U.S. Army Corps of Engineers

Galveston District
Southwestern Division

Houston Ship Channel Expansion Channel Improvement Project, Harris, Chambers, and Galveston Counties, Texas

Final Integrated Feasibility Report–Environmental Impact Statement

APPENDIX M

FISH AND WILDLIFE COORDINATION ACT COORDINATION ACTION REPORT

DECEMBER 2019

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Texas Coastal Ecological Services Field Office
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In Reply Refer To:
FWS/R2/02ETT
X00-2017-E-
01624

March 29, 2017

Colonel Lars Zetterstrom
District Commander
Attention: Andrea Catanzaro
Galveston District, U.S. Army Corps of Engineers
Post Office Box 1229
Galveston, Texas 77553-1229

Dear Colonel Zetterstrom:

The U.S. Fish and Wildlife Service (Service) is collaborating with the U.S. Army Corps of Engineers (Corps) on the evaluation of the Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) located in Harris and Galveston Counties, Texas. This project aims to improve ship movement throughout the entire length of the channel. A 2014 Corps Reconnaissance Study determined there was sufficient Federal interest in the project leading the Corps to further investigate the HSC system. A Notice of Intent was subsequently filled on March 29, 2016 to begin the current HSC ECIP study. Improvement features to be considered under the current study include the following:

- Bay – reach safety and efficiency enhancements
- Bayport Ship Channel
- Barbours Cut Channel
- HSC – Boggy Bayou to Sims Bayou
- HSC – Sims Bayou to I-610 Bridge
- HSC – I-610 Bridge to Main Turning Basin

The Corps will evaluate an array of alternatives, for each improvement, that may include deepening and widening portions of existing channels, creation of new turning basins, bend easing, addition of jetty/hard structures, flare improvements, creation of passing lanes, and the strategic placement of anchorage / berthing locations. Our comments in this Planning Aid Letter (PAL) will be of a general nature and focused on the overall project footprint instead of evaluating each of the currently proposed improvements which may be described in the forthcoming Fish and Wildlife Coordination Act Report (FWCAR).

The purpose of this letter is to provide the Service's comments and recommendations regarding the HSC ECIP while identifying planning constraints that may influence the Service's ability to fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This PAL is prepared under the authority of the FWCA; however it does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of the FWCA. The Service will provide copies of this letter to the National Marine Fisheries Service (NMFS) and the Texas Parks and Wildlife Department (TPWD); if any comments are received on this letter they will be forwarded under a separate cover. Comments in this letter are also provided under the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.) as a cooperating agency for the HSC ECIP and the Endangered Species Act (ESA) of 1973.

The Service bases this evaluation on the current data, modeling, and analyses made available by Corps sources and Service files. The Service understands construction of the project is subject to Congressional approval and the Tentatively Selected Plan funding will occur sometime in the future with or without project modifications. Additional Service involvement for subsequent detailed planning, habitat analysis, engineering, design, and construction phases of each planning effort is required to fulfill our responsibilities under the FWCA. Since there may be a significant time lag between the study and construction phases, the Service recommends the Corps reinitiate coordination under a separate FWCA agreement when construction funding is made available. This will allow the Service to conduct a comprehensive review of the project footprint, impacts, and update recommendations based on environmental conditions at the time of construction.

Background

Since 1872, the Corps has participated in navigation improvement projects in the Galveston Bay system (USFWS, 1995). The HSC, an extensive deep draft channel system, is vital to the port facilities and local economies of Houston, Texas City, and Galveston. The HSC extends approximately 51 miles from its juncture with the Texas City Channel at Bolivar Roads at the entrance to Galveston Bay and terminates at the turning basin in the City of Houston. The lower 26 miles of the HSC completes the bay reach and the upper 25-mile riverine section follows the two tributaries: San Jacinto River and Buffalo Bayou, to the bay. The upper riverine section of the HSC has extensive development with port facilities and industries dependent upon water transportation. The Galveston Channel extends almost four miles from Bolivar Roads between the northeastern portion of Galveston and Pelican Islands. The most recent deepening and widening effort of the HSC, completed in 2005, resulted in a project depth of 45 feet in the main channel, a width of 530 feet, and 200-foot barge lanes on either side of the channel between the Gulf Intracoastal Waterway and Morgan's Point (Figure 1). Two Texas ports, Port of Houston and Texas City, greatly benefited from the channels expansion with both being ranked in the top 15 nationally for waterborne transported tonnage in 2014 with 234.3 and 47.9 tons respectively. Based on current Port of Houston (POH) container traffic data, the POH typically handles over 68 percent of the container traffic in the Gulf of Mexico, over 95 percent of the container traffic in Texas, and is 1st ranked US port in foreign tonnage. The HSC also includes side channels known as Bayport Ship Channel, Barbours Cut Channel, and Greens Bayou Channel. Both the Bayport Ship Channel and Barbours Cut Channel are authorized to a depth of 45 feet (to match

the HSC) while the Greens Bayou Channel remains deep (40 feet deep) for lower portions of the channel and a shallow draft (15 feet deep) tributary.

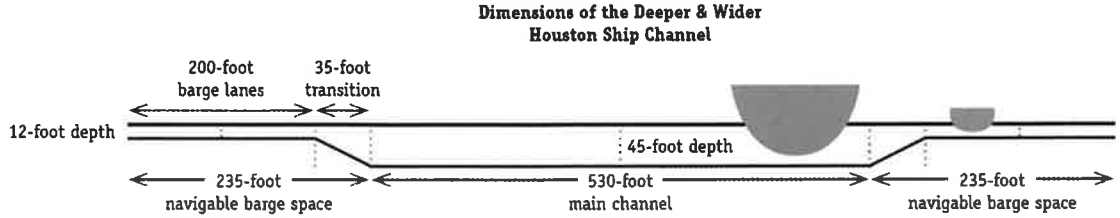

Figure 1 Current HSC dimensions

Source: Houston-Galveston Navigation Safety Advisory Committee, 2011

The Service provided recommendations to the Corps throughout the planning processes on previous HSC expansion projects as seen in Table 1.

Table 1 Service Involvement with the Corps and the HSC

Document Name	Year
FWCAR Galveston Bay Area Navigation Study Galveston, Harris, and Chambers Counties, Texas (U.S. Fish and Wildlife Service, 1986)	1986
Supplemental FWCAR Galveston Bay Area Navigation Study Galveston, Harris, and Chambers Counties, Texas (U.S. Fish and Wildlife Service, 1995)	1995
Supplemental FWCAR Houston-Galveston Navigation Channels, Texas-Barge Lane Widening (U.S. Fish and Wildlife Service, 2002)	2002
Existing Conditions and Recommendations for the Expansion of Placement Areas 14 and 15 in the Houston Ship Channel, Houston, Texas (U.S. Fish and Wildlife Service, 2009)	2009
Modification of Bayport Flare-Houston Ship Channel, Houston, Texas (U.S. Fish and Wildlife Service, 2010)	2010
Federal Assumption of Jacintoport Navigation Channel (U.S. Fish and Wildlife Service, 2010)	2010
Cedar Bayou Dredge Material Management Plan, Harris and Chambers Counties, Texas (U.S. Fish and Wildlife Service, 2014)	2014

Galveston Bay, the largest inland bay on the Texas coast, is noted for commercial and recreational fisheries including, oyster, shrimp, crab, and a variety of finfish. Scattered throughout Galveston Bay are dredged disposal islands frequented every year by nesting colonial waterbirds. Galveston Bay has incredibly diverse and rich natural resource communities (oysters, marshes, bay bottom, colonial waterbirds and other wildlife). Houston Galveston Navigation Channel improvement projects negative and positive environmental impacts are well documented in the reports contained in Table 1. Ultimately, 4,250 acres of intertidal marshes and a six acre offshore colonial waterbird nesting island were created through the beneficial use of dredge material to offset the deepening and widening project's short term and permanent impacts on Galveston Bay's natural resources. In addition, 12 reef pads totaling 118 acres were created to compensate for oyster impacts. The presence and importance of oyster reefs

throughout Galveston Bay is well documented. As such, the Service has concerns regarding any deepening or widening efforts in Galveston Bay where oyster reefs or shell-bearing mud are documented.

HSC fraught with problems

Since 2005 deepening and widening efforts, pilots have voiced new concerns regarding unsafe channel bends, limited mooring facilities, lack of adequate depths and widths of passing lanes, limited channel depths in portions of the channel, and difficult turning from the HSC to the Bayport Ship Channel resulting in tug assisted vessel movements (Lone Star Harbor Safety Committee, 2016). Due to the anticipated growth in the containerized trade, the POH moved forward with $325 million in capital improvements (including Bayport Ship Channel and Barbours Cut Channel) to handle post-Panamax vessels which make up a growing share of the world fleet. These vessels (requiring drafts greater than 42 feet) will be confined to the POH and will facilitate lightering, lightening and offloading for the Bayport Ship Channel, Barbours Cut Channels, and the upper HSC reaches resulting in continued inefficiencies. The current Houston Pilots working rules restrict the maximum vessel size from Bolivar Roads to Barbour's Cut to 1,000 feet in length and 138 feet in beam (Port of Houston Authority, Updated February 6, 2017) and larger vessels frequently only meet along the straight reaches of the channel (avoiding bend reaches) due to extreme narrow conditions and the risk of collision. The National Transportation Safety Board (National Transportation Safety Board 2017) documents 14 marine accidents within the study area since 1991 and includes collisions, capsizing, and fires.

Project Site

Galveston Bay is located along the upper Texas coast in the northwestern Gulf of Mexico. The Trinity River contributes 54% of the annual average flow to the bay while the San Jacinto River/Buffalo Bayou watersheds contribute 38% of the total annual average inflow to the bay (Texas Water Development Board, 2007), where peak flows generally occur in May and June and low inflows occur August through October. Galveston Bay covers roughly 600 square miles while the watershed contains approximately 24,000 square miles. This watershed stretches northward, to the Trinity River basin, and past the Dallas-Ft. Worth area. Half of the population of Texas currently lives within the Galveston Bay watershed (24,000 square miles) boundaries including Houston, the nation's fourth most populous city (Galveston Bay Esturary Program). The watershed includes highly industrialized, urbanized and agricultural settings all posing unique challenges to maintaining suitable water quality levels that support aquatic wildlife due the increased presences and usage of harmful chemicals. This semi-closed body of water receives freshwater inflows from the Trinity and San Jacinto rivers and the extensive bayou and creek systems that lie within the watershed. The Galveston Bay watershed contain a wide variety of important habitat types: open water, sand flats, seagrass meadows, oyster reefs, bird islands, fringing saltwater wetlands, freshwater wetlands, and coastal prairie that continue to support rich and diverse coastal fish and wildlife communities.

The actual project area footprint starts at Little Pelican Island and continues north through the lower reaches of the channel passing the Bayport and Barbour's Cut channels, passing by several

upland placement areas and continuing up the channel pass the I-610 Bridge and terminating at the turning basin (Figure 2).

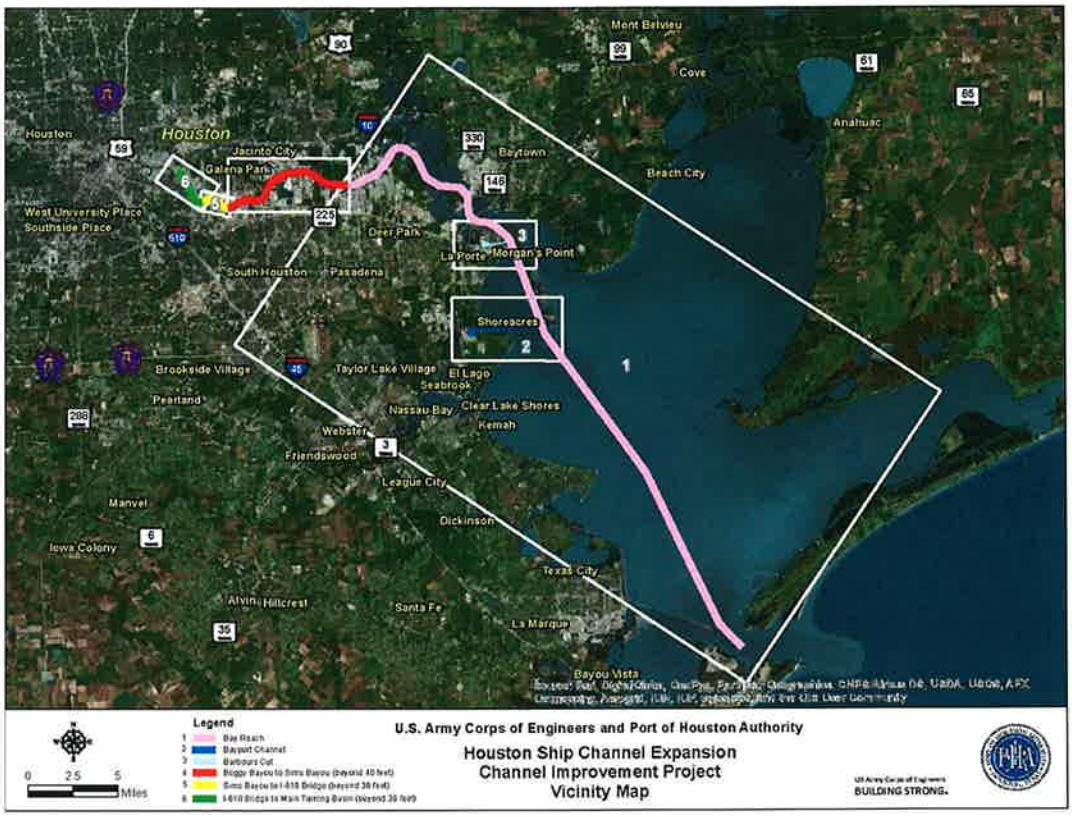

Figure 2 HSC Project Area

Source: Port of Houston Authority 2016

Habitats within the Project Area

Open Bay Bottom

The open bay bottom of Galveston bay is the second largest habitat in the bay and is made up of mostly soft rippling mud and silt that is not covered by oysters and vegetation. Over the years, the area of open bay bottom has increased mainly due to oyster removal and dredging activities. Biological decomposition, a major function for the breakdown of plant material, occurs in this habitat, where it is eventually re-suspended in the water column to provide food for fish and other wildlife species. Wildlife usage of and negative impacts by deepening and widening construction of Galveston Bay's open bay bottom were recognized in the Service's reports noted in Table 1. Previous HSC open bay bottom impacts were mitigated through the creation of over 4,000 acres of smooth cordgrass *Spartina alterniflora* marsh within the project area.

Bayous

Canals and larger bayous typically range in depth from 4 feet, to over 15 feet. Strong tidal flow occurs at times through those waterways, especially where they provide hydrologic connections to other large waterbodies. Such canals and bayous may have mud or clay bottoms that range

from soft to firm. Dead-end canals and small bayous are typically shallow and their bottoms may be filled in to varying degrees with semi-fluid organic material. Erosion due to wave action and boat wakes, together with shading from overhanging woody vegetation, tends to retard the amount of intertidal marsh vegetation growing along the edges of these waterways.

The larger Buffalo Bayou and San Jacinto Rivers make up the upper portion of the HSC. The Buffalo Bayou watershed is heavily urbanized, fed by natural springs, and is affected by the drainage waters impounded and released by the Addicks and Barker Reservoirs, surface runoff, and three tributary bayous (White Oak Bayou, Greens Bayou and Brays Bayou). The HSC turning basin, located upriver at the navigational head of Buffalo Bayou and once the hub of shipping and receiving in Houston, has unsuitable fish and wildlife habitat and is only frequented by highly urbanized scavenger species such as coyotes *Canis latrans* and raccoons *Procyon lotor*. The HSC portion of the San Jacinto River is rendered unsuitable for recreational purposes primarily due to excessive contaminant dumping by an adjacent pulp and paper mill during the 1960s and 1970s. Aquatic life, namely fish and oysters, and public health were immediately affected and testing of the same area continues to indicate that bans on wading, swimming, fishing, crabbing and collecting oysters for consumption should remain in effect.

The smaller and more shallow drainage canals in the project area may become stagnant, anoxic, exhibit increased water temperatures during dry weather periods, and most likely do not provide any suitable fish and wildlife habitat. Also, runoff from developed areas has likely reduced the value of aquatic habitat by introducing various urban pollutants, such as oil, grease, and excessive nutrients to the aquatic systems. Clearing and development has eliminated much of the riparian habitat that would normally provide shade and structure for many aquatic species thereby limiting the presence for fish and wildlife along portions of the bayous and the HSC where industrialized and commercial shipping activities are prevalent.

Oyster Reef

Historically, oyster reefs, dominated by Eastern oyster *Crassostrea vircinic,* in Galveston Bay covered large areas (Figure 3), especially near Red Fish Bar (which once extended across the middle of Galveston Bay from Eagle Point to Smith Point), in East Bay, and in West Bay. Oyster reef is as an essential habitat for finfish. It can support a higher abundance, biomass and species richness of most fish species than either marsh or shallow non-vegetated bay bottoms. Reefs may attenuate wave energy and reduce erosion, provide protection for other nearby habitats such a submerged aquatic vegetation or salt marsh. Oyster reef area has decreased in the study area over the last decade due to three primary factors, coastal storm surges, drought, and fishing pressure; however, reefs grow primarily in the middle of the bay and cover more than 10,000 hectares of bay bottom (Powell et al, 2003).

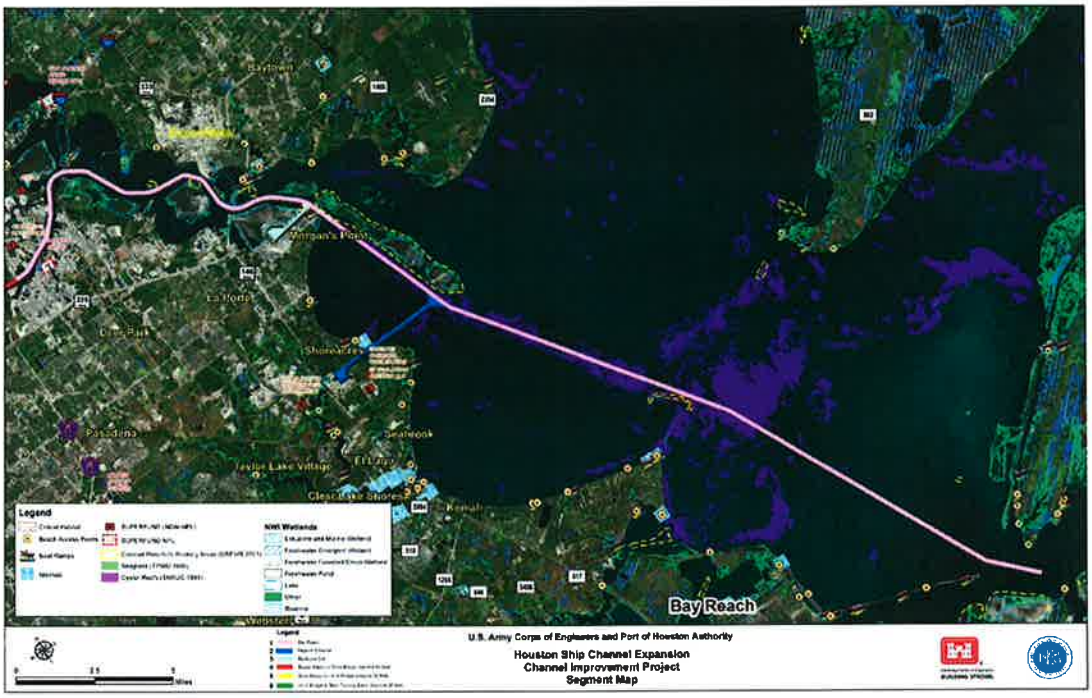

Figure 3 HSC and Galveston Bay mapped oyster reefs

Source: USACE 2016

Most of oyster habitat along the HSC has been severely scoured and the majority of the oyster shell from Atkinson Island south past Redfish Reef is dead (Service 1986, 1995, 2002 and 2009). Much of the Galveston Bay oyster reefs were devastated as freshwater from heavy spring rains in 2015 and 2016 flooded Galveston Bay resulting in a massive oyster die off forcing a disaster declaration for the local oyster industry. Oyster habitat should be avoided during construction activities; however should the Corps find that avoidance of oyster shell and reef habitat is not in the best interest of the POH, the Service strongly urges the Corps to coordinate with the Beneficial Use Group (BUG), the Inter Coordination Team (ICT), and specifically TPWD to identify oyster reef restoration opportunities in Galveston and adjacent bay systems. The Service recommends mitigation efforts with full in-kind compensation for any impacts to oyster habitat. The Service understands and approves of the Corps choice of the Swannack (Swannack, Reif, & Soniat, 2014) oyster model to evaluate direct and indirect impacts to oyster habitat within the study area and will evaluate the model and results in the FWCAR.

Coastal Marshes

Coastal marsh habitat armors shorelines from erosion, filters pollutants, enhances water quality and promotes primary production (Mitsch & Gosselink, 1993). Ravens et al., (2009) reports that between 1950 and 1989 almost 12% of the salt marshes in Galveston Bay were lost due to subsidence, eustatic sea-level rise, wave action, filling. Ravens (2009) also indicates low and insufficient sediment accretion rates relative to sea-level rise are likely the main causes for localized coastal marsh loss in Galveston Bay. Coastal marsh and wetland habitats within the project area are well documented by the Service in the reports listed in Table 1 and the continued

loss of this signifcant natural resource remains a concern. Maintaining the economic values, fish and wildlife resources, and aesthetic qualities of the Texas Coast depends on re-establishing and restoring its wetlands. The Service continues to support creation and restoration efforts by the POH, other natural resource agencies, non-governmental organizations, and the public. As mitigation for past deepening and widening efforts, the POH, in coordination with the BUG, designed and constructed over 4,000 acres of intertidal marsh that serves as productive fish and wildlife habitat within the project area. Salt marsh restoration projects must include components aimed at enhancing the sediment supply rather than focusing on wave protection alone and should be addressed in future Corps plans as maitenance needs.

Estuarine and marine wetlands

Fringing or estuarine wetlands are tidal in nature, are extremely productive, they occur along the edges of Galveston Bay and some of the land features found within the bay. Prevalent species in the estuarine and marine wetlands include smooth cordgrass *Spartina alterniflora*, saltwort *Batis maritime*, saltgrass *Distichlis spicata* and glasswort *Salicornia* spp. Estuarine wetlands are present in some of the placement and beneficial use areas located adjacent to the HSC, and areas located just west of the most northern reach of the HSC at the turning basin. Estuarine wetlands are valuable for commercial and recreational fishery species with most species completing all or part of all of its life cycle in this habitat. Wetlands should be avoided during construction activities to the greatest extent practicable. However, if the Corps deems that avoidance is not possible, the Service recommends mitigation with full in-kind compensation to fully offset impacts to the existing functions and values of this habitat.

Freshwater Emergent Wetlands

Freshwater wetlands are primarily found in areas where rainfall runoff accumulates in relic depressions and stream channels. Closer to the coast, this wetland type can be found inland of salt or estuarine wetlands and intertidal swales (Dick & Hunt, 2012). These wetlands tend to have reduced salinties and are suitable for plants such as sedges, rushes, and coastal arrowhead *Sagittaria lancifolia*. While many freshwater wetlands are found on the mainland within the project area, some of the placement and disposal areas (filled placement areas not currently being used or upgraded) provide excellent freshwater emergent wetlands. These wetlands provide valuable stop-over habitat for many migrating species such as waterfowl, raptors, shorebirds, and should be avoided during construction activities. However, if the Corps deems that avoidance is not possible, the Service recommends mitigation with full in-kind compensation for any impacts.

Fish and Wildlife Impacts

The Service recommends the Corps conduct a review for threatened and endangered species two years prior to construction. In order to obtain information regarding fish and wildlife resources concerning a specific project or project area, we recommend that the Corps first utilize the Service developed Information, Planning, and Conservation (IPaC) System. The IPaC system is designed for easy, public access to information about the natural resources for which the Service has trust or regulatory responsibility such as threatened and endangered species, migratory birds, National Refuge lands, and the National Wetland Index. One of the primary goals of the IPaC system is to provide this information in a manner that assists project proponents in planning their

activities within the context of natural resource conservation. The IPaC system can also assist people through the various regulatory consultation, permitting and approval processes administered by the Fish and Wildlife Service, helping achieve more effective and efficient results for both the project proponents and natural resources. The IPaC system can be found at the following website: http://ecos.fws.gov/ipac/.

Finfish and shellfish

Finfish and shellfish species that are commercially and recreationally important occur within the Galveston Bay complex. Galveston Bay is home to more than 100 species of finfish, making up a significant recreational fishery, which positively contributes to the Houston area economically. Almost 85% of recreationally important fish species use coastal wetlands and estuarine habitats during at least one life stage. Texas routinely accounts for almost a quarter of the red snapper harvested in the Gulf of Mexico and a third of the Gulf's shrimp landings based on pounds. About one quarter of all domestic shrimp landed in the United States comes from Texas. In fact the Gulf States Marine Fisheries Commission (2016) states that during the 2013 and 2014 seasons, 14 million pounds of shellfish and 23 million pounds of finfish were harvested in Galveston Bay.

Finfish are usually highly mobile therefore the Service believes any impacts to those species will be minimal and temporary. However, increases in suspended sediments and turbidity levels from dredging and disposal operations, could under certain conditions, result in adverse effects on marine animals and plants by reducing light penetration into the water column and by the actual physical disturbance. Likewise, shellfish can suffer from breathing problems associated with clogged and damaged feeding apparatus and young fish can have increased fatalities when sediments become trapped in their gills from heavily turbid waters (Wilbur & Clarke, D.G., 2001).

Colonial Waterbirds

Islands host nesting colonies for most North America seabirds as well as many of the last populations of endemic landbird species. On most islands, invasive predators such as rats, raccoons, and coyotes depredate nests and pose a severe threat to nesting bird populations. Actions to eradicate predators have prevented extinction of vulnerable bird populations. Continued comprehensive restoration of priority islands for breeding birds is needed as many islands are still overrun by invasive species. The Service has identified 18 historic colonial waterbird colonies within the project area. These islands or sites are no longer suitable due to the presence of invasive predator species, overgrown vegetation, lack of open ground nesting habitat, experiencing erosion or subsidence and no longer have appropriate elevations to support nesting birds, or the lack of available forage sites in close proximity to nesting habitat. The Texas Colonial Waterbird Society recognizes 12 colonies within the project area as active. Several of these sites lie along the HSC (highlighted with an * below in Table 2), direct and indirect impacts to these sites resulting from construction activities should be avoided during the breeding season. The Service defines the breeding season for colonial waterbirds as February 1 to September 1: however, this can vary from colony to colony necessitating site inspections to confirm that all nestlings have fledged.

Table 2 Colonial Waterbird colonies in or near the project area

Colony Name	TCWBS Code
*St. Mary's Island	600-166
*Alexander Island	600-161
*Atkinson Island	600-181
Smith Point Island	600-261
*Evia Island	600-551
*288-Acre Marsh	600-500
*Big Reef	600-460
*Bolivar Flats	600-441
Dickinson Bay Spoil Island	600-341
TCCP Spit Rookery	600-343
Space Center Rookery	600-418
Armand Bayou Nature Center	600-151

The construction of bird islands using new work dredged matieral is well documented, but it was not until the 1970s that the importance of this dredged material to nesting waterbirds was realized (Golder, Allen, Cameron, & Wilder, 2008). Dredge spoil islands created out of local sand and clays provides immediate nesting opportunties for bare ground nesters such as terns and skimmers. Successional vegetation including mangroves, bacharris, and other shrub spieces provide suitable nesting habitat for three species of egrets, five species of herons, white ibis *Eudocimus albus*, and rosette spoonbills *Platalea ajaja*. This and subsequent projects could positively contribute to the colonial waterbird populations across the Gulf of Mexico. The presence of bird islands may be directly related to increases in ecotourism and fishing opportunities resulting in additional local revenues for coastal businesses.

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

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

Marsh, bird islands, and placement areas created by large scale Corps projects all are suitable habitat for shorebirds to forage, nest, and may play a critical life cycle role as other coastal habitats erode and become less suitable. The recent State of North America's Birds 2016 (North American Bird Conservation Initiative, 2016) identifies seabirds as declining. They are severely threatened by invasive predators on nesting islands, accidental by catch by commercial fishing vessels, as well as overfishing of forage fish stocks, pollution, and climate change. By adopting broad best management practices such as the continued building of bird islands, managing invasive species and vegetation on existing islands and placement areas, the Corps will help to ensure the growth of colonial waterbird populations and shorebirds along the upper Texas coast and at the broader Gulf of Mexico level for years to come.

Other Migrating Birds

Most Texas birds are not year-round residents and are considered to be seasonal residents or migrants. The upper Texas coast is critically important habitat for migrating birds due to their use of uplands, wetlands, beaches and marshes as feeding, resting and nesting sites. The Galveston Bay area is located within the path of the Central and Mississippi flyways. There are 338 Neotropic North American species, 333 have been documented in Texas (Haggerty & Meuth, 2015). The coastal and bay shorelines provide stop over and fall-out habitat for many neotropical birds migrating across the Gulf of Mexico to their summering grounds in the northern United States and Canada. These weary and energy-drained birds seek wooded areas to feed and recharge before taking flight again. Various species of hawks and raptors are found in the project area throughout the year, however most are migrants and are found primarily during the winter months. Eagles, owls, and hawks are resident and are common on the landscape. The Service has extensively documented the importance of the Texas coastal habitats to resident and migratory birds in the reports listed in Table 1 and recommends the POH avoid impacting migratory bird habitat all together.

Beneficial Use of Dredge Material

The Corps has not provided the Service with a copy of the dredge material management plan (DMMP) for the HSC for review. The development of a well thought out plan addressing how dredge material will be used over the life of this project (50 years) is critical to a successful and environmentally responsible outcome. The Corps has historically included the Service and other natural resource agencies in the development of past HSC DMMPs. However, for this study effort, the Service was not included in the early coordination meetings. As a result, the Service recommends the Corps adopt an aggressive dredge material policy aimed at using 75% of the dredge material beneficially. The Corps has supported numerous research projects aimed at identifying uses for dredge material in lieu of costly upland placement areas and boasts several projects where sucessful dredged material placement has restored or replaced lost wetland habitat and function. However, the Corps falls short in beneficial use of dredge material when only 11 % (1.64 million cubic yards [mcy]) of the 14.58 mcy dredged in FY15 in Texas were used beneficially (Frabrotta, 2016) . We strongly urge the Corps to develop a DMMP identifing markets for commerical and other end users of dredge material products as well as identifying technologies that will aid in pumping/or barging the material greater distances with reduced costs. Developing costly upland placement areas assures that sediment removed during initial

construction and subsequent maintenance phases are permanetly removed from the system ultimately disrupting natural processes that help sustain local marsh habitats.

Maintenance material can be used to create wetland features that buffer the effects of increased vessel size and frequency from the widening of the HSC. We recomend all features consider some type of levee armoring to mitigate excessive wave action or have a design using sacrifical berms until a functioning mature marsh can be established. New work material, while suitable for levee construction, could be benefically used to create bird islands ultimatley supporting thousands of nesting colonial waterbirds throughout Galveston Bay and the Gulf of Mexico. Strategically placed earthen terraces (also uses new work material) can successfully control wave action promoting shoreline stabilization and marsh growth over time. New work material can be transported to other areas of Galveston Bay or other bay systems where an island or terracing project may be of some benefit. The Service strongly supports long term creative solutions where sediments are responsibly returned to the aquatic ecosytem and wildlife habitats are restored, enhanced, and protected. The Service will coordinate with the BUG and ICT to determine suitable placement of wetland and island features should this option become available.

Recommendations

As a result of the extensive coordination efforts on the HSC between the Service and the Corps, numerous hydrodynamic, oyster, salinity, and sedimentation studies were conducted resulting in a better understanding of the complex ecosystem dynamics of Galveston Bay. While most of these surveys may be outdated and not applicable for this study effort, the Service supports the Corps desire to include future modeling efforts to determine potential impacts with the associated alternatives. The Service requests access to the modeling data, reports, and summaries as they become available and understands that not all of the modeling or surveys may not be completed and reviewed in time for the final FWCA report. As such, the Service may not be able to appropriately comment and make recommendations to reduce environmental impacts or mitigation. Should these surveys and modeling reports become available after the final FWCA report is submitted, the Service recommends a supplemental FCWA report aimed at addressing those additional modeling and mitigation issues not previously accounted for in the first FWCA report.

The Service does not object to the Corps providing greater accessibility and safety measures for shipping traffic to access the Houston Ship Channel provided the following fish and wildlife recommendations are incorporated into future project planning and implementation:

1. Conduct oyster sampling efforts in coordination with the ICT to confirm live shell and cultch material presence/absence in areas of the HSC that lie within Galveston Bay. Should live oyster shell be found, the Service recommends complete avoidance of the shell or reef. If avoidance is not possible, the Service recommends the Corps minimize dredging and siltation impacts within 500-ft of the project area and fully coordinate with the ICT and BUG prior to the commencement of any dredging activities. Full mitigation for any direct or indirect oyster impacts will be fully compensated as coordinated with the ICT.

2. The Service agrees with the Corps' use of the Swannack (2014) model to quantify unavoidable impacts to shell and oyster habitat within the study area. Results from the modeling efforts shall be used to develop a mitigation plan to be coordinated with the BUG and the ICT.
3. Provide data/modeling reports documenting the hydrodynamic changes forecasted in Galveston Bay as a result of the preferred alternatives for the Service's evaluation.
4. The Service urges the Corps to adopt a policy/standard operating procedure to use at least 75% of maintenance dredge and new work material responsibly over the 50-year time period of this federal project. As such, we recommend the Corps reevaluate the DMMP to include beneficial use opportunities in lieu of disposing of the material offshore or to confined upland disposal sites. Additionally, we urge the Corps to evaluate transporting new work and maintenance material to areas outside of the typical 6-mile pump distance to other areas along the Galveston Bay shoreline and along the Gulf Inter-coastal Waterway (GIWW) as cost alternatives to placement area construction and levee rising. Dredged material can be used to combat changes in water levels, erosion, and subsidence in most marsh habitats found along Galveston Bay and the entire GIWW.
5. All new work and maintenance material should be thoroughly tested for contaminants using the standards outlined in the Environmental Protection Agency's Inland Testing and Ocean Dumping Manuals prior to being used in any beneficial use projects, placement in upland confinement, or offshore disposal sites. Should data suggest toxic levels of contaminants are present, the Service recommends disposal of the material in accordance to Environmental Protection Agency guidelines and within an approved landfill site.
6. The Service strongly supports long term solutions where sediments are responsibly returned to the aquatic ecosytem. New material from deepening or widening measures is usually suitable for island construction, while finer dredged materials and sands may be used for marsh or sand mound creation or restoration. The Service can assist with appropriate location and design of new island, marsh, mound, or terracing projects within and outside of the immediate study area. Island specifics may include construction of a 2 to 12-acre island, approximately 8ft above mean high water or flood stage at least one half mile (preferably one mile) or offshore in a nearby bay. The island should include a sloping sand beach, preferably protected by a rock breakwater structure similar in design to Evia Island in Galveston Bay. Fully coordinate and vet all island and marsh design plans through the BUG and the ICT prior to commencement of any marsh construction.
7. The Service encourages the Corps to initiate coordination during the design phases of the project and prior to the commencement of any construction activities in Galveston Bay so the site specific best management practices (BMPs) can be developed. Measures should be implemented to avoid or minimize the adverse effects of pollution, sedimentation, and erosion by limiting soil disturbances, scheduling work when the fewest number of fish are likely to be present, managing likely pollutants, and limiting the harm that may be caused by accidental discharges of pollutants and sediments. BMPs attempt to minimize impacts to fish and wildlife species within the immediate construction and nearby areas and may consist of floating turbidity curtains, limiting certain construction activities to daylight hours, limiting the use of or shielding lights at night, no vegetation removal or

soil disturbance should be allowed outside of the project area, removal of mature trees providing soil or bank stabilization should be coordinated with the Service and TPWD, erosive banks should be stabilized using bioengineering solutions and minimize the use of riprap, and using monitors in open water areas to identify sensitive species.

8. Construction of any study features shall occur at least 1,000 feet away from a colonial waterbird rookery site during the breeding season.
9. Avoid contact with any colonial waterbird rookery sites that may be within the project area. These sites are most likely active February 1 through September 1.
10. Any newly created marsh sites shall be planted as early as possible to minimize erosion. Plants and planting schedules should be fully vetted and coordinated with the BUG and ICT.
11. Any newly created sand mound projects shall be placed in low energy wave environments, include wave protection measures (e.g. temporary erodible berms), and be constructed to mitigate wave fetch. The Service may recommend delayed plantings so as to allow for natural vegetative recruitment and threatened and endangered species utilization.
12. Monitoring and maintenance of the project features shall be coordinated with the BUG and all BUG guidelines and recommendations adhered to.
13. Avoid impacts to all existing marsh. If the Corps deems impacts to be unavoidable, the Service recommends mitigation for any direct or indirect wetland impacts with full compensated as coordinated with the ICT.
14. The Corps shall initiate coordination with National Marine Fisheries Service regarding Essential Fish Habitat impacts and mitigation issues within the project area.
15. Cumulative effects from this and the Texas Coastal Study project must be considered when developing project features and mitigation plans. We recommend the federal sponsor along with the Corps work in coordination with counterparts from the Texas Coastal Study to develop complimentary project features and mitigation plans.
16. The Service supports acquisition, restoration and preservation of natural resources within the project area and is willing to assist the Corps in identifying suitable areas in need.
17. Should this project move to the design and construction phases, the Service recommends the Corps evaluate the project's effects on threatened and endangered species and other natural resources by using the IPaC system at http://ecos.fws.gov/ipac/and initiate any necessary consultation procedures pursuant to Section 7 of the ESA.
18. The Corps should identify areas where shoreline erosion is imminent as a result of the channel's widening efforts. Protection of these shorelines using non-structure or living shoreline methods is preferable to the use of hard structures when mitigating for shoreline erosion impacts.
19. The Corps and the POH should work with local shipping companies to develop a responsible HSC wide dredge material management plan that uses sediment responsibly for the foreseeable future. The creation and modification of placement areas are costly alternatives and more times than not, is the preferred alternative. The Service's National Wildlife Refuge System has three nearby refuges that would greatly benefit from dredge material and barging the material out of the study area should be considered as an alternative to upland or offshore disposal. Many placement areas within the study area

may be at or near capacity and raising levees and constructing new placement areas are costly may not be the environmentally preferred option. Barging new work dredge material or mining material from placement areas should be thoroughly considered as an alternative prior to new placement area construction.

We appreciate the opportunity to identify and highlight key natural resources within the project area and the fish and wildlife that inhabit them. The Service believes the recommendations in this letter will guide the Corps in developing an environmentally sound project that eliminates or significantly reduces negative impacts to these natural resources within the project area.

We look forward to working with the Corps and our partners on the BUG and ICT to further define the alternatives and develop a Tentatively Selective Plan that meets the goals of the project while remaining environmentally responsive.

Please contact staff biologist, Donna Anderson or myself at 281-286-8282 with any questions.

Sincerely,

Charles Ardizzone
Field Supervisor

cc: Winston Denton, TPWD
Rusty Swafford, NMFS
Barbara Keiler, EPA

Works Cited

Dick, J. A., & Hunt, G. H. (2012). *Status and trends of wetlands for Galveston County, Texas 2004-2009.* Albuquerque, NM: Fisheries and Habitat Conservation, Department of th Interior, U.S. Fish and Wildlife Service .

Frabrotta, C. (2016, August 22). Personal Communication.

Galveston Bay Esturary Program. (2013). *Discover Galveston Bay.* Retrieved March 15, 2017, from Back the Bay: http://www.gbep.state.tx.us/discover-galveston-bay/

Galveston Bay Foundation. (2016). *Wetlands of Galveston Bay.* Retrieved Sept. 26, 2016, from Galveston Bay Status and Trends: http://www.galvbaydata.org/Habitat/Wetlands/tabid/846/Default.aspx

Gulf States Marine Fisheries Commission. (2016). *Gulf Fisheries Economics.* Retrieved September 20, 2016, from U.S. Gulf of Mexico Fisheries Information: Demonstrating Sustainability Through Education: http://gulffishinfo.org/gulf-fisheries-economics

Haggerty, M., & Meuth, M. P. (2015). *Texas Master Naturalist.* College Station: Texas A&M AgriLife Extention Service and Texas Parks and Wildlife Department.

Houston-Galveston Navigation Safety Advisory Committee. (2011). *Navigating the Houston Ship Channel a reference for commerical users.* Houston: Houston-Galveston Navigation Safety Advisory Committee.

Lone Star Harbor Safety Committee. (2016, March 15). *Lone Star Harbor Safety Committee.* Retrieved March 1, 2017, from NOAA, Nautical Charts: https://www.nauticalcharts.noaa.gov/ocs/hsrp/galveston2016/Pontikos_NOAA_HSRP_LSHSC.pdf

Mitsch, W., & Gosselink, J. G. (1993). *Wetlands.* New York: Van Nostrand Reinhold.

Moulton, D. W., Dahl, D. E., & Dall, D. M. (1997). *Texas coastal wetlands status and trends; mid-1950s to early 1990s.* Albuquerque: United States Department of the Interior, Fish and Wildlife Service, Southwest Region.

National Transportation Safety Board. (2017, March 22). *Marine Accident Reports.* Retrieved March 27, 2017, from National Transportation Safety Board: https://www.ntsb.gov/investigations/AccidentReports/Pages/marine.aspx

North American Bird Conservation Initiative. (2016). *North American Bird Conservation Initiative, 2016. The State of North American's Birds 2016.* Ottaw Ontario: Environment and Climate Change Canada.

Port of Houston Authority. (Updated February 6, 2017). *Houston Pilots Working Rules.* Houston.

Port of Houston. (n.d.). *Port of Houston.* Retrieved March 14, 2017, from Statistics: http://porthouston.com/portweb/about-us/statistics/

Powell, E., Klinck, J. M., Hoffman, E. E., & McManus, M. A. (2003). Influence of water allocation and freshwater inflow on oyster production: A hydrodynamic-oyster population model for Galveston Bay, Texas USA. *Environmental Management, 31*, 100-121.

Ravens, T., Thomas, R. E., Roberts, K. A., & Santschi, P. H. (2009). Cuases of salt marsh erosion in Galveston Bay, Texas. *Journal of Coastal Research, 25*(2), 265-272.

Swannack, T., Reif, M., & Soniat, T. M. (2014). A Robust, Spatially Explicit Model for Identifying Oyster Restoration Sites: Case Studies on the Atlantic and Gulf Coasts. *Journal of Shellfish Research, 33*(2), 395-408.

Texas Water Development Board. (2007). *In Coastal Hydrology, Basin Water Inflow Summary for Galveston Bay.*

U.S. Army Corps of Engineers. (2014). *Houston Ship Channel Expansion, Texas Section 905(b) of the Water Resources Development Act of 1986 Analysis Report.* Galveston, Texas: U.S. Army Corps of Engineers.

U.S. Fish and Wildlife Service. (1986). *Fish and Wildlife Coordination Act Report Galveston Bay area navigation study Galveston, Harris and Chambers Counties, Texas.* Houston, TX: U.S. Fish and Wildlife Service, Clear Lake Field Office.

U.S. Fish and Wildlife Service. (1995). *Supplemental Fish and Wildlife Coordination Act Report, Houston-Galveston Navigation Channels, Texas.* Fish and Wildlife Servcice, Department of the Interior. Houston: Texas Coastal Ecological Services Office.

U.S. Fish and Wildlife Service. (2002). *Supplemental Fish and Wildlife Coordination Act Report Houston-Galveston Navigation Channels, Texas Barge Lane Widening.* Houston: U.S. Fish and Wildlife Service Clear Lake Office.

U.S. Fish and Wildlife Service. (2008). *Birds of Conservation Concern.* Fish and Wildlife Service, Deparetment of the Interior. Arlington, VA: Division of Migratory Bird Management.

U.S. Fish and Wildlife Service. (2009). *Existing Conditions and Recommendations for the Expansion of Placement Areas 14 and 15 in the Houston Ship Channel, Houston, Texas.* Houston: U.S. Fish and Wildlife Service Texas Coastal Ecological Services Office.

U.S. Fish and Wildlife Service. (2010). *Federal Assumption of the Jacintoport Navigation Channel* . Houston: U.S. Fish and Wildlife Service Texas Coastal Ecological Services Office .

U.S. Fish and Wildlife Service. (2010). *Modification of Bayport Flare - Houston Ship Channel, Houston, Texas Planning Aid Letter.* Houston, Texas: U.S. Fish and Wildlife Service Texas Coastal Ecological Field Office.

U.S. Fish and Wildlife Service. (2014). *Cedar Bayou Dredged Material Management Plan Harris and Chambers Counties, Texas Planning Aid Letter.* Houston, Texas: U.S. Fish and Wildlife Service Texas Coastal Ecological Services Office.

Wilbur, D., & Clarke, D.G. (2001). Biological effects of supsended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activites in estuaries. *North American Journal of Fisheries Management, 21*(4), 855-875.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

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In Reply Refer To:
FWS/R2/02ETT
X00-2016-CPA-0051

September 30, 2019

Colonel Timothy Vail
Attention: Harmon Brown, Environmental Section
U.S. Army Corps of Engineers, Galveston District
P.O. Box 1229
Galveston, TX 77553

Dear Colonel Vail:

The Fish and Wildlife Coordination Act (FWCA) (Public Law 85-624; 16 U.S.C. 661 - 666) requires that the U.S. Army Corps of Engineers (Corps) coordinate with the Department of Interior U.S. Fish and Wildlife Service (Service) where waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted or otherwise controlled or modified to consult for the purpose of "preventing loss of and damage to wildlife resources." This Fish and Wildlife Coordination Act Report (FWCAR) provides the Service's analysis of impacts and mitigation options for important fish and wildlife resources related to the proposed widening, dredging, and dredged material disposal activities for the Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP). The project is located in Harris, Chambers, and Galveston Counties, Texas. It is in fulfillment of our joint Scope of Work on this project, dated August 20, 2016 that this CAR is presented. Procedurally, project construction is not authorized; however, attached is the report from the Secretary of the Interior as required by Section 2(b) of the FWCA (48 Stat. 401, as amended; 16 U.S.C. 661 et. seq.) to aid in the U. S. Army Corps of Engineers' (Corps) planning efforts. The FWCA requires that the Section 2 (b) report be made an integral part of any report supporting further project authorization or administrative approval.

Previous Service involvement with the HSC ECIP occurred by way of a Planning Aid Letter (PAL), dated March 29, 2017 and participation in monthly Corps coordination meetings. The PAL provided an initial analysis of the proposed project and made recommendations to avoid and minimize the proposed project impacts to important trust fish and wildlife resources. Due to the uncertainties regarding the final project design, the project's complete impacts cannot be determined at the current stage of planning. Therefore, we cannot fully complete our evaluation of the Study's effects on fish and wildlife resources at this time nor can we entirely fulfill our reporting responsibilities under Section 2(b) of the FWCA (48 Stat, 401, as amended; 16 U.S.C.

661 et seq.). We understand the next phase of the study will produce more definitive project information and we recommend additional Service involvement to fulfil our reporting requirements and responsibilities under the FWCA. The Texas Parks and Wildlife Department (TPWD) nor the National Marine Fisheries Service (NMFS) have reviewed this report and any comments received will be forwarded under separate cover.

We appreciate the opportunity to participate in the planning of the HSC ECIP and look forward to working with your staff on this and future federal projects. If you have any questions or comments concerning this report, please contact staff biologist Donna Anderson at (281) 286-8282.

Sincerely,

Charles Ardizzone
Project Leader
Texas Coastal Ecological Services Office

Houston Ship Channel Extension Channel Improvement Project, Harris County, Texas

Submitted to:
Galveston District
U.S. Army Corps of Engineers

Prepared by:
Texas Coastal Ecological Services Field Office
Houston, Texas

Reviewed by:
Chuck Ardizzone
Project Leader

U.S. Fish and Wildlife Service
Region 2
Albuquerque, New Mexico
September 30, 2019

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Report Acronyms

Barbours Cut Channel	BCC
Bayport Ship Channel	BSC
Beneficial Use	BU
Best Management Practice	BMP
Dredged Material Management Plan	DMMP
Endangered Species Act	ESA
Environmental Protection Agency	EPA
Essential Fish Habitat	EFH
Federal Register	FR
Fish and Wildlife Coordination Act	FWCA
Future With Project	FWP
Future Without Project	FWOP
General Reevaluation Report and Environmental Assessment	GRR-EA
Gulf Intercoastal Water Way	GIWW
Gulf of Mexico Fishery Management Council	GMFMC
Houston Ship Channel Expansion Improvement Project	HSC- ECIP
Magnuson-Stevens Fishery Conservation and Management Act	MSFCMA
Mean Lower Low Water	MLLW
Migratory Bird Treaty Act	MBTA
National Marine Fisheries Service	NMFS
Natural Resource Conservation Service	NRCS
Ocean Dredged Material Disposal Site	ODMDS
Operations and Maintenance	O&M
Placement Area	PA
Port of Houston Authority	PHA
Preconstruction Engineering and Design	PED
Tentatively Selected Plan	TSP
Texas General Land Office	TxGLO
Texas Park and Wildlife Department	TPWD
United States Corps of Engineers	USACE
United States Fish and Wildlife Service	USFWS
Water Resources Reform and Development Act	WRDA

Executive Summary

A resource rich and shallow estuary, Galveston Bay spans approximately 600 square miles with numerous sub-bays, rivers, bayous, and deep draft navigation channels. The Houston Ship Channel, a 50-mile deep navigation channel located in Chambers, Harris, and Galveston Counties, supports the nation's third busiest port. To evaluate alternatives aimed at reducing transportation costs while providing safe, reliable navigation on the HSC, the local sponsor, the Port of Houston Authority, collaborated with the U.S. Army Corps (Corps) on the Houston Ship Channel Expansion Channel Improvement Project (HSC ECIP) feasibility study. The study examined deepening, possible moorings, and bay widening opportunities limited only to the Houston Ship Channel (HSC), Barbours Cut Channel, Bayport Ship Channel, Jacintoport Channel, and Greens Bayou Channel. The study did not include the Galveston Entrance Channel, Galveston Channel, Texas City Ship Channel, or the Cedar Bayou Navigation Channel.

The Corps evaluated nine alternatives including the no action alternative and selected Alternative 8, which will deepen, widen the HSC and associated channels, and improve the Hunting and Brady Island turning basins. The PHA desired two-way traffic from Bolivar Roads to BCC and developed a Locally Preferred Plan (LPP) where the Port of Houston Authority would bear 100 percent of the cost for the increments over the cost of the Corps' National Economic Development (NED) plan. Selection of either the LPP or the NED will reduce the number of vessel calls from the future forecasted levels by alleviating light loading of vessels and reducing transportation delays by enabling two-way transit and extending daylight navigation hours. The improvements would accommodate fully loaded current sized vessels and may even reduce the number of larger ships into the PHA, both of which reduce fuel consumption and emissions to deliver the same cargo.

The Corps anticipates (at this stage of the planning process) impacts to 2,131 acres to unvegetated bay bottom in Galveston Bay and 456 acres in the Buffalo/San Jacinto River; no significant effects to the hydrodynamics of the bay; and no significant impacts to tidal marsh or wetlands. However, to construct the NED Plan or the LPP, dredging to widen and deepen channels, excavate turning basins, ease bends, channel flares, and incorporate anti-shoaling features within Galveston Bay will permanently impact 85.1 and 321.3 acres (respectively) of mapped oyster reef.

This HSC ECIP Fish and Wildlife Coordination Act Report (FWCAR) provides the Service's comments and recommendations to avoid adverse impacts to fish and wildlife resources that could occur due to construction of the proposed ship channel improvements while identifying planning constraints that may influence the Service's ability to fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This FWCAR is prepared under the authority of the FWCA; and does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of the FWCA. The Service will provide copies of the FWCAR to the National Marine Fisheries Service and the Texas Parks and Wildlife Department; if any comments are received, they will be forwarded under a separate cover. Comments in this report are also provided under the Endangered Species Act (Act) of 1973 and the Migratory Bird Treaty Act (MBTA) of 1918.

Our evaluation is based on the current data, modeling, and analyses made available by Corps sources and Service files. The Service understands construction of the project is subject to Congressional approval and funding will occur sometime in the future with or without project modifications. Additional Service involvement is necessary for subsequent detailed planning, habitat analysis, engineering, design, and construction phases of each planning effort is required to fulfill our responsibilities under the FWCA. Since there may be a significant time lag between the study and construction phases, the Service recommends the Corps reinitiate coordination under a separate FWCA agreement when Planning, Engineering, and Design phase funding is available. This will allow the Service to conduct a comprehensive review of the project footprint, impacts, and update recommendations based on environmental conditions and designs that are more complete at the time of construction.

Regulatory Authorizations

The U.S. Fish and Wildlife Service (Service) is mandated to provide expertise during the planning and development of major federal projects, to ensure fish and wildlife resources are conserved, and that impacts to these resources are avoided or minimized. The Fish and Wildlife Coordination Act (16 U.S.C. 661-667e; the Act of March 10, 1934; Ch. 55; 48 Stat. 401), requires consultation with the Service and State fish and wildlife agencies where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted or otherwise controlled or modified" by any agency under a Federal permit or license. Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources." Second, The Rivers and Harbors Act of 1938 (33 U.S.C. 540, and other U.S.C. sections; Chapter 535, June 20, 1938; 52 Stat. 802), provides for wildlife conservation to be given "due regard" in planning federally authorized water resource projects.

The Fish and Wildlife Coordination Act (FWCA) provides a basic procedural framework for the orderly consideration of fish and wildlife conservation measures to be incorporated into Federal and federally permitted or licensed water development projects. The principle provisions of the Coordination Act include:

1. A statement of Congressional purpose that fish and wildlife conservation shall receive equal consideration with other project features;
2. Mandatory consultation with wildlife agencies to achieve such conservation;
3. Full consideration by action agencies of the recommendations resulting from consultations;
4. Authority for action agencies to implement such recommendations as they find acceptable.

Section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531-1544, 87 Stat. 884, as amended) requires Federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify critical habitat. The Migratory Bird Treaty Act of 1918 (16. U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755, as amended) establishes a Federal prohibition, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, at any time, or in any manner, any migratory bird (e.g. waterfowl, shorebirds, birds of prey, song birds, etc.) included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird."

This HSC ECIP Fish and Wildlife Coordination Act Report (FWCAR) provides the Service's comments and recommendations to avoid adverse impacts to fish and wildlife resources that could occur due to construction of the proposed ship channel improvements. It also identifies planning constraints that may influence the Service's ability to fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). Our comments in this FWCAR are focused on the alternatives under consideration by the Corps and the effects on the trust fish and wildlife resources within the overall project footprint. This FWCAR is prepared under the authority of the FWCA; and **does not** constitute the final report of the Secretary of the Interior as required by Section 2(b) of the FWCA. The Service will provide copies of the FWCAR to the National

Marine Fisheries Service (NMFS), Environmental Protection Agency (EPA) and the Texas Parks and Wildlife Department (TPWD); if any comments are received, they will be forwarded under a separate cover. Comments in this letter are also provided under the Endangered Species Act (Act) of 1973 and the Migratory Bird Treaty Act (MBTA) of 1918.

The Service sent the Planning Aid Letter for the Houston Ship Channel Expansion Channel Improvement Project (2017) to TPWD and NMFS and no comments were received back.

Background

Since 1872, the Corps has participated in navigation improvement projects in the Galveston Bay system (USFWS, 1995). The Houston Ship Channel (HSC), an extensive deep draft channel system, is vital to the port facilities and local economies of Houston, Texas City, and Galveston. The HSC extends approximately 50 miles from its juncture with the Texas City Channel at Bolivar Roads at the entrance to Galveston Bay and terminates at the turning basin in the City of Houston. The lower 26 miles of the HSC completes the bay reach and the upper 25-mile riverine section follows the two tributaries: San Jacinto River and Buffalo Bayou, to Galveston Bay. The upper riverine section of the HSC has extensive development with port facilities and industries dependent upon water transportation. The Galveston Channel extends almost four miles from Bolivar Roads between the northeastern portion of Galveston and Pelican Islands. The most recent deepening and widening effort of the HSC, completed in 2005, resulted in a main channel depth of 46.5 feet, width of 530 feet, with two 200-foot barge lanes (one on either side of the channel) between the Gulf Intracoastal Waterway and Morgan's Point.

The Texas Ports of Houston and Texas City benefited from the 2005 channel expansion. Texas ports rank first in the nation in foreign waterborne tonnage, largest Gulf Coast container port, handling 68% of the U.S. Gulf Coast container traffic in 2017 (**Table 1**), largest Texas port with 45% of market share by tonnage and 96% market share in containers by total twenty-foot equivalents units, and ranked 2nd in the U.S. in total tonnage (USACE, 2017).

Table 1 Cargo total for the Port of Houston

Cargo Type (Short Tons)	2013	2014	2015	2016	2017
Containerized	19,124,618	19,441,193	21,601,005	21,907,270	24,290,910
Gen. Cargo: Steel	4,656,258	6,694,288	4,796,470	2,231,515	3,694,676
Gen. Cargo: Other General Cargo	975,727	902,867	1,048,133	870,556	892,217
Total General Cargo	24,756,603	27,038,348	27,445,608	25,009,341	28,877,803
Total Bulk Cargo*	11,156,656	10,722,731	8,654,108	10,053,452	9,396,090
Total PHA Tonnage	35,913,259	37,761,079	36,099,716	35,062,793	38,273,893

The HSC includes side channels known as the Bayport Ship Channel (BSC), the Barbours Cut Channel (BCC), and the Greens Bayou Channel. Both the BSC and BCC are authorized to dredging depths of 46.5 feet (to match the HSC) while the Greens Bayou Channel maintains a 40 foot depth for lower portions of the channel and a shallow draft (15 feet deep) tributary.

In a continued effort to modernize the HSC to accommodate larger vessels and increases in vessel traffic, the Corps identified three issues with the HSC as outlined in the HSC ECIP Draft Feasibility Impact Statement (U.S. Army Corps of Engineers, 2017):

- Inefficient deep and shallow draft vessel utilization of the HSC system resulting from existing channel depth, width, and configuration (Segment 4-6);
- Navigation safety concerns for deep and shallow-draft vessel traffic (Segment 1-6); and
- Identifying environmentally acceptable dredge material placement with capacity to serve the system (Segments 1-6) over the 50-year period of analysis.

Based on the three issues identified above, the Corps determined the following planning objectives for the Study:

- Reduce navigation transportation costs by increasing economies of scale for vessels to and from HSC over the 50-year period of analysis;
- Increase channel efficiency, and maneuverability in the HSC system for the existing fleet and future vessels over the 50-year period of analysis;
- Develop environmentally suitable placement for dredged material and maximize use of beneficial use of dredged material for the placement over the 50-year period of analysis;
- Increase channel safety for vessels utilizing the HSC, BSC, BCC; and
- Reduce high shoaling at BSC Flare to reduce dredging frequency

The Service provided recommendations to the Corps throughout the planning processes on previous HSC expansion projects as seen in **Table 2** and most recently through a Planning Aid Letter (PAL) dated March 29, 2017.

Table 2 Service involvement with HSC and the Corps

Document Name	**Year**
FWCAR Galveston Bay Area Navigation Study Galveston, Harris, and Chambers Counties, Texas (U.S. Fish and Wildlife Service, 1986)	1986
Supplemental FWCAR Galveston Bay Area Navigation Study Galveston, Harris, and Chambers Counties, Texas (U.S. Fish and Wildlife Service, 1995)	1995
Supplemental FWCAR Houston-Galveston Navigation Channels, Texas-Barge Lane Widening (U.S. Fish and Wildlife Service, 2002)	2002
Existing Conditions and Recommendations for the Expansion of Placement Areas 14 and 15 in the Houston Ship Channel, Houston, Texas (U.S. Fish and Wildlife Service, 2009)	2009
Modification of Bayport Flare-Houston Ship Channel, Houston, Texas (U.S. Fish and Wildlife Service, 2010)	2010
Federal Assumption of Jacintoport Navigation Channel (U.S. Fish and Wildlife Service, 2010)	2010
Cedar Bayou Dredge Material Management Plan, Harris and Chambers Counties, Texas (U.S. Fish and Wildlife Service, 2014)	2014
PAL Houston Ship Channel Expansion Improvement Project	2017

Description of Study Area

Galveston Bay is a large shallow bay extensively interconnected by a system of deeper navigation channels, where tides range approximately one foot, and fresh water pulses experienced during the spring and summer can result in fresh/saltwater wedges in deeper areas and navigation channels. Upper portions of the bay experience salinities ranging between 5 and 10 parts per thousand (ppth) while the remainder of the bay is highly variable with salinities as high as 35 ppth in lower Galveston Bay. Winds are predominantly out of the southeast during the warm spring and summer months and northerly winds dominate during the winter months. Tidal flats remain exposed during winter storms and are covered during summer months due to higher tides and winds. Fresh water inflows into Galveston Bay are influenced by the Trinity and San Jacinto Rivers and numerous bayous. Pulses of fresh water resulting from rain events can significantly alter salinities throughout the bay.

The larger study area focuses on the entire 50 miles of the HSC from Bolivar Roads to the Main Turing Basin, and Galveston Bay. Included in the Study are the side channels, BSC, BCC, Jacintoport Channel, and Greens Bayou Channel. However, the Corps chose not to include the Galveston Entrance Channel, Galveston Channel, Texas City Ship Channel, or the Cedar Bayou Navigation Channel within the HSC ECIP study area since each has their own sponsor.

The Corps divided the study area into following six study segments as shown in **Figure 1**:

- Segment 1 Bay Reach
- Segment 2 Bayport Ship Channel
- Segment 3 Barbours Cut Channel
- Segment 4 Boggy Bayou to Sims Bayou
- Segment 5 Sims Bayou to I-610 Bridge
- Segment 6 I-610 Bridge to Main Turning Basin

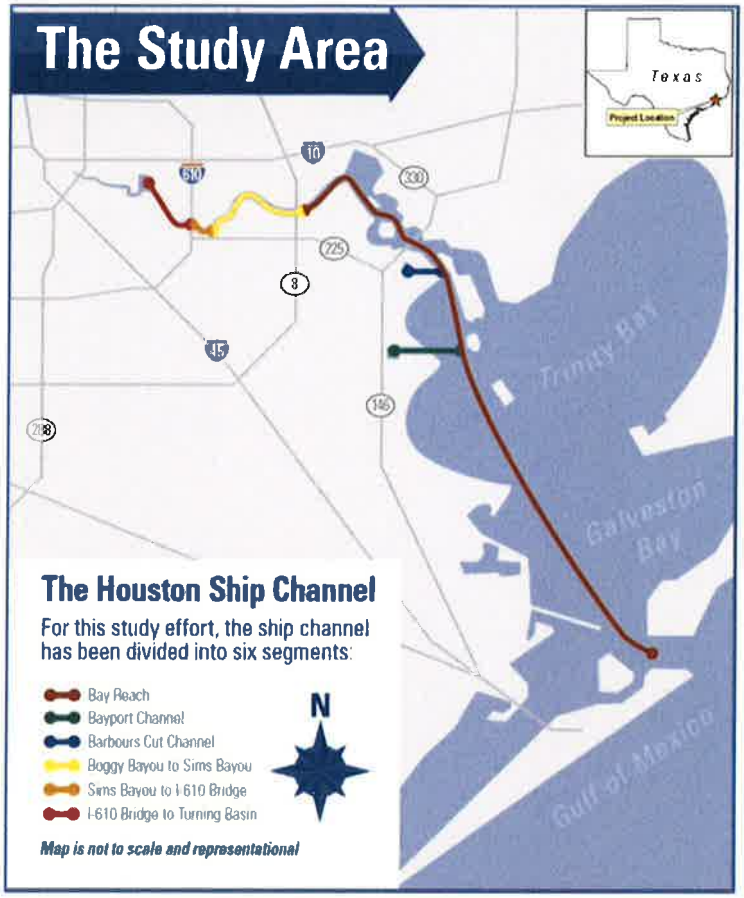

Figure 1 Houston Ship Channel segments (Source: Corps 2017)

Conservation Areas

The greater Houston area supports several conservation areas aimed to provide refuge for fish and wildlife species in an urban environment. Numerous city and county parks surround Galveston Bay providing recreational opportunities for local residences. Conservation areas strive to restore, enhance, or create marsh, prairie, forested, and beach habitats. Larger conservation areas in the Houston area that provide foraging, nesting, and resting benefits to fish and wildlife include (**Figure 2**):

Armand Bayou Nature Center

Founded in 1974, Armand Bayou Nature Center (Center) encompasses 2,500 acres of land and is home to 370 species of birds, mammals, reptiles, and amphibians. Vegetation is characteristic of East Texas coastal plains and is a biological transition zone between the southern mixed hardwood forest, the coastal prairie, and the coastal salt marshes. The Center contains remnants of one of the few remaining native prairies, small areas of shallow, brackish marshlands, and bottomland hardwood, or riparian woodland areas. Located approximately 8.5 miles from the HSC, direct impacts to the Center are unlikely. Indirect impacts from noise or air pollution and water quality should be evaluated during the Planning Engineering and Design (PED) phase as construction details become available.

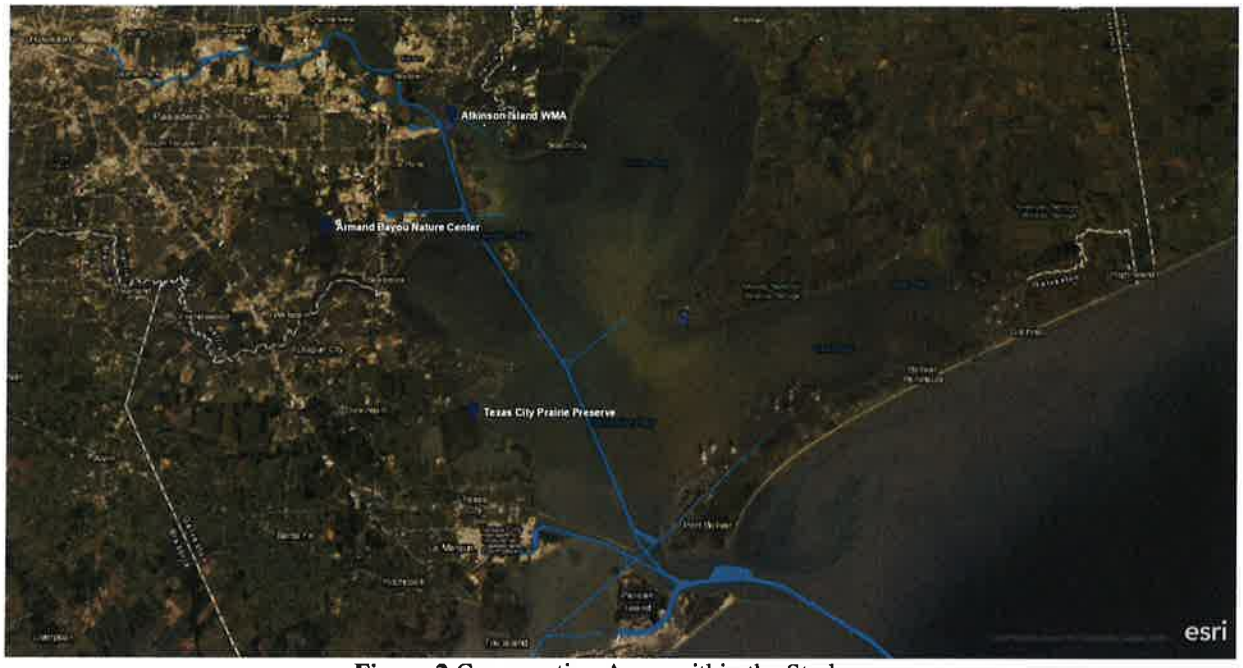

Figure 2 Conservation Areas within the Study area

Atkinson Island WMA
Donated by Conoco, Inc. as a wildlife preserve area, the 150-acre site lies adjacent to the HSC at the northern most portion of Atkinson Island. Originally created from dredge materials, the site is only accessible by boat and does not provide any amenities. The Wildlife Management Area (WMA) is a preserve comprised of 90 acres of brackish marsh, 40 acres of woodlot composed of mainly hackberry and yaupon, and the remaining 20 acres is a spoil site. Common wildlife found at the WMA include shore and wading birds, raccoons, and rattlesnakes and hunting is not permitted. Located less than a mile from the HSC, direct impacts to the WMA are unlikely. Indirect impacts from noise or air pollution and water quality should be evaluated during the PED phase as construction details become available.

Texas City Prairie Preserve
In 1993, The Nature Conservancy established the Texas City Prairie Preserve (Preserve), a 2,303-acres site, to restore and revitalize coastal habitats and preserve species that depend on it. Year-round populations of waterfowl, shorebirds, and wading birds make their way to the Preserve and use the Preserve's marsh complexes and open prairie habitats. Native prairie vegetation such as little bluestem, yellow indiangrass, switchgrass, eastern gammagrass, gulf cordgrass and the rare coastal gayfeather are cultivated here. Located five miles from the HSC, direct impacts to the Preserve appear unlikely. Indirect impacts from noise or air pollution and water quality should be evaluated during the PED phase as construction details become available.

Available Habitats

Wetlands
The major estuarine and palustrine habitats of Galveston Bay include salt, brackish, and fresh marshes, forested scrub-shrub, subtidal aquatic beds, intertidal flats, and estuarine open water

(White, Tremblay, & Wermund, Jr. , 1993). Coastal marsh habitat armors shorelines from erosion, filters pollutants, enhances water quality and promotes primary production (Mitsch & Gosselink, 1993). In general, coastal salt, brackish, and fresh marshes serve as nurseries for fish and shellfish and serve as buffer zones helping to slow and absorb storm surges that might otherwise do greater damage farther inland. Coastal marsh and wetland habitats within the project area are documented by the Service in the reports and letters listed in **Table 2**. Maintaining the economic values, fish and wildlife resources, and aesthetic qualities of the Texas Coast depends on re-establishing and restoring its wetlands. The Service continues to support creation and restoration efforts by the PHA, other state and federal natural resource agencies, non-governmental organizations, and the public. If the Corps is not able to avoid direct and indirect impacts to coastal marsh habitat because of the TSP, we recommend the Corps engage the Beneficial Use Group (BUG) to determine appropriate habitat impact modeling and restoration or mitigation site selection.

Fringe or estuarine wetlands are tidal in nature, extremely productive; occur along the edges of Galveston Bay. Prevalent flora of the estuarine and marine wetlands include smooth cordgrass, saltwort, saltgrass, and glasswort spp. Estuarine wetlands are valuable for commercial and recreational fishery species with most species completing all or part of all of its life cycle in this habitat. We encourage the Corps to avoid this habitat during construction activities to the greatest extent practicable. However, if the Corps determines avoidance is not possible, the Service recommends appropriate modeling and analysis with complete in-kind compensation to mitigate impacts to the existing functions and values of wetland habitat.

Freshwater wetlands are found in areas where rainfall runoff accumulates in relic depressions and stream channels. Closer to the coast, this wetland type can be found inland of salt or estuarine wetlands and intertidal swales (Dick & Hunt, 2012). These wetlands tend to have reduced salinities and are suitable for plants such as sedges, rushes, and coastal arrowhead. While many freshwater wetlands are found on the mainland within the project area, some of the dredge placement and disposal areas (filled placement areas not currently being used or upgraded) provide excellent freshwater emergent wetlands. Wetlands in general can provide valuable stop-over habitat for migrating species such as waterfowl, raptors, shorebirds, and should be avoided during construction activities. However, if the Corps deems that avoidance is not possible, the Service recommends mitigation for any impacts.

Coastal marsh habitats play an integral part of the life cycle of many commercially and recreationally important species of fish and wildlife. While no coastal marsh habitat is located within the immediate project area, there are thousands of acres of marsh lining the Gulf Galveston Bay most of which are in declining conditions. Marsh habitat deteriorates when the supply of sediment is interrupted, water levels increase, and subsidence occurs from increased periods of inundation, inhibiting plant growth resulting in marsh deterioration. Artificially supplying sediments to compensate for declining sedimentation or reestablishing natural elevation levels has the potential to help restore damaged marshes and provide a beneficial use of dredged material (Ray, 2007).

Bay Bottom

The open bay bottom habitat of Galveston Bay is the second largest habitat type in the bay made up of mostly soft rippling mud and silt not covered by oysters and vegetation. Over the years, the area of open bay bottom has increased mainly due to oyster removal and dredging activities. Biological decomposition, a major function for the breakdown of plant material, occurs in this habitat, where eventually it is re-suspended in the water column to provide food for fish and other wildlife species. The Service documents (**Table 2**, USFWS 1986, 1995, 2002, 2009, 2010, 2014, 2017) the negative impacts of channel deepening and widening to open bay bottom and the fish and wildlife found there. Direct physical impacts to bay bottom will almost always result from the disposal of dredged material. The deposition of millions of cubic yards of new work and maintenance materials may have the potential to: change circulation or erosion patterns; alter the water depth and bathymetry; alter chemical and biological characterizations of the site (salinity; temperature; substrate); modify benthic recolonization of the site; cause a decline in species richness; and reduce habitat complexity (loss of erect and sessile epifauna, smoothing of sedimentary bedforms, reduction of bottom roughness, and removal of taxa that produce structure). With the deposition of new dredge material, benthic and demersal species are buried; motility and migration abilities are diminished, and species become vulnerable to predation.

Some Service trust fish and wildlife resources (including threatened and endangered species) feed extensively on fishery resources within Galveston Bay. Activities that would degrade water quality, increase turbidity, increase sedimentation, or alter flows, temperature, or water depths could affect the biological productivity of this area. All species would be adversely affected by water pollution, such as chemical contamination (including food chain effects resulting from bioaccumulation), oil spills, excessive turbidity or sediment loading, non-point source run-off, waste disposal (including vessel wastes), and storm water runoff. The Service recognizes the importance of maintaining a high standard of water quality in Galveston Bay. Benefits to trust fish and wildlife resources combined with the economic significance of the shellfishery make water quality a top priority for the Service.

Fish and Wildlife Resources

The Service detailed the vast fish and wildlife resources within the Study area in previous Service documents list in **Table 2** (1986, 1995, 2002, 2009, 2010, 2010a, 2014, 2017) and will briefly describe them here. All previous Service recommendations related to fish and wildlife are still supported by the Service.

Essential Fish Habitat

While the majority of the construction will occur within shallow to deeper open water areas, we believe migratory or resident fish species will quickly move away from any dredging activities. However, dredging and open-bay disposal of dredge material can release toxicants promoting low mobility and will affect all eggs and larvae in the area. A suspended sediment plume can encourage visual predators, affect demersal eggs, produce sticky buoyant eggs, and affect gills particularly larvae with open mouths. Settlement of sediments potentially affect benthic spawners, herbivores, and demersal eggs. Noise caused by dredging can produce variable flight responses and affect swim bladders causing buoyancy control issues (Wenger, 2017).

The project is located within an area identified as Essential Fish Habitat (EFH) by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA, Magnuson-Stevens Act; P.L. 104-297). The updated and revised 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council, identifies EFH in the project area to be estuarine emergent wetlands, mangrove wetlands, mud, sand, shell, and rock substrates, and estuarine water column. Under the MSFCMA, wetlands and associated estuarine waters in the project area are identified as EFH for federally managed species including various life stages of brown shrimp, white shrimp, red drum, gray snapper, lane snapper, red snapper, gray triggerfish, almaco jack, greater amberjack, king mackerel, and cobia. NMFS has also identified the project area as EFH for shark species including Atlantic sharpnose, bonnethead, bull, blacktip, finetooth, scalloped hammerhead, and spinner. The 2017 Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan should be consulted for additional information on habitats identified as shark EFH (https://www.federalregister.gov/documents/2017/09/07/2017-18961/atlantic-highly-migratory-species-essential-fish-habitat).

Water bodies and wetlands in the project area provide nursery and foraging habitats for a variety of economically important marine fishery species, such as striped mullet, Atlantic croaker, gulf menhaden, spotted seatrout, sand seatrout, southern flounder, black drum, and blue crab. Some of these species are prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by NMFS (e.g., billfishes and sharks).

As the primary type of EFH in Galveston Bay, estuarine marsh continues to be degraded and lost in part due to storm events, sea level rise, and deterioration from wind and wave action. Although an increase in some types of EFH (i.e., mud bottom and estuarine water column) would occur as a result of wetland loss and conversion to open water, an inverse but equal adverse impact would occur to more productive types of EFH (i.e., estuarine emergent wetlands). The loss of estuarine emergent wetlands would result in negative impacts to these federally managed species. We recommend the Corps reinitiate coordination with both offices for further guidance.

Threatened and Endangered Species

Federally listed threatened (T) and endangered (E) species and/or their designated critical habitat potentially occurring in the study area include the West Indian manatee (T), the piping plover (T) and its designated critical habitat, and the red knot (T). Several species of threatened/endangered sea turtles are also known to nest and/or forage in the coastal waters of the study area. Those species include the loggerhead sea turtle (T), Kemp's ridley sea turtle (E), green sea turtle (T), leatherback sea turtle (E), and hawksbill sea turtle (E). Additionally, the saltmarsh topminnow, diamond backed terrapin, and the black rail, all at risk species, may exist in the project area and are discussed in greater detail below. For the purposes of a conservation strategy, the Service's Southwest Region has defined "at-risk species" as those that are; proposed for listing as threatened or endangered under the Act; a candidate for listing, or; it has been petitioned by a third party for listing. The Service's goal is to work with private and public entities on proactive conservation to conserve these species thereby precluding the need to federally list as many at-risk species as possible.

According to Section 7(a)(2) of the Act and the implementing regulations, it is the responsibility of each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any federally listed species. Based upon an inventory of listed species and other current information, the federal action agency determines if any endangered or threatened species may be affected by the proposed action. The Service's Consultation Handbook (http://endangered.fws.gov/consultations/s7hndbk/s7hndbk.htm) is available online for further information on definitions and process.

The Service recommends the Corps conduct a review for threatened and endangered species two years prior to construction. In order to obtain information regarding fish and wildlife resources concerning a specific project or project area, we recommend the Corps first utilize the Service developed Information, Planning, and Conservation (IPaC) System. The IPaC system is designed for easy public access to information about the natural resources for which the Service has trust or regulatory responsibility such as threatened and endangered species, migratory birds, National Refuge lands, and the National Wetland Index. One of the primary goals of the IPaC system is to provide this information in a manner that assists project proponents in planning their activities within the context of natural resource conservation. The IPaC system can assist users with the various regulatory consultation, permitting, and approval processes administered by the Service, helping achieve more effective and efficient results for both the project proponents and natural resources. The IPaC system can be found at https://ecos.fws.gov/ipac/.

Piping Plover

The piping plover, federally listed as a threatened species, is a small (7 inches long), pale, sand-colored shorebird that winters in coastal Texas and may be present for 8 to 10 months annually. Piping plovers arrive from their northern breeding grounds as early as late July and remain until late March or April. They feed on polychaete marine worms, various crustaceans, insects and their larvae, and bivalve mollusks that they peck from the top of or just beneath the sand. Piping plovers forage on intertidal beaches, mudflats, sand flats, algal flats, and wash-over passes with no or very sparse emergent vegetation. Piping plovers roost in unvegetated or sparsely vegetated areas, which may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. They also forage and roost in wrack (i.e., seaweed or other marine vegetation) deposited on beaches. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependent on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

Critical habitat units for the piping plover, outlined in orange, are designated within the Study area (**Figures 3 and 4**). Of importance, Critical Habitat Units TX-35 (Big Reef) and TX-36 (Bolivar Flats) lie on either side of the HSC. When evaluating the effects of the TSP for Section 7 purposes, we recommend the Corps consider cumulative and indirect effects in addition to effects from direct dredging on critical habitat. Complete avoidance of these areas during construction of the TSP measures are recommended; however, if the Corps deems it necessary to affect critical habitat, consultation procedures pursuant to Section 7 of the Act should be initiated with our office. The Texas Coastal Ecological Office can be reached at 281-286-8282.

Figure 3 Piping plover critical habitat

Figure 4 TX-35 and TX-36

Red Knot

The red knot, federally listed as a threatened species, is a medium-sized shorebird about 9 to 11 inches in length with a proportionately small head, small eyes, short neck, and short legs. The black bill tapers steadily from a relatively thick base to a relatively fine tip; bill length is not much longer than head length. Legs are typically dark gray to black, but sometimes greenish in juveniles or older birds in non-breeding plumage. Non-breeding plumage is dusky gray above and whitish below. The red knot breeds in the central Canadian arctic but is found in Texas during spring and fall migrations and the winter months (generally September through May). Critical habitat for the Red knot has not been designated.

During migration and on their wintering grounds, red knots forage along sandy beaches, tidal mudflats, salt marshes, and peat banks. Observations along the Texas coast indicate that red knots forage on beaches, oyster reefs, and exposed bay bottoms, and they roost on high sand flats, reefs, and other sites protected from high tides. In wintering and migration habitats, red knots commonly forage on bivalves, gastropods, and crustaceans. Coquina clams, a frequent and often important food resource for red knots, are common along many gulf beaches. Major threats to this species along the Gulf of Mexico include the loss and degradation of habitat due to erosion, shoreline stabilization, and development; disturbance by humans and pets; and predation.

West Indian Manatee

West Indian manatees occurring west of Florida and to the north of Mexico are generally considered to be strays originating from populations in either Florida or Mexico (Domning, 1986). Although more frequent than first thought, Fertl et al., (2005) notes that traveling manatees use warm-water refuges along their migratory routes during both the early spring and late fall. Federally listed as threatened, the West Indian manatee migrates through Galveston Bay and its associated coastal waters, boat basins, and power plant effluents. Infrequently reported because of their secretive nature, manatees do journey along the upper Texas coastal areas while the average water temperature is warm. Based on data maintained by the Texas Marine Mammal Stranding Network, over 80 percent of reported manatee sightings (1999-2017) in Texas have occurred from the months of June through November with the majority occurring in October and November (Whitehead, 2018). Most sightings are single individuals; however, rare sightings of calf/cow pairs have occurred between June and December. Reported manatee occurrences in Texas appear to be increasing as populations from Mexico and Florida make their way along coastal shorelines including canals and coastal marshes of Galveston Bay. Most recently, reported on the north side of the Texas City Dike on July 30, 2019, a single manatee was confirmed and remained in the area for about 12 hours (**Figure** 5). Cold weather and outbreaks of red tide may adversely affect these animals. However, human activity is the primary cause for declines in species numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution.

Figure 5 Texas City manatee sighting July 30, 2019
Source: Texas Marine Mammal Stranding Network (2019)

All on-site personnel are responsible for observing water-related activities for the presence of manatee(s). We recommend the following conservation measures to minimize impacts to manatees in areas of their potential presence:

- All work, equipment, and vessel operation should cease if a manatee is spotted within a 50-foot radius (buffer zone) of the active work area. Once the manatee has left the buffer zone on its own accord (manatees must not be herded or harassed into leaving), or after 30 minutes have passed without additional sightings of manatee(s) in the buffer zone, in-water work can resume under careful observation for manatee(s).

- If a manatee(s) is sighted in or near the project area, all vessels associated with the project should operate at "no wake/idle" speeds within the construction area and at all times while in waters where the draft of the vessel provides less than a four-foot clearance from the bottom. Vessels should follow routes of deep water whenever possible.

• If used, siltation or turbidity barriers should be properly secured, made of material in which manatees cannot become entangled, and be monitored to avoid manatee entrapment or impeding their movement.

• Temporary signs concerning manatees should be posted prior to and during all in-water project activities and removed upon completion. Each vessel involved in construction activities should display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign at least 8½ "X 11" reading language similar to the following: "CAUTION BOATERS: MANATEE AREA/ IDLE SPEED IS REQUIRED IN CONSRUCTION AREA AND WHERE THERE IS LESS THAN FOUR FOOT BOTTOM CLEARANCE WHEN MANATEE IS PRESENT". A second temporary sign measuring 8½ " X 11" should be posted at a location prominently visible to all personnel engaged in water-related activities and should read language similar to the following: "CAUTION: MANATEE AREA/ EQUIPMENT MUST BE SHUTDOWN IMMEDIATELY IF A MANATEE COMES WITHIN 50 FEET OF OPERATION".

• Collisions with, injury to, or sightings of manatees should be immediately reported to the Service's Texas Coastal Ecological Services Office (281/286-8282). Please provide the nature of the call (i.e., report of an incident, manatee sighting, etc.); time of incident/sighting; and the approximate location, including the latitude and longitude coordinates, if possible.

Sea Turtles

There are five species of federally listed threatened or endangered sea turtles that nest and/or forage in the near shore waters, bays, and estuaries of Texas. The September 18, 2015 Memorandum of Understanding (U.S. Fish and Wildlife Service, 2015) between the Service and the NMFS acknowledges the joint administration of marine sea turtles whereby NMFS has sole jurisdiction of sea turtles when in a marine environment and the Service shall have sole jurisdiction over sea turtles when on land. Please contact Kelly Shotts (727-824-5312) at the NMFS Regional Office in St. Petersburg, Florida, for information concerning those species in the marine environment.

When sea turtles leave the marine environment and come onshore to nest, the Service is responsible for those species. Three species, the loggerhead sea turtle (T), the green sea turtle (E), and the Kemp's ridley (E) nest in Texas during the summer months (i.e., May through November). Nesting records from the National Park Service Padre Island National Seashore in 2018 indicate 250 Kemps ridley, six loggerhead, and five green sea turtles nested along Texas beaches. Within the project area, four Kemp's ridley nests were found on Galveston Island and three on Bolivar Peninsula were found during the 2019-nesting season (National Park Service, 2019); thus, nesting attempts could increase within the project area as species populations increase and habitat remains suitable. The primary threats to nesting beaches include coastal development and construction, placement of erosion control structures and other barriers to nesting, beachfront lighting, vehicular and pedestrian traffic, sand extraction, beach erosion, beach nourishment, beach pollution, removal of native vegetation, and planting of non-native vegetation (USFWS 2007).

Migratory Birds

The Service is the principal federal agency with the oversight for all species (16 U.S.C. 703-712) protected under the MBTA (50 CFR 10.13). The Gulf Coast of Texas lies within the Central Flyway, a critically important conservation area that sustains the millions of migratory birds that seasonally move along the Texas coast. Tens of millions of individuals of at least 300 species of migratory birds funnel through the Texas coast. They rest, and replenish fat reserves throughout coastal Texas as they move between temperate breeding areas in North America and wintering areas in Central and South America. Of these migratory species, many are also designated as conservation priorities due to declining, threatened, or otherwise vulnerable populations. These priorities are generated by federal and state natural resource agencies and international bird conservation initiatives such as Partners in Flight.

The Service's list of Birds of Conservation Concern (BCC) includes species of migratory birds of high conservation priority at national, regional, and eco-regional scales. Species identified on these lists are considered vulnerable and are among the highest bird conservation priorities for the Service and our partners. Many of these species are experiencing widespread declines and could potentially become candidates for federal listing under the ESA in the future. Therefore, it is particularly important to fully consider impacts to BCC species when assessing short-term and cumulative effects of projects that can reasonably be expected to influence habitats, behaviors, and demographics of these species. The proposed project area lies within Bird Conservation Region 37 – Gulf Coastal Prairie (U.S. portion only). The BCC list for this Bird Conservation Region includes 44 species (USFWS 2008, https://www.fws.gov/migratorybirds/pdf/management/BCC2008.pdf). In addition to BCC lists maintained by the Service, TPWD maintains lists of state listed species (http://tpwd.texas.gov/huntwild/wild/wildlife_diversity/nongame/listed-species/birds.phtml) and rare species by county (http://tpwd.texas.gov/gis/rtest/).

Colonial nesting waterbirds and/or seabirds commonly inhabit the dredge spoil and natural islands, and where suitable habitat are located on mainlands. Islands typically provide a boundary to most predators; however, mammals such as coyotes and raccoons are known to swim to nearby islands. Islands located greater than a mile from any shoreline are more likely to have minimal predator interference and greater fledging success. Colonies may be present within the study area that are not currently listed in the database maintained by the Texas Colonial Waterbird Society (TCWBS). The database is updated primarily by monitoring previously known colony sites; however, new sites are added as new colonies are located. Although several comprehensive coast-wide surveys have been recently conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season because some waterbird colonies may change locations year-to-year.

The construction of bird islands using new work dredged material is documented, but it was not until the 1970s that the importance of this dredged material to nesting waterbirds was realized (Golder, Allen, Cameron, & Wilder, 2008). Dredge spoil islands created out of local sand and clay provide immediate nesting opportunities for bare ground nesters such as terns and skimmers. Successional vegetation including grasses, mangroves, baccharis, and other shrub species provide suitable nesting habitat for three species of egrets, five species of herons, white

ibis, pelicans, and rosette spoonbills. The Service supports the creation of new waterbird habitats and management of active colonial waterbird islands in Galveston Bay. Both will positively contribute to the larger Gulf of Mexico colonial waterbird populations.

In general, natural and dredge spoil islands host nesting colonies for most North American seabirds (Golder, Allen, Cameron, & Wilder, 2008). The Service has identified 32 colonial waterbird colonies (**Table 3**) located within the greater Galveston and West Bay areas. Of the 32 colonies, 20 are inactive or no longer available for nesting due to development, erosion, subsidence, or changes in habitat (lack of suitable vegetation or bare ground, presence of predators etc.). Island denoted by an asterisk (*) are active nesting colonies. The Service defines the breeding season for colonial waterbirds as February 1 to September 1; however, this can vary from colony to colony. A thorough survey of the project area should be completed two weeks prior to construction initiation to confirm presence of nesting sites, nestling stages, and predict fledge dates.

Table 3 HSC ECIP Study Area Colonial Waterbird Nesting Colonies

Colony	Colony Code
San Jacinto Marsh	600-167
San Jacinto Monument	600-165
Goat Island	600-162
*St. Mary's Island	600-166
Alexander Island	600-161
Baytown Tunnel	600-160
Exxon Baytown North	600-163
Atkinson Island	600-181
Midbay Island	600-553
Redfish Island	600-240
*Smith Point Island	600-261
Vingt-Et-Un Island	600-260
Vingt-Et-Un Island New Shell Island	600-263
Hanna Reef	600-360
*HCNC Evia Island	600-551
*HGNC Bolivar Marsh	600-550
Port Bolivar	600-441
Big Reef	600-460
Fort San Jacinto	600-444
Little Pelican Island	600-442
Texas City Dike	600-440
Swan Lake	600-420
Monsanto	600-342
Moses Lake Spoil	600-340
*Dickenson Bay Spoil	600-341
*New Island	
Tiki Island	600-421
*Marker 52 Spoil Island	600-422
*South Deer Island	600-426
*North Deer Island	600-425
*Jigsaw Island	600-423
*Struvylucy	600-451

Approximately 25 species of colonial-nesting waterbirds (gulls, terns, herons, egrets, pelicans, spoonbills, and skimmers) occur in the Galveston Bay estuary, feeding in wetland and bay areas and nesting February through September primarily on seven large nesting islands: Evia, St. Mary's, North Deer, South Deer, Marker 52 Spoil Island, Jigsaw, Dickinson Bay Bird Island, and an unnamed island. While some individual species show yearly increases in numbers of breeding pairs, the average number of total breeding pairs (189,848) (Society, 2019) for Galveston Bay area indicate a downward trend for the last 10 years (2009-2018) of data. Of the 10 active islands within the general Galveston Bay area, two (St. Mary's and New Island) lie within a third of a mile of the HSC and the most productive island (Evia) lies 3.77 miles from the

HSC. St. Mary's Island, lies between Goat and Alexander Islands, is a privately owned dredge island with a protected perimeter and counted since 2002. Evia, is an eight-acre dredge spoil island with a beach, supports an average of 20,700 pairs of nesting colonial waterbirds annually and is the most diverse (13 species) and productive island in Galveston Bay. Designed by the BUG, constructed in 2001 as part of a previous HSC deepening and widening effort and with side slopes protected by rock, Evia lies north of Bolivar Peninsula approximately one mile. Evia and St. Mary's Islands are the largest contributors to the greater Galveston Bay colonial waterbird populations; however, West Bay colonies support six islands with strong nesting pair numbers demonstrating that Galveston Bay is extremely important on the local and regional biological landscapes.

Actions to eradicate predators have prevented extinction of vulnerable bird populations. On most HSC dredge spoil islands, invasive predators (raccoons, snakes, and coyotes) depredate nests posing as a severe threat to nesting bird populations due to a lack of management. Ground nesting species are often thought to be the most vulnerable to predation; however, Cote and Sutherland (1995) found no difference in the rates of nest predation of ground nesting versus other bird species. Local natural resource agencies, non-governmental organizations, and the TCWBS generally recommend comprehensive management for islands overrun by invasive species, including those within greater Galveston Bay. Predator trapping and construction of exclusionary fencing are strategies commonly employed to manage predators. Cote and Sutherland (1997) and Smith et al. (2010) concluded that predator removal can produce significant increases in breeding population numbers and increase hatchling and fledging success. While beneficial for enhancing bird populations, predator removal requires consistency and a long-term commitment to manage the site.

The Service's HSC PAL (2017) documented important conservation areas within the larger project landscape. Of equal importance but neglected to be mentioned in that document, Bolivar Flats (1,100 acres), owned and administered by Houston Audubon Society, is an extremely important stop-over site for migrating shorebirds, wading birds, and other bird species. Similar to Anahuac National Wildlife Refuge, Bolivar Flats is designated as a Western Hemisphere Shorebird Reserve Network Site of International Importance; hosting greater than 100,000 shorebirds and at least 10% of some species' global populations. At least 25 species of shorebirds including many of conservation concern are found at Bolivar Flats, and the area is a critically important site for the federally listed piping plover and for the snowy plover, a species of special conservation concern (www.whsrn.org/site-profile/bolivar-flats). While bird species that use Bolivar Flats typically specialize on beach and mudflat habitats, many may travel outside of the area to forage in nearby flooded agricultural fields such as those that are available within the project area. A large portion of the passage of birds to and from this site, especially during migration, likely occurs through the project area.

Colonial waterbird colonies may relocate to adjacent areas due to resource availability. Listed and known colonies in the TCWBS should be verified and new surveys conducted prior to construction to identify any new colonies within the project area. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. Brown pelicans are known to nest on barrier islands and other coastal islands in Galveston and Harris counties. For colonies containing nesting brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31).

2. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present).

3. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, exact dates may vary within this window depending on species present).

The Service recommends a qualified biologist conduct surveys prior to construction to: determine the presence and/or location of eagle's nests; colonial nesting wading/water birds and/or rookeries; or other nesting migratory birds; and determine if nesting prevention measures would be necessary. Nest prevention measures are intended to deter birds from nesting within construction areas without physically harming birds or disturbing any existing nests. Nest prevention measures may be used in combination and may be adjusted to improve effectiveness. Standard deterrent measures may include, but are not be limited to the following:

- Flagging/Streamers
- Vehicular/Pedestrian Traffic
- Clapping and Yelling
- Horn Blowing

Close coordination with the Service is recommended prior to deploying any nest prevention measures, to determine if permitting is necessary, and avoiding any negative impacts to migratory birds.

At Risk Species

Restored saline marsh and nourished barrier shoreline are proactive conservation strategies that may benefit habitat used by several at risk species including reddish egret, snowy plover, saltmarsh topminnow, diamond backed terrapin, and black rail.

Reddish Egret

The reddish egret nests in mixed species colonies amidst shrubby vegetation and is generally restricted to sandy beaches or shallow ponds near the coast or on barrier islands when feeding. During nesting season, the greatest concentration of reddish egrets lies on islands in mid to south Texas; however, fewer pairs are scattered across the coastal Texas landscape. The reddish egret is threatened by coastal land loss, decreases in the quantity of suitable habitat, human disturbance resulting in nest abandonment, beach development (especially in Florida), and entanglement in

fishing nets and lines. Reddish egrets are known to nest on Evia Island and islands located in West Galveston Bay and may be encountered within the immediate project area.

Snowy Plover

The snowy plover nests in loose colonies on open beaches. Winter habitat consists of mostly dry sandy or shell beaches, above the high tide mark and along the coast or on barrier islands. They eat a variety of invertebrates including crustaceans, worms, and insects. In Texas, the species is a relatively rare migrant and winter resident along the coast. Threats include trampling of eggs and nests by humans, vehicles, entanglement in discarded fishing line, habitat degradation, or abandonment because of the expansion of beachfront development and recreation, habitat loss due to coastal land loss and erosion. There are a handful of known snowy plover occurrences in upper Galveston and Trinity Bays; however, the majority of occurrences lie south of Moses Lake at the Texas City Dike and along Galveston Island and Bolivar Peninsula at Bolivar Flats. Snowy plovers are known to nest on East Beach (Galveston Island) and on Bolivar Peninsula and would only be encountered on Gulf beaches.

Saltmarsh Topminnow

The saltmarsh topminnow is a small (approx. 1-2 inches), coastal fish, considered a resident species of coastal marsh, and closely related to other killifish species such as the Gulf killifish. It occurs sporadically in low-salinity smooth cordgrass or black rush marshes from Galveston Bay, Texas to Escambia Bay, Florida (Lopez et al. 2011); however, historic occurrences expand the range to Aransas Bay. For Texas, the species is most likely to occur in the coastal counties of Jefferson, Galveston, Brazoria, Matagorda, Calhoun, and Aransas.

This species is typically found in coastal salt marsh habitats characterized by smooth cordgrass. Numerous studies indicate that the species is most abundant in low-salinity salt marsh ecosystems that range from 0 ppt to 31.4 ppt. Small rivulets are important for access to interior marsh areas. Threats include loss of coastal salt marsh habitat from natural causes (e.g., storms) and human activities (e.g., development). The saltmarsh topminnow may be encountered within the project area.

Diamond backed terrapin

The diamond backed terrapins are turtles with concentric, diamond-shaped markings and grooves on the scutes of the carapace which range from medium gray or brown to nearly black with no two individual diamond terrapins exactly alike in coloration and pattern. Adult males reach of shell length of 5.5 inches while females are considerable larger with shell lengths up to 11 inches. Diamond backed terrapins are restricted to saline or brackish habitats, estuaries, and tidal creeks along the U.S, Atlantic and Gulf coasts from Cape Cod, Mass. To Corpus Christi, Texas. They favor seagrass beds, marshes, and estuaries (especially those bordered by mangroves) and more open channels to the "grassy" flats. One of seven subspecies, the Texas diamondback terrapin occurs in marshes, tidal creeks, and embayments from western Louisiana throughout much of Texas. In Texas, barrier island marshes and seagrass beds on the bayside of the islands are important areas for the species. Like all turtles, terrapins nest on land and in most states, terrapins seem to prefer sandy, non-vegetated areas for nesting although they are limited by the available habitat and substrate type. Nesting occurs above the normal high tide line, although above normal rainfall or tides may result in the inundation of normally exposed nesting sites.

Shell hash is the principal nesting substrate documented across most of the Texas' coast for this species. Diamondback terrapin populations have declined considerably in many parts of their geographic range and in some states are federally and state listed.

Threats to the species include poor water quality (pollution), human disturbance on nesting areas, loss of population in derelict crab traps, habitat altered or lost by dredging and siltation, coastal land loss of nesting beaches and saline marsh. Diamondback terrapins may be encountered openly swimming in Galveston Bay while nesting will only occur on shell hash island beaches with adjacent marsh habitat most likely in West Galveston Bay.

Black rail

On October 9, 2018, the Service proposed to list the eastern black rail be listed as "threatened" under the Act (83 FR 50610 50630). The Service is also proposing a special rule under Section 4(d) of the Act that would tailor protections for the bird. If finalized, this 4(d) rule would exempt certain activities from the take prohibitions of the Act. The eastern black rail is a wetland dependent species that favors coastal settings. It is found in a variety of salt, brackish, and freshwater marsh habitats that can be tidally or non-tidally influenced. Within these habitats, the birds occupy relatively high elevations along heavily vegetated wetland gradients, with soils that are moist or flooded to a shallow depth. The eastern black rail requires dense vegetation cover that allows movement underneath the canopy. Plant structure is considered more important than plant species composition in predicting habitat suitability. Occupied habitat tends to be primarily composed of fine-stemmed emergent plants (rushes, grasses, and sedges) with high stem densities and dense canopy cover. However, when shrub densities become too high, the habitat becomes less suitable for the eastern black rail. The black rail is not found in areas with woody vegetation. Soils are moist to saturated (occasionally dry) and interspersed with or adjacent to very shallow water (1 to 6 centimeters). (83 Federal Register 50610). While it is possible to encounter the black rail within the study area, it seems unlikely if avoidance of wetlands remains a goal of the project.

Oysters

Eastern oysters are natural components of estuaries along the Gulf of Mexico and mostly tend toward forming reefs. These reef structures accrete shell material via recruitment and growth, which is in turn degraded at varying rates (Powell, 2006 and Powell and Klinck, 2007). Because larvae produced from nearshore oysters settle and grow in subtidal areas, the permanent loss of nearshore oysters and the reefs they form can disrupt the regional larvae pool and contribute to the lack of recovery via oyster recruitment ((National Oceanic and Atmospheric Administration, 2019). Additionally, extended periods of failure of any part of the reproductive cycle can lead to sedimentation of existing reefs, causing the removal of substrate for settlement further reducing oyster cover over time. Oysters also provide habitat for commercial fisheries species (Grabowski et al., 2007). The loss of oyster reefs means more than just the loss of an important commodity. It can also cause decline in habitat for sustaining other commercially important species and species important to ecosystem stability (Beck et al., 2011).

The Service and others have extensively documented Galveston Bay oyster habitat with respect to the HSC. The Service remains committed to supporting avoidance of oyster habitat where practicable and oyster reef creation or restoration if impacts are deemed inevitable.

Future Fish and Wildlife Concerns

Fish and wildlife resource concerns in the study area include ecosystem-wide hydrologic alterations associated with construction of major navigation channels within the study area, sea level rise, shoreline retreat, the continued loss or transition of coastal wetlands, creation and restoration of oyster reef, and loss of beach habitat. Additionally, the Service remains concerned over water-quality degradation from agricultural and urban run-off, and industrial discharges into Galveston Bay.

Dahl (2012) claims estuarine wetlands have been lost a rate of about 14,000 acres per year nationwide where the main causes were hurricanes interacting with rising sea level and man-made channels. Tidal wetlands once recovered quickly following hurricane damage due to reduced supplies of replacement sediments and salt water intrusion by way of dredge channels (Gossalink et al. 1998). However, locally, Galveston Bay lost 30,000 acres of freshwater and saltwater wetlands from 1953 to 1989 (White, et. al. 1993). Much of the loss is attributed to development, wave action, subsidence, eustatic sea level rise, and insufficient sediment supply. Constructed dams upstream resulting in diminished sediment supplies from the Trinity and Mississippi Rivers may be a factor in Galveston Bay marsh loss (Ravens et al, 2009). Yet, in areas where wave fetch is notably, the issue and protective measures are not in place, wetland loss can be significant. We expect future wetland losses to be attributed to wave action, subsidence, saltwater intrusion, eustatic sea level rise, and insufficient sediment supply. Sediments supplies are notably deficient along the upper Texas coast mainly due to ship channel dredging, damned upstream rivers, and the presence of jetty structures. We do not expect sediment supplies to improve in this area of the coast in the future. The lack of sediments increases in salinity, and higher water levels can vastly change the landscape. These changes may lead to significant declines in coastal fish and shellfish production, which in turn can limit carrying capacity for wading and migratory bird usage, decrease available nesting, and forage habitats for migratory waterfowl, decrease apex predators such as the alligator, and limit usage by furbearers and game mammals possibly affecting local economic growth.

In general, increases in salinity levels, water levels, and duration of high tides in some areas are linked to deepening and widening efforts of deep draft channels (U.S. Fish and Wildlife Service, 2010). Those hydrologic changes can result in rapid conversion of shoreline and interior low-salinity wetlands to open water and brackish wetlands. Once those changes occur, rates of loss decrease as the most vulnerable areas have become open water. Further, saltwater intrusion continues to impact sensitive low-salinity wetland areas during drought-induced high salinity periods. Changes to wetland habitats may stress fish and wildlife leading to decreased breeding productivity, limitations on sheltering and foraging, increased predation opportunities, contributing to potential habitat abandonment. Habitat quantity will increase for species such as brown shrimp, spotted seatrout, and black drum, which prefer brackish and saline conditions. However, continued degradation of those brackish and saline marshes may reduce production of those fish and shellfish as lifecycles for many fish and shellfish are dependent upon shallow estuarine marsh complexes.

There are water quality problems in the upper Galveston Bay estuary from industrial discharges that contaminated the upper basin marshes and water bottoms with dioxins, polychlorinated biphenyls, and heavy metals. Aquatic resources and migratory birds are particularly vulnerable

to contaminants. Continued efforts to improve water quality by industry and area residents are highly desirable actions. Should non-structural protection measures occur in those environments, contaminants might be re-suspended and distributed to other portions of the aquatic ecosystem. Strict adherence to a robust list of best management practices (BMPs) will help avoid and offset undesirable impacts to trust species from contaminants. Bivalves are regularly used as biomonitors of contaminants in coastal and estuarine waters. Considered as filter feeders, oyster and can take up toxic microalgae directly from the water column then store and accumulate toxins as they continue to feed becoming harmful to consumers once ingested.

Oyster reef habitat provides essential aquatic ecosystem services for fish, shellfish, and birds, improved water quality, reduce shoreline erosion, buffer storm waves, and contributes millions annually to the Texas economy as a commercial fishery. Galveston Bay oyster beds are sensitive to changes in salinity (either too much fresh water caused by flooding events lowering salinity or by prolonged drought conditions raising salinity), contamination by toxic chemical spills, and the redistribution of sediments by large storm events. While pulses of fresh or saline conditions are usually tolerated, inundation of one condition or another can be detrimental. Recent examples of sever ecosystem fluctuations include sediment deposits from Hurricane Ike in 2008 which covered nearly 60% of the oyster reefs in East Galveston Bay (Rohrer, et al., 2010). Unfortunately, several years of drought conditions followed Hurricane Ike disrupting the flow of nutrients to the oysters further crippling the reefs. Then, three consecutive years of flood events (2015-2017) flushed the saline bay waters. Hurricane Harvey (2017) dumped more than 51 inches of rain on the Houston area flooding Galveston Bay with fresh water lowering salinities to lethal levels killing almost 80% (Knapp, 2017) of the oyster population.

The western shoreline of Galveston Bay has substantial development with only spotty fringe emergent tidal wetlands remaining. Indirect effects to wetlands from increased wave fetch, intensity, and duration located along the eastern portions of Galveston Bay are possible. Ship simulation modeling efforts are ongoing with results expected during the PED phase of the study. Should the data indicate indirect impacts from increased ship wakes, the Service recommends in-kind mitigation for wetlands within the watershed.

Developed lands within the Study area limit terrestrial use to that of highly adapted urban wildlife. Foreseeable actions include additional industrialization along the main HSC and side channels where limited wildlife habitat is available. Existing parks and natural areas within the Study area are not expected to be directly affected by implementing the TSP. However, shoreline protection measures are recommended at all natural areas located on Galveston Bay due to potentially increasing wave fetch, winds, and sea level rise.

The PHA has been cooperative in mitigating wetland losses resulting from past deepening and widening efforts by creating over 4,000 acres of intertidal marsh adjacent to the HSC through the beneficial use of dredge material. When designed and constructed with ample circulation, elevation, and protection, created marsh can provide the life requisites necessary to support shellfish, finfish, reptiles, avian, and terrestrial mammalian wildlife. The Service however, remains concerned regarding the cumulative loss of coastal wetlands, oyster reef, prairie, shoreline, and interior forested habitat within the Galveston Bay study area. Additionally, shoreline and interior forests that once provided important stopover habitats for neotropical

migrants, have suffered extensive losses due to development, sea level rise, and subsidence.

Future fish and wildlife resource conditions may vary greatly from current conditions based on the Corps' and the Texas General Land Office's (TxGLO) proposal to construct storm surge gates across the mouth of Galveston Bay restricting tidal exchange by as much as 30%. Corps' modeling of various gate structure scenarios predict changes in salinities, tidal amplitudes, vegetation, and marsh loss. The Service remains engaged in both studies and will continue to coordinate with the Corps to minimize future fish and wildlife impacts.

Description of Alternatives and Recommended Plan

The Corps identified nine alternatives including the No Action Alternative as part of their analysis. An engineering and environmental evaluation was conducted during the feasibility-level design and analysis phase to determine the plan with the greatest net benefits to be identified as the NED and adopted as the TSP. If another plan is recommended instead of the NED Plan, such as a locally preferred plan (LPP), the NED is still presented as a basis of comparison.

The Corps selected Alternative 8 as the NED since it provides the highest net benefits (economic and environmental considerations) of all the alternatives considered and best meets the study objectives. PHA desires two-way traffic throughout the Bay from Bolivar Roads to BCC. While the NED plan provides opportunity for meeting and passing between Bolivar Roads and Redfish; the additional increments of widening (Redfish-BSC and BSC-BCC) of the desired LPP would allow two-way traffic of the design vessel up to BCC. The PHA decided to move forward with the LPP and subsequently provided the Corps with a letter of support dated May 31, 2019. If the PHA prefers a plan more costly than the NED plan, the Corps may grant a waiver from the requirement to recommend the NED Plan as long as the sponsor agrees to pay the difference in cost between the NED Plan and the LPP. **Table 4** describes the differences between the components of the NED and the LPP (LPP highlighted in italics). If granted, the Corps will adopt the LPP as the Recommended Plan for TSP.

Table 4 NED Plan and the LPP for the HSC ECIP

Segment 1 – Bolivar Roads to Boggy Bayou

- Widen 11 miles of lower bay channel from 530 feet to 700 feet (Bolivar Roads to Redfish Reef) with associated barge lane relocations
- *Widen approximately 10 miles of channel from 530 feet to 700 feet (Redfish Reef to Bayport Ship Channel) with associated barge lane relocations.*
- *Widen approximately 5 miles of channel from 530 feet to 700 feet (Bayport Ship Channel to Barbours Cut Channel) with associated barge lane relocations.*
- Bend easing in four locations with associated barge lane relocations

Segment 2 – Bayport Ship Channel

- BSC flare expansion
- Widen BSC from existing 300-400 feet to 455 feet

Segment 3 – Barbours Cut Channel

- BCC combined flare and turning basin
- Widen BCC from existing 300 feet to 455 feet

Segment 4 – Boggy Bayou to Sims Bayou

- Deepen HSC from Boggy Bayou to Hunting Turning Basin from the existing 41.5-foot depth up to 46.5 feet
- Widen HSC from Boggy Bayou to Greens Bayou from the existing 400-foot wide channel up to 530 feet
- Improvements to Hunting Turning Basin

Segment 5 – Sims Bayou to the I-610 Bridge

- Deepen HSC from Sims Bayou to I-610 Bridge from the existing 37.5-foot depth up to 41.5 feet

Segment 6 – I-610 Bridge to Main Turning Basin

- Deepen HSC from I-610 Bridge to Main Turning Basin from existing 37.5-foot depth up to 41.5 feet deep
- Improvements to Brady Island Turning Basin

Impact Analysis

General Concerns

The Service has reviewed all Corps supplied documents and Service files relevant to the HSC ECIP and the identified LPP measures. Typically, the deepening and widening of ship channels promotes expansion of port facilities, enables larger ocean-going vessels with expanded cargo capacity, and leads to increases in volume of vessels entering the port, revenue, and new jobs. The Port Of Houston has one of the largest concentrations of petroleum refineries, petrochemical companies, and storage structures in the nation. Continued development will likely result in additional industrialization increasing the possibility of spills thus posing potential harm to Galveston Bay ecosystems. We understand the project footprint has not been finalized and staging and construction areas are not fully identified at this time. Due to the highly industrialized nature of the project area, we recommend that all construction and staging areas be limited to right-of-ways or previously impacted areas to avoid and minimize impacts to terrestrial wildlife species.

Review of Service and other federal and state natural resource agency publically available data suggests the aquatic environment within the immediate project area supports fish species of both commercial and recreation importance. Dredging and dredge material placement activities may result in exposure of fish to various stimuli that may result in positive, negative, or neutral behavioral response (ECORP, 2009). Germano and Cary (2005) believe the majority of fish

behavioral effects from dredging activities are associated with the re-suspension of sediments and the resulting physical and chemical alterations within the water column. Migrating behaviors of fish can be disrupted when encountering dredging activity or localized dredge plumes; however, most migration patterns return to normal after the dredging is completed. While the majority of the construction will occur within the HSC, we believe any migratory or resident fish species will quickly move away from any dredging activities. Once construction is complete within the channel, we expect aquatic species to once again occupy this area.

Avian species frequent Texas coastal shorelines including the greater project area. Mueller and Glass (1988) documented the disturbance role of petroleum development activities in relation to nesting bird colonies. Others document complete abandonment of bird colonies due to human disturbance (Allen 1938, Majic & Mikuska 1970, Burger 1981, Safina & Burger, 1983). The Service previously documented the 32 historic colonial waterbird nesting sites located within the greater study area and the local project area. While there are no active colony locations within the immediate channel-dredging footprint of the project, the Service recognizes the potential threats from dredging or disposal operations to birds.

Due to the transient nature of fish and wildlife more commonly found in the immediate project area and the extensive shipping activities, it does not appear that the construction and dredging activities outlined in the study area will have a noticeable long-term negative impact on any fish or wildlife species if best management practices are implemented. Short-term dredging impacts will remain the same for all alternatives and no noticeable long-term impacts to fish and wildlife is anticipated from the proposed construction measures; therefore, the Service does not support one alternative over another. However, the Service recommends continued coordination during the refinement process to further eliminate impacts to fish and wildlife species and habitats.

Galveston Bay estuary remains a testament to the resiliency of the many estuarine organisms, which are physiologically adapted to a wide range of salinities and conditions. Overall, the Corps asserts that the increases in salinity caused by the TSP are not expected to cause significant deleterious effects to motile species. However, more subtle and cumulative impacts should not be overlooked, particularly in concert with possible future changes in freshwater inflows into the Galveston Bay estuary. The biotic health of Galveston Bay depends on the maintenance of adequate freshwater inflow more than any other single factor. Should these be diminished or altered, then incremental increases in salinity caused by the TSP could impact bay habitats and the Service's trust resources.

No significant adverse effects to Federally listed endangered or threatened species are expected to occur, provided safeguards prescribed for the development of HSC ECIP measures are adhered to. However, the Corps should evaluate the effects on threatened and endangered species pursuant to Section 7 of the Act. Federally-listed endangered, threatened, or candidate species may benefit long term from the creation of BU beach and marsh features.

Wetlands

The Corps (2017) claims permanent wetland impacts from the TSP are limited to several upland PAs because of levee construction. The Service agrees with the Corps wetland direct impact determination, however has concerns regarding future indirect wetland impacts. Overall,

wetland loss (whether direct or indirect) results in increasing acreages of open water, reduces storm surge protection of developed lands, and will likely contribute to water quality degradation associated with excessive nutrient inputs. Continued wetland losses are expected to cause significant declines in coastal fish and shellfish production and a decline in the Study area's carrying capacity for migratory waterfowl, wading birds, other migratory birds, alligators, furbearers, and game mammals. Habitat quantity may increase for species such as brown shrimp, spotted seatrout, and black drum, which prefer brackish and saline conditions. However, continued degradation of brackish and saline wetlands (necessary for the life cycle requisites of many aquatic species) will reduce the production of those same recreational and commercially important fish and shellfish species.

Open Bay Bottom and EFH

The Corps estimates between 2,100 and 2,770 acres of estuarine river, in the upper HSC and Galveston Bay bottom, would be directly impacted by dredging activities associated with the TSP. We expect the impacts to the benthic community to be temporary with recolonization expected within a year. Upper portions of the HSC are void of vegetation and are not expected to revegetate once construction is complete. The Corps plans to offset open bay bottom impacts with the creation of intertidal marsh by beneficially using dredge material. Details are discussed in the Mitigation section of this document.

Oyster

Oyster reefs are one of the primary geological features of Galveston Bay (Powell et. al, 1993). The Service's Supplemental FWCA report (1995) thoroughly documents the significance of oyster reef habitat within the Galveston Bay estuary in terms of both commercial and ecological importance. Historical mapping conducted by Powell in 1991 and reported in 1993 and 1997 (Powell et al. 1993 and 1997) and more recent efforts by TPWD confirm oyster reef is constant and continuous along the HSC (U.S. Army Corps of Engineers, 2017). While most mapping efforts concentrated on the lower reaches of the HSC where the majority of deepening and widening efforts have focused, the Corps recognizes a data gap in oyster mapping in areas above Morgan's Point. Desktop analysis indicates that oyster reef growth may be limited due to salinity and the unmaintained shallow depths necessary to support reef growth in this area. Most areas above Morgan's Point where proposed TSP measures lie are within the existing HSC, turning basins, or adjacent berths where conditions may not be favorable for oyster growth due to increased dredging and deeper channel conditions. The Corps will acquire newer side scan data during the post-planning or PED phases to determine the final impact and mitigation amounts. However, no additional impacts are anticipated in areas south of MidBay as this area (previously mapped by Powell) indicates solid reef, was assumed constant, and is accounted for in the Corp's impact analysis efforts. Additionally, if necessary, the Corps proposes to survey additional areas (as directed by the Beneficial Use Group (BUG)) identified as potential reef habitat using probing, side scan, or other technology.

The Oyster/Habitat modeling subcommittee of the BUG met three times during 2017 to discuss impact assessment, habitat modeling, and mitigation for oyster reef impacts by the proposed TSP. Implementation of the either NED or LPP would require all existing reef within the channel footprint be dredged to a depth greater than 18 inches, resulting in permanent oyster impacts. Direct impacts to oyster reefs from previous channel deepening and widening efforts were

determined to be biologically significant and of a permanent nature, therefore requiring mitigation. As demonstrated in **Table 5**, the anticipated impacts for the NED (88.2 acres) is substantially less than what is expected with the implementation of the LPP (321.3 acres). Credits for previous regrowth along the HSC was predicted by the Service and the BUG therefore those amounts previously credited with mitigation have been subtracted from the direct acres resulting in Net Acres (red highlight in Table 5). Indirect oyster impacts from dredging caused turbidity are considered to be minimal (U.S. Army Corps of Engineers, 2017).

Table 5 Oyster impacts quantified for the NED and LPP

NATIONAL ECONOMIC DEVELOPMENT MITIGATION		
National Economic Development Measure	**Acres Impacted**	**AAHUs Impacted**
CW1_BR-Redfish_700 (lower leg w/ standalone bend transition)	52.8	-48.0
BSC Widening to 455' wide channel	5.0	-3.5
Bayport Flare Easing	13.5	-9.4
BE_28+604 for ex. 530' channel	13.7	-9.6
BETB3_BCCFlare_1800NS	3.3	-2.7
Total National Economic Development mitigation needed	**88.2**	**-73.2**
Mitigation Chosen	**Acres**	**AAHUs Provided**
6 ac Long bird island oyster mitigation acreage	4.0	3.6
3-Bird Island oyster mitigation acreage	14.1	9.9
Dollar Mitigation Site	67.0	59.8
Total Replacement Oyster Reef Provided	**85.1**	**73.2**
LOCALLY PREFERRED PLAN INCREMENT MITIGATION		
Locally Preferred Plan Measure	Acres Impacted	AAHUs Impacted
Transition (overlap) of National Economic Development into the lower section of the middle leg of Locally Preferred Plan		
National Economic Development lower leg	52.8	48.0
CW1_BR-Redfish_700 (lower leg) of Locally Preferred Plan	35.0	31.8
Transition of National Economic Development into Locally Preferred Plan to be subtracted from Locally Preferred Plan middle leg	17.8	16.2
CW1_Redfish-BSC_700 (middle leg, MIDG regime) minus National Economic Development overlap	97.5	-88.7
CW1_Redfish-BSC_700 (middle leg, RED regime)	107.7	-75.8
Total CW1_Redfish-BSC_700 with 28+604 Bend	**205.2**	**-164.6**
CW1_BSC-BCC_700 (upper leg)	143.3	-114.4
Total CW11_BSC-BCC_700 with 28+604 Bend	**143.3**	**-114.4**
Minus Bayport Flare Easing	13.5	-9.4
Minus BE_28+605 Acreage in the National Economic Development	13.7	-9.6
Total Locally Preferred Plan incremental mitigation needed	**321.3**	**-259.9**
Mitigation Chosen	**Acres**	**AAHUs Provided**
San Leon and Dollar Mitigation Sites	**291.3**	**259.9**

Source: U.S. Army Corps of Engineers, 2019

Salinity
McAlpin et al, 2018 claims that salinity will not vary greatly (2 ppt or less) when the project is in place. The tidal prism was shown to increase by less than 2% and the tidal amplitude increases by no more than 0.01m (0.4 inches). Of special note, the McAlpin (2018) model did indicate a greater impact to salinity over the life of the project most likely due to expected changes in sea level rise and predicted freshwater inflows. A cumulative effects analysis should be performed that examines salinity impacts from the HSC ECIP and the Coastal Texas gate structures. The Service will update any significant salinity findings by way of a PAL or supplemental CAR once the comprehensive hydrodynamic modeling is complete.

Cumulative impacts
The Service has reviewed all the studies and evaluations to date provided by the Corps. We understand the majority of impacts will occur over bay bottom habitat but have concerns regarding the impacts to oyster habitat and adjacent wetlands. We understand the staging and construction areas have not been identified nor evaluated under the current phase of the study but rather will be finalized during the PED and construction phases of the project. The Service recommends all construction and staging areas be limited to right-of-ways or previously impacted areas to avoid and minimize impacts to terrestrial wildlife species.

Unfortunately, given the Corps guidance and evaluations under the SMART planning processes there has been little discussion regarding the cumulative effects for the HSC and the larger landscape level Coastal Texas Protection and Restoration Feasibility Study (Coastal Texas). Modeling efforts for both studies are concurrent and are independent of each other. The Coastal Texas Study seeks to develop a comprehensive plan for flood risk, hurricane, and storm risk management and ecosystem restoration for Texas coastal areas primarily in Galveston Bay. The Corps and the TxGLO propose to construct a gated structure across the entrance to Galveston Bay to reduce storm surge affecting navigation in the HSC and the GIWW. The gated structure (designs are not finalized) could potentially use millions of cubic yards of new work material during construction. Maintenance dredging of the structures will occur on a regular operations schedule and could impact the HSC dredge material management plan. While it may not be feasible to identify and model impacts for all potential projects within the Coastal Texas study area, the Corps must evaluate the impacts from the HSC ECIP TSP and the Dredge Material Management Plan (DMMP) as project features from both studies may have significant environmental impacts. The Service is aware that modelers for the Coastal Texas Study were directed to model (salinity and circulation) without consideration of the HSC expansion or possible DMMP features associated with the expansion (Buzan, 2018). The models will only evaluate the impacts of the Bolivar Roads barrier on salinity and velocities in Galveston Bay. Conversely, the HSC ECIP project continues to model circulation and salinities without regard for project features (ex. gated barrier structure) for the Coastal Texas Study.

We believe the cumulative impacts from the Coast Texas Study and the HSC may have greater implications than what is currently being evaluated by the Corps. We strongly recommend additional analysis of both projects during the PED phase. Continued coordination with natural resource agencies remains crucial to avoid and minimize negative impacts from both Studies. The Service requests additional transfer funds (as required under the FWCA) during the PED

phase to continue oversight and provide additional recommendations to further reduce impacts to Service trust fish and wildlife resources.

Contaminants
Previous Service documents related to the HSC identified the San Jacinto River Waste Pits (SJRWP) as a highly toxic paper mill waste site containing dioxin and polychlorinated biphenyl (PCB) dumped into shallow, unlined pits along the San Jacinto River. Listed as a superfund site by the EPA in 2008, the SJRWP remedial actions will take 29 months to complete and have not begun yet. The Corps does not anticipate any impacts to the SJRWP through the dredging or construction of the NED or LPP.

The water quality of Galveston Bay has improved significantly over the last 20+ years, is considered excellent by the Galveston Bay Report Card (Galveston Bay Foundation, 2016) and is consistent with long-term trends of improving water quality as a result of Clean Water Act and Watershed Protection Plan implementation in the region. However, health advisories and food consumption warnings are issued regularly in Galveston Bay most likely due to accidental and illegal discharge of toxic chemicals, runoff pollution from industry, roads, agriculture, and septic tanks. Specifically, the Texas Department of State Health Service advises consumers to restrict consumption of catfish and blue crabs caught in the HSC due to elevated dioxin concentrations and the presence of PCBs (a toxic chemical).

Considered the largest Gulf Coastal container port, in 2018 the Port of Houston (POH) handled 69% of the U.S. Gulf Coast container traffic, was considered the largest Texas port with 45% of market share by tonnage and 96% market share in containers. Along with the growth of the POH and the adjacent ports, the potential for vessel collisions and spills are evident. In 2014, and inbound bulk carrier collided with an oil tank-barge releasing 168,000 gallons of fuel oil into Galveston Bay during peak shorebird migrations. The ramifications of the collision were felt over four weeks where the clean-up extended to the Port Mansfield Jetties in South Texas. Critical habitat, numerous threatened, endangered, and migratory species were injured, some fatally.

In 2019, a massive fire lasting four days at a petrochemical storage and distribution facility released a toxic combination of chemicals into the air and water spurring an immediate response that disrupted traffic on the HSC, caused people to seek medical attention, endangered nearby nesting colonial waterbirds, and killed thousands of fish. Less than two months later, a ship collided with two barges slicing one in half, releasing 25,000 barrels of a refined gasoline product. The wreck occurred in the HSC, near the largest colonial waterbird-nesting island in upper Galveston Bay. While the shoreline of the nesting island was spared from floating product, Galveston Bay shoreline wetlands and shell-spit habitats were not. The sheen was removed however; affected habitats are still being monitored.

The Service continues to advocate for and work with partners to increase protections to quickly identify and predict spill trajectories, deploy boom, and protect colonial waterbird colonies and critical habitat from channel spills. By working with our partners at the POH, local, state and federal natural resource agencies, we hope to improve water quality, contain contaminants, and minimize effects to trust resources.

Climate Change

The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). "Climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (Solomon, et al., 2007). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007 p. 78). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, along with other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (Solomon, et al., 2007 p.8-14, 18-19). Changes in temperature and/or precipitation patterns will influence the status of the Galveston Bay ecosystem. These changes may contribute to threats that have already been identified and discussed for the piping plover, red knot, West Indian manatee, and nesting sea turtles.

Sea Level Rise

Coastal ecosystems are vulnerable to climate change with increased flooding from sea level rise along with changes in storm frequency and intensity that may increase flooding and coastal erosion (Thorne, K. M. et al., 2015). The melting of glaciers and continental ice masses, which are linked to atmospheric temperature, can contribute significant amounts of freshwater to the Earth's oceans. Additionally, a steady increase in global atmospheric temperature creates an expansion of saline seawater contributing to increases in ocean volume. Short (daily) and long term (30 years) variations such as seasonal weather patterns, changes in coastal and ocean circulation, anthropogenic influences (such as dredging), vertical land motion are just a few of the many factors influencing changes in sea levels over time.

Tidal marshes are transitional ecosystems between land and sea, found along low-energy intertidal coastlines. They are influenced by regular flushing from tidal actions and storms (Mitsch & Gosselink, 1993). Typically, decomposition and accumulation of below and above ground organic matter allow marsh to maintain elevation relative to sea level rise over time (Morris et al. 2002). Should vertical accretion not keep pace with inundation frequqncy due to sea level rise, a decrease in elevation may occur (Thorne et al .2015 and Yeager et al., 2007). For a *Spartina alternaflora* salt marsh to persist in the long-term, the accretion rate must a least match the rate of relative sea level rise. Generally, salt marsh along the upper Texas coast are currently experiencing submergence and erosion in most locations (White W. A., 1997). Feagin and Yeager (2019) showed low accretion rates when compared to the rate of relative sea level rise in West Galveston Bay. Further Feagin and Yeager (2019) claim erosion is the dominant process in West Galveston Bay as shown in their study and those of other researchers (Gibeaut et al., 2003). However, Ravens (2009) points to a deficit in the sediment supply caused by the damming of the Mississippi and Trinity Rivers as the limiting factor for Galveston Bay marshes. Whether the loss is attributed to a reduced sediment supply or wave action, these habitats will likely become inundated and convert to open water habitat as the sea levels continue to rise.

The DEIS (2017) discusses the Corps guidance and analysis used to evaluate sea level rise within the project area. A local relative trend (Pier 21 tidal gauge data in Galveston Bay) was used instead of the global sea level trend and estimated an increase of 6.39 mm/year compared to NOAA's estimate of 6.37 mm/yr. The Corps adjusted for the discrepancy in their calculations. As a result, the Service accepts the Corps sea level analysis and assumptions outlined in Appendix C of the DEIS with regards to sea level rise. The Service recommends additional coordination and funding under the FWCA during the PED phase to further evaluate sea level rise impacts caused by the NED or LPP.

Table 7 of the Engineering Appendix is a qualitative matrix for evaluating the level of risk of sea-level rise to a navigation project. We encourage the Corps and POH to reevaluate the matrix, specifically the environmental and habitat areas entry located in the "Critical resources in study area" column and place additional emphasis on protecting the environment. This entry scored low (1 out of 3 with 3 being high) for density and risk from sea level rise. While promoting the economic benefits of the NED or LPP is critical for the local sponsor and the Corps, we remind the Corps of their commitment to avoid and minimize federal project effects within the study area. The Corps, in concert with the BUG should access additional protective and mitigation measures for island and shoreline wetlands in the project area.

Dredged Material Management Plan

The Corps removes over five million cubic yards of maintenance material from the HSC and associated channels annually. Current dredging practices will result in new or expanded PAs by 2034. Typically, there are three placement options for dredge material (new work and maintenance): off shore placement, confined upland placement, and beneficial use. The Service and other natural resource agencies worked with the Corps to remove in-bay unconfined dredge material disposal practices in Galveston Bay during the 1998 HSC deepening and widening effort. The beneficial use of dredge material such as marsh, beach nourishment, oyster reef, and bird island creation is the preferred option for all maintenance and new work material; however, the Service understands and is sympathetic to the economic burden of excessive pumping distances to create said features. As such, the Service may support the use of confined upland placement and ocean dumping on a case-by-case basis.

Upland disposal sites remain costly in terms of construction and property acquisition. As an alternative to upland disposal or off shore placement options, the Service recommends the Corps adopt a policy aimed at beneficially using at least 75% of the dredge material. The Corps previously supported research projects intended to identify uses for dredge material in lieu of costly upland placement areas and boasts several projects where successful placement has restored or replaced lost wetland habitat and function. However, in FY 15, the Corps was only able to use 11 % (1.64 mcy) of the 14.58 mcy of dredged material from project beneficially (Frabrotta, 2016). We strongly urge the Corps to develop an adaptive management plan that identifies markets for commercial and other end users of dredge material products. Developing costly upland placement areas assures that sediment removed during initial construction and subsequent maintenance phases is permanently removed from the system ultimately starving local marsh habitats. Supporting local marsh habitats through beneficial use, ensures that economic and environmental benefits will be available to all those that rely on the Texas coast for many years.

The Corps dredging and placement needs for the life of the NED or LPP (2035 to 2085) are outlined as part of the HSC ECIP in Appendix K (USACE, 2019). The dredge material management plan (DMMP) serves as a stand-alone document for the operations and management of the future dredge placement needs for federal and non-federal facilities. These include the following: HSC main stem from Bolivar Roads to the Upper Turning Basin, BSC complex, Barbours Terminal Cut, Greens Bayou, Jacinto Port, the light-draft channels, Turkey Bend, Turkey Bend Cut off, boater cuts, and barge lanes. The DMMP will function as a decision document for any modifications to existing placement areas, creation of new PAs, and offshore placement as necessary to accommodate maintenance material over the 50-year study period for the HSC-ECIP and will be finalized during the PED phase of the study. **Table 6** is a summary of the maintenance material needs for FWOP conditions (used as the baseline) for each segment. The Corps estimates a total of 347,036,000 cubic yards will be dredged and of that, 236,360,000 cubic yards will be placed in alternate sites (off shore maintenance disposal sites and confined aquatic cells) due to capacity restrictions.

Table 6 50-Year Conceptual DMMP (FWOP)

Placement Area	Study Segment	Dredging Reach	Total 50-YR OM Dredging Volume, CY[2]	Available Capacity in PA, CY[2]	PA Life, YR[3]	Year Full	Alternate Placement Location After End of PA Life	Volume Placed in Alternate Location, CY[2]
ODMDS	1	HSC Bolivar Roads to Redfish Reef	4,761,000	NEL	50	NA	NA	0
Mid Bay	1	HSC Redfish Reef to Bayport	75,494,000	11,406,000	7	2035	ODMDS	64,088,000
PA 14	2	Bayport Ship Channel	45,843,000	9,031,000	10	2038	ODMDS	36,812,000
PA 14/PA 15 Conn.	2	Bayport Ship Channel	19,710,000	10,060,000	25	2053	ODMDS	9,650,000
PA 15	1	HSC Bayport to Morgans Point	38,714,000	11,386,000	17	2045	ODMDS	27,328,000
Spilman Is.	1,3	HSC Morgans Point to Exxon and Barbours Cut Channel	43,553,000	14,244,000	16	2044	BABUS	29,309,000
Alexander Is.	1	HSC Morgans Point to Exxon	39,689,000	17,862,000	22	2050	BABUS	21,827,000
Peggy Lake	1	HSC Exxon to Carpenters Bayou	12,195,000	6,296,000	26	2054	BABUS	5,899,000
Lost Lake	1,4	HSC Carpenters Bayou to Boggy Bayou and Boggy Bayou to Greens Bayou	34,915,000	6,225,000	6	2034	BABUS	28,690,000
Rosa Allen	4	HSC Greens Bayou to Sims Bayou	5,477,000	2,934,000	19	2047	BABUS	2,543,000
East Clinton	4	HSC Greens Bayou to Sims Bayou and Greens Bayou	10,364,000	6,290,000	29	2057	BABUS	4,074,000
West Clinton	5,6	HSC Sims Bayou to Turning Basin	8,711,000	5,651,000	31	2059	BABUS	3,060,000
House Tract	5,6	HSC Sims Bayou to Turning Basin & Light Draft	7,610,000	4,530,000	28	2056	BABUS	3,080,000
Glendale	6	HSC Sims Bayou to Turning Basin & Light Draft	Not Used	3,926,000	-	-	-	-
Filterbed	6	HSC Sims Bayou to Turning Basin & Light Draft	Not Used	-	-	-	-	-
Totals	-	-	347,036,000	109,841,000	-		-	236,360,000

Source: Corps (2019)

The Corps evaluated the federal and non-federal dredge material needs and estimates a volume of 347,036,000 cubic yards for the 50-year study period. Developed by the Corps' Operation & Maintenance (O&M) Division as part of the future without project (FWOP) conditions, the Bay Aquatic Beneficial Use Sites (BABUS) are confined aquatic disposal (CAD) cells excavated below the existing bay bottom with an emergent dike and constructed using the excavated soils hydraulically placed to create beneficial habitat. Four BABUS sites (three 384-acre and one 247-acre) located south of Atkinson Island and north of Midbay PA (**Figure 6**) are proposed to

accept new work and maintenance material from federal channel and non-federal facilities once existing confined upland PAs reach capacity. The Service has reviewed Corps provided conceptual designs for the BABUS units and we understand final design will occur during PED phase. Further, we have provided comments on the proposed BABUS design in the Recommendations section of this report.

Under the Future with Project (FWP) conditions, the Corps proposes to construct oyster reef, a 402-acre bird island marsh complex and two bird islands (6 and 8+ acre) as new BU features with new work and maintenance dredge material located north of Evia Island (**Figure 6**). Existing BU features (M7/8/9, M11, and M12) will receive maintenance material and when targeted marsh elevations are reached, be planted with *Spartina alternaflora* to encourage marsh stabilization. The Service has reviewed conceptual designs for the Bird Island Marsh complex and the two new bird islands and will continue to provide technical input on these features during the PED phase. Comments for island design are found in the Recommendations section of this report.

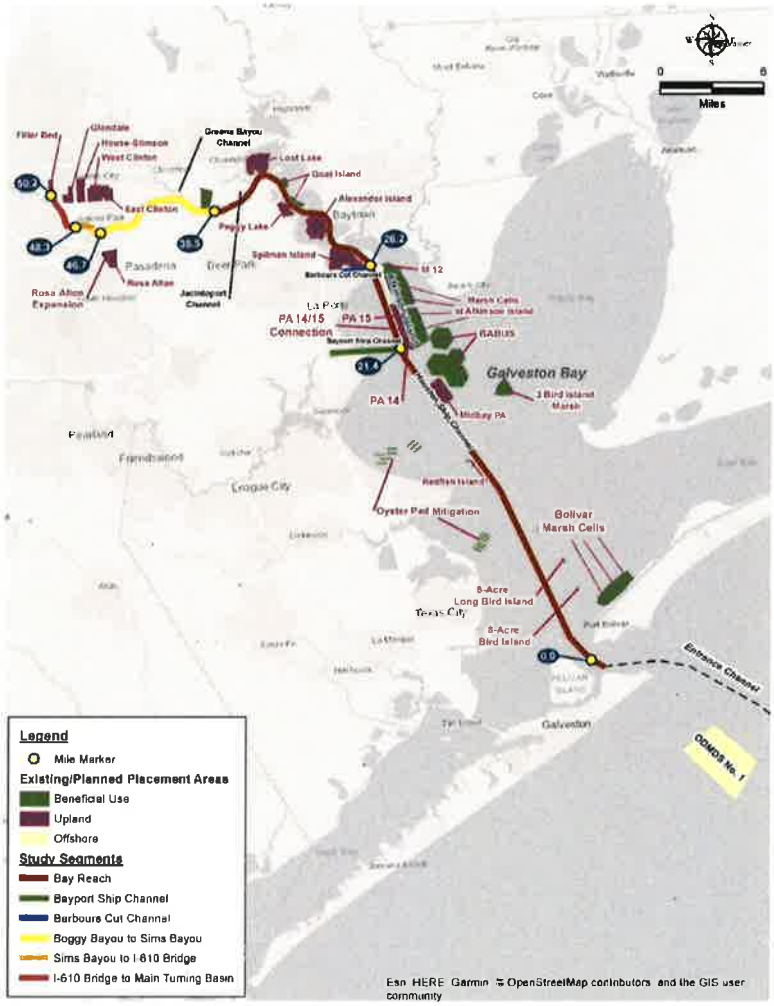

Figure 6 DMMP features (NED and LPP)

Source: DMMP (2019)

The Corps expects a 76,285 mcy increase with the FWP over the amount anticipated with the FWOP (**Table 7**). However, this will be offset by the increased capacity of existing PAs (34,734 mcy) resulting in an overall increase of 41,551 mcy. The amount to be utilized at the BABUS sites will result in a slight decrease, conversely, the amount going to ODMDS will increase by almost 50% under FWP.

Table 7 FWOP and FWP DMMP quantities compared

DESC.	FWOP (MCY)	FWP (MCY)	DIFF (MCY)
Total 50-Yr O&M, CY	332,982	409,267	76,285
PA Capacity, CY	105,915	140,649	34,734
Qty. to Non-PA, CY	227,067	268,618	41,551
-To ODMDS	129,524	172,020	42,496
-To BABUS	97,543	96,599	-944
Total CY to Alternate PAs	227,067	268,618	41,551

Source: Corps (2019)

The LPP combined with the FWOP DMMP components (for areas of the HSC not being modified under this effort), will move forward as the Recommended Plan (RP). We understand dredge quantities and final feature designs will be adjusted and finalized during the PED phase of the study. However, the resulting amount of dredge material from the FWP to be disposed of is considerable and the Service recommends additional consideration of beneficial use in lieu of ODMDS disposal. Further Service coordination under a separate FWCA agreement is necessary to design BU DMMP features during the PED phase.

The DMMP acknowledges the capacity restrictions in portions of the upper channel and proposes to use and modify current PAs to maximize upland placement.

Robert Randall (2000) reports thin layer placement of dredged material as a suitable alternative to upland confined placement. Thin layer placement of dredged material is accomplished by spraying a slurry mix of dredge material and water through a high pressure hose system (often the slurry will reach up to 200 feet from the barge) and spraying to depths between two and six inches across the landscape depending on the habitat needs. Private, state, and federal lands outside of the immediate HSC could benefit from this resource if material is toxin free. In his report, Randall (2000) further identified marsh habitat in Big Boggy and San NWRs that may benefit from thin layer placement. Anahuac, Moody, and McFaddin NWRs located along the eastern Galveston Bay shoreline may also benefit from additional sediment. The Service is available to assist in identifying marsh areas in need of thin layer placement within its own boundaries, and is willing to work with partners to identify other areas (State and private properties) that may be able to use dredged material from the project.

Mitigation

The Service appreciates the Corps continued refinement of the NED and the LPP to reduce and minimize impacts to natural resources within the HSC ECIP study area. However, we do expect permanent impacts to natural resources resulting from both the NED and LPP requiring

mitigation. The President's Council on Environmental Quality defined the term mitigation in the National Environmental Policy Act regulations to include:

a) avoiding the impacts altogether by not taking a certain action or parts of an action;
b) minimizing impacts by limiting the degree or magnitude of the action and its implementation;
c) rectifying the impacts by repairing, rehabilitating, or restoring the affected environment;
d) reducing or eliminating the impacts over time by preservation and maintenance operations during the life of the action; and,
e) compensation for the impacts by replacing or providing substitute resources or environments.

The Service supports and adopts this definition of mitigation and considers its specific elements to represent the desirable sequence of steps in the mitigation planning process. Based on current and expected future without-project conditions, the planning goal of the Service is to develop a balanced project, i.e., one that is responsive to the needs of the Corps and the POH while addressing the need for fish and wildlife resource conservation.

The Service's mitigation policy (FR, Volume 46, Number 15, pages 7656-7663, January 23, 1981) provides guidance to help ensure that the level of compensatory mitigation recommended by the Service is consistent with the value and scarcity of the fish and wildlife resources involved. In keeping with that policy, the Service usually recommends that losses of high-value habitats, which are becoming scarce be avoided or minimized to the greatest extent possible. Unavoidable losses of such habitats should be fully compensated by replacement of the same kind of habitat value; this is called in-kind mitigation. The mitigation planning goals and associated Service recommendations should be based on the four categories, as shown in **Table 8.**

Table 8 Service resource categories

Resource Category 1 - Habitat to be impacted is of high value for evaluation species and is unique and irreplaceable on a national basis or in the ecoregion section. The mitigation goal for this Resource Category is that there should be no loss of existing habitat value.
Resource Category 2 - Habitat to be impacted is of high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the ecoregion section. The mitigation goal for habitat placed in this category is that there should be no net loss of in-kind habitat value.
Resource Category 3 - Habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national basis. FWS's mitigation goal here is that there be no net loss of habitat value while minimizing loss of in-kind habitat value.
Resource Category 4 - Habitat to be impacted is of medium to low value for evaluation species. The mitigation goal is to minimize loss of habitat value.

Additionally the Service works to support the following goals specific to coastal habitats:

- Creating coastal ecosystems that are resilient and adaptive to climate change impacts
- Using science based conservation design at a landscape scale that supports habitat connectivity and ecological integrity.
- Benefiting the conservation and recovery of federal trust species and other priority species
- Building conservation partnerships that leverage resources and promote community stewardship of fish and wildlife resources.

Texas coastal habitats include bottomland hardwood forests, bald cypress swamps, oyster reef, sea grass beds, coastal prairie, and coastal marsh. The Service considers oyster reef and coastal marsh habitats to be aquatic resources with a high value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and inter-jurisdictional fisheries). The increasing scarcity of oyster and marsh habitats in Galveston Bay clearly places these habitats within Resource Category 2. Therefore, the Service recommends avoiding losses of those habitats found within the project footprint. If unavoidable impacts are necessary, we recommend in-kind mitigation within the greater Study area and additional coordination with our office and the other resource agencies.

Oyster

Because of the NED and the LPP, the Corps estimates permanent impacts to 321.3 acres of oyster reef habitat requiring 291.3 acres of constructed oyster reef. During the early phases of planning the Corps and PHA consulted with TPWD, NMFS, TxGLO, NRCS, EPA, the Service, and the Texas Water Development Board to avoid and minimize impacts to oyster reef resulting from possible improvement measures. Led largely by TPWD and its efforts to restore reef buried in Galveston Bay resulting from Hurricane Ike in 2008, the group provided input and site selection criteria to the Corps. Substrate, previously known reef sites, water depth, salinity, and hydrological flows are known to influence oyster reef site success and were taken into consideration. Previous deepening and widening efforts by the Corps resulted in reef creation and restoration within Galveston Bay using artificial cultch (limestone or other rock) as a hard base and constructed to a specific height. Oyster spat moves throughout the bay during the spawning season, when salinity conditional are permissible, and settles on suitable substrates.

The Corps used the Oyster Habitat Suitability Index Model developed by Swannack et. al, (2014) to assess reef function, quality, and identify appropriate mitigation acreages. The variables used in the model and the use of Habitat Evaluation and Assessment Tool are documented by the Corps (U.S. Army Corps of Engineers, 2017) in Appendix P-1 of the Study's Draft Integrated Feasibility Report. This model is a modification of a 2012 suitability index model that follows the methodology in the USFWS habitat suitability indices (HSI) model for the Gulf of Mexico American Oyster (Cake 1983).

Galveston Bay oyster reefs are predominantly Eastern oyster and have been compromised in recent years due to overfishing, drought, extreme and numerous freshwater events, and by burying from hurricanes. The Service considers the permanent dredging impacts to 321.3 acres of oyster reef under the LPP to be significant thus requiring mitigation. The 291.3 mitigation acres consist of fourteen reefs in two location most likely along the western portions of

Galveston Bay where historic reef has been compromised or buried (**Figure 7**). In conjunction with the BUG and TPWD, the Corps selected San Leon and Dollar Reef locations based on optimal salinity parameters. Plans are conceptual at this point; however, the base will most likely be constructed of 1.5 feet of new work material and then topped with 6-inch cultch (rock or limestone) however, geotechnical and water depth must be considered during the design phase. Impacts to live reef resulting from the turbidity and placement of dredge material are of concern to the BUG. The use of submerged diffusers will minimize turbidity during reef base construction and shall be used during the construction process. The Service understand the conceptual design of the fourteen reefs to be 300 feet wide and 2,900 feet long although the design could vary to 600 feet wide and 1,450 feet long.

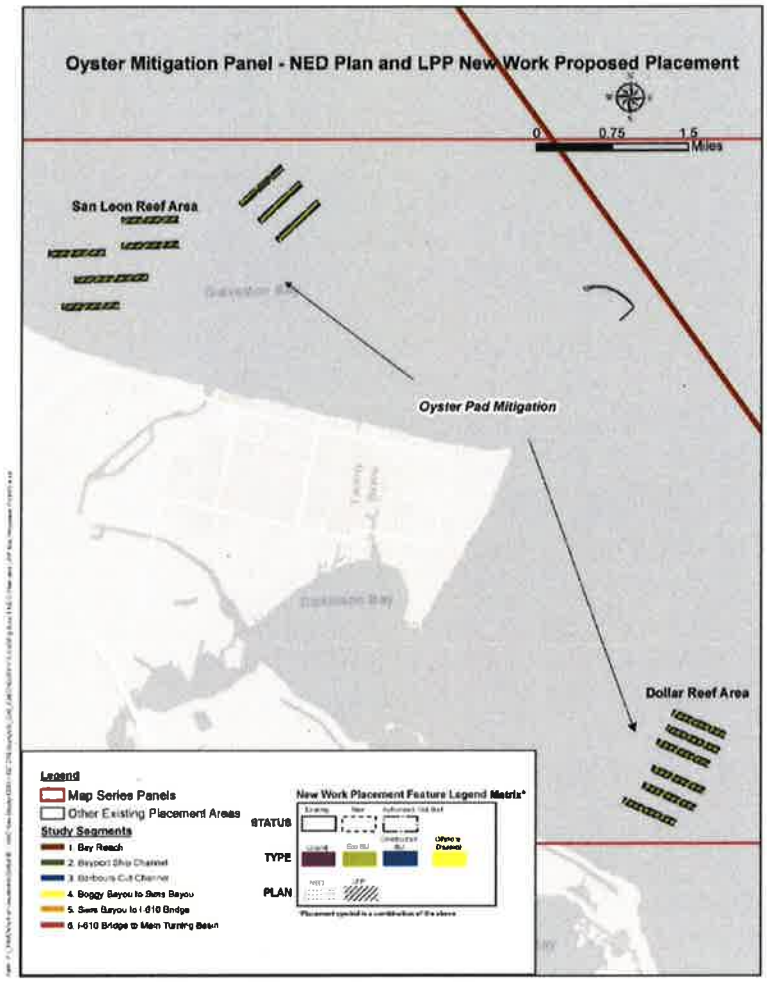

Figure 7 Potential oyster mitigation sites

The Service considers the permanent loss of 321.3 acres (LPP plan) of oyster habitat a detriment to the ecosystem due to the scarcity within Galveston Bay. We accept the Corps analysis and results of the Swannek model and the proposed 291.3 acres of oyster mitigation. However, close coordination with TPWD and the BUG are imperative as design and construction phases move forward.

Wetlands
Permanent wetland (XX forested and XX emergent acres) are expected as a result of construction at Filterbed, Glendale, and East-east Clinton upland placement areas. The Corps proposes to compensate for these impacts by purchasing credits at a nearby (possibly Greens Bayou Mitigation Bank) mitigation bank. The Service does not object to the purchase of mitigation bank credits as compensation and recommends continued coordination with the BUG through the mitigation bank process.

Bay bottom
We anticipate that with the implementation of the TSP, much of the direct impacts to project-area marshes and EFH would be compensated by creating additional emergent marsh habitat in open water areas within Galveston Bay and open water areas in the vicinity of the HSC. As with previous beneficial marsh restoration projects, proposed beneficial use placement areas should have:

- Constructed bayous and openings (e.g., fish dips) connecting existing bayous to facilitate water exchange and fish and wildlife access.
- These openings would be constructed after dredge material has stabilized and vegetation is well colonized.
- Fish dips should have a minimum bottom width of 20 feet, a minimum depth of at least one foot below targeted marsh elevations, and rock armoring on sides and bottom to minimize scouring.
- Natural bayous and waterways should not be obstructed by proposed shoreline protection features, and gaps should be incorporated into the design every 1,000 feet to allow for appropriate hydrologic exchange, avoid impoundment of shallow open water areas, and provide some estuarine organism access.

The Corps proposes to construct a new tidal marsh complex with three bird islands east (**Figure 8**) of the HSC to receive maintenance dredge material over several cycles.

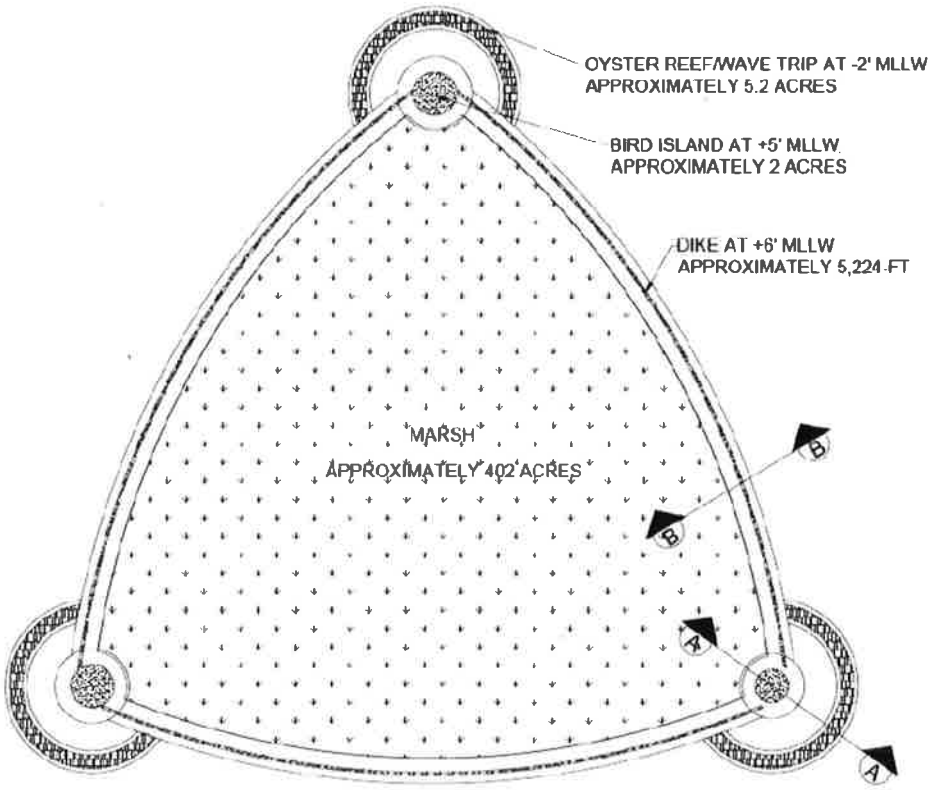

Figure 8 Conceptual marsh and bird island complex

Source: Corps DMMP (2019)

The design is conceptual at this point; however, we expect future evaluations to include circulation channels, marsh height, protection for constructed containment levees, and seed planting. The Service recommends the Corps design the levees to maximize additional nesting opportunities by adding a shell substrate.

Ecosystem Benefits of Created or Restored Habitats
Creation of saline marsh (converted from open water), oyster reef, bird islands, and nourishment of barrier shoreline habitats improve habitat conditions for shorebirds, neotropical migratory birds including threatened and endangered species, fish, mammals, reptiles and amphibians. If designed correctly, these created and nourished habitats develop complex food web systems, provide desirable nesting, foraging, and roosting habitats, increase local populations, while combatting wetland and island fragmentation and deterioration.

Restored and nourished habitats provide greater food supplies resulting in increased intertidal marsh, marsh edge, mudflats, and shallow water habitats; benthos; detritus; and a general increase in abundance and diversity of habitats for food sources. Several avian species feed on micro-invertebrates and crustaceans found on mudflats, which are exposed at low tide and in shallow-water areas of the appropriate depth. Small fishes and crustaceans are often found in greater densities along vegetated marsh edge (Castellanos & Rozas, 2001 and Rozas and Minello 2001), and many of those species are important prey items for shorebirds, neotropical migrants,

and other wildlife species. Saline marsh and barrier shorelines may also provide more desirable nesting habitat for some species, such as the diamond backed terrapin.

Galveston Bay has limited availability for nesting colonial waterbirds due to the lack of vegetation and predator management on dredge spoil islands. Several islands not under the direct management of the PHA or the Corps suffer wind and wave erosive forces or lie close to bay shorelines promoting predation. Successful islands design should meet a target range of needs for specific avian guilds. Using material from the construction of the TSP, a combination of shell islands for ground nesters (terns, gulls, black skimmers) and islands with larger shrubs and trees for the larger wading birds (egrets, herons, spoonbills, white ibis, neotropic cormorants, and brown pelicans) will provide relief for the three islands in Galveston Bay. With the design and construction of additional bird island(s) as part of the NED or LPP, we would expect increasing population trends for local nesting species that contributing to coast-wide colonial waterbird management goals.

The construction of bird islands using new work dredged material is documented but it was not until the 1970s that the importance of this dredged material to nesting waterbirds was realized (Golder, Allen, Cameron, & Wilder, 2008). Construction of a bird island with new work and maintenance material from this and subsequent projects would positively contribute to the coastal colonial waterbird populations and may provide valuable habitat for several bird species that remain a focus of the Service and other governmental and non-governmental natural resource agencies. By creating a mosaic of nesting opportunities, created islands provide a valuable resource for nesting colonial waterbird populations, opportunities for ecotourism activities, and ideal angler spots that equate to additional revenue for coastal businesses.

Monitoring

Oyster

Restored reefs can vary in height and density, either of which could affect sampling efficiency. The POH sought the expertise of the BUG to recommend a suitable sampling method. Scuba diving, while effective, accurate, and non-destructive proved to be inefficient and costly due to the number of man-hours necessary to complete surveys across the large geographic area. Dredging, a relatively inexpensive method used to sample reefs for many years, can be highly variable and generally unreliable, and with low efficiency (Schulte, Lipcius, R.N., & Burke, 2018). Tongs (hydraulic and mechanical) are thought to be 100% efficient (Schulte, Lipcius, R.N., & Burke, 2018) and patent tongs provide more accurate information on stock size and oyster population characteristics than other methods (Chai, Homer, Tsai, & Goulletquer, 1992). TPWD currently supports the use of patent tongs while accurately assessing oyster reef habitat in Galveston Bay. When compared to dredging, patent tongs provide better estimates for density of spat, small oysters, marketable oysters, and total oysters. (Chai, Homer, Tsai, & Goulletquer, 1992) . The BUG recommends sampling commence two years post reef construction and then again at year 5 confirming reef success. The sampling period should be timed such as to consider the two major spawning/spat set peak periods in the year: greatest peak from April to June and a smaller one occurring in August. The results of the monitoring efforts and any identified deficiencies should be discussed with the BUG at the earliest possible time.

For the first ten years post construction, TPWD will prohibit commercial harvest on the mitigation reefs allowing for vertical structure and faunal community establishment.

We understand the monitoring plan will be revised during the PED phase. Any monitoring plan moving forward should recommend the implementation of an Adaptive Monitoring Team, which may be filled by the BUG, during the PED phase of the Study. Focusing the team on reviewing, interpreting, and recommending actions reflecting the mitigation goals of the Study that are consistent with species and habitat needs in the area is vital. Such teams should be comprised of Corps, TPWD, local sponsors, federal resource agency staff, and NGOs (as necessary). Monitoring efforts should focus on evaluating the success of creation or restoration features and species usages of these features as well as providing recommendations for additional nourishment and levee stabilization opportunities.

Bay bottom
Evaluation of the created marsh complex will occur after initial construction and subsequent deposits of maintenance material. The Corps and the PHA will evaluate compaction and update the BUG for further recommendations. Interior marsh plantings will occur after final material is deposited and dewatering is complete.

We encourage the Corps to continue coordination with the BUG ensuring new information and considerations are evaluated for each mitigation feature and adaptive management is used to recognize the importance of natural variability in contributing to the ecological resilience and productivity of Galveston Bay.

Evaluation of Alternatives
The Service continues to work with the Corps, PHA, and the BUG to evaluate and refine the measures identified in the NED and LPP. Overall, the Service does not object to the PHA's desire to increase navigation safety, reduce transportation costs, and improve channel accessibility throughout the entire HSC. All the alternatives developed by the Corps include direct and permanent impacts to oyster reef and bay bottom habitats. However, the PHA proposes to mitigate those permanent impacts with the construction of marsh and oyster habitat. Additionally, the PHA proposes to construct 5 bird islands of varying sizes and shapes providing nesting opportunities to 23 species of colonial waterbirds.

Service Position and Recommendations

Overall, the Service does not object to the PHA's desire to increase navigation safety, reduce transportation costs, and improve channel accessibility throughout the entire HSC. However, we provide the following recommendations be incorporated into future project planning and implementation of the TSP to reduce impacts to fish and wildlife resources:

1. Provide Service funding through the PED phase of the Study to evaluate fish and wildlife impacts resulting from the TSP.
2. To the greatest extent practicable, avoid impacts to oyster habitat. If avoidance is not an option, compensate (ratio of at least 1:1) for lost ecological value. Continue coordination with the BUG to identify suitable

mitigation sites and preferred construction methods through the PED phase. We understand the final mitigation design may not be available until the next phase of the Study making continued coordination with natural resource agencies essential for successfully constructed mitigation sites.

3. To the greatest extent practicable, beneficially use dredge material as the primary disposal option instead of confined and offshore disposal sites.
4. The Service does not object to the General Considerations listed in the DMMP Appendix K (2019) Section 7.12 regarding BU. Using a collaborative approach with the BUG will insure the minimization of affected natural resources.
5. Maximize current PAs in lieu of new construction to house dredge material.
6. In conjunction with the Service, develop a HSC-wide management plan aimed at promoting future nesting, discouragement, and removal of predators, and resiliency to sea level rise.
7. Provide funding for the life of the project for maintenance and management of the bird islands. Management of islands shall be coordinated with the Service and the BUG.
8. Continue to coordinate with the BUG on the use of a baffle diffuser for dredge material disposal.
9. Involve the Service, NMFS, TPWD, and NRCS early in the planning effort to identify any potential changes in conditions including additional beneficial use disposal options and the overall placement capacity needed for maintaining the HSC and associated channels.
10. Detailed design documents (e.g. design reports, plans and specifications, etc.) of the waterway and disposal sites should be prepared in consultation with the Service, NMFS, TPWD, and NRCS to avoid unnecessary wetland impacts and to achieve the anticipated wetland creation benefits.
11. Update habitat-modeling calculations during the PED to better reflect project impacts and/or benefits and coordinate results with the BUG.
12. General design features for beneficial use should be considered in all future sites:
    a. Beneficial use disposal areas should have constructed bayous and openings to existing bays and bayous (e.g., fish dips) to facilitate hydrologic exchange and aquatic organism access. Openings should be constructed after dredge material has stabilized and vegetation has colonized;
    b. Marsh design and elevations should be thoroughly coordinated with Service, NMFS, TPWD and NRCS;
    c. Beneficial use disposal containment dikes should be breached or degraded to the settled elevations of the disposal area.
    d. Beneficial use sites should be designed with fish dips or gaps located every 1,000 feet to allow for aquatic organism access and hydrologic exchange with those marsh creation areas;
    e. Fish dip or gap design should have a minimum bottom width of 20 feet, a minimum depth of at least one foot below target marsh

elevations, and rock armoring on all sides and bottom to minimize scour.

f. Implement beneficial use of dredge material in the construction of oyster reef habitat. Constructed berms can be topped with substrates suitable for oyster growth.

13. Conduct shoreline monitoring as part of the DMMP review. Should shoreline erosion rates increase along natural marsh shorelines, protection measures should be provided for the duration of the project.
14. Conduct surveys and document active wading bird rookeries and colonial nesting birds within the project area. If active nests are found, we recommend consultation with the Service to ensure project activities do not impact colonial nesting bird colonies.
15. Evaluate transporting new work and maintenance material for beneficial use to areas outside of the typical 6-mile pump distance as cost alternatives to Placement Area (PA) construction and levee rising.
16. Work with the Service and the BUG to develop suitable plans for the design of colonial waterbird nesting islands. Design features may include: islands 2-12 acres in size, approximately 8 ft. above mean high water or flood stage, situated at least one half mile (preferably one mile) offshore in a nearby bay, varying substrate composition, and vegetative plantings. The island could include sloping sand beaches preferably protected by a rock breakwater structure similar in design to Evia Island in Galveston Bay. A suite of islands with varying habitats, sizes, and shapes would provide habitat for most of the 23 species of colonial waterbirds that nest in the Galveston Island vicinity and may provide necessary stopover, feeding, and resting habitat for threatened and endangered species.
17. Any tracts of land identified as potential PA property not previously constructed upon, should be evaluated for prairie habitat. If a tract exhibits characteristics consistent with that of native prairie, the Corps should consult with the Service and mitigate accordingly prior to construction.
18. The Service does not anticipate any direct negative impacts to terrestrial or avian wildlife during the course of the dredging and staging portions of the project if the Corps incorporates best management practices into their construction strategies. These best management practices should include but are not limited to:
    a. avoiding contact with any wildlife species;
    b. removal of trash daily;
    c. incorporate slower transportation speeds within the project area (on land and in the water);
    d. educate construction staff about the presence of wildlife species within the project area.
19. Initiate coordination with NMFS regarding Essential Fish Habitat impacts and mitigation issues within the project area.
20. Test all new work and maintenance material for contaminants using the standards outlined in the Environmental Protection Agency's Inland Testing and Ocean Dumping Manuals prior to being used in any beneficial use

projects, placement in upland confinement, or offshore disposal sites. Should data suggest toxic levels of contaminants are present, the Service recommends disposal of the material within an approved landfill site.

21. Fully compensate for any unavoidable losses (direct or indirect) of wetland habitats resulting from the implementation of the NED or LPP. The Service understands the Corps proposes to purchase credits from a mitigation bank for forested and emergent wetland impacts resulting from construction at an upland placement area. Continue to coordinate with the BUG regarding mitigation bank purchase status.
22. The Service remains concerned that the HSC ECIP and the Coastal Texas Study appear to be operating independently and not considering the other's project features moving forward. Increase coordination efforts during PED phase. Continue to coordinate with Coastal Texas Study staff
23. Corps and/or the applicant fund research aimed at evaluating piping plover and red knot usage of beneficial use areas and tidal flats of the Galveston and Trinity Bay systems. Information gained can be utilized to maximize design and location of beneficial use areas favoring threatened and endangered species usage.
24. Evaluate how HSC improvements might impact currently funded and future restoration shoreline projects as well as how data generated from funded monitoring and restoration projects can be incorporated into future HSC modeling considerations.
25. Implement a monitoring program to assess the impacts from increased wave action from additional traffic and larger ships pose to marsh, submerged aquatic vegetation (SAV) and Bay associated wetlands.
26. If the proposed TSP project features change, the status of species change, or the project is not implemented within five years of the date of our Endangered Species Act (Act) coordination, we recommend that the Corps reevaluate the project's effects and species status and initiate any necessary consultation procedures pursuant to Section 7 of the Act.
27. Evaluate adding a mosaic of substrates or vegetation on the levees of the marsh complex encouraging additional nesting and stabilization of the levee crown.
28. Coordinate with the BUG for a list of planting material suitable for bird islands.

Works Cited

Allen, R. R. (1938). Black-crowned Night Heron colonies on Long Island. *Proceedings Linnaean Society*, (pp. 43-51). New York.

Baxter, K., & Renfro, W. C. (1967). *Seasonal occurance and size distribution of postlaval brown and white shrimp near Galveston, Texas, with notes on species identification.*

Burger, J. (1981). Overall effects of human disturbance on colonial species, particulary gulls. *Colonial Waterbirds, 4*, 28-36.

Burger, J. (1984). Colony stability. *Condor, 86*, 61-67.

Buzan, D. (2018, Jan. 05). Personal communication.

Chai, A., Homer, M., Tsai, C. F., & Goulletquer, P. (1992). Evaluation of oyster sampling efficiency of patent tongs and an oyster dredge. *North American Journal of Fisheries Managmement*, 825-832.

Conner, J., & Truesdale, F. M. (1973). Ecological implications of a freshwater impoundment in a low-salinity marsh. *Proceedings of the coastal marsh and estuary management symposium*, (pp. 259-276). Louisana State University, Division of Continuing Education, Baton Rouge.

Cote, I. M. (1995). The scientific basis for predator control for bird conservation. *English Nature, Research Report 144.*

Cote, I. M. (1997). The Effectivenesss of Removing Predators to Protect Bird Populations. *Conservation Biology, 11*(2), 395-405.

Dahl, T. (2012). *Status and trends of wetlands in the conterminous United States 2004 to 2009.* Washington D.C. : U.S. Fish and Wildlife Service.

Dick, J. A., & Hunt, G. H. (2012). *Status and trends of wetlands for Galveston County, Texas 2004-2009.* Albuquerque, NM: Fisheries and Habitat Conservation, Department of th Interior, U.S. Fish and Wildlife Service .

Domning, D. H.-A. (1986). Interspecific and intraspecific morphological variation in manatees (Sirenia: Trichechus). *Marine Mammal Science*, 87-144.

ECORP Consulting. (2009). *Literature Review for Studies Conducted Prior to 2008: Fish Behavior in Response to Dredging and Dredge Material Placement Activities.* Rocklin: ECORP.

Frabrotta, C. (2016, August 22). Personal Communication.

Galveston Bay Foundation. (2016). *Galveston Bay Report Card.* Houston: Galveston Bay Foundation.

Germano, J., & Cary, D. (2005). *Rates and effects of sedimentation in the contect of dreging and dredged material placement.* Vicksburg: United States Army Engineering Research and Development Center.

Gibeaut, J., Waldinger, R., Hepner, T., Tremblay, T. A., & White, W. A. (2003). *Changes in bay shoreline position, West Bay System, Texas.* Report to the Texas General Land Office, Bureau of Economic Geology, University of Texas at Austin.

Golder, W., Allen, D., Cameron, S., & Wilder, T. (2008). *Dredge Material as a tool for management of tern and skimmer nesting habitats.* U.S. Army Corps of Engineers - ERDC.

Golder, W., Allen, D., Cameron, S., & Wilder, T. (2008). *Dredged material as a tool for management of tern and skimmer nesting habitat.* Vicksburg: U.S. Army Engineer

Research and Development Center. Retrieved from http://el.erdc.usace.army.mil/dot/doer/doer.html

Houston Chronicle. (2015). *"Galevston County declares oyster disaster"*. Retrieved June 15, 2016, from Houston Chronicle: http://www.houstonchronicle.com/neighborhood/bayarea/business/article/Galveston-County-declares-oyster-disaster-8152865.php

Institute for Water Resources. (2012). *Environmental Impact Mitigation Needs for futre Port and Waterway Modernzation Activities in the United States.* U.S. Army Corps of Engineers.

Knapp, G. (2017, September 26). Here's why Galveston Bay oysters will take three years to recover from Harvey. Houston, Texas: Houston Press. Retrieved August 2, 2018, from https://www.houstonpress.com/restaurants/have-you-ever-tried-vin-santo-and-biscotti-before-10647798

Majic, J., & Mikuska, J. (1970). Heron nesting int he Kopucevski Reservation and immediate environs over the period from 1954 to 1970. *Larus, 24*, 65-77.

Minello, T. (2000). Temporal development of salt marsh value for nekton and epifauna: utilization of dredged material marshes in Galveston Bay, Texas, USA. *Wetlands Ecology and Management*, 327-341.

Mitsch, W., & Gosselink, J. G. (1993). *Wetlands.* New York: Van Nostrand Reinhold.

Moore, W. R. (1969). *A contribution to the biology of the blue crab (Callinectes sapadiaus) in Texas, with a description of the fishery.* Texas Parks and Wildlife Department.

Morris, J., Sundareshwar, P. V., Neitch, C. T., Kjerfve, B., & Cahoon, D. R. (2002). Responses of coastal wetland to rising sea level. *Ecology, 83*, 2869-2877.

Mueller, A. J., & Glass, P. O. (1988). Disturbance tolerance in a Texas waterbird colony. *Waterbird Society, 11*(1), 119-122. doi:10.2307/1521181

National Oceanic and Atmospheric Administration. (2019, May 1). *Deepwater Horizon Oil Spill Natural Resource Damage Assessment Strategic Framework for Oyster Restoration Activities.* Retrieved from Gulf Spill Restoration NOAA: https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/Oyster_Strategic_Framework_06.23.17.pdf

National Oceanic and Atmospheric Administration. (2019, July 2). *Submerged Aquatic Vegetation.* Retrieved from NOAA Chesapeake Bay Office: https://chesapeakebay.noaa.gov/submerged-aquatic-vegetation/submerged-aquatic-vegetation

National Park Service. (2019, July 27). *Current Sea Turtle Nestin Season.* Retrieved from National Park Service Padre Island: https://www.nps.gov/pais/learn/nature/current-nesting-season.htm

Odum, W. E., Zieman, J. C., & Heald, E. J. (1973). The importance of vascular plant detritus to estuaries. *Proceedings of the coastal marsh and estuarine managment symposium. R.H, Chadreck, ed.*, pp. 91-114. Baton Rouge: Louisiana State University Division of Continuing Education.

Pattillo, M., Czapla, T. E., Nelson, D. M., & Monaco, M. E. (1997). *Distribution and abundance of fishes and invertebrates in Gulf of Mexico estuaries* (Vol. II: Species life history summaries). Washington D.C.: U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration.

Port of Houston. (2019, August 22). Beneficial Use Group meeting. Houston, Texas.

Powell, E., Song , J., Ellis, M., & Choi, K. (1997). *Galveston Bay Oyster Reef Survey: Technical Reports Volume 1.* Texas A&M Univeristy, Department of Oceanography. College Station: Galveston Bay Esturay Program Publication GBNEP-50.

Powell, E., Song, J., & Ellis, M. (1993). *The status of oyster reefs in Galveston Bay, Texas.* Draft GBNEP Report, Texas A&M Univeristy, Department of Oceanography, College Station.

Randall, R. E. (2000). *TEXAS GULF INTRACOASTAL WATERWAY (GIWW) DREDGED MATERIAL: BENEFICIAL USES, ESTIMATING COSTS, DISPOSAL ANALYSIS ALTERNATIVES, AND SEPARATION TECHNIQUES.* College Station: Texas A&M Univeristy.

Ravens, T., Thomas, R. C., Roberts, K. A., & Santshi, P. H. (2009). Causes of Salt Marsh Erosion in Galveston Bay, Texas. *Journal of Coastal Research, 25*(2), 265-272.

Ravens, T., Thomas, T. C., Roberts, K. A., & Santschi, P. H. (2009). Causes of salt marsh erosion in Galveston Bay, Texas. *Journal of Coastal Research, 25*(2), 265-272.

Ray, G. L. (2007). *Thin Layer Placement of Dredged Material on Coastal Wetlands: A Review of Technical and Scientific Literature.* Vicksburg: Army Engineer Research and Development Center, Environemental Laboratory.

Rohrer, J., Bauer, J., Rodney, W., Westbrook, D., Robinson, L., Carlin, J., . . . Dellapenna, T. M. (2010). The Impact of Hurricane Ike on Oyster Reefs in Galveston Bay and On-going Recovery Efforts. *Restore America's Estuaries* . Restore America's Estuaries .

Safina, C., & Burger, J. (1983). Effects of human distrubance on reproductive success in the Black Skimmer. *Condor, 85*, 164-171.

Scharf, F., & Schlicht, K. K. (2000). Feeding habits of red drum (Sciaenops ocellatus) in Galveston Bay, Texas: Seasonal diet variation and predator-prey size relationships. *Estuaries, 23*(1), 128-139.

Schulte, D., Lipcius, R.N., & Burke, R. P. (2018, May 2). Gear and survey efficiency of patent tongs for oyster populations on restoration reefs. *PLOS.* doi:10.731/journal.pone.0196725

Smith, R. K. (2010). Effectiveness of Predator Removal for Enhancing Bird Populations. *Conservation Biology, 24*(3), 820-829.

Society, T. C. (n.d.). Texas Colonial Waterbird Society Database. Retrieved August 23, 2019

Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., . . . Miller, H. L. (2007). *Climate Change 2007: The Physical Science Basis, Contribution of Working Group 1 to the Forth Assessment Report of the Intergovernmental Panel on Climate Change.* Cambridge University Press.

The Nature Consevancy. (2019, June 18). *Half Moon Reef.* Retrieved from The Nature Conservancy: https://www.nature.org/en-us/about-us/where-we-work/united-states/texas/stories-in-texas/half-moon-reef/

The Texas General Land Office. (2019, June 12). *The Texas General Land Office*. Retrieved from Oil Spill Toolkit: http://www.glo.texas.gov/coast/oil-spill/toolkit/index.html

Thompson, D. H., & Landin, M. C. (1978). *An aerial survey of waterbird colonies along the upper Mississippi River and their relationship to dredged material deposits.* Vicksburg, Mississippi, USA.: U.S. Army Engineer Waterways Experiment Station.

Thorne, K. M., Buffington, K. J., Elliott-Fisk, D. L., & Takekawa, J. Y. (2015). Tidal marsh susceptibility to sea level rise: importance of local scale models. *Jousrnal of Fish and Wildlife Management, 6*(2), 290-304.

Turner, R. E. (1979). Louisiana's coastal fisheries and changing environmental conditions. *Proceedings of the third coastal marsh and esturary management symposium* (pp. 363-

370 in J.W. Bay, Jr., D.R. Culley, Jr., R.E. Turner, and A.J. Mumprhey, Jr. eds.). Baton Rouge: Louisiana State University Division of Continuing Education.

U.S. Army Corps of Engineers. (2009). *Final Environmental Impact Statement for the Matagorda Ship Channel Improvement Project Calhoun and Matagorda Counties, Texas.* Galveston: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. (2009). *Louisiana coastal protection and restoration final technical report: Appendix, coastal restoration plan and structural environemtnal impacts.*

U.S. Army Corps of Engineers. (2012). *Final Environmental Impact Statement for the Proposed Freeport Harbor Channel Improvement Project Brazoria County, Texas.* Galveston: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. (2013, December 1). *Spotlight on USACE Galveston District's Christopher Frabotta.* Retrieved August 21, 2016, from US Army Corps of Enginners: https://www.army.mil/article/116203/Spotlight_on_USACE_Galveston_District_s_Christopher_Frabotta

U.S. Army Corps of Engineers. (2015). *Sabine Pass to Galveston Integrated Feasibility Study and Environmental Impact Study Draft Appendix O Wetalnd Value Assessment Modeling.* Galveston: USACE Galveston District.

U.S. Army Corps of Engineers. (2016). *Freeport Harbor Channel Improvement Project; 50-Year Dredged Material Managment Plan.* Galveston: U.S. Army Corps of Enginners.

U.S. Army Corps of Engineers. (2017). *Draft Mitigation Plan for oyster reef habitat Houston Ship Channel Expansion Channel Improvement Project, Texas.* Houston: The Port of Houston Authority.

U.S. Army Corps of Engineers. (2017). *Houston Ship Channel Expansion Channel Improvement Project, Harris, Chambers, and Galveston Counties Texas Draft Intedgrated Feasibility Report-Enviornmental Impact Statement.* Galveston, Texas: U.S. Army Corps of Engineers.

U.S. Army Corps of Engineers. (2017). *Houston Ship Channel Expansion Channel Improvement Project, Harris, Chambers, and Galveston Counties, Texas.* Galveston: Galveston District Southwestern Division.

U.S. Army Corps of Engineers. (2019). *Houston Ship Channel Expansion Channel Improvement Project, Appendix P-1 Mitigation Plan for Oyster Reef Habitat.* Galveston: U.S. Army Corps of Engineers.

U.S. Fish and Wildlife Service. (1995). *Supplemental Fish and Wildlife Coordination Act Report, Houston-Galveston Navigation Channels, Texas.* Fish and Wildlife Servcice, Department of the Interior. Houston: Texas Coastal Ecological Services Office.

U.S. Fish and Wildlife Service. (2007). *Planning Aid Letter.* Houston: Texas Coastal Ecological Services Office.

U.S. Fish and Wildlife Service. (2008). *Fish and Wildlife Coordination Act Report.* Houston: Coastal Texas Ecological Services Office.

U.S. Fish and Wildlife Service. (2009). *Piping Plover (Charadrius melodus) 5-year review: summary and evaluation.* Hadley, Massachusetts.

U.S. Fish and Wildlife Service. (2010, March). *Sabine Neches Water Way Channel Improvement Project Coordination Act Report.* Houston: Texas Coastal Ecological Services Office.

U.S. Fish and Wildlife Service. (2015, September 18). Memorandum of Understanding Defining the Roles of the US Fish and Wildlife Service and the National Marine Fisheries Service. Washington D. C.

United States Federal Governemnt. (2013). General Provisions; Revised List of Migratory Birds; Final Rule. In D. o. Interior, *Federal Register* (Vol. 78, pp. 65844-65864). United States Federal Governemnt.

United States Federal Government. (2015). *Federal Register* (181 ed., Vol. 80). United States Governemnt. Retrieved August 20, 2016

URS. (2007). *Matagorda Ship Channel Improvement Project Oyster Reef Impacts Assessement. Prepared for Calhoun County Navigation District* . URS.

USACE. (2017). *Navigation Data Center.* New Orleans: US Dept. of Commerce Bureau of Census, Customs Data from Census Bureau.

USACE. (2019). *DMMP Appendix K Houston Ship Channel Expansion Channel Improvemet Project, Harris, Chambers, and Galveston Counties, Texas* . Galveston: USACE.

Walme, P. (1972). The importance of esturaries to commerical fisheries. In B. R. Green, & J. Green (Ed.), *The estuarine environement* (pp. 107-118). London: Applied Science Publishers.

Wenger, A. H. (2017, Feb 2). A critical analysis of the direct effects of dredging on fish. *Fish and Fisheries, 18*, 967-985.

Western Hemisphere Shorebird Reserve Network . (n.d.). *Anauhac NWR*. Retrieved February 12, 2018, from Western Hemisphere Shorebird Reserve Network : https://www.whsrn.org/anahuac-nwr

White, W. A. (1997). Wetland losses releated to fault movement and hydrocarbon production, Southeastern Texas Coast. *Journal of Coastal Research*, 1305-1320.

White, W., Tremblay, T. A., & Wermund, Jr. , E. G. (1993). *Trends and status of wetlands and aquatic habitats in the Galveston Bay System, Texas.* Austin: The Galveston Bay National Estuary Program.

Whitehead, H. (2018, Feb 8). personal communication.

Whittaker, R., & Likens, G. E. (1973). Primary production: the biosphere and the man. *Human Ecology, 1*, 357-369.

Williams, B., Szaro, R. C., & Shapiro, C. D. (2007). *Adaptive Management: The U.S. Department of th Interior Technical Guide.* Washington, DC: Adaptive Management Working Group, U.S. Department of the Interior.

Williams, H. (2003). Modeling shallow autocompaction in coastal marshes using Cesium-137 fallout: Preliminary results from the Trinity River Estuary, Texas. *Journal of Coastal Research*(19), 180-188.

Yeager, K., Santschi, P. H., Rifai, H., Suarez, M., Brinkmeyer, R., Hung, C.-C., . . . Weaver, E. A. (2007). Dioxin chronology and fluxes in sediments of the Houston Ship Channel, Texas: influences of non-steady state sediment transport and total organic carbon. *Environmental Science and Technology, 41*, 5291-5298.

Appendix A

Reptiles	
Diamond back terrapin	*Malaclemys terrapin littoralis*
Kemps Ridley	*Lepidochelys kempii*
Green sea turtle	*Chelonia mydas*
Loggerhead sea turtle	*Caretta caretta*
Leatherback sea turtle	*Dermochelys coriacea*
Hawksbill sea turtle	*Eretmochelys imbricata*
Avian	
Black rail	*Laterallus jamaicensis*
Snowy plover	*Charadrius nivosus*
Piping plover	*Charadrius melodus*
Brown pelican	*Pelecanus occidentalis*
Black skimmer	*Rynchops niger*
Rosette spoonbill	*Platalea ajaja*
Reddish egret	*Egretta rufescens*
White ibis	*Eudocimus albus*
Whooping crane	*Grus americana*
Reddish egret	*Egretta rufescens*
Mammals	
West Indian manatee	*Trichechus manatus*
Fish and Invertebrates	
Eastern oyster	*Crassostrea virginica*
Brown shrimp	*Crangon crangon*
White shrimp	*Litopenaeus setiferus*
Red drum	*Sciaenops ocellatus*
Gray snapper	*Lutjanus griseus*
Saltmarsh topminnow	*Fundulus jenkinsi*
Lane snapper	*Lutjanus synagris*
Red snapper	*Lutjanus campechanus*
Gray triggerfish	*Balistes capriscus*
Almaco jack	*Seriola rivoliana*
Greater amberjack	*Seriola dumerili*
King mackerel	*Scomberomorus cavalla*
Cobia	*Rachycentron canadum*
Atlantic sharpnose	*Rhizoprionodon terraenovae*
Bonnethead	*Sphyrna tiburo*
Bull	*Carcharhinus leucas*
Blacktip	*Carcharhinus limbatus*
Finetooth	*Carcharhinus isodon*
Scalloped hammerhead	*Sphyrna lewini*
Spinner	*Carcharhinus brevipinna*

Striped mullet	*Mugil cephalus*
Atlantic croaker	*Micropogonias undulatus*
Gulf menhaden	*Brevoortia patronus*
Spotted trout	*Cynoscion nebulosus*
Sand trout	*Cynoscion arenarius*
Southern flounder	*Paralichthys lethostigma*
Black drum	*Pogonias cromis*
Blue crab	*Callinectes sapidus*

Plants	
Smooth cordgrass	*Spartina alterniflora*
Saltwort	*Batis maritime*,
Saltgrass	*Distichlis spicata*
Glasswort	*Salicornia* spp.
Yucca	*Yucca* spp.
Coastal arrowhead	*Sagittaria lancifolia*
Shoalgrass	*Halodule wrightii*,
Widgeongrass	*Ruppia maritima*,
Turtlegrass	*Thalassia testudinum*
Clovergrass	*Halophila engelmannii*

USACE Responses to USFWS Coordination Act Report Recommendations
1. Provide Service funding through the PED phase of the Study to evaluate fish and wildlife impacts resulting from the TSP.
Partially-concur. *Funding can be provided to the Service through the PED phase to continue to coordinate with the PDT on the design and construction of the project. However, in general USACE does not provide funding for research into long-term impacts to fish and wildlife.*
2. To the greatest extent practicable, avoid impacts to oyster habitat. If avoidance is not an option, compensate (ratio of at least 1: 1) for lost ecological value. Continue coordination with the BUG to identify suitable mitigation sites and preferred construction methods through the PED phase. We understand the final mitigation design may not be available until the next phase of the Study making continued coordination with natural resource agencies essential for successfully constructed mitigation sites.
Concur*. The PDT has conducted oyster surveys to determine the extent and quality of the oyster habitat within the project area to determine the impact and mitigation requirements. The details of the mitigation plan can be found in Appendices G and P1. The PDT will continue to coordinate with the BUG during the PED to finalize the design of the mitigation sites.*
3. To the greatest extent practicable, beneficially use dredge material as the primary disposal option instead of confined and offshore disposal sites.
Concur. *The PDT has worked extensively with the BUG to develop beneficial use sites throughout the bay and to utilize as much dredge material as possible within the watershed.*
4. The Service does not object to the General Considerations listed in the DMMP Appendix K (2019) Section 7.12 regarding BU. Using a collaborative approach with the BUG will insure the minimization of affected natural resources.
Concur. *The PDT has been working with the BUG collaboratively throughout the study process and will continue to do so during the PED phase.*
5. Maximize current P As in lieu of new construction to house dredge material.
Concur*. The PDT has worked with our Navigation section and the BUG in the development of a long-term DMMP that maximizes the current placement areas before it becomes necessary to find new placement options, including new beneficial use sites.*
6. In conjunction with the Service, develop a HSC-wide management plan aimed at promoting future nesting, discouragement, and removal of predators, and resiliency to sea level rise.
Non-concur. *USACE does not generally fund general management efforts not directly tied to Corps projects. An HSC-wide effort would be beyond the scope of this project.*
7. Provide funding for the life of the project for maintenance and management of the bird islands. Management of islands shall be coordinated with the Service and the BUG.
Partially-concur. *The bird islands will require construction over a period of several years. These features will be designed and constructed to be self-sustaining for the 50 year life of the project and will incorporate adaptive management concepts to assure success. Therefore, additional funds for on-going maintenance, funds that are not available in the project construction budget, nonetheless should not be required with regard to these self-sustaining features. Once construction has been completed and the islands meet the functional requirements specified in the project environmental documents, the Corps will coordinate management of islands with the Service and the BUG.*
8. Continue to coordinate with the BUG on the use of a baffle diffuser for dredge material disposal.
Concur. *The PDT will continue to coordinate with BUG on the use of the baffle diffuser during PED and the construction of the oyster mitigation sites.*

9. Involve the Service, NMFS, TPWD, and NRCS early in the planning effort to identify any potential changes in conditions including additional beneficial use disposal options and the overall placement capacity needed for maintaining the HSC and associated channels.
Concur. *The PDT will continue to coordinate with the agencies during the PED and construction phases to keep them informed of any changes in conditions regarding disposal options and placement area capacities.*
10. Detailed design documents (e.g. design reports, plans and specifications, etc.) of the waterway and disposal sites should be prepared in consultation with the Service, NMFS, TPWD, and NRCS to avoid unnecessary wetland impacts and to achieve the anticipated wetland creation benefits.
Concur. *The PDT will coordinate with the agencies during the design phases to avoid unnecessary wetland impacts and the achievement of wetland creation benefits.*
11. Update habitat-modeling calculations during the PED to better reflect project impacts and/or benefits and coordinate results with the BUG
Concur. *If more detailed information becomes available during PED that would allow for higher quality modeling results, the PDT will update the habitat modeling calculations and coordinate the results with the BUG.*
12. General design features for beneficial use should be considered in all future sites: a. Beneficial use disposal areas should have constructed bayous and openings to existing bays and bayous (e.g., fish dips) to facilitate hydrologic exchange and aquatic organism access. Openings should be constructed after dredge material has stabilized and vegetation has colonized; b. Marsh design and elevations should be thoroughly coordinated with Service, NMFS, TPWD and NRCS; c. Beneficial use disposal containment dikes should be breached or degraded to the settled elevations of the disposal area. d. Beneficial use sites should be designed with fish dips or gaps located every 1,000 feet to allow for aquatic organism access and hydrologic exchange with those marsh creation areas; e. Fish dip or gap design should have a minimum bottom width of 20 feet, a minimum depth of at least one foot below target marsh elevations, and rock armoring on all sides and bottom to minimize scour. f. Implement beneficial use of dredge material in the construction of oyster reef habitat. Constructed berms can be topped with substrates suitable for oyster growth.
Concur. The PDT will consider the features listed above when designing the beneficial use sites and coordinate with the agencies regarding the designs.
13. Conduct shoreline monitoring as part of the DMMP review. Should shoreline erosion rates increase along natural marsh shorelines, protection measures should be provided for the duration of the project.
Non-concur. *USACE does not generally fund general research efforts not directly tied to Corps projects.*
14. Conduct surveys and document active wading bird rookeries and colonial nesting birds within the project area. If active nests are found, we recommend consultation with the Service to ensure project activities do not impact colonial nesting bird colonies.
Concur. *The PDT will work with the Service to refine and identify locations where surveys are needed prior to construction and consult with the Service to ensure project activities do not impact colonial nesting bird colonies.*

15. Evaluate transporting new work and maintenance material for beneficial use to areas outside of the typical 6-mile pump distance as cost alternatives to Placement Area (PA) construction and levee rising.
Concur. *The PDT has done a thorough evaluation of the placement areas available to the project in order to develop a system-wide DMMP. The DMMP is a least cost plan that offers the project the flexibility to use upland, in-bay, offshore, and beneficial use sites.*
16. Work with the Service and the BUG to develop suitable plans for the design of colonial waterbird nesting islands. Design features may include: islands 2-12 acres in size, approximately 8 ft. above mean high water or flood stage, situated at least one half mile (preferably one mile) offshore in a nearby bay, varying substrate composition, and vegetative plantings. The island could include sloping sand beaches preferably protected by a rock breakwater structure similar in design to Evia Island in Galveston Bay. A suite of islands with varying habitats, sizes, and shapes would provide habitat for most of the 23 species of colonial waterbirds that nest in the Galveston Island vicinity and may provide necessary stopover, feeding, and resting habitat for threatened and endangered species.
Concur. *The current project includes the creation of multiple bird islands as part of the beneficial use site creation plan. This plan was coordinated with the BUG during its development. The PDT will continue to coordinate with the BUG during the design and construction phases to develop suitable plans for the multitude of species present in the Galveston Bay area.*
17. Any tracts of land identified as potential PA property not previously constructed upon, should be evaluated for prairie habitat. If a tract exhibits characteristics consistent with that of native prairie, the Corps should consult with the Service and mitigate accordingly prior to construction.
Concur. *The potential upland PA sites have been evaluated during the feasibility study process. No prairie habitat was identified during those evaluations.*
18. The Service does not anticipate any direct negative impacts to terrestrial or avian wildlife during the course of the dredging and staging portions of the project if the Corps incorporates best management practices into their construction strategies. These best management practices should include but are not limited to: a. avoiding contact with any wildlife species; b. removal of trash daily; c. incorporate slower transportation speeds within the project area (on land and in the water); d. educate construction staff about the presence of wildlife species within the project area.
Concur. *The PDT will work with the agency to include BMPs in the contract specifications to minimize or avoid direct negative impacts to terrestrial or avian wildlife.*
19. Initiate coordination with NMFS regarding Essential Fish Habitat impacts and mitigation issues within the project area.
Concur. *The PDT has coordinated with NMFS regarded EFH impacts and mitigation issues within the project area.*
20. Test all new work and maintenance material for contaminants using the standards outlined in the Environmental Protection Agency's Inland Testing and Ocean Dumping Manuals prior to being used in any beneficial use projects, placement in upland confinement, or offshore disposal sites. Should data suggest toxic levels of contaminants are present, the Service recommends disposal of the material within an approved landfill site.
Concur. *Testing of new work and maintenance material has been coordinated with the EPA and the sampling of the material has been conducted during the feasibility study process. A report detailing the laboratory testing on those samples has been delivered to the EPA. The data did not indicate any toxic levels of contaminants present in the samples.*

21. Fully compensate for any unavoidable losses (direct or indirect) of wetland habitats resulting from the implementation of the NED or LPP. The Service understands the Corps proposes to purchase credits from a mitigation bank for forested and emergent wetland impacts resulting from construction at an upland placement area. Continue to coordinate with the BUG regarding mitigation bank purchase status.
Concur. *The PDT plans to purchase credits from a mitigation bank for marsh impact compensation. The PDT will continue to coordinate with the BUG regarding the purchase of mitigation bank credits.*
22. The Service remains concerned that the HSC ECIP and the Coastal Texas Study appear to be operating independently and not considering the other's project features moving forward. Increase coordination efforts during PED phase. Continue to coordinate with Coastal Texas Study staff
Concur*. The PDTs of both the HSC and Coastal Texas Study meet to discuss potential synergies on an ongoing basis. This coordination can continue during the PED phase of the project.*
23. Corps and/or the applicant fund research aimed at evaluating piping plover and red knot usage of beneficial use areas and tidal flats of the Galveston and Trinity Bay systems. Information gained can be utilized to maximize design and location of beneficial use areas favoring threatened and endangered species usage.
Non-concur. *USACE does not generally fund general research efforts not directly tied to Corps projects.*
24. Evaluate how HSC improvements might impact currently funded and future restoration shoreline projects as well as how data generated from funded monitoring and restoration projects can be incorporated into future HSC modeling considerations.
Non-concur. *No restoration projects were identified by the resource agencies or any non-governmental agency within the study area during the study process which would require further investigation of the projects effects.*
25. Implement a monitoring program to assess the impacts from increased wave action from additional traffic and larger ships pose to marsh, submerged aquatic vegetation (SAV) and Bay associated wetlands.
Non-concur. *USACE does not generally fund general research efforts not directly tied to Corps projects.*
26. If the proposed TSP project features change, the status of species change, or the project is not implemented within five years of the date of our Endangered Species Act (Act) coordination, we recommend that the Corps reevaluate the project's effects and species status and initiate any necessary consultation procedures pursuant to Section 7 of the Act.
Concur*. Upon reaching the PED phase, the Corps will utilize the IPaC system for any necessary updates to the ESA coordination and reinitiate consultation, if necessary.*
27. Evaluate adding a mosaic of substrates or vegetation on the levees of the marsh complex encouraging additional nesting and stabilization of the levee crown.
Concur. *The PDT will work with the agencies during the design and construction phases to help determine suitable substrate and vegetation compositions suitable for nesting along the levee crowns.*
28. Coordinate with the BUG for a list of planting material suitable for bird islands.
Concur. *The PDT will continue to coordinate with the BUG during the PED phase to obtain a list of planting materials suitable for bird islands.*