes, loaders etc.), vehicles (trucks), and the intermodal rail yard (trains). The impacts of the various alternatives on operational air emissions relate to how the proposed channel improvements are expected to influence these air emission activities through changes in navigation efficiency, cargo tonnage, and vessel calls. Except for the immediate vessel transit effects (i.e. faster, less restricted entry/exit from the channel), these impacts are indirect effects. For the project area, the vessel operations expected to be affected are vessel turns into/out of the BSC from the HSC associated with the Flare, and vessel transit across the bend in the HSC just south of the Flare. Vessel transit along the length of the HSC and BSC away from the proposed project features would be expected to be primarily affected by the current configuration of HSC and ongoing modifications of the BSC Improvements Project and not the proposed project. The following discusses the operational air emissions impacts of the alternatives.

No Action Alternative

Vessel Emissions

Under current conditions, the average vessel requires two tugs, to assist with turning into the BSC from the HSC. For vessels transiting the HSC through the bend just south of the Flare, tugs are not required to make the transit; however, the bend reduces maneuverability along this segment for some distance past the bend. Under the No Action Alternative, the same emissions associated with the current tug assist to make the turn would continue for these vessel sizes.

Terminal Emissions

Emissions from terminals serviced by the HSC and BSC are directly related to the containerized cargo tonnage processed there. These emissions come from terminal equipment (cranes, loaders etc.), vehicles (trucks), and the intermodal rail yard (trains). The amount of emissions is determined by the cargo demand, which is largely influenced by market forces, population center locations, inland transportation factors (i.e. rail and road networks), and the throughput capacity of the terminals (how much cargo can be handled in a given time), which is largely determined by the terminals' crane and backland infrastructure. Neither the Flare nor the bend affect or influence these factors. Though the current Flare and bend configuration result in some vessel delay around the HSC/BSC intersection, these are relatively short time delays that do not preclude or alter the anticipated berthing and unloading of vessels at terminals. Therefore, the Flare and bend under the No Action alternative are not expected to impact terminal emissions.

Maintenance Dredging

Maintenance dredging is currently performed yearly for the existing Flare, and is needed to maintain the current channel dimensions. Therefore, the existing maintenance dredging emissions would continue to occur. Maintenance dredging is currently exempt from the General Conformity rules in 40 CFR 93, Subpart B.

<u>Preferred Alternative</u>

Vessel Emissions

The impacts of the Preferred Alternative on operational air emissions are related to the potential effects of the proposed corrective actions on navigation, vessel fleet, cargo traffic, and terminal operations compared to the existing channel condition. The modifications proposed for the channel directly address increasing the navigability of the Flare and HSC through the bend, and therefore would improve vessel transit. The improvement in navigability would tend to reduce emissions, albeit slightly. The localized and limited corrections to the channel would not have any impact on increasing vessel traffic, which is determined by available terminal facilities and shipping market forces. The Flare easing would directly result in reducing the tug assists required to guide vessels into and out of the BSC. Therefore, the Preferred Alternative would reduce emissions associated with vessel transit in and out of the BSC. However, the time involved with these maneuvers under existing channel conditions is brief, as the corrective actions are being made for safety purposes, and not to improve vessel travel or terminal throughput efficiencies for economic purposes. Therefore, the emissions reduction would accordingly be a small portion of the transit emissions. The main channel widener and Flare easing will reduce vessel congestion on the HSC through the bend and Flare intersection, reducing vessel slowdown or delay on the HSC for potentially several vessels. Because the decrease in delay for the vessel making the turn would be a relatively short compared to total vessel transit time in the Bay, decrease in delays to vessels going up the HSC would also be short compared to their total transit times in the Bay, and the associated emissions reductions would be a small percentage of transit emissions for those vessels. Overall, the impact on vessel emissions would be a small reduction of emissions. Therefore the Preferred Alternative will not adversely impact vessel emissions.

Terminal Emissions

The Preferred Alternative would only propose modifications to short, isolated segments of the HSC that connects to the BSC, and far down-channel from the rest of the port facilities along the HSC. Therefore, it would not involve any modifications to the terminal facilities, offloading equipment, intermodal yard, roads, or vehicles. Therefore, it would not alter the efficiency, operation practices, or inherent emission rates of the equipment and facilities used to load/unload and transport cargo from docked ships to landside facilities or to other surface transportation modes (e.g. rail, truck). As a result, the Preferred Alternative will not impact terminal emissions.

Maintenance Dredging

Maintenance dredging would continue to be needed to maintain the planned and constructed channel dimensions. Considering this, maintenance dredging is necessary to maintain the full navigation efficiency that would result in the positive impacts for air emissions discussed in the preceding subsections. Without the periodic dredging of the proposed Flare easing and wideners, the longer term small, but positive benefits of reducing tug assists and relieving vessel congestion around the HSC/BSC intersection would cease. The incremental increase in maintenance dredging emissions due to the extra material that would occur every few years would be offset by potential emissions reductions that could be realized with a fully maintained project, especially considering the reductions would occur repeatedly with the hundreds of vessel calls each year, and over a 20 year period. Therefore, the overall impact of 20 years of maintenance dredging for the Preferred Alternative would be expected to be positive, given that it is necessary to maintaining the navigability afforded by the modifications, and their associated emission reductions.

Conclusion

The Preferred Alternative would be expected to have small, but positive impacts on emissions from reductions associated with reduced tug assists and traffic congestion around the HSC/BSC intersection. The Preferred Alternative would not impact terminal emissions. Maintenance for the Preferred Alternative would be necessary to maintain the channel dimensions that would result in correcting deficiencies, relieving congestion, reducing tug assist to turn into the BSC, and the associated vessel emission reductions, and would therefore produce positive impacts compared to the relatively small incremental increase in current maintenance dredging emissions. Considering that the Preferred Alternative would have positive effects on vessel transit emissions and would not impact terminal emissions, this alternative would not be expected to negatively impact air quality from these operational emissions sources.

4.3.8.3. Greenhouse Gas Emissions and Climate Change

No Action Alternative

There will be no change in GHG emissions from the present under the No Action alternative. GHG emissions from the present sources such as vehicles, power plants, and residential and commercial combustion (e.g. furnaces etc.) would continue.

Preferred Alternative

The GHG emissions from the Preferred Alternative will result from construction activities of the channel and during dredged material placement, as well as from vehicular traffic associated with on-road construction equipment and support vehicles associated with those activities. The principal greenhouse gases that enter the atmosphere as a result of human activities include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases. GHG contribution from the Preferred Alternative will be temporary and only occur during construction, most of which will take place in one year. The Preferred Alternative will result in no permanent emission source, and will not have indirect effects of increasing the terminal equipment and vehicle activity that consume fossil fuel. As such, the contribution to GHG will be limited to construction emissions.

Climate change due to GHG is a global and at most, a regional-scale issue, and locally, the largest contributions are from on-road mobile sources (cars, trucks) and power plant stationary sources. CO_2 is the largest component of GHG emitted by these sources. The GHG emitted from constructing the Preferred Alternative will be insignificant compared to regional emissions. Consider that the maximum yearly NO_x emissions estimated for General Conformity determination constitute only 0.5% of the regional on-road, marine, construction, and mobile source emissions contained in the proposed revision to the HGB area SIP for the modeled year 2018. If stationary emissions from power plants, commercial and residential use were incorporated, the percentages would be substantially less. The Preferred Alternative emissions will occur primarily from combustion of diesel by marine engine dredges and support vessels (tenders, barges etc.). The ratio of average CO_2 emissions of diesel compared to gasoline is approximately 1.14 (EPA 2005). Directly comparable emissions factors for marine diesel engines are not readily available, but the combustion and exhaust process is similar to that of engines used for Heavy Duty Diesel Vehicles (HDDV). The ratio of average NO_x emissions per mass of fuel consumed between HDDV compared to gasoline light-duty trucks and passenger vehicles (which constitute the majority of on-road GHG sources) ranges from 9.06 to 12.43 (EPA 2008a and b). Because the ratio comparing average emissions for NO_x of diesel to gasoline sources is greater than the ratio between these sources for CO_2, if Preferred Alternative NO_x emissions constitute an insignificant percentage of regional emissions, Preferred Alternative CO_2 emissions will constitute an even smaller percentage of regional emissions, demonstrating its negligibility to regional CO_2 emissions. Also in consideration of the guideline threshold provided by the CEQ guidance discussed in Section 3.3.8.1, the CO_2 emissions were co-estimated with General Conformity emissions, and totaled approximately 22,000 metric tons of CO_2 equivalents (CO_2e). This is less than the 25,000 metric tons threshold suggested as a benchmark for warranting quantitative analysis of GHG emissions, below which a qualitative discussion would suffice. Therefore, Preferred Alternative emissions contribution to regional GHG emissions will be temporary and negligible.

4.3.9 Noise

Short term impacts of the different alternatives would primarily involve the construction sound during dredging. Since dredged material placement activity would take place in locations in the bay more than 1.3 miles away from mainland shoreside receptors, the short term impacts would be much less, if at all perceptible. Dredged material PAs do not involve permanent noise activity, and would therefore have no potential for long-term impacts.

No Action Alternative

The No Action Alternative would not change the sound environment around potential sensitive mainland receptors.

Preferred Alternative

The Preferred Alternative would result in temporary impacts due to the dredging activities required for construction of modifications to the channel. Construction sound at the existing PA sites would be primarily from diesel shore or land-based equipment, such as bulldozers, backhoes, and marsh buggies. However, dredging for the Preferred Alternative and placement at the PA sites would be distant enough from potential landside sensitive receptors to not be perceptible. Because the construction noise impacts would be temporary and similar to noise already generated periodically by maintenance dredging, they are considered minor.

To demonstrate this, calculations were performed for the attenuation in sound pressure level (dBA) at various receiver distances relevant to the nearest potential receptors discussed in Section 3.3.9. The calculations were performed assuming the sound source behaves as a point source, given the distance from the mainland and given the slow and/or near stationery movements of dredges and earthwork equipment, and therefore, sound spreads spherically. Sound level measurements from a hydraulic dredge conducted in 2014, and submitted for the sound control plan required for the BSC Improvements Project, were used as source data for dredging. The highest value for sound level measurements, taken without noise suppression treatment, was 82 dBA at 50 feet from the main engine compartment. Sound level data for earthwork equipment that would be used during placement activities was selected from the Federal Highway Administration (FHWA) Construction Noise Handbook (USDOT FWHA 2006). Considering the greater of the values listed in the table (either actual measurements or the referenced noise control specification limit) for the various equipment possible, such as an excavator, dozer, or front end loader, the highest value of 85 dBA was chosen, corresponding to dozer or excavator maximum specified limits at 50 feet. The calculations were performed using the following standard sound propagation equation for this assumption.

$$L_{p2} - L_{p1} = 20\log\left(\frac{r_2}{r_1}\right) \quad \text{(Spherical)}$$

Where:

L_{p1} = sound pressure level (dBA) from the source measured at 50 feet

L_{p2} = sound pressure level (dBA) at the potential sensitive receptor distance

r_1 = distance at which sound source was measured

r_2 = the distance from sound source to potential sensitive receptor

The results of the calculations are summarized in Table 4.3.9-1, with the distances associated with nearest potential sensitive receptors from the dredge or PA activity bolded. The nearest potential sensitive receptor discussed in Section 3.3.9 was located in the El Jardin del Mar community, which ambient background sound measurements taken during the BSCCT FEIS indicated a 24-hr L_{eq} of 59 dBA and an L_{dn} of 67 dBA. The results show that the sound levels from dredging or placement activity at the receptor (Lp_2) would drop to well below average ambient noise levels expected at the nearest distance to a potential receptor.

Table 4.3.9-1 Project Sound Levels at Various Receiver Distances

Sound Source		Receptor			
Sound Level	Distance	Distance		Sound Level	Difference
Lp_1 (dBA)	r_1 (feet)	r_2 (feet)	r_2 (miles)	Lp_2 (dBA)	(Lp_1-Lp_2)
82	50	2,640	0.50	47.5	-34.5
82	**50**	**6,864**	**1.30**	**39.2**	**-42.8**
82	50	7,500	1.42	38.5	-43.5
82	50	13,200	2.50	33.6	-48.4
85	**50**	**12,250**	**2.32**	**37.2**	**-47.8**
85	50	13,200	2.50	36.6	-48.4

The Preferred Alternative would have no impact on any landside terminal activity because it would not alter any terminal facilities or enable any new vessel traffic as detailed in Section 4.3.8.2. Therefore, the Preferred Alternative will not impact any landside sound or vibration sources such as terminal equipment, truck, or rail traffic.

Maintenance dredging for the improved channel over 20 years would have the same impacts as the current maintenance for the existing channel, and therefore would not pose new impacts, as sound levels would be the same, and as demonstrated in Table 4.3.9-1, would be well below expected landside ambient levels.

In summary, the Preferred Alternative is expected to have only minor impacts on noise and vibration from new work and maintenance dredging and placement, and no impacts from vessel transit, terminal, public roadway, or rail activity. Therefore, the Preferred Alternative would have negligible impacts on the sound environment.

4.3.10 Cultural Resources

The inspection and review of historical records and aerials only identified previously recorded anomalies described as modern debris or naturally occurring bottom features. In addition to the thorough literature review, high-frequency side-scan sonar and magnetic remote sensing survey operations were simultaneously conducted within the project area to identify potential cultural resources. The marine survey was conducted in accordance with Federal and local standards.

As a result of the remote sensing survey performed in the APE of the Preferred Alternative, two targets (W5, W7) both located in the area of the proposed barge lane relocation, were signatures that were significant enough to warrant either avoidance with a 164 feet (50 meter) avoidance zone around each of the targets in accordance with 13 TAC 28.2. or further ground-truthing investigations to determine the National Register eligibility if avoidance by the proposed project was not an option. As discussed in Section 3.3.10, these targets were investigated and found to be modern debris. Therefore, no National Register-eligible historic properties or archeological resources were identified within the APE of the Preferred Alternative.

No Action Alternative

Under the No Action Alternative there would be no new impacts to cultural resources.

Preferred Alternative

The two anomalies found within the footprint of the barge lane relocation were recommended for further investigation or would require avoidance by a distance of 164 feet (50 meters). Diver investigations conducted in 2012 confirmed that both anomalies were modern debris and the SHPO concurred with this determination on August 22, 2012. A copy of the concurrence letter from USACE to the SHPO is provided in Appendix 2. Therefore, the proposed corrective actions would not impact any Nation Register-eligible historic properties or archeological cultural resources. If unidentified cultural resources are encountered during construction of the project, work would be suspended in that area until the resources are further evaluated.

The cultural resource coordination for existing PAs proposed for new work and maintenance dredged material placement were previously conducted and documented in the PA 14/15 Expansion EA and HGNC EIS. This also includes the associated cells proposed for maintenance material. The results of that survey and coordination indicated that no potential for resources is likely and no further investigation was warranted, except for one anomaly warranting further investigation identified in the area of the planned Atkinson Marsh Cell M11. As discussed in Section 3.3.10, Cultural Resources, this was cleared by subsequent groundtruthing. Because no potential cultural resources have been identified within the new work footprint of the proposed corrective actions, and makes use of existing and planned PAs, O&M over 20 years for the improved channel would not result in any impacts on cultural resources.

4.4 MITIGATION

The following sections discuss the mitigation proposed for oyster reef impacts that would occur from implementing the proposed action. The full detail of mitigation and monitoring for the proposed action will be outlined in the Mitigation Plan included in this report as Appendix 7. In accordance with CECW-PC policy memorandum *Implementation Guidance for Section 2036(a) of the Water Resources and Development Act of 2007 (WRDA 07) – Mitigation for Fish and Wildlife and Wetland Losses*, dated 31 August 2009, the Mitigation Plan was developed to comply with the mitigation standards and policies of the regulatory program regarding plan content.

4.4.1 Proposed Oyster Reef Mitigation

The corrective actions of the Preferred Alternative would result in unavoidable, permanent impacts to approximately 29.9 acres of oyster hard-bottom habitat. Mitigation for these direct impacts would replace the oyster habitat that would be removed by the construction of this alternative by restoring oyster habitat on San Leon Reef in the Clear Lake embayment of Galveston Bay, Chambers County, Texas as shown on Exhibit 4.4.6-1. Specifically, the mitigation would add approximately 36,445 CY of cultch (limestone, rock or clean, crushed concrete rubble) to 30.1 acres on San Leon Reef to offset impacts of the corrective actions to the HSC. This would increase the existing oyster habitat in San Leon Reef by 30.1 acres of hard surface area available for natural recruitment of oyster larvae. The San Leon Reef mitigation area was recommended by TPWD. San Leon Reef was impacted by Hurricane Ike induced sedimentation in 2008. San Leon Reef has approximately 40 acres identified by TPWD for rehabilitation. This oyster reef restoration would replace the important ecological benefits to Galveston Bay of impacted oyster habitat such as improvement of water quality and clarity as well as re-establishment of essential fish and invertebrate habitat. As discussed in Section 4.2.2.2.3, the oyster habitat impacted predominantly consists of oyster clusters overlying shell hash (shell-in-mud) substrates of primarily high density, and contains approximately 6 acres of consolidated reef in the Flare easing of the Preferred Alternative. The reef in the barge lane relocation was not groundtruthed, but based on the extensive, dense side scan sonar signal, could be assumed at minimum to be Class 3 high density reef. If the barge lane reef was assumed to be consolidated reef, the average density of all reef impacted by the Preferred Alternative would be less than consolidated reef density, but would still be relatively high given the percent of total reef that the barge lane relocation represents. To determine the amount of mitigation required, a functional assessment model as applied, and is discussed in Section 4.4.3. Because the dredging activity to construct the proposed action is not expected to result in any lasting impacts to oyster reef outside of the direct impact footprint from material resuspension and re-deposition, as explained in Section 4.2.2.2.5, no mitigation is proposed for these effects. The details of the proposed mitigation are provided in Appendix 7, Mitigation Plan.

4.4.2 Background on Site Selection and Method

The San Leon Reef area was selected based on post-Hurricane Ike TPWD side-scan sonar data and sub-bottom profiling data collected by Texas A&M University at Galveston. The sub-bottom data indicated San Leon Reef was silted over by greater than 6 inches of sediment, and would be conducive to restoration by cultch placement. The San Leon Reef area was recommended by the TPWD as the preferred location for oyster reef restoration, following preliminary USACE discussions with the agency in 2012. The reef footprint is in waters restricted for shellfish harvesting, which means the area is closed to harvesting for direct marketing. Harvesting for personal consumption would still be allowed. Cultch material would be placed in a layer approximately 9 inches deep to produce a relief of 6 inches and allow for minimal settling. The placed cultch would then be colonized by oysters through natural recruitment during spawning seasons. As the selected site is in Galveston Bay, the mitigation occurs in the same bay system that the impacts would occur in, and where restoration efforts have been planned and targeted by the resource agency with primary responsibility for oyster reef conservation. Direct on-site mitigation is not applicable in this situation as replacement reef cannot be appropriately located in the deepened navigation channel. The restoration relies on natural oyster larvae recruitment and growth, and would be self-sustaining. This method has been successfully used on past similar restoration projects in Galveston Bay and around the nation

4.4.3 Determination of Amount of Mitigation Required (Credit Determination)

ER 1105-2-100, PGN requires mitigation of significant impacts to significant resources. Oyster reefs are considered significant resources because their impacts and management are regulated by several Federal and State agencies. They are considered EFH in the GOM with impacts and management regulated by NMFS as discussed in Section 3.2.3. They are managed in the State of Texas by the TPWD and compensation for losses are regulated under the general authority provided by the Restitution and Restoration Rule, Chapter 69 of Title 31 of the Texas Administrative Code (TAC). They are considered Critical Areas under Coastal Zone Management State regulations in 33 TNRC §33.203 as explained in Section 3.2.6. The CECW-CP policy memorandum, *Policy Guidance on Certification of Ecosystem Output Models*, dated August 13, 2008, requires the use habitat models certified under the USACE's model certification program to be used to justify the amount of mitigation for Civil Works projects. This memo provided a list of existing functional and habitat models that were considered certified. The USFWS Habitat Suitability Index (HSI) models listed included the American oyster (*Crassostrea virginica*) HSI model, which was selected for use in determining mitigation for the Preferred Alternative.

4.4.3.1. Mitigation Planning

The mitigation planning steps listed in the PGN, Appendix C, Paragraph C-2.e.(8)(a) were followed. The net impact of the Preferred Alternative on oyster habitat was determined with the American oyster HSI model to be a loss of 29.16 Average Annual Habitat Units (AAHU). The mitigation planning objective was to replace these AAHUs. The next section summarizes the application of the American oyster HSI model to determine impacts. Potential mitigation strategies identified and assessed were mitigation banks, participation in local restoration projects, reef restoration through artificial cultch placement with either natural recruitment or with spat seeding, and bagless dredging. All but restoration through cultch placement with natural recruitment were dismissed due to a variety of reasons including, local unavailability, inefficacy, uncertainty, and the natural conditions present or required. Several alternatives for cultch placement with natural recruitment were developed at different sites in Galveston Bay, representing various mitigation increments, including those that specifically met the mitigation planning objective. The alternative sites were at Fishers Reef, San Leon Reef, and Levee Reef. These alternatives were modeled using the American oyster HSI model.

4.4.3.2. Habitat Modeling

The American oyster HSI model uses six required variables to determine habitat suitability: V_1 (% bottom covered with cultch), V_2 (Mean summer salinity), V_3 (Mean abundance of living oysters), V_4 (Historic mean salinity), V_5 (Mean interval between killing floods), and V_6 (Mean substrate firmness). These represent the physical and environmental factors that influence suitability for oyster reef development. Modeling was supported by collecting data, or assuming values based on literature, consultation with TPWD oyster restoration staff, and other past project and restoration experience, to provide supported input values for model variables. Cultch coverage was commensurate with field data collected during benthic habitat surveys or with the planned cultch coverage under mitigation scenarios. Values for salinity variables typically came from Texas Water

Development Board (TWDB) datasonde program data (collected on a continuous basis) for the monitoring stations closest to the various sites. Living oyster density was based on previous field data collected for the impacted site, or for projected with-mitigation values, based on consultation with TPWD oyster restoration staff, and past HGNC project mitigation experience. Killing flood interval data was based on data compiled in literature where the model was applied for various locations around Galveston Bay. Substrate firmness was based on knowledge of impacted site conditions from project geotechnical data, or consistency with silted-over conditions at mitigation sites that were impacted by Hurricane Ike. The changes in these values through the 20-year period of analysis were based on continuing existing conditions in the without project scenario, or the proposed mitigation action of adding cultch (clean, crushed limestone, concrete etc.) in the with mitigation project scenario. Addition of cultch would make V_1 and V_3 optimal, which drives the HSI score to the optimal value of 1.0. Details of the variable assumptions for the proposed mitigation are discussed in Section 6.0 of the Mitigation Plan.

Spreadsheets were developed to perform the model calculations, and calculate AAHUs according to the required HEP procedure. For mitigation alternatives meeting the mitigation objective of 29.16 AAHUs exactly, the Excel numerical method application Solver was used to converge on an acreage value that would result in producing this AAHU value. Two scenarios, the Without Project and With Project conditions, were modeled for the Proposed Project site to determine the net impact by subtracting the AAHUs of one scenario from the other. Two scenarios, the Without Mitigation Project and With Mitigation Project conditions, were modeled for each mitigation alternative to determine the net impact by subtracting the AAHUs of one scenario from the other. The CE/ICA was conducted with the habitat modeling results and costs developed for each alternative, to identify the mitigation plan justified for the Preferred Alternative. For the mitigation alternative selected from the CE/ICA process to propose in the Mitigation Plan, Table 4.4.3-1 provides a summary of the results of modeling. The results show that the recommended mitigation provides full mitigation of functional losses.

Table 4.4.3-1 Summary of American Oyster HSI Modeling of Without and With Project Condition

Project Location/Condition	Area (acres)	Endpoint HSI Score*	AAHUs
Proposed Project Site			
Without Project	29.9	1.00	29.87
With Project	29.9	0.00	0.71
		Net Impact	**-29.16**
San Leon Reef Mitigation Site			
Without Mitigation Project	30.1	0.00	0
With Mitigation Project	30.1	1.00	29.16
		Net Impact	**+29.16**

4.4.4 Ecological Performance Standards and Monitoring

Monitoring of the restoration sites would be conducted pre- and post-restoration in order to assess the success of the project. Criteria for restoration success would include one structural and one functional endpoint. The structural endpoint would be the number of reef acres restored. Pre-restoration and post-restoration side-scan sonar data would be collected and processed into ArcGIS data layers. Restored reef acreage would be quantified by subtracting pre-restoration reef acreage from post-restoration reef acreage to determine the amount of habitat restored. Success would be defined as an increase in reef acreage of at least 30.1 acres. The functional endpoint would be live oyster density (oysters/m^2). Density would be measured using the diver quadrat method twice a year (pre- and post-oyster harvest season) for three years. SCUBA divers would sample random points along a transect line by placing a 0.25 m^2 quadrat on the bay bottom and placing all shells and live oysters from within the quadrat into a mesh bag. All live oysters would be enumerated and a maximum of 10 individuals would be measured for shell length. Success would be defined as a post-restoration oyster density equal to or greater than densities observed during a pre-construction survey of the reef to be impacted at the Proposed Project site. Once the success criteria are met, the monitoring would cease and the mitigation project is determined to be successful.

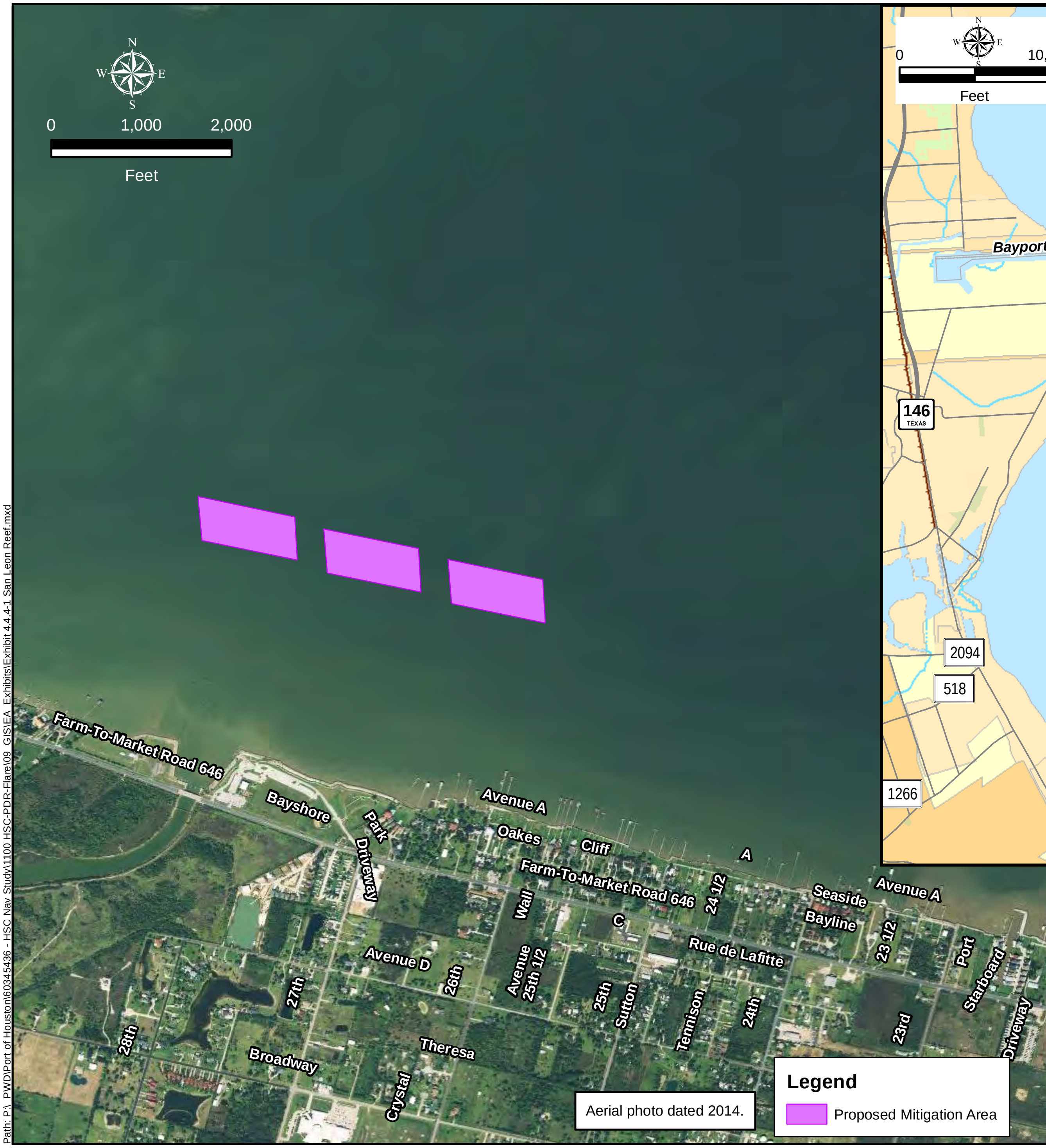
4.4.5 Reporting

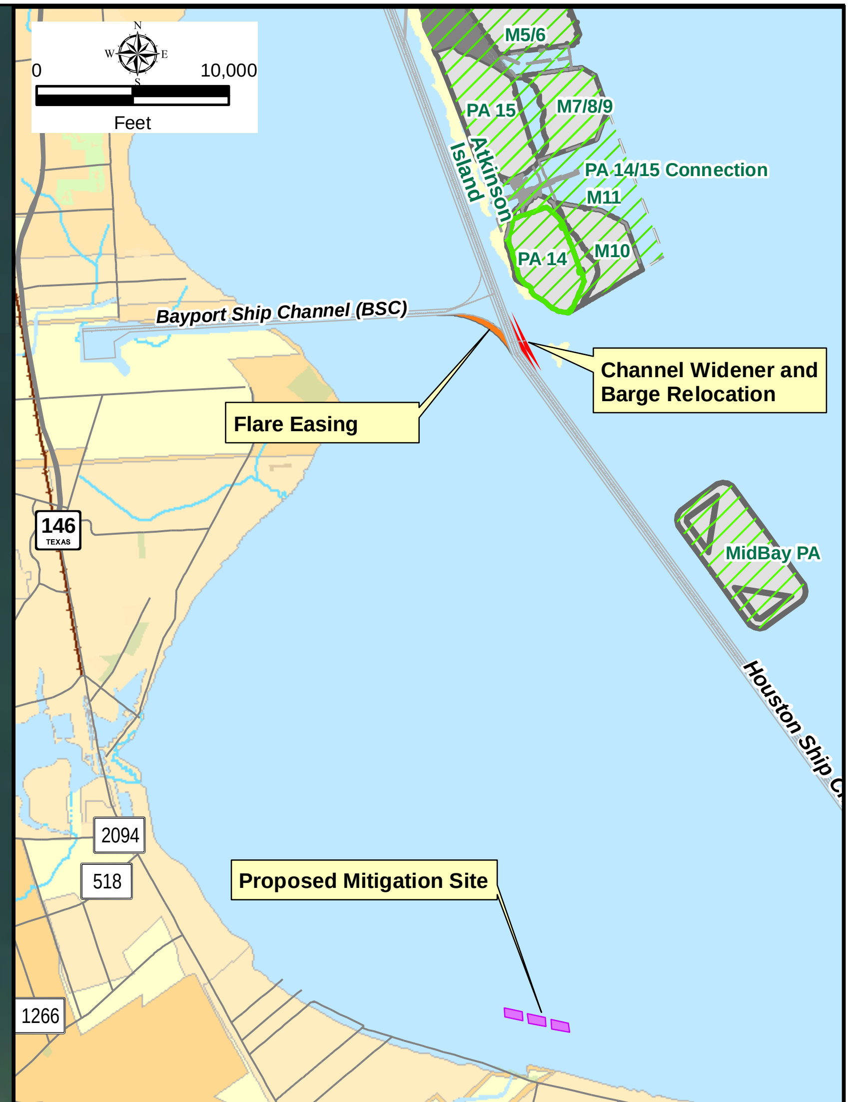
The results of all monitoring activities would be summarized in an annual report that summarizes the findings of final reports. The first report would include the findings of the restored reef acreage as determined by side-scan sonar and would be submitted no later than 90 days after project completion. The three annual reports would include the oyster density findings of the SCUBA divers including if the post-restoration oyster density has met the success criteria.

If the mitigation is not progressing to meeting the success criteria within three years, the TPWD would be notified by the USACE as soon as possible so that the mitigation plan can be evaluated and measures pursued to address deficiencies of the mitigation plan. The USACE will conduct mitigation monitoring until success is documented.

4.4.6 Implementation and Long-Term Management

The proposed mitigation would be implemented either before or concurrently with the construction of the proposed project. Currently, it is anticipated that construction of the proposed project would begin in 2016, with construction lasting less than one year. Pre- and post-construction monitoring for meeting the restoration objectives would occur before and after constructing the mitigation with post-construction monitoring lasting for three years. After the success criteria are met, the long-term management of the mitigation area would be conducted by the TPWD as part of its mission to manage public reefs.





HSC PDR FLARE AT BAYPORT MITIGATION PLAN

Proposed Oyster Reef Restoration at San Leon Reef Chambers County, Texas

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date March 2016	Job No. 60345436	Exhibit 4.4.4-1

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5.0 CUMULATIVE IMPACTS

This chapter discusses the cumulative impacts expected to result from the proposed action, in addition to impacts that have already occurred in the project area due to projects and development relevant to the impacts, and the impacts of relevant projects that are expected to occur in the project area and are reasonably foreseeable. This chapter provides the following information:

- The definition of cumulative impacts and an introduction to cumulative impact analysis

- A discussion of the methodology used, a summary of direct and indirect impacts, and a description of the types of impacts that were included in the cumulative impact assessment

- A description of past, present, and reasonably foreseeable future projects and activities that may have cumulative impacts to the project area and the surrounding region

- A discussion of cumulative impacts of those projects and activities relevant to the impacts included in the cumulative impact assessment.

5.1 INTRODUCTION

For purposes of this EA, cumulative impacts were discussed in further detail if the indirect and direct impacts have more than insubstantial temporary adverse or positive impacts on the particular resource. In addition, the health of the resource was taken into consideration.

The President's Council on Environmental Quality (CEQ) regulations defines cumulative effects as:

"…the impact on the environment which result from the incremental impact of the action (project) 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 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Impacts include both direct effects (caused by the action and occurring at the same time and place as the action), and indirect effects (caused by the action but removed in distance and later in time, and reasonably foreseeable)."

Cumulative effects include both direct and indirect, or induced, effects that would result from the project, as well as the effects from other projects (past, present, and reasonably foreseeable future actions) not related to or caused by the proposed action. The cumulative effects analysis considers the magnitude of the cumulative effect on the resource health. Health refers to the general overall condition, stability, or vitality of the resource and the trend of that condition. Laws, regulations, policies, or other factors that may change or sustain the resource trend were considered to determine if more or less stress on the resource is likely in the foreseeable future. Cumulative effects of the proposed project would be the incremental effects that the project's direct or indirect effects have on that resource in the context of other past, present, and reasonably foreseeable future effects on that resource from unrelated activities. Cumulative impacts may also occur when the occurrence of disturbances are so close that the effects of one are not dissipated before the next occurs, or when the timings of disturbances are so close that their effects overlap.

5.2 METHODOLOGY

No standard methodology is provided by NEPA or CEQ regulations to quantify cumulative effects, or to define the geographic area for which cumulative impacts should be assessed. A general approach and suggested analytical techniques are provided in the CEQ's 1997 publication, *Considering Cumulative Effects under the National Environmental Policy Act*. Where these were useful and appropriate, they were considered. The first step in the general approach is to scope for the cumulative effects, which involves the following sub-steps:

- Identify the primary cumulative effects issues associated with the proposed action and define the assessment goals.
- Establish the geographic scope for the analysis.
- Establish the time frame for the analysis.
- Identify other actions affecting the resources, ecosystems, and human communities of concern.

The first step and associated sub-steps are discussed in Section 5.3 and includes a summary of the direct and indirect effects, which effects were carried forward in the cumulative impact analysis, what their geographic scopes are, what the other actions affecting the resources are, and the timeframe for analyzing these actions. Parameters addressed in the scoping included ecological, physical, chemical, socioeconomic, and cultural resources and attributes.

The second step is to describe the affected environment, and consists of the following sub-steps:

- Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses.
- Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds,
- Define a baseline condition for the resources, ecosystems, and human communities.

This first sub-step was done implicitly in describing the Affected Environment in Chapter 3, but a general discussion is provided in Section 5.4 for the cumulative impacts analysis. The second sub-step was carried out in the Affected Environment Chapter 3, by discussing the pertinent regulatory thresholds and statuses for the various resources, where applicable. Both of those sub-steps are also partially addressed in the discussion of trends for the resources in the cumulative impact analysis. The last sub-step was explicitly carried out for all resources in the Affected Environment Chapter 3, by discussing the existing conditions of the physical, biological, and human environmental resources of the project area. The baseline condition and general health of the resource were considered in the assessment of cumulative impacts.

The third step in the general approach is to determine the environmental consequences. The following sub-steps were accomplished in this analysis:

- Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities.

- Determine the magnitude and significance of cumulative effects.

The first sub-step was carried out in the cumulative impact analysis. Where quantitative data was practical, and reasonably available or estimable for the past, present, and reasonably foreseeable actions, it was used. Otherwise, the discussion of the magnitude and significance of the effects was qualitative, employing knowledge of the scale of projects, resources, and impacting agents (e.g. air or water emitters, size of development) to provide perspective of the effects against the resources impacted. Because the cumulative impact analysis did not identify substantial contributions from the proposed action to cumulative impacts, mitigation of effects or monitoring of them was not part of the analysis.

5.3 CUMULATIVE EFFECTS SCOPING AND SUMMARY OF DIRECT AND INDIRECT IMPACTS

The first step in the CEQ's general approach is to scope for the cumulative effects, of which the first sub-step is to identify the significant cumulative effects issues associated with the proposed action and define the assessment goals. This involves defining the direct and indirect effects of the proposed action, which resources are affected, and which effects are important from a cumulative perspective. This is done to focus the analysis on meaningful impacts relevant to the effects of the proposed action, and not include those effects that are irrelevant or inconsequential to decisions about the proposed action and alternatives. To accomplish this step, this section summarizes and discusses the direct and indirect effects detailed in Chapter 4, and which of those effects were carried forward in the cumulative impact analysis. The second sub-step in scoping is to identify the geographic scope for the analysis. This is also discussed for the effects carried forward in the cumulative impact analysis.

Generally, if a more than an insubstantial temporary positive or adverse direct or indirect impact was identified in these resource categories, considering the status or health of the resource, then the resource discussion was carried forward to the cumulative impact analysis section. The subsections below synopsize the reasoning for focusing on the effects carried forward in the cumulative impact analysis relative to the direct and indirect impacts to the physical, human and biological environments.

5.3.1 Physical Environment Impacts

Scoping for the physical environment impacts of the proposed action is provided below. Regarding, the potential for indirect effects, no indirect changes to land features would occur. The proposed action is located entirely in open water and man-made uninhabited PA islands, and indirect effects to land-based resources or activity such as population, surface transportation, and terminal activity would not occur as discussed in Sections 4.3.1, 4.3.3, 4.3.6. and 4.3.8.2. Therefore, the proposed action is not expected to induce any substantial changes in land use patterns, such as the facilitation of agriculture, mining, or urbanization.

- **Topography, Soils, Geology, and Physical Oceanography** – Lack of terrestrial impacts, small proportion of the resource affected, and regional nature of these resources, would result in a minor and negligible direct impact on topography, soils, and geology. The small scale or lack of impact of the proposed action on the factors that cause changes to physical oceanographic phenomena such as currents or salinity, would result in minor or negligible effects on these resources, Therefore, effects to topography, soils, geology, and physical oceanography are not carried forward in the cumulative impacts analysis.

- **Water Quality and Sediment** – Indirect impacts to water quality from terrestrial land use changes are not expected for the reasons discussed at the beginning of this section. Temporary and minimal impacts to water quality, primarily from turbidity, during dredging and placement could result in temporary effects that overlap temporally or spatially with other foreseeable dredging projects. Therefore, water quality effects due to turbidity are carried forward in the cumulative impact analysis. In accordance with the determination by the LOE/WOE analysis discussed in Section 4.1.5.2, new work native material being dredged during construction of the proposed action is not be expected to be impacted by contaminants in sediment, therefore, chemical impacts during maintenance dredging and placement from the proposed action are not expected.

Considering the limited spatial (several hundred meters) and temporal (several hours) range of turbidity effects and related sediment movement, the geographic scope used for water and sediment quality in cumulative impact analysis was Upper Galveston Bay (north of Redfish Island).

5.3.2 Biological Impacts

Scoping for the biological environment impacts of the proposed action is provided below. Regarding, the potential for indirect effects, the same factors discussed for the physical environment also limit potential for indirect effects to biological resources from land-based development. The reduction in numbers of vessels required to move a given tonnage allowed by the proposed action limits the potential for effects to marine resources due to vessel traffic changes.

- **Vegetation and Wetlands** – Lack of terrestrial impacts other than non-natural upland habitat isolated from the mainland that are associated with existing PAs would result in a minor impact on terrestrial habitat. Indirect impacts are not expected for the reasons discussed at the beginning of this section. Therefore, terrestrial vegetation and habitat impacts are not carried forward in the cumulative impacts analysis. There would be no impacts to wetlands that would result from the proposed action. Therefore, wetlands are not carried forward in the cumulative impacts analysis.

- **Wildlife and Aquatic Fauna** – Only temporary disturbance impacts to migratory and colonial water bird nesting and foraging habitat similar to periodic maintenance dredging placement are expected, and other terrestrial species in PAs, like raccoons and coyotes, are common, resulting in a less than substantial impact to terrestrial wildlife. Therefore, terrestrial wildlife impacts are not carried forward in the cumulative impacts analysis. Permanent impacts to benthic habitat and 29.9 acres of oyster reefs within the dredging footprint, and temporary but minor effects primarily from disturbance and turbidity would result in an impact to aquatic fauna. Also, the indirect temporary impacts could be overlapping or cumulative considering other bay dredging projects. Therefore, aquatic fauna impacts are carried forward in the cumulative impacts analysis. Considering the estuarine habitat involved and the spatial extent of dredging effects, the geographic scope for aquatic fauna in the cumulative impact analysis was Galveston Bay, with a focus on the Upper Bay.

5.3.3 Human Environment Impacts

Scoping for the human environment impacts of the proposed action is provided below. Lack of substantial direct terrestrial impacts limits the direct and indirect effects, and influence, on land-based socioeconomic or community resources. Regarding, the potential for indirect effects, the same factors discussed for the physical environment also limit potential for indirect effects to human environment resources from land-based development. Regarding the potential for indirect inducement of port-related development and activity, the proposed action would not affect terminal activity, as explained in Section 4.3.8.2. Therefore, no substantial indirect effects on socioeconomic resources resulting from induced development are anticipated from the proposed action.

- **Socioeconomic, Community and Aesthetic Resources** – Lack of direct impacts, and lack of indirect effects for the reasons explained at the beginning of this section, would result in a minimal effect to socioeconomic resources. Although benefits to shipping from time and fuel savings through relief of the congestion around the HSC-BSC intersection would be a positive economic impact, the impact would be minor, and the shipping industry economy in Houston has historically been and continues to be strong. Therefore, impacts to socioeconomic resources are not carried forward in the cumulative impact analysis. Lack of direct impacts, and lack of indirect effects for the reasons explained at the beginning of this section, would result in a minimal effect to land-based community or recreational resources. Therefore, impacts to community resources are not carried forward in the cumulative impact analysis. Lack of sight line impacts, or perceptible long-term visible changes to the horizon would result in minimal impacts to visual and aesthetic resources. Therefore effects to visual and aesthetic resources are not carried forward in the cumulative impact analysis.

- **Traffic, Transportation and Infrastructure** – No direct impacts, and no indirect effects for the reasons explained at the beginning of this section, would result in a minimal impact to surface transportation or traffic. Lack of impact on terminal activity as explained in Section 4.3.8.2 for the terminal emissions of the Preferred Alternative, also would result in no indirect effect on terminal truck or rail traffic. Marine transportation in the HSC would be improved from a safety standpoint, but this is not a critically or regionally impaired resource. Therefore impacts to transportation and traffic are not carried forward in the cumulative impact analysis. No direct impacts to municipal infrastructure, and continued access for pipelines and oil and gas facilities associated with future PAs that would be used for maintenance material until they can be relocated, would result in a minimal impact to infrastructure. Therefore impacts to infrastructure are not carried forward in the cumulative impact analysis.

- **Air Quality –** Temporary constructions emissions, lack of direct and indirect effects on terminal emissions, and the long-term but small positive direct and indirect effects on vessel emissions would result in a minimal impact to air quality. Therefore, impacts on air quality are carried forward in the cumulative impact analysis.

- **Noise –** Temporary construction sound similar to current periodic maintenance dredging, lack of substantial direct or indirect effects on terminal and vessel sound sources, and lack of negligible sound levels calculated for potential sensitive receptors, would result in a minimal impact on noise. Therefore, effects on noise are not carried forward in the cumulative impact analysis.

- **Cultural Resources** – No impact on any cultural resources or historic properties would occur from the proposed channel improvements or the use of existing PAs. Therefore effects on cultural resources are not carried forward in the cumulative impact analysis.

5.3.4 Relevant Past and Present Actions

As a result of considering the environmental consequences described Chapter 4 and the associated conclusion of direct and indirect impacts on the various resources, two resource effects were carried forward in the cumulative effects analysis. Water quality due to turbidity during construction dredging was carried forward to examine the possibility of overlap in these temporary effects from other reasonably foreseeable actions. Aquatic fauna and habitat effects were carried forward due to the permanent impacts on oyster reef, and the possibility of overlap in the temporary dredging effects to aquatic fauna from other reasonably foreseeable actions.

5.3.5 Reasonably Foreseeable Actions

The third and fourth sub-steps of the scoping step are to identify the timeframe for the analysis, and other actions affecting the resources, ecosystems, and human communities of concern. The relevant past and present actions are those that have had or continue to have effects on the resources carried forward in the analysis, and within the geographic scope identified for those effects. These represent the other actions that affect the resources, ecosystems, and human communities of concern. For purposes of these past or present impacts, a timeframe of 50 years from the present to the past was selected, which is the assumed lifespan of a USACE navigation/dredging project. This is also a timeframe for which sufficient impact information is reasonably and readily available.

The analysis focused on projects with a substantial impact to Galveston Bay and bay bottom through dredging or dredged material placement. Channel dredging projects that were for changes to an existing channel geometry were selected. Other projects resulting in substantial dredged material placement in Galveston Bay were also sought. Private docks and berthing areas were considered. However, with the exception of the Clear Lake Channel, the private berthing facilities on Upper Galveston Bay north of Redfish Island (which has a northern limit of Morgan's Point) are all small piers and docks for recreational or small fishing shallow draft vessels that would only require small-scale dredging to maintain depths near the docks and shoreline to the relatively shallow drafts of Galveston Bay (6 to 8 feet). Therefore, small docks and piers were not considered further for past actions. The other projects were considered further with regard to their completion and status and whether they could result in the effects carried forward in the cumulative analysis. Following this, they were segregated into projects carried forward only due to water quality and aquatic effects from dredging during maintenance, and those carried forward due to all of the resource effects carried forward in the analysis. Table 5.3.6-1 summarizes the projects constituting the past and present actions. Data from publicly available environmental documents (i.e. EAs, EISs), Federal feasibility studies, and related documents were used. In a few cases where acreage information was lacking but channel project dimensions were available, approximate areas were estimated. The following synopsizes the individual past and present actions.

Past and Present Projects Carried Forward for Maintenance Dredging Effects

These projects had no impacts to oyster reef based on their NEPA documents, or based on location in an area where reef would not be present. These are projects that have been constructed (e.g. new work dredging completed), and only receive maintenance dredging within the originally constructed channel dimensions. Therefore, only the temporary effects to water quality and aquatic species during maintenance dredging would be considered in the cumulative impact analysis.

- Cedar Bayou Federal Navigation Channel – This project involved the deepening of the Federal navigation barge channel in 1975, and is completed. The channel is located approximately 4.5 miles northeast of the BSC starting near Atkinson Island and extending into Cedar Bayou, to approximately Mile 3, near the City of Baytown in Chambers and Harris Counties, Texas. It joins the HSC between the north tip of Atkinson Island and Hog Island. No impact on oyster reef is listed in the project EIS.

- Odfjell Bulk Liquid Terminal – This project involved the construction of 2 large vessel wharves and 3 smaller barge docks to service bulk petrochemical liquid vessels on the BSC TB, west of the BSCCT.

Project is in the land cut of the BSC, which is known to have been excavated out of uplands which would not have contained oyster reef.

- LBC Bulk Liquid Terminal – This project involved the construction of 3 large vessel wharves and 5 smaller barge slips to service bulk petrochemical liquid vessels on the BSC TB, west of the BSCCT. Some of these facilities were originally built by Celanese and sold to LBC in 2000. Project is in the land cut of the BSC, which is known to have been excavated out of uplands which would not have contained oyster reef.

- LBC Water Injection Dredging Method Permit Amendment [SWG-2002-01382: Permit 20679(04)], Bayport Ship Channel Turning Basin, Harris County – Permit extension and modification to allow water injection method for existing maintenance dredging permit. Similar to the project above, it involves the same location in the BSC land cut known to have been excavated out of uplands with no oyster reef.

- Texas City Channel Deepening – This project involves deepening the Federal navigation channel, which was recently completed. The Texas City Channel is approximately 17 miles southeast of the BSC in the lower part of the Galveston Bay near its outlet to the GOM. This project is interrelated with the Shoal Point Container Terminal project, as it assumed the responsibility to deepen the channel from the Shoal Point project. No impact on oyster reef is listed in the project EA.

- Expansion of PAs 14 and 15 – This project involves expanding the existing PAs 14 and 15 by filling the gap between them with an upland PA connection and creating adjacent BU marsh cells M10 and a future cell M11. Mitigation for impacts to the saline marsh and tidal flats in the connection were achieved by construction of 88 acres of marsh at the Bolivar BU Marsh site, which is reflected under the HGNC project. This is the project that the BSC Improvements Project has plans to provide levee construction material for in addition to raising the levees to increase capacity under the Preferred Alternative of the EA. PAs 14 and 15 are just to the east and north of the HSC-BSC confluence. No impact on oyster reef is listed in the project EA.

- Barbours Cut Terminal and Channel – This project involved the deepening of the Barbours Cut turning basin and side channel to the HSC, and constructing a container terminal along the channel in the 1970's. Barbours Cut Terminal and Channel are located approximately 4.6 miles north of the BSC at Morgan's Point, which is at the mouth of the HSC/Buffalo Bayou leading into Galveston Bay.

- Barbours Cut Terminal Modernization – This is a project to modernize the terminal facilities to accommodate the larger, more modern container vessels at the existing berths. It would involve upgrading of the 6 existing wharves, the associated cranes, and other terminal facilities to better handle the larger vessels already calling at the Port of Houston. It is currently in progress, with Wharf 1 upgrades completed.

- Barbours Cut Channel (BCC) Improvements – This project involves modifying the existing channel last modified in the 1970's by deepening it 5 feet (plus 2 feet of advance maintenance and 2 feet of allowable overdepth), and shifting it to the north by 75 feet, to accommodate new safety setbacks and larger cranes planned for the modernization of the terminal. The project in progress, anticipated to be completed by October 2015.

- Amendment to Original BCC Permit 1090206 – SWG-1999-02499: Permit amendment for PHA to allow Terminal 7 to be dredged 5 feet deeper, and a 0.62 acre expansion of the Terminal 7 footprint located at the end of the BCC turning basin. This project has been completed.

- Bayport Ship Channel Container Terminal (BSCCT) – This is an ongoing project to build a container and cruise ship terminals with the first phase completed in 2007 providing three berths. The terminal is located on the south shore of the BSC within the land cut. Landside container yard work for Berth 6 is planned for the near future. The permit for this project was also amended to allow dredging berths 5 feet deeper than originally planned. The existing Berths 2, 3 4 and 5 will also be deepened during the current contract implementing the BSC Improvements. The next planned terminal and berth construction is not anticipated within the next several years.

- Clear Lake Channel – An approximate 7-feet deep channel running the length of Clear Lake and emptying to Galveston Bay at a draft of 10 to 12 feet. It receives periodic maintenance to maintain this draft for recreational users. No NEPA information available on oyster impacts of original channel work, but based on historical reef mapping, the channel is a narrow recreational channel that appears to go through the gap between the only two mapped reefs in this area that coincide with spoil areas from the original channel (Powell et al 1997, NOAA 2015). It is very likely little to no reef was impacted by the original channel and that reef accretion developed on the channel excavation spoil banks.

Past and Present Projects for All Effects Carried Forward in Cumulative Impact Analysis

- HGNC Project – This project involves deepening and widening the 53-mile long HSC and deepening the 2-mile long Galveston Ship Channel (GSC), which have already been completed as of 2010. Placement of dredged material was planned for 50 years to go to existing and future upland and BU marsh PAs and ocean disposal sites along these channels from the lower reach of the Buffalo Bayou/HSC before it enters Galveston Bay to just outside of Galveston Bay in the Gulf of Mexico (GOM).

- BSC – This project involved the dredging of the current BSC, originally dredged in the mid 1960's and deepened in the 1970's.

- BSC Improvements – This project involves dredging the existing channel last modified in the 1970's to further deepen it by 5 feet (plus 2 feet of advance maintenance and 2 feet of allowable overdepth), widen it by 100 feet outside of the land cut and 50 feet inside of the land cut, under Department of the Army Permit SWG-2011-1183. This project is currently underway and is anticipated to be completed by March 2016.

Other Present Projects Not Carried Forward in Cumulative Impact Analysis

Other recently permitted actions were found to be associated with the private liquid bulk cargo tenants on the BSC or near the project area, and are discussed for whether these actions would be expected to have impacts on the resources carried forward in the cumulative analysis:

- Odfjell
    - SWG-2002-02976: Amend Permit No: 20671(04) to add disposal area – Amendment would be to allow another disposal area to be used for their maintenance dredging permit. This would not involve

dredging in the Bay, and would therefore not impact resources carried forward in the cumulative impacts analysis.

- SWG-2010-00616: NWP for bulkheads at terminal – Action would be for repair or installation of bulkheads, and would comparatively involve only a very small amount bay bottom in the current turning basin, would involve pile and sheetpile driving and not significant dredging. Therefore potential aquatic impacts (turbidity etc.) from dredging would be negligible.

- LBC – SWG-2010-00794: NWP and Regional General Permit for 8-Inch Diameter HDPE Pipeline, Taylor Bayou, Harris County, Texas – Action would be in Taylor Bayou, and therefore not involve dredging in the Bay. Therefore, it would not impact resources carried forward in the cumulative impacts analysis.
- MMKP Exploration – SWG-2010-00293: Cedar Point Prospect Well #1 & Pipelines, Galveston Bay, Chambers County – No further information available. Assumed to be offshore well and associated servicing pipeline installation based on latitude/longitude information. Permit was issued in 2010, and is assumed to have occurred. Since it involves oil and gas equipment installation, it would not involve ongoing maintenance dredging. Location is in an area of Trinity Bay devoid of historical reef mapping. Therefore, it would not impact resources carried forward in the cumulative impacts analysis.

Considering that these permit actions would not involve any impacts to the resources carried forward, nor would they involve continuing maintenance effects, these actions were not carried forward in the analysis.

5.3.6 Reasonably Foreseeable Actions

This section presents the other part of the actions that affect the resources, ecosystems, and human communities of concern. No specific timeframe was selected as this is dictated by the long-term project planning information available used to identify foreseeable projects. Data from publicly available Federal and State permitting sources, NEPA related filings and postings, and USACE planning project forecasts, were used to search for potential projects to include in the cumulative impact analysis. The following summarizes the sources searched and a synopsis of information or project types relevant to the proposed action:

- EPA Environmental Impact Statement (EIS) Database (EPA 2015b) – Any major projects that would involve work in open water near the project area, such as dredging, marinas, navigation channels, terminals, and other port facilities.

- TRRC New Permits (TRRC 2015) – Pipelines permitted in State waters that include Galveston Bay.

- USACE CWA Section 404 Permits Issued (USACE 2015) – All work involving dredging or filling in waters of the U.S. near the project area (i.e. within Upper Galveston Bay) that would include all the project types and pipelines discussed in the first two sources, typically concurrently or in latter stages of planning. This information would also capture smaller-scale projects (individual docks, bulkheads, terminal repairs etc.) near the project area.

- USACE Galveston District Current and Future Studies – Information from the District Plan Formulation Section for major HSC area navigation system improvement studies for the HSC or its surrounding side (e.g. BSC) and connecting channels (e.g. Gulf Intracoastal Waterway). This would capture major Federal waterborne projects that do not get permitted under CWA Section 404.

Where possible, these sources were queried for projects three years ago to the present, as a practical timeframe and assumed timespan for projects that have not yet been constructed. The exceptions were the TRRC new permits, which only present the last year, and USACE Galveston District current and future studies which cover studies presently underway, and those anticipated one year into the future. These information sources were queried for location and project type indicators that specified or implied waterborne projects located in Galveston Bay. For water quality effects and overlapping temporary effects to aquatic fauna, indicators for Upper Galveston Bay, and north of Redfish Island were searched for prospective projects, as scoped in Section 5.3.1. For oyster reef impacts, indicators of projects that could impact reef in greater Galveston Bay, such as dredging projects, were searched for prospective projects, as scoped in Section 5.3.2. Private docks and berthing areas were considered.

Several candidate projects were eliminated upon reviewing location information that placed the project outside of Galveston Bay in Cedar Bayou, such as Chambers County Improvement District No. 1 Dredging, Bulkhead, New Barge Dock, and Cedar Bayou Towing, LLC Bulkhead, Cedar Bayou Area. Table 5.3.6-1 summarizes the projects constituting the reasonably foreseeable actions. Data from publicly available environmental documents (i.e. EAs, EISs), Federal feasibility studies, and related documents were mostly used for project information and impacts. The following synopsizes the individual reasonably foreseeable actions considered further in the cumulative impact analysis.

- LBC Houston, LP Permit 20679(04) – SWG-2002-01382: Bayport Ship Channel Turning Basin, Harris County – Amendment to permit to allow expansion of a dock and berth facility to dredge two new berths out of upland ,for LBC bulk liquid terminal in the BSC TB.

- Shoal Point Container Terminal – This is a project to build a container terminal on the existing Shoal Point PA Island on the Texas City Channel, and dredge the required berths and turning basin. This project had some related elements, namely the channel deepening and some PAs, which became part of the Texas City Channel Deepening Federal project, whose impacts are reflected under that project.

- Texas Department of Transportation – SWG-2007-00173: Bolivar Ferry Landing Dredging, Galveston Bay, Galveston County – Proposed maintenance dredging for a period of 10 years within three Port Bolivar Ferry slips and approach ways to maintain a depth of 23.5 feet below MLLW (22 feet below MLT), with placement of material for beach, tidal flat, and marsh restoration The dredging would occur in existing berths and placement in areas that inherently would not contain oyster reef. Therefore, impacts to oyster reef would not be anticipated.

- Chauviere – SWG-2014-00346: Pier Extension, Trinity Bay, Chambers County – Location is just north of Umbrella Point in Trinity Bay. No further information.

- Garber – SWG-2014-00437: Boathouse with T-head, Galveston Bay, Chambers County. Location is approximately 1.25 miles south of Morgan's Point along the shoreline.

Table 5.3.6-1 Summary of Past and Present; and Reasonably Foreseeable Actions

Project	Action[1]	Year Built/Projected to Start Building[2]	Construction Status[3]	Approximate Dredging Area in Bay (acres)	Oyster Reef Impacts (acres)	Comments
Past and Present Actions						
Houston-Galveston Navigation Channels (HGNC)	Deepen/widen existing 53 mi HSC to -46.5 ft MLLW (-45 ft MLT) X 535 ft Deepen existing 2.2 mi GSC to -46.5 ft MLLW (-45 ft MLT)	1998-2005 (HSC complete), 2011 (GSC complete)	Maintenance	480	118 main channel 54 barge lanes	
Cedar Bayou Federal Navigation Channel (FNC)	Dredge 8 mi -11.5 ft MLLW (-10 ft MLT) X 100 ft barge channel	1931, 1975	Maintenance	83	0	
Barbours Cut Terminal and Channel	Build container terminal - Dredge 1.6 mi X 300 ft -41.5 ft MLLW (-40 ft MLT) side channel	1977	Maintenance	56	0	
Barbours Cut Terminal Upgrade	Upgrade terminal facilities	2014	In progress. Wharf 1 complete. Wharves 2 and 3 planned next.	No dredging	None. See project description text for explanation.	
Barbours Cut Channel Improvements	Deepen and shift channel to accommodate modern setbacks	2014	In progress. Completion anticipated by end of 2015.	26.8	0	
Amendment to Original BCC Permit 1090206	Dredge Terminal 5 feet deeper. 0.62 acre footprint expansion, in BCC TB	2015	Maintenance	See Note 4	0	
Clear Lake Channel	Shallow draft recreational channel	Unknown	Maintenance	18.4		
Bayport Ship Channel Container Terminal (BSCCT)	Build container & cruise terminals, dredge 7 container & 3 cruise berths, dredge cruise TB	2007 - ongoing	In progress – 4 container & 1 cruise berths, cruise terminal & TB built	74	0	
Bayport Ship Channel (BSC)	Dredge 4 mi -41.5 ft MLLW (-40 ft MLT) X 305 feet side channel	1977	Maintenance	220	None. See project description text for explanation.	
BSC Improvements	Deepen the existing BSC by 5 ft and widen by 50 ft in the land cut, and by 100 ft in the Bay	2014	In progress. Completion anticipated March 2016	68	4.6	
Odfjell Bulk Liquid Terminal	Petrochemical terminal with 2 wharves and 3 barge docks	1980-1989	Maintenance	See Note 4	None. See Note 6	
LBC Bulk Liquid Terminal	Petrochemical terminal with 3 wharves and 5 barge docks	1978-late 1990's	Maintenance	See Note 4	None. See Note 6	
Expansion of PAs 14 and 15	Expand existing PAs by building new cells	2010-2012	All placement and marsh cell dikes built, except M11	none	0	
Texas City Channel Deepening	Deepen channel from -41.5 ft to -46.5 ft MLLW (-40 ft to -45 ft MLT) [requires nominal widening]	2011	Maintenance	15	0	
Reasonably Foreseeable Actions						
LBC Houston, LP Permit 20679(04)	Dock and berth expansion in BSC TB	2015	In progress	See Note 4	None. See Note 6	
Shoal Point Terminal	Construct container terminal, berths, & TB	unknown	Future	125	0	
TxDOT Bolivar Ferry Landing Dredging	Maintenance of 3 ferry slips to -23.5 ft MLLW (-22 ft MLT) with placement for beach, tidal flat, and marsh restoration	2014	In progress	33	None. See project description text for explanation.	
Chauviere Pier Expansion (SWG-2014-00346)	Private pier extension	unknown	Future	None expected. See Note 5.	None expected. See Note 5.	
Garber Boathouse with T-head (SWG-2014-00437)	Construction of a boathouse and T-head dock	unknown	Future	None expected. See Note 5.	None expected. See Note 5.	

1. Abbreviations: HSC = Houston Ship Channel, GSC = Galveston Ship Channel, TB = turning basin, PA = placement area, ft = feet
2. Denotes year construction and new work dredging to build channel, berth, terminal, or placement feature was completed or projected to start
3. Denotes construction status. For channels, maintenance means new work dredging is done and channel is being maintained
4. Dredging occurs in current upland, or open water created from modern excavation of upland.
5. Action would involve pile and sheet driving instead of dredging. Therefore, minimal bay bottom would be converted. Minimal reef impacts expected based on scale and nature of action.
6. Action occurs in current upland, or open water created from modern excavation of upland, that would be devoid of oyster reef.

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5.4 CUMULATIVE EFFECTS ANALYSIS

The third step in the general approach suggested in the CEQ guidelines is to determine the environmental consequences of the cumulative effects of the projects identified. This step involves the following four sub-steps:

- Identify the important cause and-effect relationships between human activities and resources, ecosystems, and human communities.
- Determine the magnitude and significance of cumulative effects.
- Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects.
- Monitor the cumulative effects of the selected alternative and adapt management.

The first two sub-steps are carried out and discussed in this cumulative effects analysis, and the last two are discussed in the conclusions to this chapter. The following subsections provide the details of the cumulative effects analysis.

5.4.1 Results

5.4.1.1. Water Quality

Water

As discussed in the scoping, the primary water quality effect of the proposed action carried forward in the analysis with respect to cumulative effects was the temporary effect of turbidity caused by dredging and placement. The past actions would not continue to have effects on turbidity since they have been constructed and dredging has long since ceased, though periodic maintenance dredging for these projects would. The present projects that still have berths to dredge, or PAs to be constructed to accommodate channel maintenance material, would have effects from the berth or maintenance dredging and placement, and PA construction. The reasonably foreseeable projects would have effects from dredging berths and channel improvements, and the associated placement to create new PAs. For the Expansion of PAs 14 and 15 project, mining to provide levee material would have turbidity effects.

As previously discussed in Section 4.1.4, the temporary effect from dredging lasts a few hours and extends typically a few thousand feet (<3,281 feet or 1,000 meters). Therefore, the most important cause and effect relationship of concern to turbidity from these projects is the timing and spacing of the projects and whether their effects would spatially or temporally overlap. Considering this, only the following projects would be close enough spatially for effects to potentially overlap with the BSC Improvements Project: HGNC, Existing BSC, and Expansion of PA 14 and 15. The other projects are located at least several miles away, outside the range of interest (<3,281 feet). The planned private pier extension and boathouse projects in the Upper Bay would only involve small, very localized dredging and minor pile driving, and their locations along the mainland shoreline are also well outside the range of interest to the Preferred Action location for effects involving turbidity during dredging. Their effects would be expected to negligible.

For the remaining projects under consideration (HGNC, Existing BSC, BSC Improvements etc.), the turbidity effects would not overlap. For the Expansion of PAs 14 and 15, all cells, except M11 have been constructed.

Maintenance material placement would take place within these dikes with outlets controlled to dewater sediments. M11 is a cell that has only been conceptually planned, and specific planning for it to determine its size and configuration would not take place until capacity at other planned and constructed cells are forecasted to reach limitations. The Preferred Action is planned to be implemented concurrent with maintenance of the existing Flare in 2016. Considering the demand and planning to implement M11 is not anticipated to occur in the next few years, it is not likely that these projects would be constructed during the same times. Also, M11 is located on the other side of Atkinson Island, approximately two or more times the distance of interest (<3,281feet).

Regarding the HSC, existing BSC, and BSC Improvements, several dredging, scheduling, and planning factors do not make their effects likely to overlap spatially or temporally with the Preferred Action. These factors included practicalities of dredging operations, HPA and USCG safety spacing restrictions, recently completed dredging, and USACE planned work and dredging forecasts. Because of these factors, it was determined that turbidity effects from the proposed action were unlikely to overlap spatially or temporally with those from the past, present, or reasonably foreseeable actions. For example, even if the existing or improved BSC maintenance were scheduled to occur around the same time window as the proposed project, spacing restrictions of 3 to 5 miles between dredges, and limited availability of suitable dredges, makes it unlikely these projects would be dredged simultaneously. Also, because this project and the Preferred Alternative would be maintained by the USACE, it is likely that both actions would be programmed to be executed under the same contract, to reduce mobilization costs and simplify execution. As such, the dredge effects would likely not overlap, since on dredge would likely perform the work sequentially. The current plan for implementation is to dredge the proposed corrections of the Preferred Alternative concurrent with the programmed FY2016 contract to maintain the existing Flare and HSC Redfish to Beacon 78 reach. Therefore, effects from HSC maintenance would similarly not likely overlap with those of the Preferred Action. Considering these factors, the proposed action's temporary localized effects from turbidity would likely not have cumulative effects with the past, present, or reasonably foreseeable actions since their effects would not overlap due to either timing or distance. With respect to the dredging frequency of the proposed action, the dredging frequency is not expected to increase as indicated in the shoaling analysis. Therefore, the frequency of dredging events is not expected to increase.

5.4.1.2. Aquatic Fauna and EFH

Each of the past, present, and reasonably foreseeable actions that continue to have dredging or placement activity associated with it would have the same type of localized short-term effects to aquatic fauna and EFH as the proposed action, including direct impacts such as impingement, entrainment, and burial, and indirect temporary impacts from increased turbidity, sedimentation, noise, light, and vessel activity during the construction period. The most important cause and effect relationship of concern to aquatic fauna from the cumulative effects of these temporary impacts is one of overlapping of these effects leading to a greater or more long-lasting effect. Of these temporary effects, the most far-reaching effect would be from turbidity as the other effects would be more localized to the immediate vicinity of the dredge and cutterhead. In terms of the direct impacts like impingement and entrainment from dredge vessel activity, mobile species such as finfish would be able to readily avoid vessel activities from other projects associated with the cutterhead and intakes etc., and such effects would not overlap. Such effects from other projects to less mobile fauna such as phytoplankton and zooplankton would also be small, localized, and temporary since recovery would be quick as described for the proposed action in Section 4.2.2.2. Therefore, there would be no cumulative effect. Given that the effects of turbidity from these actions would not overlap, due to distance and timing as discussed in Section 5.4.1.1, then the temporary effects to aquatic fauna and EFH would not either. Therefore, the proposed action's temporary localized effects to aquatic fauna and EFH would likely not have significant cumulative effects with the past, present, or reasonably foreseeable actions due to either timing or distance. Because maintenance dredging would occur once every few years, the same dredge distance limitations would apply and the same effects during those activities would also be expected to temporary in nature, and not cumulative.

The permanent direct impacts include conversion of bay bottom, water column and oyster reef habitat to other forms that would either not be useful or less useful by aquatic species and EFH (e.g. deeper navigation channel,), or would be useful to the same or different species, but in a different life stage. Therefore, the most important cause and effect relationship of concern to aquatic fauna from the cumulative effects of these permanent impacts is one of the additive natures of these effects compared to the availability of these types of habitat.

The bay bottom and known oyster reef impacts of the cumulative projects, as well as the proposed action are summarized in this section. Data from publicly available environmental documents (i.e. EAs, EISs), Federal feasibility studies, and related documents were mainly used. Quantities summarizing the bay bottom impacts are for impacts to undisturbed bay bottom and do not include channels artificially excavated out of land, or new areas of open water created by a project as they represent areas of high vessel traffic and disturbance from their inception. Galveston Bay is approximately 600 square-miles (384,000 acres) in area, with all of this providing water column, and most of the bay bottom consisting of unvegetated shallow bay bottom, and a smaller percentage covered by oyster reef. The cumulative projects impact water column and shallow bay bottom habitats in two principle ways: by deepening the shallow bottom when navigation channel, berths, and turning basins are excavated, and by filling in most or all of the water column and converting shallow bay bottom to upland or marsh when dredged material PAs or other terminal facilities are built. Because the Preferred Alternative proposes only to use existing PAs, there would be no new impact and therefore, no cumulative impact to bay bottom from dredged material placement with the past, present or reasonably foreseeable future actions. Therefore, effects from dredged material placement are not discussed. The total excavation impacts from past, present and reasonably foreseeable actions are approximately 1,200 acres, or about 0.31% of the Galveston Bay area, a relatively small proportion. A total of approximately 56.7 acres of bay bottom containing 29.9 acres of oyster habitat would be impacted by the proposed action of the Preferred Alternative and 20 years of maintenance dredge disposal. Considering the bay bottom, the Preferred Alternative's impact on 56.7 acres together with the past, present, and reasonably foreseeable future actions, would represent 0.33%, a negligible change in an already-small proportion of the available bay bottom comprised of the ubiquitous soft bottom habitat. These impacts are negligible compared to the unaffected bay bottom of the 600 square-mile Galveston Bay habitat.

Data from previous mapping of oyster reef by the Galveston Bay National Estuary Program (GBNEP) in 1994 indicate approximately 28,000 acres identified in all of Galveston Bay. This data also indicates approximately 5,942 total acres of oyster habitat within the Upper Bay. Surveys from TPWD estimate that approximately 60 percent of all reefs in Galveston Bay were impacted by sedimentation induced by Hurricane Ike in 2008. The known oyster impacts for the past, present and reasonably foreseeable actions have either been mitigated (HGNC) or have plans and requirements to do so, as the TPWD manages the impacts for this resource, and requires reef creation or restoration for impacts. Therefore, there would be no net loss expected from these actions. The impacts of these projects include the 118 acres for the HGNC Project distributed along the length of the HSC in the Upper and Lower Bay, 54 acres for the associated HGNC barge lanes, that have already been mitigated, and the 4.6 acres impacted from the BSC Improvements Project for which mitigation has been constructed and is in the monitoring phase. Without mitigation, this amount represents approximately 0.6% of all Galveston Bay reef, and 1.6% if it is assumed 60 percent of the original reef was lost due to Hurricane Ike. With the proposed action of the Preferred Alternative, this changes to 0.7% and 1.8%, a minor change. In terms of Upper Bay reef, the past, present and reasonably foreseeable actions represent approximately 3.0% of Upper Bay reef if all of the HGNC Project-associated reef impact is assumed to occur in the Upper Bay (which part of it actually occurs in the Lower Bay), and 7.4% if it is assumed 60 percent of the original reef was lost due to Hurricane Ike. With the proposed action of the Preferred Alternative, this changes to 3.5% and 8.7%, a minor change, and still below 10% of Upper Bay Reef. Considering that these impacts have been or are being mitigated, and that without mitigation, they constitute a relatively small portion of reef, no significant cumulative effect is expected to occur with the proposed action of the Preferred Alternative, considering the past, present and reasonably foreseeable actions,

In the historical context of this resource, analysis of the reef acreage trends and growth patterns observed in the GBNEP data compared to previous TPWD data indicated oyster reef acreage grew rather than declined, with most of the increase attributed to accretion along the HSC and other channels, evident in the mapping (Powell et al., 1994). Considering the negligible percentage impacted, the mitigation for those impacts, the accretion that has been attributed to navigation channels, and the general trend for the resource, a cumulative impact to oyster reef would not be expected to occur from the past, present, reasonably foreseeable and proposed actions.

Considering the negligible contribution by the proposed action to a small cumulative impact on water column and bay bottom habitat and the nature of these impacts, and considering the negligible impact to Galveston Bay's oyster reef acreage, a significant cumulative effect to aquatic fauna and EFH would not occur from the past, present, reasonably foreseeable, and proposed actions, including 20 years of O&M for the proposed action.

5.5 CONCLUSIONS

The final sub-steps for the third step in the general approach of the cumulative impact analysis are to modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects, and to monitor the cumulative effects of the selected alternative and adapt management for their mitigation. Since the proposed action would not result in significant cumulative effects, these sub-steps are not implemented. The proposed action would include mitigation for oyster reef impacts, and monitoring and adaptive management actions to respond to results compared to success criteria are part of the mitigation plan. However, these impacts were shown to be cumulatively minor without mitigation.

The cumulative impacts due to past, present, and reasonably foreseeable actions, along with the proposed action of the Preferred Alternative, are not expected to have more than negligible effects to resources in the study area. The majority of cumulative impacts associated with these projects would either be localized and temporary. The permanent impacts would not be significant, given the scale of the non-impacted resource available. Existing Federal and State regulations, and the goals and coordination of community planning entities such as the HGAC, address the issues that influence impacts to the resources analyzed. The coordination of the numerous stakeholder groups, local organizations, and State and Federal regulatory agencies, and regulations such as the CWA and the CAA, provide some protection for these resources in the area. These measures should continue to prevent, minimize, or in some cases, improve negative impacts that could threaten the general health and sustainability of these resources in the region.

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6.0 COMPLIANCE WITH STATUTES AND REGULATIONS

6.1 NATIONAL ENVIRONMENTAL POLICY ACT

This EA has been prepared in accordance with CEQ regulations to aid in complying with NEPA. The environmental and socio-economic consequences of the proposed action have been analyzed in accordance with the NEPA and presented in this report.

6.2 FISH AND WILDLIFE COORDINATION ACT OF 1958

The USACE's proposed action were coordinated with the USFWS, NMFS, TPWD and other State and Federal resource agencies through the BUG and additional coordination and consultation. Additionally, the USFWS, NMFS and TPWD were sent copies of the Draft EA for review and comment during the agency and public review period. Pursuant to Fish and Wildlife Coordination Act (FWCA), the USFWS provided a draft Planning Aid Letter to assist with the planning of the proposed project by providing comments and recommendations related to impacts on fish and wildlife resources. Among the recommendations made, the use of the American oyster HSI model, mitigation of the impacted reef, and continued coordination of the mitigation with the BUG, are being implemented. Comments were received from the USFWS during the agency and public review period. A copy of the comment and response is provided in Appendix 2.

6.3 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (PUBLIC LAW 104-297)

The MSFCMA (PL 94-265), as amended, establishes procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Regulations codifying the Act in 50 CFR Sections 600.805–600.930 specify that 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 Act and identifies consultation requirements. EFH consists of habitat necessary for spawning, breeding, feeding, or growth to maturity of species managed by Regional Fishery Management Councils (RFMC) in a series of FMP. The GMFMC is the RFMC applicable to the project location.

Informal consultation with NMFS has been initiated regarding EFH in the project area during a May 28, 2015 BUG meeting to present the proposed project. Subsections 3.2.3.2 and 4.2.3 of the EA were prepared to summarize the existing EFH in the project area and the potential impacts. Per the recommendation of NMFS, a separate EFH Assessment containing all the elements required in the EFH Final Rules for an assessment has been prepared for this project, is being coordinated with NMFS, and will be available upon request.

6.4 NATIONAL HISTORIC PRESERVATION ACT OF 1966

Compliance with the National Historic Preservation Act of 1966, as amended, requires identification of all National Register of Historic Places (NRHP)-listed or NRHP-eligible properties in the project's APE and development of mitigation measures for those resources adversely affected in coordination with the Texas SHPO and the Advisory Council on Historic Preservation (ACHP). As indicated in Section 4.3.10, surveys of the channel, including those for potential submerged cultural resources, were completed in coordination with the SHPO, and in accordance with the Texas State Antiquities Code. No NRHP listed or NRHP-eligible properties were identified in the project's APE.

Only two anomalies warranting further investigation or avoidance were identified in an area associated with the Preferred Alternative. As discussed in Section 3.3.10, a follow-up marine remote sensing survey resulted in the identification of three magnetic anomalies that had characteristics similar to that of known shipwrecks. Diver investigations revealed that all three of the anomalies were modern debris. In addition, Target #28/W5, identified in the previous survey, was also investigated by divers and the source was identified as modern debris. On August 12, 2012, USACE-SWG provided a letter to the SHPO describing the results of the marine remote sensing survey. Subsequently, the SHPO concurred with these findings on August 22, 2012. A copy of this correspondence is provided in Appendix 2.

Therefore, the Preferred Alternative would not have any impacts on historic properties, and no additional surveys are planned for this area. In accordance with regulations in 36 CFR 800.2, promulgated for Section 106 of the NHPA, the ACHP consults with and comments to agency officials on individual undertakings and programs when they affect historic properties. Since no historic properties were found in the APE, consultation or review by the ACHP was not initiated.

6.5 CLEAN WATER ACT

Section 404 of the CWA regulates dredge and/or fill activities in U.S waters. The proposed action would require dredging in U.S. waters. Since 1989, the USACE and EPA have implemented policy under the Section 404 program to achieve a Presidential goal of “no net loss” of wetlands. The Section 404 program is responsible for ensuring the Administration’s policy regarding “no net loss” of wetlands by requiring permit applicants to make every effort to avoid and minimize aquatic resource impacts, and provide compensatory mitigation to offset any permitted impacts. Therefore, impacts to wetlands and achieving no net loss of wetlands are important factors in complying with the CWA. No wetlands will be impacted by the Preferred Alternative. The regulations implementing the CWA Section 404 also include the mandatory guidelines developed to implement Section 404(b)(1) which prescribes procedures for specifying dredged material disposal sites and determining the suitability of dredged material for disposal. The EA was prepared to support the decision-making process of the proposed action, and the discussion of the impacts of the proposed action, including dredged material placement, has taken into consideration the guidelines developed under the CWA Section 404(b)(1). A review of previous dredged material testing in the project area, including recent new work material sampling at locations directly adjacent to the Preferred Alternative footprint, indicated no contaminant concerns for the new work or maintenance material that would be placed into the proposed PAs. This information is discussed in Sections 3.1.5.2 and 4.1.5.2 of the EA. USACE ERDC conducted an extensive analysis of this testing information, and factors affecting contaminant source, transport, exposure pathways, and receptors, using a LOE and WOE approach, as described in Section 4.1.5.2. The LOE/WOE analysis concludes that there was no reason to believe that the proposed dredging and placement will mobilize contamination to cause adverse effects, and that further testing of material is not required. This analysis and review were pursuant to Subpart G of the 404(b)(1) Guidelines, and the USACE RGL 06-02 and is available upon request. A completed 404(b)(1) Evaluation Form documenting compliance is provided in Appendix 1 of this EA.

The TCEQ is responsible for conducting Section 401 certification reviews of USACE Section 404 permit applications for the discharge of dredged or fill material into waters of the U.S., including wetlands, for the purpose of determining whether the proposed discharge would comply with State water quality standards. A comment was received from the TCEQ on September 25, 2015 via email during the public and resource agency comment period for the Draft EA, recommending operation of the proposed upland confined placement area to achieve an effluent concentration of 300 milligrams per liter. A copy of the comment and response to it is provided in Appendix 2 of the EA. The TCEQ sent a letter dated October 13, 2015 providing State Water Quality Certification of the proposed project. A copy of the letter is also provided in Appendix 2 of the EA.

6.6 CLEAN AIR ACT

The CAA contains provisions under the General Conformity Rule to ensure that actions taken by Federal agencies in air quality nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality. Under the General Conformity Rule (the Rule), Federal agencies must work with state, Tribal and local governments in a nonattainment or maintenance area to ensure that Federal actions conform to the air quality plans established in the applicable state or tribal implementation plan. The regulations codifying the Rule under 40 CFR Part 93, Subpart B, specify that no Federal agency shall engage in, support in any way or provide financial assistance for, license or permit, or approve any activity which does not conform to an applicable implementation plan.

Section 4.3.8.1 of this EA discusses the conformity demonstration requirements in more detail, and the construction emissions estimate conducted to determine if the de minimis thresholds for the ozone precursors NO_x and VOCs under this rule would be exceeded. The estimated construction emissions indicated these emissions would be above the de minimis threshold applicable to the HGB Non-attainment Area for NO_x and VOCs, indicating a GCD would be required. To support the General Conformity process for USACE consultation with the TCEQ and the EPA, an estimate of project construction emissions and a Draft GCD were prepared to help determine if emissions that would result from construction of the proposed action are in conformity with the Texas State Implementation Plan (SIP) for the HGB Non-attainment Area. This Draft GCD was publicly coordinated in accordance with 40 CFR Part 93, as described in the next paragraph. A Final GCD, with the results and details of the air conformity threshold analysis and coordination are presented in Appendix 4.

The USACE sent a letter summarizing the calculated emissions, containing documentation of the estimate methodology, and requesting a determination of conformity with the SIP to the TCEQ, the agency responsible for the SIP for Texas, via a letter dated August 25, 2015. A copy of this letter is provided in Appendix 2. Concurrently with the public and agency review period, the USACE-SWG issued a Draft GCD based on the analysis, which preliminarily determined the proposed action will conform to the SIP, pending a response from TCEQ with their determination that the total direct and indirect emissions from the action, along with all other emissions in the area, would not exceed the current SIP emission budget. The TCEQ sent a letter responding to the request dated November 4, 2015, which concluded that the total direct and indirect emissions from the action, along with all other emissions in the area, would not exceed the current SIP emissions budget and would conform to the SIP. A copy of this letter is provided in Appendix 2. This letter and the USACE's final determination of conformity are also included in the Final GCD provided in Appendix 4. The USACE-SWG also sent copies of the Draft GCD to the EPA Region 6, and the HGAC, the designated MPO for the HGB Nonattainment Area. The USACE-SWG published a public notice of availability of the Draft GCD in the Houston Chronicle on September 14 and 15, 2015, during the concurrent Draft GCD coordination and public and agency review. A copy of the published public notice and affidavit of publishing are attached to the Final GCD provided in Appendix 4. Comments were received from the TCEQ and the public during the 30-day Draft GCD public comment period. Responses to TCEQ comments are provided in Appendix 2, and responses to public comments are provided in Appendix 3, and have been summarized in the Final GCD. A public notice of availability for the Final GCD will be published in the Houston Chronicle in accordance with 40 CFR Part 93.

6.7 COASTAL ZONE MANAGEMENT ACT

The CZMA of 1972, as amended, provides for the effective management, beneficial use, protection, and development of the resources of the nation's coastal zone. The CZMA directs Federal agencies proposing activities or development projects, within or outside of the coastal zone that could affect any land or water use or natural resource of the coastal zone, to assure that those activities or projects are consistent, to the maximum extent practicable, with the approved State programs. Requirements in the CZMA include demonstration of consistency with the objectives of the CZMA for Federal actions. The TCMP is the State entity that participates in the Federal Coastal Zone Management Program created by the CZMA. The TCMP designates the coastal zone and coastal natural resource areas (CNRA) requiring special management in that zone, including coastal waters, waters under tidal influence, coastal wetlands, submerged lands and aquatic vegetation, dunes, coastal historic areas, and other resources. The Coastal Coordination Council (CCC), composed of several State agencies and local officials, administers the TCMP for the coordination of local, State, and Federal programs for the management of Texas coastal resources. The TCMP reviews all Federal actions that may affect natural resources in the coastal zone for consistency with the Federal goals and objectives. The Federal Agency proposing the action prepares a Consistency Determination for review by the TxGLO for consistency with the TCMP. A completed Statement of Compliance with the TCMP was prepared and was submitted to the TxGLO as part of the Draft EA during the public and agency review period. TxGLO provided a letter dated February 1, 2016, concurring with the determination of consistency with the TCMP. A copy of this letter is provided in Appendix 2.

6.8 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) provides a program to conserve threatened and endangered plants and animals, and the habitats in which they are found. The lead agencies for implementing and administering the ESA are the USFWS and the NMFS. The Act requires Federal agencies to consult with the USFWS and NMFS, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or result in destruction or adverse modification of designated critical habitat of listed species. The Act also prohibits any action that causes an avoidable "taking" of any listed species of endangered fish or wildlife.

A BA prepared for the purposes of the ESA, is provided in Appendix 5 of this EA. A draft of the BA and EA were sent to USFWS and NMFS. A comment to add discussion of the possible, but unlikely presence of the West Indian manatee was received from USFWS, and was addressed through revision of Section 1.2 of the BA. A copy of the comment is provided in Appendix 2 of the Final EA. Though it is not likely that the listed marine and shorebird species would be encountered within the project area, their presence in the area is possible. An advisory for construction contractors to be aware of their possible presence, and contact numbers to immediately call in case of contact with any of these species for the USFWS's Houston Coastal Ecological Services Field Office in the case of listed shorebirds, or the Marine Mammal Stranding Network in the case of a turtle or manatee, will be added to the USACE contract specifications for this project.

6.9 MARINE MAMMAL PROTECTION ACT OF 1972

The Marine Mammal Protection Act (MMPA) was passed in 1972 and amended through 2007. It establishes a moratorium on the taking and importation of marine mammals and marine mammal products by persons subject to the jurisdiction of the U.S, with certain exceptions. The definition of "persons" also includes any officer, employee, agent, department, or instrumentality of the Federal Government. The Act is intended to conserve and protect marine mammals and it established the Marine Mammal Commission, the International Dolphin

Conservation Program, and a Marine Mammal Health and Stranding Response Program. Review and consultation for the MMPA is also triggered via the ESA when actions involve marine mammals.

The only marine mammals covered under the MMPA expected to regularly be present in Galveston Bay are bottlenose dolphins (*Tursiops truncatus*). These are highly mobile species that would be able to readily avoid dredging activities and vessels. Therefore, the proposed action would not impact marine mammals and would be consistent with the requirements of this act.

6.10 NOISE CONTROL ACT

The Noise Control Act of 1972 established a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. To accomplish this, the Act established a means for the coordination of Federal research and activities in noise control authorized the establishment of Federal noise emissions standards for products distributed in commerce, and for the provision of noise emission and noise reduction information and labeling of such products. The Act directed Federal agencies to consult the EPA whenever they developed noise control standards or regulations. The Act also directed Federal agencies engaged in any noise emitting activity to comply with Federal, state, interstate, and local requirements regarding environmental noise control and abatement to the same extent that any person is subject to such requirements. The Act did not establish requirements related to project planning, permitting or NEPA analysis. Apart from the requirement to follow existing Federal, state, interstate, and local noise-related regulations, there are no other relevant requirements under this Act applicable to this EA or the permit requested.

Other than temporary minor impacts during construction, the USACE's proposed action is not expected to have impacts on the sound environment as discussed in Section 4.3.9.

6.11 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

This EO directs Federal agencies to avoid undertaking or assisting in new construction located in wetlands, unless no practical alternative is available, and the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use. The EO directs agencies to take such actions in carrying out its responsibilities in (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing federally undertaken, financed, or assisted construction and improvement; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities. As discussed in Section 6.5, the CWA Section 404 program is responsible for ensuring the Presidential policy to achieve "no net loss" of wetlands. This EO further strengthens the commitment for Federally-implemented and permitted projects to achieve no net loss of wetlands, primarily through avoidance of impacts. Therefore, impacts to wetlands and achieving no net loss of wetlands are important factors in complying with this EO. The proposed action would not impact any wetlands.

6.12 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE IN MINORITY POPULATIONS AND LOW INCOME POPULATIONS

This EO directs Federal agencies to determine whether their programs, policies, and activities would have a disproportionate impact on minority or low-income population groups within the Project Area. This includes permitting activities.

As documented in Section 3.3.2, the project area is in the middle of Galveston Bay with no populated census tracts. The latest demographic data for the mainland closest to the proposed project illustrates that only a low percentage of the population is low-income or minority, and is well below the percentages for the general population, indicating a low potential for any EJ impacts or issues. The proposed action will have no direct or indirect adverse impacts on landside populations. Therefore, the USACE's proposed action is not expected to have any disproportionately high or adverse effect on low-income or minority population groups.

6.13 EXECUTIVE ORDER 13045, PROTECTION OF CHILDREN FROM ENVIRONMENTAL HEALTH RISKS AND SAFETY RISKS

This EO mandates that federal agencies identify and assess disproportionate environmental health and safety risks to children, and ensure that its policies, programs, activities, and standards address them. "Environmental health risks and safety risks" are defined as risks to health or safety that are attributable to products or substances that the child is likely to come in contact with or ingest, such as air, food, drinking or recreational use of water, soil children may live on, and products they use or are exposed to. As an assessment of activities of the USACE pursuant to this order, the proposed action was evaluated for disproportionate effects towards children. As documented in Section 3.3.2, the project area contains no populations of children or facilities built for children due to its location in the open water of Galveston Bay. Therefore, as documented in 4.3.2, there would be no disproportionate effects on children due to environmental health or safety risks.

6.14 EXECUTIVE ORDER 13186, THE MIGRATORY BIRD TREATY ACT

This EO directs Federal agencies to increase their efforts under the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Acts, Fish and Wildlife Coordination Act, the ESA of 1973, NEPA of 1969, and other pertinent statutes to avoid or minimize impacts on migratory bird resources. The 2006 Memorandum of Understanding (MOU) between the DOD and the USFWS developed pursuant to this EO lists activities covered under the purpose and scope of the MOU, including natural resource management activities. The EO directs DOD to encourage incorporation of comprehensive migratory bird management objectives in the preparation of DOD planning documents, including NEPA analyses. The EO also directs DOD to, prior to starting any activity likely to affect migratory birds populations, 1) identify the species likely to occur in the area of the proposed action and determine if any species of concern could be affected by the activity, 2) assess and document the effect of the proposed action on species of concern through the NEPA process when applicable, and 3) engage in early planning and scoping with the USFWS to proactively address conservation, and initiate appropriate actions to avoid or minimize the take of migratory birds.

The proposed action is not expected to permanently impact migratory bird populations. As discussed in Section 3.2.2, the PAs on the south end of Atkinson Island are part of the area mapped by the USFWS as part of a colonial waterbird rookery. Several of the species documented in Section 3.2.2 as having been recorded at PAs 14 and 15 are on the USFWS's 2008 Birds of Conservation Concern (BCC) for the Gulf Coast Bird Conservation Region (BCR) 37, including Reddish Egret (*Egretta rufescens*), Sandwich Tern (*Sterna sandvicensis*) and Black Skimmers (*Rynchops niger*) (USFWS, 2008). The most recent BCC defines the species of concern for the purposes of EO 13186. While migratory birds commonly have been observed on these PAs foraging, nesting, and roosting, they are active PAs, and the timing of construction would be coordinated to avoid impacts to migratory and nesting birds. Options to avoid migratory and nesting bird impacts may include adjusting the construction timeline to accommodate the nesting season or re-sequencing construction activities to work in areas where no active nests are present. Maintenance dredged material placement cycles in these and other PAs have been conducted successfully with minimal disturbance to migratory species. Similar construction practices and timing would be implemented for the proposed action if the existing PAs are used for dredged material placement.

6.15 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT OF 1980

As amended by the Superfund Amendments and Reauthorization Act of 1986, Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) provides for liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and cleanup of inactive hazardous substances disposal sites. The HTRW investigation discussed in Section 3.3.7 did not identify any potential CERCLA sites within the project footprint for the proposed corrective actions or the existing PAs that would be used for dredged material placement under the Preferred Alternative.

Agencies with purview over CERCLA-related regulations, such as TCEQ and EPA, were sent copies of the Draft EA to provide an opportunity to comment during the public and agency review period. No comments related to CERCLA were received.

6.16 RESOURCE CONSERVATION AND RECOVERY ACT

This Federal law governs the management and disposal of solid waste. Resource Conservation and Recovery Act (RCRA) may impose substantial requirements on Federal projects that manage even small amounts of hazardous waste. The HTRW investigation discussed in Section 3.3.7 did not identify any RCRA sites within the project footprint for the proposed action under the Preferred Alternative.

Agencies with purview over RCRA-related regulations, such as TCEQ and EPA, were sent copies of the Draft EA providing an opportunity to comment during the public and agency review period. No comments related to RCRA were received.

6.17 EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

This EO directs Federal agencies to avoid possible impacts associated with the modification of floodplains and to avoid support of floodplain development wherever there is a practicable alternative. In carrying out the activities described above, each agency has a responsibility to evaluate the potential effects of any actions it may take in a floodplain associated with the one percent annual chance event. The EO also directs agencies to include adequate provision for the evaluation and consideration of flood hazards in the regulations and operating procedures for the licenses, permits, loan or grants-in-aid programs that they administer.

The proposed action is entirely in an open water area not mapped by the Federal Emergency Management Agency as subject to inundation by the one percent annual chance event. The dredged material placement option is located outside of any area mapped as a one percent floodplain. Therefore, the proposed action would not impact the one percent annual chance floodplain.

6.18 FARMLAND PROTECTION POLICY ACT OF 1981 AND PRIME OR UNIQUE FARMLANDS

The purpose of the Farmland Protection Policy Act is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses. The act requires among other things, agencies to identify and take into account the adverse effects of Federal programs on the preservation of prime and unique farmlands, and consider alternative actions, as appropriate that could lessen such adverse effects. The CEQ issued a memorandum "Analysis of Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act" that supplemented NEPA procedures to include analysis of these impacts in NEPA documents. The regulation codifying the Act in 7 CFR Part 658 specified procedures and criteria for the analysis of these impacts. The definitions in this regulation specify that farmland does not include land already used as water storage, which would include open water. The proposed project is entirely in open water.

No terrestrial resources are impacted by the proposed action, and therefore, no prime or unique farmlands would be affected.

6.19 GALVESTON BAY NATIONAL ESTUARY PROGRAM

The National Estuary Program (NEP) was established under Section 320 of the 1987 CWA Amendments as an EPA place-based program to protect and restore the water quality and ecological integrity of nationally significant estuaries. Section 320 of the CWA calls for each NEP to develop and implement a Comprehensive Conservation and Management Plan (CCMP) that contains specific targeted actions designed to address water quality, habitat, and living resources challenges in its estuarine watershed over the long-term.

The Galveston Bay National Estuary Program was established in 1989 as one of twenty-eight NEPs in the U.S. It has continued as a non-regulatory program administered by the TCEQ under the name "Galveston Bay Estuary Program" (GBEP). It is charged with implementing the Galveston Bay Plan, the CCMP for Galveston Bay. Functions of the GBEP include acquiring, managing, and dispersing funds, coordinating activities, reviewing Federal projects, providing for coordination with the TCMP and the CCC, tracking and monitoring, public and agency outreach and education regarding the Galveston Bay, and advocacy.

Although this program is non-regulatory, the Galveston Bay Council established under this program performs an advisory role to the TCEQ during consistency reviews of eligible Federal projects. The Galveston Bay Plan contains numerous goals addressing water/sediment quality improvement, habitat/living resource conservation, and balanced human uses. Some examples of the highest priority categories of "Very High" and "High" in the various types of goals are the Habitat goals of increasing the quantity and quality of wetlands for fish and wildlife, eliminating or mitigating conversion of wetlands to other uses, and reversing the declining population trend for affected marine and bird species and maintaining populations of economic and ecologically important species, and Water/Sediment Quality goal of reducing toxicity and contaminant concentrations in water and sediments. The proposed project does not run counter to any of the goals of the Galveston Bay Plan. The priority ranking of management actions for the plan also include "Restore, Create, and Protect Wetlands", and "Promote Beneficial Uses of Dredged Material to Restore and Create Wetlands" as the top two management actions. Use of the maintenance material from this project to fill in the marsh cells at Atkinson Island is consistent with these management actions.

6.20 MEMORANDUM OF AGREEMENT WITH THE FAA TO ADDRESS AIRCRAFT WILDLIFE STRIKES

Several Federal agencies, including the Department of the Army, signed a 2002 Memorandum of Agreement with the Federal Aviation Administration (FAA) to adopt coordination procedures in order to minimize the risk that project features create the potential for aircraft-flight strike hazards. Project features that might attract wildlife include wetland mitigation, such as those administered by the USACE under the CWA Section 404, or ecosystem restoration habitat. The memorandum recognizes the USACE's expertise in protecting and managing jurisdictional wetlands and their associated wildlife. It also directs signatory agencies to cooperatively review proposals to develop or expand wetland mitigation sites, or wildlife refuges that may attract hazardous wildlife, and diligently consider the siting criteria and land use practice recommendations stated in FAA Advisory Circular (AC) 150/5200-33 when planning such sites.

The FAA recommends separations when siting any of the wildlife attractants, to accommodate aircraft movement. The recommended separation distance between the airport (typically applies to the edge of the airport's air operations area) and the attractant (i.e., mitigation feature) varies between 5,000 feet and 6 miles, depending on the type of aircraft served and attractant. The proposed project does not involve creating new PAs or new mitigation features that would serve as wildlife attractants; only the use of existing ones. Therefore, no specific evaluation of attractant distances from area airports is necessary for these corrective actions and dredged material placement.

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7.0 CONCLUSIONS

This chapter summarizes the impacts of the proposed action and presents the adverse environmental impacts that cannot be avoided, and the irreversible or irretrievable commitments of resources that would occur if the proposed action is implemented. The chapter concludes with the USACE's assessment of the impact of the proposed action.

7.1 SUMMARY OF IMPACTS

The proposed action includes dredging to implement the corrective actions to the HSC, placement of new work dredged material to raise dikes at the existing PA 14 or the existing Mid Bay PA as a contingency, and placement of maintenance material at existing PAs 14, 15, other Atkinson Island PA cells, and Mid Bay. Construction of the proposed action is not anticipated to result in any unmitigated substantial direct, indirect, and cumulative impacts to the environment. The following summarizes the findings of this EA regarding those impacts:

- Only minimal impacts to the physical environment including topography, geology, soils, bathymetry, and water and sediment quality are anticipated.
  - The proposed action would take place only in open water and existing PAs; therefore, terrestrial impacts would not occur. Changes to topography, geology, and bathymetry would be negligible compared to the regional nature and character of these attributes in the Galveston Bay.
  - Only temporary, localized impacts to water quality during dredging and placement would result from temporary turbidity and other more localized and minor water quality impacts.
  - Sediment data was reviewed and evaluated for suitability of the proposed placement. It was determined that there was no reason to believe the proposed dredging and placement will mobilize contamination to cause adverse effects, and that further testing of material is not required.
- No long-term impacts to biological resources including both terrestrial and aquatic vegetation and wildlife, EFH, T&E species, and invasive species are anticipated.
  - Localized, temporary effects to aquatic fauna and EFH would occur during dredging and placement from turbidity, impingement, entrainment, and burial, but would not be significant due to regrowth/repopulation, size of impact compared to available like habitat, and avoidance. These effects are further summarized in Section 7.2.
  - Permanent effects to oyster from removal of reef during dredging would be mitigated by restoring 30.1 acres of oyster reef at San Leon Reef that was damaged by sedimentation as a result of Hurricane Ike. The mitigation plan is discussed in detail in Section 4.4. These unavoidable impacts to oyster reef as a result of project implementation are further summarized in Section 7.2.
  - Permanent effects to shallow, unvegetated, bay bottom from dredging the channel improvements would occur.
    - The loss of associated benthic habitat and EFH would not be permanent for channel impacts, but would likely be perpetually or periodically degraded within the navigation channel footprint.

    - The size of both impacts is negligible compared to the available similar habitat in Galveston Bay. These effects are further summarized in Section 7.2.

- No long-term substantial impacts to the human environment including socioeconomic, community, recreational, visual and aesthetic, infrastructure, traffic, transportation, HTRW, air, noise and cultural resources.

  - No induced development is expected from the proposed action, and therefore no indirect impacts from this development are expected.

  - Information and data collected for this EA have not identified active infrastructure such as pipelines, or HTRW sites, such as sites undergoing environmental cleanup, in the proposed project footprint. No direct impacts would occur.

  - Substantial effects to marine recreation such as fishing and boating are not expected.

  - Substantial effects to air quality are not expected.

    - Temporary emissions during construction estimated to exceed the NO_x and VOC de minimis threshold for the HGB NAA would occur, requiring a GCD. The Draft GCD has indicated that these emissions are minor enough compared to the SIP emissions budget, so as not to jeopardize the State's ability to meet CAA standards and SIP commitments. Therefore project construction emissions would not be significant to regional air quality.

    - The proposed action would not result in a net increase in terminal activity or the associated emissions, since the project would have no impacts on terminal facilities or activity. The proposed corrective actions are localized channel modifications.

  - Substantial effects from noise are not expected.

    - Sound levels to the nearest receptors on land would be negligible due to distance from the proposed project site.

    - The proposed action would not result in a net increase in terminal activity or the associated sound levels, for the same reasons discussed above for air quality regarding terminal activity.

  - No impacts to cultural resources are expected.

Submerged marine cultural resources were not identified in the footprint of the proposed corrective actions for the channel. Existing PAs being considered for placement were previously surveyed and cleared for cultural resource issues.

7.2 ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED

The proposed project would result in the following minor, localized, and temporary impacts during dredging and dredged material placement: impacts to benthos and fish (and associated EFH) from turbidity and other more minor water quality changes within the dredge footprint and typically less than a few hundred meters away for turbidity. Because the organism populations are common throughout the bay and would be expected to recover quickly, or the organisms would avoid these effects through their mobility, and considering the small percentage of like habitat affected, the effect would be considered minor and temporary. These effects cannot be avoided because dredging is necessary to excavate below water.

The proposed action would result in the following permanent impacts during dredging and dredged material placement:

- Removal of oyster reef within the dredged footprint for corrective actions to the channel, impacting 29.9 acres of reef.

- Conversion of approximately 26.8 acres of shallow and deep unvegetated bay bottom (portion of corrective action footprint that is not oyster reef) to deeper, navigation channel bottom and side slopes subject to more vessel activity and periodic maintenance dredging.

Though the amount of oyster acreage impacted is small compared to the amount in Upper Galveston Bay, this is an EFH resource of general greater productivity for the Galveston Bay requiring mitigation by several agencies, if impacted. Therefore, a significant resource would be impacted, albeit to small extent, if not mitigated. Considering the proportion of existing oyster reef affected, the impact would be minimal. Mitigation consisting of reef restoration at San Leon Reef is planned and being coordinated with TPWD and other resource agencies. The impact cannot be avoided because corrective actions to the channel by necessity have to occur adjacent to the existing Flare and main channel, and the Preferred Alternative represents selection of an alternative sufficient to address the navigation safety issues, while minimizing other impacts.

The conversion of natural shallow unvegetated bay bottom to navigation channel is negligible compared to the amount of unvegetated bay bottom in the Galveston Bay. The cumulative effects to this type of habitat were not shown to be significant in the cumulative impact analysis. Therefore, no significant adverse effects are expected. Impacts from conversion to navigation channel cannot be avoided for the same reasons explained for oyster reef.

7.3 CONCLUSION OF IMPACTS TO THE ENVIRONMENT

Implementation is recommended of the Preferred Alternative which consists of the proposed corrective actions to the HSC, and the proposed placement at PA 14 or Mid Bay PA for new work, and these and other Atkinson Island PAs for maintenance. The existing Flare would be eased to a radius of 4,000 feet, and a depth of -41.5 feet MLLW (-40 feet MLT) plus 7 feet of advanced maintenance. The HSC would be widened around the bend at Station 28+605 to a maximum width of 235 feet, on the east side, to provide a provide a straighter navigation path up the Bay. The existing barge lanes will be relocated to the east of the proposed HSC widening with a 235-foot-wide transition. Maintenance dredged materials encountered during construction would be placed into existing PAs. New work dredged material would be used beneficially in existing PA 14 or other approved Atkinson PAs to raise dikes to increase capacity. This form of BU would not directly be beneficial ecologically, but would beneficially eliminate the need to mine new bay bottom to supply dike building clays. Maintenance material for future O&M of the corrective actions would be placed in existing HGNC upland or beneficial use PAs in the vicinity of BSC including PAs 14, 15, Mid Bay, and Atkinson Island. This alternative is recommended based on meeting the purpose of and need for the proposed action and the criteria used to identify it (discussed in Chapter 2), and the detailed environmental analysis contained in this EA. The proposed action would have no significant social, economic, or environmental impacts of a level that would warrant an EIS.

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8.0 LIST OF PREPARERS

This chapter provides the list of personnel responsible for preparation of this EA, and a listing of agencies and persons consulted during its preparation.

8.1 LIST OF PREPARERS

Topic/Area of Responsibility	Name/ Title	Years of Experience
USACE Galveston District		
PHA		
Policy Review	Mark Vincent, P.E. Channel Development Director	30 Years, Project and Program Management, Permitting
Project Management (PM) -Resources, Quality Control Review	Richard Ruchhoeft, P.E. Project Manager Channel Development	20 Years, Project Management, Survey, Agency Coordination
PM, Quality Control Review	David Casebeer, P.E. HSC Project Manager	15 Years, PM, Quality Control and Assurance, Sediment Management
JV		
AECOM		
Project Management and Quality Assurance Review	Rod McCrary, P.E. Project Director Vice President	34 Years Project Management
EA Preparation; Technical Review; Mitigation Plan; Air Quality and Noise; Water and Sediment Quality; Compliance with Statutes	Carl Sepulveda, P.E. Engineer IV	20 Years Environmental Impact Assessment, Compliance, Air, Water, Noise, and HTRW Monitoring, Water Resources Engineering
Physical Oceanography; Coastal Zone Resources; Compliance with Statutes	Ashley Judith Project Manager	11 Years Coastal Engineering and Survey Experience
Wildlife and Habitat; Threatened and Endangered Species; Habitat Modeling and Mitigation	Timothy Love Professional Wetland Scientist	23 Years Environmental Assessment and Impact Analysis
Socioeconomics; Environmental Justice; Visual and Aesthetic Resources; Hazardous, Toxic and Radioactive Waste; Water Quality Community and Recreational Resources; Existing Infrastructure; Traffic and Transportation	Miranda Maldonado Environmental Specialist	14 Years Environmental Planning
GIS and Impact Analysis	Hee Ork Rocha GIS and Graphics Specialist	30 Years Environmental document preparation and GIS analysis
Mitigation Plan	Ryan McCarthy	13+ years Field surveys and biology, aquatic science diving
Mitigation Plan	Kaitlin Sylvester	14 years Field surveys and biology, aquatic science diving
Affected and Impacted Biological Resources; Aquatic Resources; Essential Fish Habitat; Invasive Species	Paula Winchell Marine Biologist	26+ Years Marine Habitat Characterizations

Topic/Area of Responsibility	Name/ Title	Years of Experience
GBA		
Quality Assurance Review; Alternatives Analysis	Dana Cheney Vice President	17 Years NEPA Compliance, Environmental Impact Statements, Environmental Assessments, Agency Coordination and Permitting
Surveying	Chester Hedderman, P.E. Coastal Engineer	12 Years Coastal Engineering and Survey Experience
Dredging Quantities and Impact Analysis; Technical Review	Sara Halpin	4+ Years Surveying, AutoCAD drafting and Permitting
Engineering and Design Assistance	Jayne McClure, EIT	5+ Years Surveying, AutoCAD drafting and Technical Documentation Review
Subcontractors		
HRA Gray and Pape, LLC		
Cultural Resources Survey	Lee Cox Principal Investigator	29 Years Marine Archaeology
Cultural Resources Survey	Tony Scott Archeologist	17 Years Terrestrial Archaeological Survey, Permitting, Planning, Documentation
Cultural Resources Survey	Melissa Madrigal Marine Archeologist	13 Years Terrestrial & Maritime Archaeological Survey, Permitting, Planning
Starcrest Consulting Group, LLC		
Air Conformity Emissions Estimate, Draft General Conformity Determination, Operational Air Emissions Estimate	Joseph Ray Principal Starcrest Consulting Group, LLC	32 Years Air Emissions Estimates, General Conformity Evaluations, Regulatory Applicability Review

8.2 LISTING OF AGENCIES AND PERSONS CONSULTED

NEPA regulations for content of an EA require a listing of agencies and persons consulted. This section provides a list of agencies and persons contacted and consulted by the preparers of this EA. Appendix 2 also contains copies of key Federal resource and other agency correspondence for coordination conducted thus far for this EA.

The Federal and State agencies consulted were primarily through the BUG where the project alternatives were presented and input sought for them, especially dredged material placement alternatives. Chapter 2 discusses the agencies involved and their involvement. Subject matter input was sought from some of these agencies for existing resource data, and survey methodology involving T&E species, existing resource mapping, oyster habitat surveillance and mitigation, and EFH requirements. These are described in Chapters 3 and 4, and in related appendices. The representatives were from the local districts, regions, and field service offices pertinent to the project area. The following lists the Federal and State agencies consulted:

Federal Agencies

U.S. Army Corps of Engineers (USACE), Galveston District
U.S. Department of the Interior, U.S. Fish and Wildlife Service (USFWS)

National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS)
U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)
U.S. Environmental Protection Agency (EPA)

State Agencies

Texas Parks and Wildlife Department (TPWD)
Texas Commission on Environmental Quality (TCEQ)
Texas General Land Office (TxGLO)
Texas Historical Commission (THC)

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